



Liaison with other I4MS projects and DIHs, International cooperation - M18

D8.4

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Abbreviations and Acronyms:	
AI	ARTIFICIAL INTELLIGENCE
SMEs	SMALL AND MEDIUM ENTERPRISES
I4MS	ICT INNOVATION FOR MANUFACTURING SMEs
DIH	DIGITAL INNOVATION HUBS
EDIH	EUROPEAN DIGITAL INNOVATION HUBS
EU	EUROPEAN
AAL	Active and Assisted Living
ACTEMA	ACTIVE European Mobility Assistance
ADRA	AI, Data and Robotics Association
AIRISE	Artificial Intelligence in Manufacturing for Sustainability at SMEs
AIPI	AI for Industrial Processes
AAS	Asset Administration Shell
BDVA	Big Data Value Association
CAPRI	Circular Production Systems
CFD	Computational Fluid Dynamics
DIDA	Digital Intelligent Assistance
DR-BEST	Data, Remote, Business, Ecosystem, Skills, Technology
EEN	Decision Support System
EFFRA	European Factories of the Future Research Association
EIT	European Institute of Innovation & Technology
ESM	Efficient and Sustainable Manufacturing
EUCL	European Cloud Edge IoT Initiative
FENIX	New Circular Economy Business Models for Retrofitting and Repurposing of Value-Added Products
FEM	Finite Element Method
H2020	Horizon 2020
HEP	Horizon Europe Programme
I4MS	ICT Innovation for Manufacturing SMEs
JRC	Joint Research Centre
METHODIH	METHODology for DIH
MiE	Made in Europe
RIA	Research and Innovation Action
S3	Smart Specialisation Strategies
TERESA	Technology and Regulatory Sandboxes
TRL	Technology Readiness Level
TSSP	Thematic Smart Specialisation Partnerships
VANGUARD	Vanguard Initiative

Executive summary

This Report describes the dedicated plan for liaison and collaboration with other I4MS projects and Digital Innovation Hubs, as well as Pan-Eu and International cooperation Programme at M18.

Deliverable D8.4 is the result of the activities run in T8.3 Liaison with other I4MS projects and DIHs and T8.4 AI DIH World and International cooperation and describes the dedicated plan for liaison and collaboration with other I4MS projects and Digital Innovation Hubs, as well as Pan-Eu and International cooperation Programme at M18.

The task T8.3 establishes cooperation liaisons with Made in Europe MiE, AI Data and Robotics ADRA Partnerships as well as the Industry 5.0 movement in DG RTD. Special attention is given to DIH4Industry marketplace. Finally, the AI on demand platform AI4Europe is addressed form a twofold collaboration: on the one side to populate the AI Assets toolkit and Manufacturing Vertical, on the other side to use the AI4Europe experimentation environment to design and develop the needed AI pipelines.

AI REDGIO 5.0 keeps close relationships and liaison with International Cooperation programs and in particular with the World Manufacturing Forum, under the coordination of POLIMI. In the recent editions, Human-centric manufacturing, Cognitive AI Manufacturing and Circular manufacturing challenges have been discussed by international experts.

The document is arranged into 7 sections: Section 1 provides the scope of the deliverables and the structure of the document, Section 2 describes the Cooperation with the I4MS Projects, the heritage from the AI REGIO “Regions and Digital Innovation Hubs alliance for AI-driven digital transformation of European Manufacturing SMEs” Innovation Action and reports the cooperation with the VANGUARD initiative as well the Joint Dissemination and Collaboration activities with I4MS2 projects. Section 3 describes the Cooperation with Digital Innovation Hubs, and in particular with the EUROPEAN DIH NETWORK and the DIH4INDUSTRY MARKETPLACE. Section 4 describes the Cooperation with other Initiatives at EU Level and Section 5 describes the International Cooperation from beneficiaries and with the World Manufacturing Forum.

Finally, in Section 6 the Conclusions are reported.

The sentences squared in boxes represent the AIREGIO5.0 Cooperation and Liaison intentions for the second Period of the project. They will be analysed and extended in the next edition of this D8.4 at M36 (D8.8 Liaison with other I4MS projects and DIHs, International cooperation)

1. Introduction

Deliverable D8.4 is the result of the activities run in T8.3 Liaison with other I4MS projects and DIHs and T8.4 AI DIH World and International cooperation.

1.1. Scope of the deliverable

This deliverable describes the dedicated plan for liaison and collaboration with other I4MS projects and Digital Innovation Hubs, as well as Pan-Eu and International cooperation Programme at M18.

AI REDGIO 5.0 belongs to I4MS2 initiative in HEP, following the successful SME-driven experience from [I4MS in H2020](#) and in particular the [AI REGIO](#) Phase IV experience, the task T8.3 establishes cooperation liaisons with [Made in Europe MiE](#), [AI Data and Robotics ADRA](#) Partnerships as well as the [Industry 5.0](#) movement in DG RTD. Special attention is given to [DIH4Industry marketplace](#) where more than 100 DIHs specialised in Manufacturing. Finally, the [AI on demand platform](#) AI4Europe is addressed from a twofold collaboration: on the one side to populate the AI Assets toolkit and Manufacturing Vertical, on the other side to use the AI4Europe experimentation environment to design and develop the needed AI pipelines.

AI REDGIO 5.0 keeps close relationships and liaison with **International Cooperation** programs and in particular with the [World Manufacturing Forum](#), under the coordination of POLIMI. In the recent editions, Human-centric manufacturing, Cognitive AI Manufacturing and Circular manufacturing challenges have been discussed by international experts. T8.4 aims at developing workshops and events c/o the WMF and debate the future of Manufacturing Twin Transition and in particular how Industry 5.0 (human-centric, resilient, sustainable and circular value chains) could be implemented over the World in global value chains.

1.2. Structure of document

The document is arranged into 7 sections:

This Section provides the scope of the deliverables and the structure of the document.

Section 2 describes the Cooperation with the I4MS Projects, the heritage from the AI REGIO “Regions and Digital Innovation Hubs alliance for AI-driven digital transformation of European Manufacturing SMEs” Innovation Action:

- REGIONAL INNOVATION AND VANGUARD INITIATIVE
- AI ON DEMAND PLATFORM AND AI FOR MANUFACTURING CONTRIBUTIONS
- METHODIH FRAMEWORK FOR (E)DIHS ANALYSIS
- 6P AND 7P FRAMEWORK FOR DIGITAL TRANSFORMATION
- DIDACTIC FACTORIES NETWORK AND VIRTUAL FACTORY EXPERIMENTATIONS
- TERESA TECHNOLOGY AND REGULATORY SANDBOXES EXPERIMENTATIONS

Moreover it reports the cooperation with the VANGUARD initiative as well the Joint Dissemination and Collaboration activities with I4MS2 projects (*AIRISE.EU Artificial Intelligence in Manufacturing for Sustainability at SMEs*, *WASABI White-label shop for digital intelligent assistance and human-AI collaboration*, *CIRCULOOS Circular and Dynamic Manufacturing Supply Chain Orchestration and Optimisation*).

Section 3 describes the Cooperation with Digital Innovation Hubs, and in particular with the EUROPEAN DIH NETWORK and the DIH4INDUSTRY MARKETPLACE.

Section 4 describes the Cooperation with other Initiatives at EU Level:

- MADE IN EUROPE PARTNERSHIP
- AI, DATA AND ROBOTICS PARTNERSHIP
- INDUSTRY 5.0 COMMUNITY OF PRACTICE AND HUMAN DESTINATION COLLABORATION
- AI-AT-THE-EDGE AND EU-CLOUD-EDGE-IOT INITIATIVE

Section 5 describes the International Cooperation from beneficiaries and with the World Manufacturing Forum.

Finally, in Section 6 the Conclusions are reported.

2. Cooperation with I4MS Projects

I4MS, ICT Innovation for Manufacturing SMEs, is a European initiative supporting manufacturing SMEs and mid-caps in the widespread use of information and communication technologies (ICT) in their business operations. Under I4MS, SMEs can apply for technological and financial support to conduct experiments allowing them to test digital innovations in their business via open calls.

I4MS started in H2020 where especially its Phase IV is representing a Parent initiative for AI REDGIO5.0 and prosecuted in HEO with I4MS2 “ICT Innovation for Manufacturing Sustainability in SMEs (I4MS2) (Made in Europe Partnership) (IA), HORIZON-CL4-2022-TWIN-TRANSITION-01-06”.

2.1. I4MS in H2020 Framework

In H2020 Phase 4 – launched in June 2020, I4MS focused on helping service suppliers (IAs, DIHs and CCs) to provide a business-oriented description of the technological services they offer, complemented with Best Practices identification. The following Innovation Actions (IAs) covered several crucial technological areas that aimed to accelerate the digital transformation process in the European manufacturing ecosystem

- **AI Regio** (Regions and DIHs alliance for AI-driven digital transformation of European Manufacturing SMEs)
- **Better Factory** (Grow your manufacturing business)
- **Change2Twin** (Create and Harvest Offerings to support Manufacturing SMEs to become Digital Twin Champions)
- **DIGITbrain** (Digital twins bringing agility and innovation to manufacturing SMEs, by empowering a network of DIHs with an integrated digital platform that enables Manufacturing as a Service (MaaS))
- **DIH-WORLD** (Accelerating deployment and maturity of DIHs for the benefit of Digitisation of European SMEs)
- **KITT4SME** (platform-enabled KITs of artificial intelligence FOR an easy uptake by SMEs)
- **VOJEXT** (Value Of Joint EXperimentation in digital Technologies for manufacturing and construction)

POLIMI coordinated one of the two H2020 Innovation Actions, I4MS Phase IV, about AI Innovation for Manufacturing: AI REGIO (the other is KITT4SME coordinated by **SUPSI**). The phase IV projects are now over, but their heritage is still alive as demonstrated by the Manufacturing Partnership Day of 7-8 May 2024 in Brussels.

2.2. AI REGIO heritage: Regional Innovation and VANGUARD initiative

For the digital transformation of European Manufacturing SMEs, the ICT Innovation for Manufacturing SMEs (I4MS) program under Horizon 2020 has been a great success. Program Phase IV concentrated on Digital Innovation Hubs (DIHs) and cutting-edge technology like AI and digital twins. The **AI REGIO** “Regions and Digital Innovation Hubs alliance for AI-driven digital transformation of European Manufacturing SMEs” Innovation Action created a symbiotic partnership between regions, DIHs, AI solution providers, and manufacturing SMEs. This partnership is manifested by a new methodology for DIHs service portfolio and customer journey analysis, an AI4EU-focused toolkit of Data and AI resources, a network of Didactic Factories

and their TEchnology and REgulatory SAndboxes (TERESA), an ecosystem of SME-driven experiments, and their Digital Transformation pathways. With the aim of coordinating such significant outcomes with the evolution of manufacturing toward Industry 5.0, the evolution of cloud AI technologies to AI-at-the-Edge, the evolution of Horizon2020 to Horizon Europe, and the evolution of Digital Europe programmes such as EDIH, Data Spaces, and AI TEFs (Testing and Experimentation Facilities) for manufacturing, AI REDGIO 5.0 maintains the momentum of AI technology adoption in Manufacturing SMEs.

The H2020 I4MS – AI REGIO was a partnership between **Vanguard EU regions** and DIHs that is currently updated and expanded as part of AI REDGIO 5.0 in order to enable competitive AI-at-the-Edge digital transformation of Industry 5.0 Manufacturing SMEs.

The [Vanguard Initiative](#), in particular, is a unique alliance comprising 38 of Europe's most advanced industrial regions, focused on fostering industrial innovation and building European value chains through complementary regional smart specialisation strategies. By connecting innovation ecosystems and sharing knowledge and facilities across its member regions, the Vanguard Initiative promotes interregional collaboration, drives interregional innovation investments, enhances open innovation, and accelerates the market uptake of new products and innovations in Europe.

As mentioned, Vanguard Initiative is based on the *Smart Specialisation Strategies (S3)*, introduced by the European Commission as a set of initiatives and actions defined by Member States and regions. These strategies focus on strategic areas for intervention based on an analysis of economic strengths and potential, as well as an Entrepreneurial Discovery Process (EDP) involving a wide range of stakeholders. To date, over 180 Smart Specialisation Strategies have been developed at regional and national levels, prioritising domains, areas, and economic activities where regions or countries have a competitive advantage or potential for growth. To design and implement these strategies, the EC has also established the S3 Platform, which is open to regional and national administrations across the European Union (differently from Vanguard, that is a private partnership). In particular, the [S3 Thematic Platforms and Thematic Smart Specialisation Partnerships](#) (S3P and TSSP) for Industrial Modernisation aims to support EU regions in generating a pipeline of industrial investment projects through a bottom-up approach, and all Vanguard Pilots have also joined this initiative as S3P Partnerships. The VI pilots aim to connect stakeholders on the different thematic priorities from the S3 strategies. By establishing the partnership with the previous AI REGIO and the current AI REDGIO 5.0, the regional stakeholders from the pilot members could be connected to the opportunities of AI REGIO and AI REDGIO 5.0. This means working on the established networks for efficiency.

AI REGIO was conceived in one of the Thematic Areas of S3P-TSSP and Vanguard Pilots: the [Efficient and Sustainable Manufacturing \(ESM\) Pilot](#). In this initiative, **24 Vanguard EU regions**, led by Lombardy, Catalunya, and Auvergne-Rhône-Alpes, collaborate to provide industry with innovative solutions derived from research and to leverage smart specialisation to foster new, efficient, and high-value supply chains. This partnership focuses on developing a European network of pilot plants aimed at enhancing production efficiency and sustainability through advanced materials, enabling technologies, methods, processes, and standards. The goal is to support the competitiveness and resilience of the European manufacturing sector by creating and developing a European network of infrastructure and pilot plants in key manufacturing areas, where companies can test innovative solutions before they are adopted on an industrial scale. The ESM pilot plants aim to tackle various manufacturing challenges from a systemic perspective, providing a unique infrastructure where companies can test innovative solutions before full-scale industrial adoption. These pilot plants will be open to industrial stakeholders, offering a neutral and collaborative environment for cross-sector and interregional cooperation. They will facilitate access to cutting-edge process technologies for the entire European manufacturing sector.

By leveraging and valorising existing research results, the ESM pilot plants have the potential to drive innovation in breakthrough technologies and applications that demand manufacturing efficiency and sustainability. This approach will enhance the competitiveness and development of European value chains by exploiting synergies and complementarities among different regional specialisations.

Since its inception, **the ESM Pilot** has concentrated on technologies, methods, and tools aimed at:

- Increasing process **efficiency** by boosting the throughput and quality of manufacturing processes, technologies, and products while reducing costs.
- Promoting manufacturing **sustainability** by reducing emissions, waste, and the consumption of energy and materials.
- Enhancing **human inclusion** in manufacturing processes.

Addressing manufacturing efficiency and sustainability synergistically is crucial for enabling EU reindustrialization and preserving environmental and planetary resources.

This regional perspective is vital in AI REDGIO 5.0. and has been furtherly expanded involving also the Artificial Intelligent (AI) Pilot and its regions. The transition from Digital Innovation Hubs (DIHs) to European Digital Innovation Hubs (EDIHs), in fact, is fostering inter-regional collaborations, creating new roles and opportunities for leading EU regions involved in initiatives, like the AI PILOT of the Vanguard Initiative.

The [Artificial Intelligent \(AI\) Pilot](#), launched in 2021, is a vibrant platform dedicated to stimulating the demonstration and commercial deployment of AI-driven solutions within diverse industrial ecosystems. Led by Baden-Württemberg and the Basque Country, the Pilot aims at developing a European value chain for AI, addressing the demands and needs of industry. To amplify the impact of the partnership, it leverages on existing networks and initiatives such as Enterprise Europe Network (EEN), European Digital Innovation Hubs (EDIHs) and Digital Transformation Accelerator. Through those valuable connections, AI Pilot Vanguard regions and partners are already engaged, enabling to tap into a wider pool of expertise and resources.

According to this, the **H2020 I4MS – AI REGIO partnership** between Vanguard EU regions and DIHs has been updated and expanded as part of AI REDGIO 5.0 in order to enable competitive AI-at-the-Edge digital transformation of Industry 5.0 Manufacturing SMEs, involving an increasing number of regions and promoting synergies and collaborations among ESM and AI Pilots and Partnerships and with the new arising initiatives.

2.3. AI REGIO heritage: the AI on Demand Platform and AI for Manufacturing contributions

The AI REGIO project has made significant contributions to the AI-on-Demand (AIoD) platform by expanding its resource base and making it more accessible to SMEs.

Thirteen AI Assets have been published in the AI4EU Catalogue:

- 1 Library (Apache StreamPipes Python Client)
- 2 Docker Container (DIDA platform, Intelligent Computer Vision for Digital Twin)
- 3 ML Model (AI4CNC - A Federated Learning System Platform Development for CNCs, Reinforcement Learning for Assembly Line Balancing Enhancement, Supervised real-time 2D-based Object Detection System)

- 1 Executable (Digital Twin For Predictive Maintenance)
- 3 As a Service (S5 Enterprise Big Data Analytics Suite: Manufacturing, Synthetic Data Generation Engine SynData, CUSUM RLS filter service)
- 3 Jupiter Notebook (Predictive Maintenance using Machine Learning, Quality control on production lines with Computer Vision and TinyML, Supervised Learning for Multivariant Time Series Forecasting)

AI REGIO project has been one of the pioneer contributors to the AI Assets Catalogue, sharing the project outcomes through the showcase section of the platform.

Furthermore, AI REGIO defined a categorization of AI assets (starting from AI Resources, AI Pipeline Designer, AI Orchestrator, going to more details through a deep semantic classification in terms of Manufacturing Categories) useful to create a project AI Toolkit able to reduce the barriers to AI Adoption by the experiments.

AI4Manufacturing Toolkit

A collection of operational technologies, data analytics tools and platforms, designed to provide support to system integrators and technology adopters to create new AI-based applications.

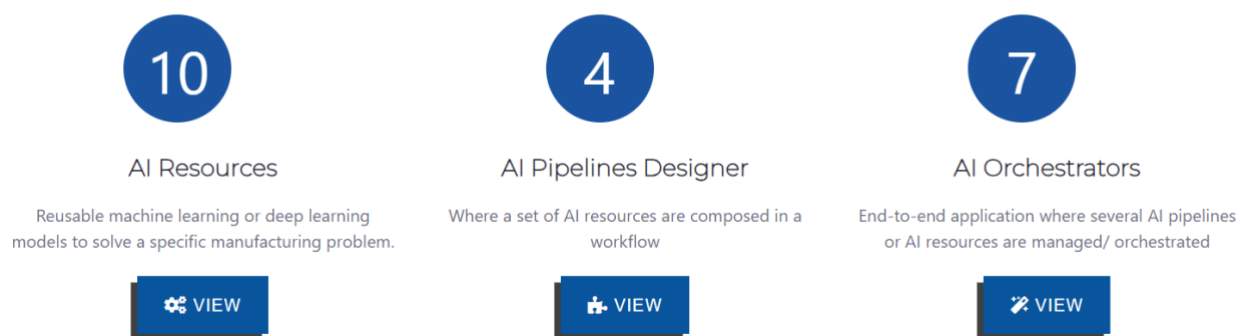


Figure 1 - AI Manufacturing Toolkit Overview

On the other hand, several contributions have been shared in the AI Builder (former AI4Experiment platform) using some of the available artifacts in the marketplace, but also contributing to it during the implementation of some project experiments:

- 1 Pipeline (AI REGIO NLP DSS) structured to receive natural language text from a microphone client over the Internet, transform audio into text, and use the produced text to help an operator in the manufacturing domain.
- 2 Classification Models (AI REGIO CUSUM RLS filter, AI REGIO DSS4TB). The first is a multi-sensor change detection algorithm using Recursive Least Squares (RLS) and Cumulative Sum (CUSUM) methods. The second is an intelligent troubleshooting system capable of identifying the most likely damaged component from a series of closed-ended questions answered by the operator.

AI REDGIO 5.0 will ensure exposure and interoperability of the AI REDGIO technologies/platforms portfolio with the AI-on- demand platform. Since AI REDGIO 5.0 essentially contributes to the Manufacturing vertical, different interoperability layers will be considered, including the seamless search and discovery of AI assets from the AI-on- demand platform (Portal level); the easy publication and trustworthy sharing of AI REDGIO 5.0 assets (data, AI models, AI pipelines) in a bi-directional manner (Data level); and the provision and monitoring of experimental facilities to run different AI solutions (Experimentation level).

The AI REGIO project has made significant contributions to the **AI-on-Demand platform** by expanding its resource base and making it more accessible to SMEs. AI REDGIO 5.0 will deliver a library of Edge AI reference implementations (trained models, preconfigured pipelines) that address specific problems of Industry 5.0, in order to ensure interoperability with the AI-on-demand platform at different levels, bringing forward and contributing to the Manufacturing vertical.

2.4. AI REGIO heritage: The METHODIH Framework for (E)DIHs analysis

AI REGIO project set up the methodological base for a structured collaboration between European R&I entities supporting SMEs. This methodology, based on a framework that will be described hereafter, became key for liaison and collaboration between I4MS projects, Digital Innovation Hubs (DIHs), Pan-Eu, and international cooperation.

METHODIH is a methodology that was conceived in AI REGIO for the analysis of the demand and supply of the DIHs, with the aim of providing a comprehensive picture of the functioning and functionality of a DIH, by analysing its offering side, its customer base, as well as its economic sustainability. The challenge that the methodology intended to tackle was that a DIH is an entity conceived to provide support in the Digital transformation processes of SMEs, but there is no entity that supports a DIH in its organisation, improvement, and evolution. METHODIH was then inserted with that purpose in the work package in charge of the DIH network management and showed to be a successful strategy to support DIHs in its activity and service provision. AI REGIO counted with a core network of **13 DIHs** and the network increased through the inclusion of new DIHs from the open calls. By the end of the project the network counted **23 DIHs** that were pioneers in the implementation of METHODIH.

Based on the successful results of its first implementation, the methodology is being applied in the DIH network of AI REDGIO 5.0, which currently has 22 members. There are some contextual aspects that have changed since the origin of METHODIH. In AI REGIO, the methodology was applied to a network of single DIHs, that operated at a local level. In AI REDGIO 5.0 instead, it's being applied to a network of European Digital Innovation Hubs (E)DIHs, whose operation has a wider scope. This change of context has challenged the methodology to evolve to face the increase in the complexity of the current reality of the DIHs.

The first and more general change from its context adaptation concerns to its structure. As observed in the images below, initially in AI REGIO METHODIH was structured in 4 pillars, and in AI REDGIO 5.0 a fifth pillar was added to address cooperation (Collaboration corridors).

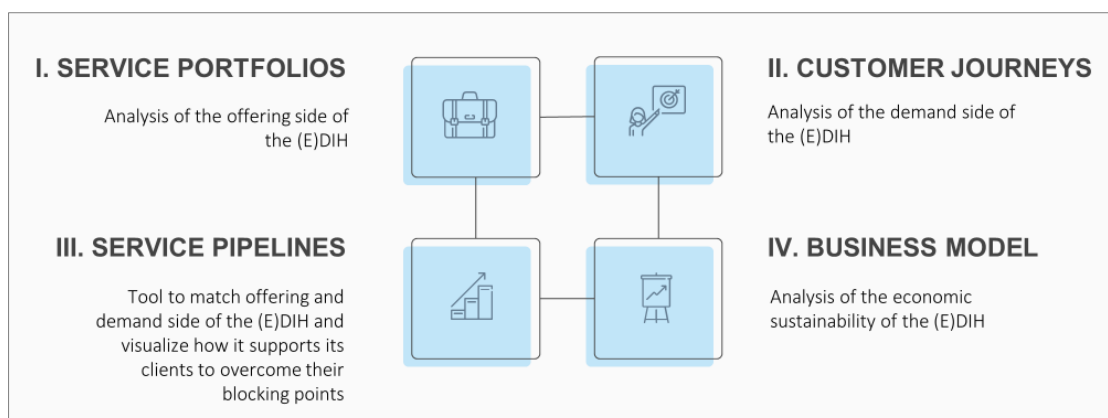


Figure 2 Former structure of METHODIH based in 4 pillars

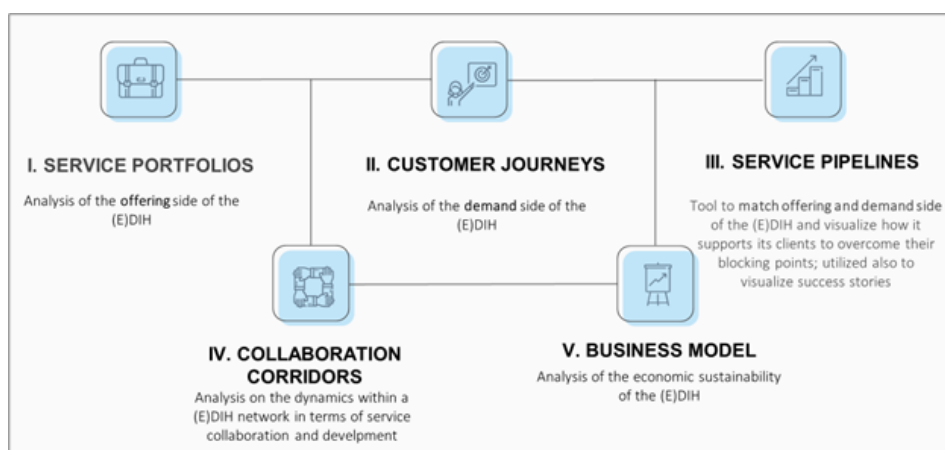


Figure 3 Updated METHODIH structure based in 5 pillars

A brief description of each pillar and how each one contributes to the collaboration is provided hereafter:

- **Service portfolio:** it's the instrument utilized to organize the offering of DIHs under the same framework, providing a common language in terms of services, to be used inside and outside the project and inside and outside Europe, facilitating the collaboration. The instrument is a service taxonomy, and AI REGGIO and AI REDGIO 5.0 utilized them to structure the service offering of the DIHs under standard categories. Each category of services is called services class which are broken into more detailed categories (service types and service instances). More details about the definition and description of a service taxonomy can be found in D3.1. AI REDGIO 5.0 implemented the **D-BEST** taxonomy proposed in AI REGGIO, that stands for DATA, BUSINESS, ECOSYSTEM, SKILLS, and TECHNOLOGY services. From the D-BEST framework inherited from AI REGGIO, currently the taxonomy has evolved to **L-DBEST**, including the Legal and Ethical (L) class that includes relevant services from the regulatory dimension, key for SMEs developing AI solutions.

The possibility to employ a common language in terms of services is key to identify collaboration opportunities as well as promote liaisons and cooperations among projects or initiatives that utilize common taxonomies. Some projects that had the opportunity to collaborate thanks to a common service structure are Hubcap, DIH4CPS, DIH4AI, AI REGGIO, AI REDGIO 5.0, among others. This can extend also in future initiatives.

- **Customer Journeys:** it's the instrument utilized to analyse the **demand** side of DIHs identifying the customer base of a DIH. A customer journey is a representation of the digitalization process of a DIH's customer, that clearly shows the services that the DIH offers in each stage of the process, tracks the evolution of the process towards higher levels of digital maturity, and identifies the Blocking points or difficulties faced by the SMEs that the DIH supports to overcome during the process. It is represented by a Matrix of 5 columns that outline the stages of evolution of a digital transformation process and the rows that represent each service class of the service portfolio. In that way, the allocation of services within the matrix shows which services intervene in the different evolutive stages of the journey. More information and details about Customer Journeys matrixes can be found in D3.1. AI REGIO identified and left as a legacy 6 typologies of customers for DIHs. The 2 more applicable to the case of AI REDGIO 5.0 are the Technology user and the Technology provider cases that are being developed by the project network members.

Both mentioned pillars can be used to identify gaps, overlaps or strengths in terms of services in a specific network or comparing different projects and initiatives. In the first pillar comparing single service portfolios or aggregated service portfolios between different networks. In the second pillar comparing matrixes and identifying strengths and weaknesses from different stages of a customer journey (See D3.1 for more detail).

- **Service pipelines:** it is an auxiliary tool utilized in the customer journeys to better visualize the matching between offering and demand side of a DIH. From one side the matrix is populated with the offering that a DIH can offer. From the other side, a customer looking for support to face a specific digitalization challenge undertake a digitalization process supported by a DIH, utilizing specific services according to its specific need. The service pipelines show the interaction between the needs of a specific customer and the services involved in each stage of its progress towards higher levels of digitalization. Service pipelines can be utilized to showcase success stories, since it clearly indicates the initial and final stage of a certain customer as well as its evolutive pathway.

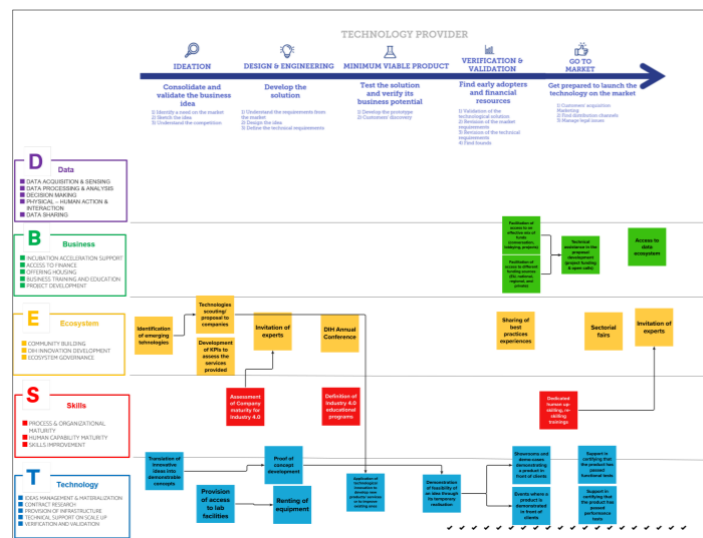


Figure 4 Customer journey and service pipeline example from the 1st iteration of task 3.1

- **Collaboration corridors:** Under AI REDGIO 5.0 project, collaboration corridors are a pillar based in the previously mentioned taxonomies that has the aim of boosting collaboration to enhance the service offering of each member network, and thus strengthen the aggregated service portfolio of the entire network. For example, it is expected that the new recently added Legal and Ethical (L) dimension would be “weak” at the beginning but for action of the collaboration corridors and best practices sharing, by

the end of the project the L dimension will be more widespread among its members. The network will become more “specialized” in the new L dimension only thanks to the collaboration corridors that have the common service language at its base. This is a synergy that can occur not only at the internal level in the project but between projects. It is the case of L dimension that was inherited from sister initiative DIH4AI project.

Since the fifth business model pillar has a more theoretical scope, and it’s not key in the collaboration identification and the scope of the current document, will be addressed only in the pertinent deliverables of work package 3.

METHODIH is one of the most relevant KERs (Key Exploitable Results) of AI REGIO in the methodological category. In AI REGIO has been further expended towards more structural collaboration among EDIHs in Digital Europe Program.

2.5. AI REGIO heritage: the 6P and 7P framework for Digital Transformation

Among the tools bequeathed by AI REGIO to next projects, the **6Ps Digital Transformation Assessment Model** deserves special mention. The 6Ps transformation model, developed inside universities boundaries and already in use since the MIDIH European project, is part of a wider methodology set up by Politecnico di Milano to assess the digital and AI maturity of organizations and to suggest roadmaps and journeys for the implementation of digital transformations and AI adoption, and consisting of three main steps: the assessment of the digital maturity of a company, the setting of the digital transformation journey (the 6Ps), the implementation of the roadmap. The 6Ps covers the second step of said methodology, by setting a clear **digital transformation journey**, so aiming at helping companies to generate strategies for approaching and moving toward digitization and AI adoption.

The 6Ps AI transformation model supports manufacturing companies to assess their **current and expected** level of Digitization and to track a Digital Transformation roadmap; from this point of view, it can be considered more a “tactical” tool than a “strategical” one, in the sense either that the company has a project to improve some aspects of its approach to digitization (in which case the roadmap to the implementation of digital solutions is implicitly defined by the project, and the 6P helps measure where progresses take place and how large they are) or the company has identified some digitization gaps and wants to fill them (in this case, 6P provides a support to focus on the potential areas of improvement, and as an “inspirational” tool, suggesting concrete ideas of actions to implement digital solutions that may add to the company’s ideas).

It is not a tool to measure the digital maturity of an enterprise, that is, to evaluate the level of readiness to embrace the paradigm of digitalization, but it provides a **concrete idea of actions** that it needs to follow along its digital transformation journey. The main objective is to put in light the level of progress that a company has towards the implementation of digital and AI solutions, identifying the aspects that can be boosted the most against those for which a valuable level has been already reached. In this frame, the 6Ps digital transformation tool assesses the current level of digital maturity of manufacturing companies (AS-IS), quantifies the desired level of digital maturity that they aim at achieving (TO-BE) and design a specific action plan to allow the transition needed to fill the gaps identified; this pushes the company to reflect about the expected digital level, not only about its current situation.

The 6Ps analysis takes place on six pillars (from which, the name “6Ps”): a basic assumption is that, in order to succeed in a digital transformation process, it is important to boost not only the technical dimensions, but also the so called “socio-business” dimensions. For this reason, the six pillars are: Product, Process and Platform, clustered as “technical pillars” and People, Partnership and Performance, clustered as “socio-

business” pillars. Each pillar contains 6 questions (that is, 6 fields of analysis) and each question has 5 possible answers, corresponding to 5 sequential levels of development, from level 1-Initial to level 5-Exploited.

The first pillar, **PRODUCT**, has the objective of evaluating to which extent the manufacturing SME is digitally mature, in terms of Product or Product-Service System, that it offers to the market.

The **PROCESS** pillar refers to the industrial manufacturing processes, and to the transition towards automated, smart and connected processes.

PLATFORM is focused on CPS and embedded systems, Industrial IoT, Industrial Internet, Industrial analytics, Vertical and horizontal interoperability.

The **PEOPLE** pillar is the first of the so called “Socio-Business” pillar, and is given particular prominence (12 questions instead of 6 questions as in the other pillars) because in a digital transformation process the involvement of staff is the real driver of digital transformation: staff skills, training and involvement are the real heart of the change. In the PEOPLE section, smart features (typical of Industry 4.0 and AI) are crossed and matched with different types of professions in the company.

The last two pillars, **PARTNERSHIP** and **PERFORMANCE**, refer to the partnerships with Digital Innovation Hubs, Universities, IT providers and suggest possible KPIs to measure the transition: KPIs are not only Operational and Economic, but also refer to the ability of the company to measure its performances over other aspects, such as Environmental, Social, Product-Service Lifecycle and performances of the entire Supply Chain.

The application process of the 6Ps tool takes place in the following steps:

- Set-up of a team bringing together different organizational areas
- Identification of the AS-IS profile of the manufacturing SME
- Definition of the target TO-BE profile of the manufacturing SME
- Identification of actions, feasibility and prioritization
- Development of the Migration Plan towards Industry 4.0.

The two highlighted parts are the most important for the definition of the pathway; their implementation takes place with the delivery of an online survey, taking about 1 hr, which output is given in form of a radar chart, allowing to visually compare the current (AS-IS) and the expected (TO-BE) levels for each dimension of analysis.

There are a considerable number of advantages in choosing the 6PS Digital Transformation assessment model as an evaluation system:

- it holds a broad and comprehensive system of indicators, not limited to purely technical and economic aspects;
- uniform criteria in the evaluation of different use cases; the 6Ps not only provides objective measurement tools, but also makes it possible to compare the results of different cases, according to different aggregation criteria; that is, it provides a common language on which to compare, fostering collaboration and knowledge;
- the tool not only takes a snapshot of the organization's current level with respect to all dimensions examined ("AS-IS"), but also requires identifying the levels of digital evolution the organization aims to achieve ("TO-BE");
- the representation of the results in form of radar charts, as comprehensive views of all the areas examined (the 6 "pillars"), helps understand the level of internal consistency of the use case to which it is applied, and offers an intuitive and immediate view of the digital transformation pathways that the organization will be following;
- the systematic approach of this assessment system and the experiences developed in its application can be easily exported to other projects, maximizing the effect of the lessons learned.

The AI REGIO project allowed us to fully appreciate the benefits described above in applying the 6Ps Digital Transformation assessment model to **17 project experiments**, divided into 4 clusters, and to **17 Open Call use cases**. The assessments were conducted in the form of online compilation followed by interviews with POLIMI's experts, in order to validate the responses and carry out ensemble considerations on the interpretation of the survey results in relation to the experiments.

The assessment took place in two iterations: a first run was conducted by asking to assess the AS-IS (current) level and the TO-BE level (expected after the experiment); a second iteration was run after the experiments had been completed, so as to compare the expected / planned outcome with the actual ones, which was useful to measure the real impact of the experiments on the company, assess the vision and planning capacity of the experiment leaders and, finally, further improving the development and use of the 6Ps model.

The cluster analysis (the 17 AI REGIO experiments were divided into 4 clusters) provided an interpretative system - based on measurable indices - of the experiments that would not have been possible without the 6P analysis. Indeed, the analysis highlighted the specificities of each cluster, the intimate coherence between the experiments in the same cluster and the difference with the other clusters in terms of relevant and irrelevant dimensions. The cluster-by-cluster analysis made it possible to clearly delineate which experiments show specificities and which share common traits. The main take-away, which was confirmed in what it always emerges as a pattern in the surveys carried out with 6Ps, is that, at the aggregate level of a large number of experiments or SMEs that do not share any characteristics or target, no particular trends or patterns emerge, whereas when experiments are aggregated into clusters in which they are united by certain characteristics or objectives, clear and distinct trends emerge.

The extension of the tool to experiments from the AI REGIO Open Calls allowed us to bring this new perspective on digitisation issues to other SMEs as well, and to increase the case histories we could draw on for our analyses.

The above explained features of the 6Ps tool have made it possible its constant and continuous application in various use cases of many European projects, among which we can mention DS4.0, CAPRI, DIH4AI, XMANAI, OPEN DEI, Circular TwAI, FlexiNDT; at the time of writing this report, we can count on more than 160 compilations (although not all with the exact same tool: in some cases, small adaptations were necessary, such as in some specific cases focused e.g. on Process Industry, or Explainable AI, or the Energy Sector).

Thanks to its versatility and ease of use, the tool lends itself to interesting 'variations on a theme', which allow us to investigate, in addition to the digitisation and AI themes present in the six pillars, also aspects specific to a project, such as, for example, Replicability, Scalability, Sustainability, Circularity and so on.

Normally, when we are asked to investigate particular fields in addition to digitisation and AI, our approach has always been not to intervene in the structure of the existing tool, but to create appendices to be filled in at the end of the tool itself. This approach makes it possible to keep the 6-pillar structure intact, making the answers from many different use cases, even from different projects, comparable with each other (so creating a "critical mass"), and to investigate separately the new dimension of specific interest.

These appendices are normally referred to as "7th P".

An early example of a "**7th P**" was when we investigated the **Scalability and Replicability** of pilot experiments within a project in addition to digitisation paths. In this case, the 7th added dimension was that of so-called '**Portability**': Portability (the added dimension, or '7th P') is a questionnaire of 6 questions that analyses the Replicability of R&D pilots to other industrial domains and their Scalability to a larger scale. "Replicability" refers to the ability of a system to be repeated consistently and reliably, to serve multiple purposes. "Scalability" is a characteristic of a system to cope and perform well under an increased workload or scope; a system that scales well will be able to maintain or even increase its level of performance or efficiency when tested by larger and larger operational demands.

This questionnaire was used, for example, in the OPEN DEI project.

Since this approach was found to be practical and effective, we decided to replicate it in other projects as well. In the AI REDGIO 5.0 project, for example, the 7th P will investigate aspects of Sustainability: in this case too the survey instrument will remain as described above: a fixed part made up of the 6 pillars (same as that already used in the other projects) and a seventh pillar dedicated to investigating Sustainability,

In all the cases, the 6 questions of the 7th P replicate the same pillars of the 6Ps DT Model, i.e., they refer to: PRODUCT, PROCESS, PLATFORM, PEOPLE, PARTNERSHIP and PERFORMANCE, so as to make the 7th P consistent and uniform with the 6Ps questionnaire. Same as in the 6Ps, questions are given with 5 possible answers, corresponding to increasing levels of maturity, and the output is in form of radar chart.

As far as the “Sustainability” 7thP is concerned, which is relevant to the AI REDGIO 5.0 project, more details on how this new tool was constructed and applied, and its results, will naturally be the subject of dedicated deliverables.



Figure 5 6Ps Framework for Digital Transformation

In AI REDGIO we are exploring different extensions of the **6Ps method** according to the Industry 5.0 three pillars. A 7th Sustainability P is Planet and concerns with the twin transition digital-green of an enterprise; another 7th P is under study to measure the resilience of a supply chain with respect to potential risks of disruption. The Human-orientation is currently not part of the 7th P method but at the moment is mostly implemented in TERESA and Human-Robot Interaction analysis.

2.6. AI REGIO heritage: Didactic Factories Network and Virtual Factory experimentations

Started in the AI REGIO project and continuing in AI REDGIO 5.0 project, the **Didactic Factories (DFs)** network embodies an ecosystem spanning almost **30 facilities across Europe**, fostering collaboration in knowledge exchange and skill development. Anchored in the pillars of Acquisition, Collaboration, and Inspiration, the network prioritises visibility, skill sharing, and innovative endeavours.

The network's sustainability hinges on structured facilitation by Brainport Industries, ensuring consistent engagement and effective organisation. Future expansion targets over 30 DFs by 2026, which has been set in the KPI's of AI REDGIO 5.0 project and is considered key for collaboration and engagement potential, as well as key for the post project exploitation strategy. It is important that upcoming DFs will align with the

joining criteria emphasising activity, European presence, willingness to share knowledge and best practices, and sustained involvement.

To support Didactic Factories (DFs) in their path, a common approach of representing services which they can offer would be beneficial to enable standardisation of services to be offered to their stakeholders. To this purpose, the first pillar of METHODIH, the service portfolio, was applied to the network members based on the DR-BEST taxonomy.

DR-BEST is the evolution of the D-BEST by adding the Remotization dimension (R) customized for the case of the DF, since it includes the services suitable for the development of Virtual Factories, from which some examples will be provided in the next section of the document. A brief description of the taxonomy and the importance of its Remotization dimension is provided hereafter.

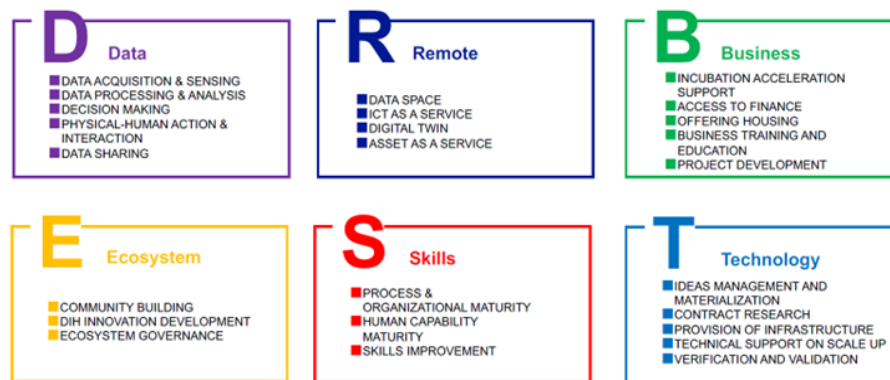


Figure 6 DR-BEST Taxonomy – First (Service classes) and second (Service Types) levels

The proposed structured method known as DR-BEST analysis serves as the foundation for the Service Portfolio study carried out by the DFs. The framework (see Figure 6) was developed considering the needs of the DFs, helping them to outline their current service portfolio and highlight any gaps in what they offer. A three-level taxonomy is used to classify services, which has two benefits: first, it provides a comprehensive overview of all the services that a DF could offer; second, it ensures that services are presented in a consistent and understandable manner.

The macro-classification (level 1 of the taxonomy) divides services into six classes (Data, Remote, Business, Ecosystem, Skills, Technology), from which the acronym DR-BEST is derived; for each class, level 2 and level 3 are defined to further clarify and categorise the type of activity.

Within the context of the AI REGIO project, the Remotization macro-class has been added to the D-BEST taxonomy to focus on the DFs that operate in the AI domain. This class contains all the services that a DF may provide from remote to enable experimentation and that do not require physical interaction with the customer. The sub-classes identified cover different degrees of DF-customer interaction, including four type of assets that can be put at disposal: **i) data space** (Real Time Industrial Data Platform, Assets Administration Shell, Assets Data Marketplace), **ii) ICT as a Service** (Software as a Service, Platform as a Service, Infrastructure as a Service), **iii) Digital Twin** (FEM/CFD/FSI simulation, Discrete event simulation, Ambient virtualisation), **iv) Assets as a Service** (Teleoperation, Monitoring platform, Avatar).

Within AI REGIO project, some business scenarios relied on Remotization services have been depicted briefly explained as follows:

- **Business Scenario 1 – Virtual Factory:** POLIMI needs to assess the feasibility of a new robotic asset to enhance its process. POLIMI had developed a semi-automated system to disassemble Printed

Circuit Boards (PCBs) during the FENIX activity, but recent safety norms prohibit certain tasks for human operators. To ensure operator safety, POLIMI decided to simulate the tasks using a digital model of the robot to check its interoperability with the existing system. POLIMI chose to employ its digital model to verify the two assets' effective interoperability in a simulation setting after being MADE cc placed in possession of a robot suitable for the task. As an interoperability enabler, the Asset Administration Shell (AAS) technology was selected. MADE CC sent its AAS model of the robot to be evaluated. This model's attributes were derived using POLIMI and fed into a simulation engine running in a virtual factory setting.

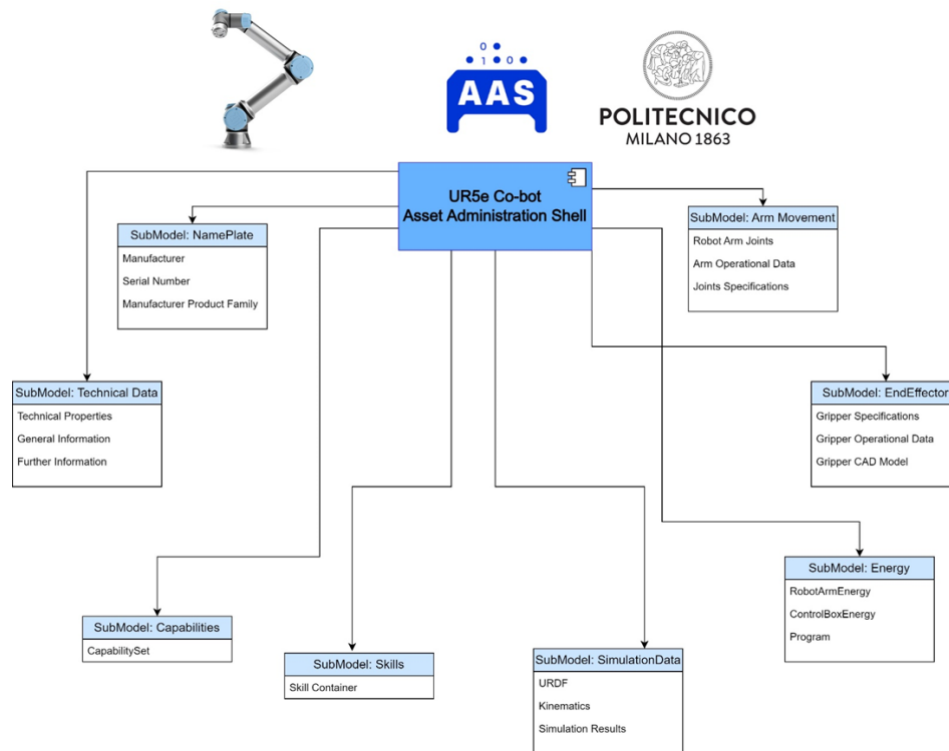


Figure 7-Example of UR5e AAS SubModels

- Business Scenario 2 – Asset Feasibility:** In the second business scenario, POLIMI needed to determine the efficacy of a new end effector for one of its robots. The gripper available at the time proved to be too expensive to handle new products added to the production line for the second time. Following an early market study, the POLIMI team decided to do some exploratory process simulations to ensure the ability to handle these new products. As a result, SUPSI provided the AAS of one of its robotic systems. In this experiment, POLIMI uses a UR5e robot with a Robotiq Hand E gripper, whereas SUPSI uses a UR5e robot with a Robotiq 85-2F gripper. The AAS model of the UR5e robot contains a SubModel for the robot's end effector, which allows for asset exchange between POLIMI and SUPSI. A basic pick and place task was carried out in the GAZEBO simulation environment using a UR5e robot equipped with two different grippers from POLIMI and SUPSI.

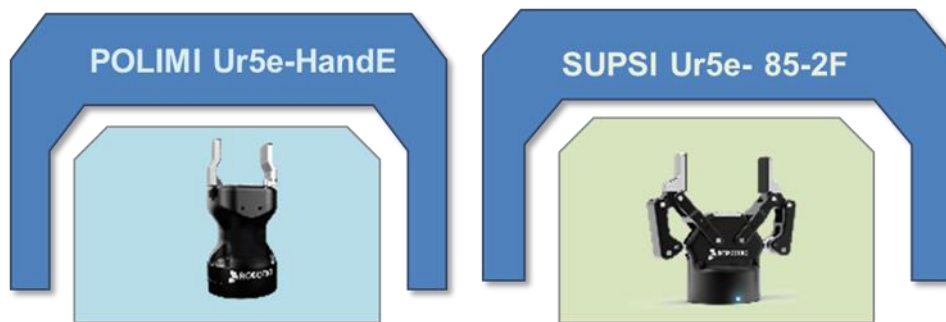


Figure 8- Grippers' representation

- Business Scenario 3 – Collision Avoidance:** In the present scenario, two UR5e robots from POLIMI and SUPSI were imported into a virtual working station in the GAZEBO simulation environment utilizing both AAS packages and URDF (Unified Robot Description Format) files. The robots were introduced into the environment while being aware of the collision with regard to each other and the working space constraints; thus, a safe cooperation of these two robots with two different grippers can be ensured while preventing collision between them.

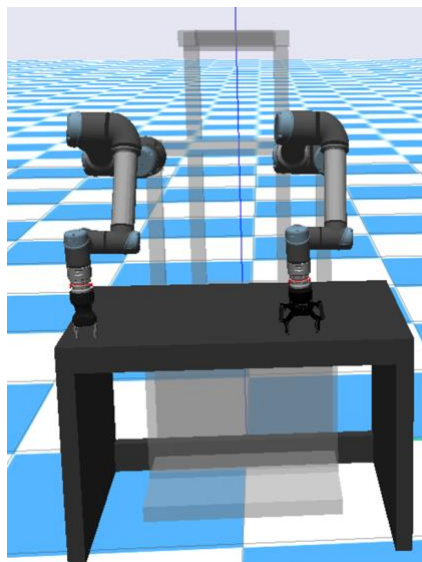


Figure 9- Collision avoidance

In AI REDGIO5.0 **Digital Factories Network and Virtual Factories** experimentations will be further enhanced following the DR BEST methodology on the one side and the TERESA / Virtual Factory experiments in WP6. Collaborations and liaisons will be opened with other running projects like RE4DY and DACAPO, running very similar initiatives. This is also quite interconnected with the servic3es to be provided in EU by the AI MATTERS project, the AI TEF for Manufacturing network.

2.7. AI REGIO heritage: TERESA Technology and REmulatory SANDboxes experimentations

TERESAs stands for “Technical and Regulatory Sandboxes” for AI.

The creation and deployment of AI REGIO TERESAs was interlinked with the growth of the Didactic Factory Network of AI REGIO.

A TERESA enables a direct testing environment for innovative CI-empowered products and services, aimed at addressing ethical challenges and shortcomings of the regulatory framework concerning such products and services. This kind of experiment is run on a limited scale, in a secure, gradual and controlled way in the Didactory Factory's facilities, as well as in real regulatory conditions and pursuant to a specific testing plan, including also the involvement of volunteers and of the Competent Authority (CA).

In the context of the project AI REGIO - "Regions and Digital Innovation Hubs alliance for AI-driven digital Transformation of European Manufacturing SMEs" Project^{AI}, the TERESA model and methodology were elaborated, including for instance three key players (namely the Competent Authority, the DF -in their role of innovators- and the Volunteers), standardized templates to gathering the contributions from the Didactic Factories on the progress of the experiments and their findings, as well as the legal and ethical aspects potentially testable in this kind of environment. Such aspects were named "WISE" and classified as:

- Well-being, Comfort and Acceptance
- Social inclusion and special categories of workers
- Safety of the worker
- Ergonomics and improving working conditions

Furthermore, in the AI REGIO Project an array of WISE Indicators was identified, conceived as human well-being indicators specifically relevant for AI-empowered workplaces and human-machine collaboration in the manufacturing domain. The WISE Indicators regard: I. Safety and Physical Health; II. Community; III. Self-esteem and Sense of worthiness; IV. Self-actualization; V. Psychological Stress; VI. Timesaving; VII. Fatigue reduction; VIII. Social inclusion; IX. Productivity/Performance; X. Sense of autonomy; XI. Skills; XII. Job satisfaction; XIII. Psychological Well-being.

In AI REDGIO 5.0 Project the Consortium, through some of its Didactic experimental facilities within the AI REDGIO 5.0 DF Network, closely associated to the VANGUARD Pilot Plants and Regional / National Industry 4.0 initiatives, is developing the following TERESA experiments:

- DFI Experiment: Industry 4.0 Lab;
- DF IV Experiment: Vision Enhancement with Synthetic Data;
- DF VIII Experiment: Digital Manufacturing Innovation Lab;
- DFIX Experiment: BEHAI – ADAPTING QUALITY INSPECTION SYSTEM TO HUMAN BEHAVIOR AND HUMAN STATES;
- DFX Experiment: IMPLEMENTATION OF QAD-AI@E SOLUTION IN THE REAL CLOTHING MANUFACTURING ENVIRONMENT
- DFXI Experiment: Testbed for Industry 4.0;
- DF XII Experiment: Data-driven IoT Suitcase Experiments
- DF XIII Experiment: SUNSYNC: AI SOLUTION FOR OPTIMIZING RECYCLING IN INDUSTRY AT THE LEVEL OF AM-LAB'S.

In these AI REDGIO 5.0 Experiments, the TERESA Framework is and will be further adopted and used, including both the model and the methodology, as well as the WISE aspects and indicators, considering the peculiarities of the evolutions towards I5.0, AI-at-the-Edge and Digital Sovereignty.

More details on the application of the TERESA model in AI REDGIO 5.0 can be retrieved in D6.4 "TERESA Experiments in TEF Network – M18".

^{AI} AI REGIO Project was , funded by the European Union Framework Programme for Research and Innovation Horizon 2020 under Grant Agreement n 952003

In AI REDGIO 5.0 Project the Consortium, through some of its Didactic experimental facilities within the AI REDGIO 5.0 DF Network, closely associated to the VANGUARD Pilot Plants and Regional / National Industry 4.0 initiatives, is developing **13 TERESA experiments**.

2.8. I4MS2 in HEP Framework

In Horizon Europe program, the I4MS initiative is continued by I4MS2 which was part of TWIN TRANSITION 2022 06: ICT Innovation for **Manufacturing Sustainability** in SMEs (I4MS2). Three more Innovation Actions have been funded to create a virtual I4MS2 cluster in HEP.



I4MS2

TWIN TRANSITION 01-06 I4MS2

HORIZON-CL4-2022-TWIN-TRANSITION-01-06: ICT Innovation for Manufacturing Sustainability in SMEs (I4MS2) (Made in Europe Partnership) (IA)

Specific conditions	
Expected EU contribution per project	The Commission estimates that an EU contribution of between EUR 4.00 and 8.00 million would allow these outcomes to be addressed appropriately. Nonetheless, this does not preclude submission and selection of a proposal requesting different amounts.
Indicative budget	The total indicative budget for the topic is EUR 30.00 million.
Type of Action	Innovation Actions
Technology Readiness Level	Activities are expected to start at TRL 5 and achieve TRL 7 by the end of the project – see General Annex B.
Procedure	The procedure is described in General Annex F. The following exceptions apply: To ensure a balanced portfolio covering all technology areas, grants will be awarded to applications not only in order of ranking but also to at least one project per technology area, provided that the applications attain all thresholds.
Legal and financial set-up of the Grant Agreements	The rules are described in General Annex G. The following exceptions apply: Beneficiaries may provide financial support to third parties. The maximum amount to be granted to each third party is EUR 60 000. The funding rate is up to 60% of the eligible costs. This funding rate applies both to members and non-members of the partnership, except for non-profit legal entities, where the funding rate is up to 100% of the total eligible costs.



Artificial Intelligence in Manufacturing for Sustainable Applications at SMEs.
The AIRISE project will support European SMEs in the uptake of Artificial Intelligence applied to manufacturing, with a specific focus on the use of AI-enabled applications at the edge.



White-label shop for digital intelligent assistance and human-AI collaboration in manufacturing.
WASABI aims at providing SMEs with the tools and knowledge to improve workers capacities and performance, providing advanced user interfaces for continuous augmented hybrid-decision-making.



Circular and Dynamic Manufacturing Supply Chain Orchestration and Optimisation.
CIRCULOOS aims to deliver circular manufacturing tools which orchestrate and continuously optimise the supply-chain end-to-end and comprehensively integrate planning and execution.

Figure 10- I4MS2 Initiative

2.8.1. AIRISE.EU Artificial Intelligence in Manufacturing for Sustainability at SMEs

AI has shown many benefits across various sectors and industries, leading to an increase in the development of innovative solutions to expand those benefits even further. In this context, the EU-funded [AIRISE](#) project, recognising the benefits of AI, aims to develop a consortium that will assist SMEs in the effective and efficient development and commercial deployment of novel AI-based technologies for the manufacturing sector, specifically for AI enabled applications at the edge. The project will mostly focus on technologies that help reduce emissions, waste as well as carbon footprint. It will offer SMEs easily accessible AI expert help and guidance.

The AIRISE project will support European SMEs in the uptake of **Artificial Intelligence** applied to manufacturing, with a specific focus on the use of AI-enabled applications at the edge. The key objective for applications is a reduction of waste and carbon footprint while ensuring the resilient operation of manufacturing. The consortium will create an eco-system where the project's AI experts will support

experimenting SMEs and connect them to Digital Innovation Hubs and commercial companies to achieve real-world applications. Open Calls will allow SMEs to easily access AI expert competence through first-stage assessments that identify the status and potential and through further proposals that support them in running pilot applications and validation experiments. The ambition of AIRISE is to support more than 500 cases from SMEs and mid-caps on key AI applications at the edge. Support from the consortium will be complemented on security and connectivity by involving external resources in cybersecurity and IoT and on smart working environments by offerings on operator interfaces and collaborative robots.

2.8.2. WASABI White-label shop for digital intelligent assistance and human-AI collaboration

In today's fast-paced business landscape, small and medium enterprises (SMEs) face a growing challenge: harnessing the power of cutting-edge software tools while ensuring their workforce can navigate them effectively.

Many struggle to bridge the gap. In this context, the EU-funded [WASABI](#) project will equip SMEs with the tools and knowledge needed to elevate employee performance. Advanced user interfaces will be designed to facilitate continuous **augmented hybrid-decision-making**. These simplify interactions with complex software, effectively lowering the skill floor for all users.

At the heart of the project's solution lies the **Digital Intelligent Assistant (DIA)**, an anthropomorphic, task-oriented AI with a conversational interface. DIA is designed to guide SMEs, ensuring hands-free, eyes-free computer interaction, AI-based advice, and augmented analytics.

WASABI aims at providing SMEs with the tools and knowledge to improve workers capacities and performance, providing advanced user interfaces for continuous augmented hybrid-decision-making. Such interfaces assist employees in interacting with complex software, effectively reducing its skill floor.

In consequence, humans will find using software easier and be more open to applying it effectively at work. WASABI's advanced interfaces will cover, for instance, situation analysis, intervention identification, action planning and execution, and impact monitoring and mitigation.

One of the key technologies in WASABI's solution portfolio is the digital intelligent assistant (DIA) - an anthropomorphic, task-oriented AI with a conversational interface. A network of DIHs that will help boosting impact by guiding SMEs in this new path will be created and integrated within other existing DIH networks.

Our customized, federated, white-label shop will include such DIAs and skill-packages to help organizations reach their sustainability goals. Blue-collar and white-collar workers will be capable of using it for hands-free or eyes-free computer-interaction, AI-based advice and guidance, and augmented analytics.

2.8.3. CIRCULOOS Circular and Dynamic Manufacturing Supply Chain Orchestration and Optimisation

[CIRCULOOS](#) aims to deliver circular manufacturing tools which orchestrate and continuously optimise the supply-chain end-to-end and comprehensively integrate planning and execution. Combining these with direct calculation of the product sustainability and circularity profile, both internally and with external partners, this environment will enable them to configure and execute disruptive circular manufacturing processes for sustainable production that cover the entire life cycle of products which become waste and are recycled in the same or other life cycles.

To achieve this objective the project aims at deploying:

- **Circular end-to-end supply chain orchestration** of collaborative workflows and connecting planning and execution metrics with advanced and multimodal visualisation -DT of supply chains formulated, factory processes and product design- and analytics.
- **Supply Chain Optimisation** that monitors the global (across the supply chain) and local (within the factory) processes and execution.
- **Dynamic Sustainability Assessment** functionalities that ponder the alternative supply-chain scenarios (varying in terms of materials used, processing technologies, suppliers involved and/or activated circular economy practices).
- **Supply Chain Data Spaces** for seamless, multi-level data flow across the supply chain partners.
- **Cybersecure and trustworthy** data sharing across the supply chain by employing a distributed, trusted and efficient Identity and Access management system together with the associated trust framework.
- **Novel circular business processes** will be demonstrated supporting reusing, reducing, and recycling material in production and consumption systems.
- **Skills upskilling and reskilling** will be provided in RAMP and through online courses.

2.8.4. I4MS2: Joint Dissemination and Collaboration activities

In the first year of the I4MS2, the projects aimed at reciprocally communicating news and events, but without a real “cluster” feeling. Major activities have been to keep aligned the **first waves of Open Calls** especially between AIREDGIO5.0 and AIRISE.

AIRISE Open Calls

AIRISE uses calls to initiate cooperation between people on AI-in-manufacturing. All of these calls ask for ideas that facilitate manufacturing for ecology, for efficiency, for resilience of just to make people's life better. The aim is to teach and to connect so that new solutions can be developed that make companies more competitive

AIRISE aims to conduct so called "experiments" to support European SME's and mid-caps to develop their idea of using artificial intelligence at their manufacturing shop floor. The AIRISE project provides support through services across all development steps from the idea to running test under realistic manufacturing conditions. These services are meant to teach and guide the applicants under the paradigm of empowerment. They shall enable the applicants to grow, to learn how to tackle future challenges with less support. The initiative runs under the umbrella of European Commission's initiative "ICT Innovation for Manufacturing SMEs (I4MS2)".

The call aims to support European SMEs and midcaps to create and deploy AI applications that support their manufacturing lines in being more sustainable with less waste and energy consumption, being more agile secure and resilient to changes and being more attractive for employees to mitigate effects from age, gender, or social and cultural background.

The anticipated AI application must address at least one of the following objectives:

- Improve the sustainability of processes and products, significantly reduce or reuse waste and must lower the energy and carbon footprint
- Make industrial processes more agile, secure and resilient to future changes
- Make manufacturing jobs more attractive for humans, whichever the age, gender or social and cultural background, through better human-machine
- interfaces and more intuitive interaction with digital tools

There is a strong communality of intents between AIRISE and AIREDDGIO5.0 especially concerning the industrial pilots and the maturity assessment tools. In the former case, AIREDDGIO5.0 will provide AIRISE with its 6P methodology, while AIRISE is promoting its maturity assessment to the AIREDDGIO5.0 community.

WASABI and DFA DIH Partnership Programme

The **Digital Factory Alliance** is born under the umbrella of groundbreaking European Commission projects aiming at modernizing and digitalizing the assets of the factories of the future, with the strong conviction that these actions will have a critical influence in the way these factories will be operated and managed in the years to come, by promoting the use of Artificial Intelligence Technologies and Data Intelligence to strive for Zero X Manufacturing Environments.

The DFA **Digital Innovation Hubs** partner programme intends to incorporate DIHs with expertise in specific Industry 4.0 areas to the DFA network. The programme will support a DIH to become a service provider and to successfully implement the DFA tools and methodological assets within its local SME ecosystem

AIREDDGIO5.0 and WASABI address different aspects of AI: AI at the Edge and Cloud Edge IoT Continuum for AIREDDGIO5.0 and Generative AI based Digital Assistants for decision making in WASABI. A common playground for collaboration will be the DFA and in particular the DIH partner programme, where both projects are expected to heavily contribute.

The Manufacturing Partnership Day

The Manufacturing Partnership Days were taken place in Brussels, on 7 and 8 May 2024. This collaborative event, co-organised by [EFFRA](#), [Factories of the Future](#), and [Made in Europe](#) projects, aimed to bring together the Factories of the Future and Made in Europe community, providing a platform to showcase ongoing project work. The event brought together the manufacturing research and innovation community once again for two days of insightful presentations, engaging discussions, and fruitful networking.

The event focused on key themes shaping manufacturing innovation today, including manufacturing excellence, resilience, circularity, skills, and future perspectives and showcased **37 Made in Europe and Factories of the Future** projects, which presented their results and goals over two days. Additionally, there was an exhibition area where the projects could interact with visitors and engage in detailed discussions about their work.

POLIMI presented the AI REDGIO 5.0 project in the session *HORIZON-CL4-2022-TT-01-06: ICT Innovation for Manufacturing Sustainability in SMEs (I4MS2) (IA)* with the sister projects AIRISE and WASABI.

The presentation highlighted the project's experiments advancement, the AI REDGIO 5.0 objectives and the exciting opportunities it offers. Additionally, the partner AFIL was also in attendance, actively engaged in networking activities to foster connections with other projects and stakeholders.

Alongside AFIL, partners Steinbeis Europa Zentrum, MADE - Competence Center Industry 4.0, POLYMERIS and TXT were instrumental in supporting AI REDGIO 5.0 presence at this important networking event.

Planned common events with I4MS2 are envisaged for the next months:

- [MADEIRA Digital Transformation Week](#) (20-28 June) and the **Digital Transformation Summit** on June 25th. The Madeira Digital Transformation Week will bring together five major events, the 30th ICE IEEE/ITMC Conference, the 2nd edition of the Madeira Digital Transformation Summit, the EIT Health Transformation Talks, the CyberSecPro Summer School and the NITIM Graduate School. This convergence of academic, policy makers and industry stakeholders provide an opportunity to showcase research, projects, solutions and initiatives.

The MDTWeek will attract a diverse audience, including academic experts, industry professionals from both large corporations and SMEs, representatives from the European Commission and governmental bodies. This mix of attendees offers great potential for networking and collaboration.

The workshop **WS108 “Industry 5.0 Digital Transformation of Manufacturing SMEs, the role of I4MS2”** aims to discuss the preliminary achievements towards I5.0 of both I4MS and EDIH in their first implementation period and to provide recommendations and guidelines for their successful completion in the current framework programme 2021-2027.

- [**EBDVF24 European Big Data Value Forum**](#) in Budapest (2-4 October) where the Manufacturing Track session will be dedicated to SMEs and in particular their Data-driven Digital Transformation under the MANUFACTURING-X Foundational Framework. The format of the session is still under discussion, but the participation of AIREGIO5.0, Manufacturing-X and Factory-X representatives, under the sponsorship of BDVA and its Smart Manufacturing Industry group is assured.

Participation in **common I4MS2 dissemination events and conferences** has already been started and brought to interesting results during the Manufacturing Partnership days beginning of May under the EFFRA patronship. This will continue in Madeira DT Week which is debating the role of I4MS2 and EDIHs in the digital transformation of manufacturing SMEs. From a more technological perspective (data spaces and digital twins) the EBDVF24 event in Budapest will discuss the role of Data Technologies in the Digital Transformation of Manufacturing SMEs in Europe.

3. Cooperation with Digital Innovation Hubs

3.1. The European DIH Network

(European) Digital Innovation Hubs act as “one-stop-shops” to help companies become more competitive regarding their business/production processes, products or services using digital technologies, by providing access to technical expertise and experimentation that are needed for a successful digital transformation.

Digital Innovation Hubs are one of the four cornerstones of the 2016 EC Communication “Digitising European Industry”



Figure 11- Digitising European Industry Initiative

Digital Innovation Hubs (DIHs) form one pillar of the DEI initiative. DIHs help companies, especially smaller companies and start-ups, to improve their business, production processes, products and services through digital innovation. At the core of a DIH, there is normally a “**competence centre**”, such as a research and technology centre or an innovation-oriented university department. DIHs offer services across the whole spectrum of the process of digital transformation.

The services available through a DIH enable businesses to access the latest knowledge, expertise and technology for testing and experimenting with digital innovations relevant to their products, processes or business models. DIHs also connect with investors in order to facilitate access to finance for digital changes. DIHs help connect suppliers of digital innovations with potential users.

Many H2020 projects have addressed DIHs from different viewpoints, business ecosystem skills test-before-invest (BEST), as for instance AI REGIO and the METHODIH framework previously reported in §2.4, where service portfolio analysis has been coupled with customer journeys, to build a tool for continuous improvement and cross-DIH collaborations.

European Digital Innovation Hubs EDIH. Following the adoption of the [Digital Europe Programme work programme \(DIGITAL\)](#), the first restricted call for **EDIHs** has been completed with **136** projects chosen and most hubs operational in January 2023. A second call was launched to supplement the selection of EDIHs and to fill the gaps in the Network which resulted in the selection of a further **15** hubs.

The four pillars of the DIHs have been renamed but the BEST paradigm maintains its validity in EDIHs:

- Test before Invest **T**
- Skills development & Training **S**
- Support to find Investments **B**
- Innovation Ecosystem & Networking **E**

Under this programme, 50% of the funding is provided by DIGITAL, and the other 50% is provided by the Member States, associated countries, their regions and/or private sources. National governments and regional authorities played a central role in the selection process of the EDIHs by identifying suitable candidate EDIHs to respond to the European calls for proposals.

High-quality candidate EDIHs, for which no DIGITAL funding was available, have received a **Seal of Excellence**. Some of these are being funded by their Member States or region and once they are operational, they can also become part of the network of EDIHs.

With the [EDIH network](#) the European Commission wants to build a vibrant community of hubs and other stakeholders fostering networking, co-operation, and knowledge transfer activities between EDIH, SME and mid-caps, the public sector and the other relevant stakeholders and initiatives. The **Digital Transformation Accelerator (DTA)** is supporting the achievement of this goal, through managing the web presence of the network, and hosting appropriate software platform and tools, including the online [catalogue of EDIHs](#).

As of today, the catalogue counts for 151 fully funded EDIHs (136+15) and additional 75 with the so-called Seal of Excellence, for a total of **226 EDIH**. **153** of them have expressed their interest in Manufacturing sector.

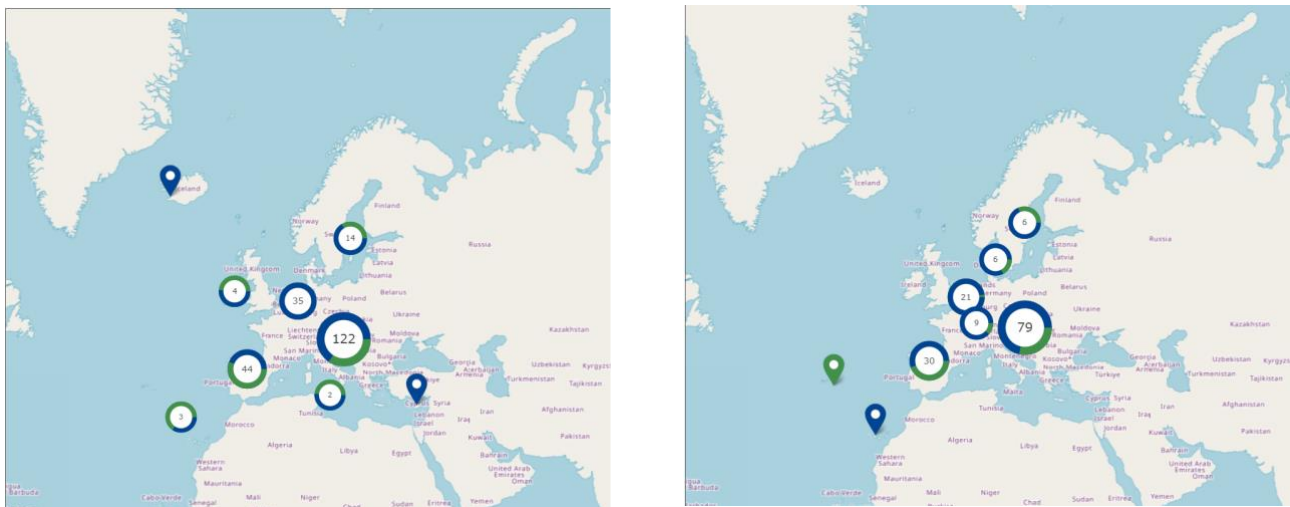


Figure 12- EDIHs

The [EDIH network web portal](#) includes tools to assess the performance of the EDIH network, gauging the impact that EDIHs have on the digital maturity of the organisations they support. To this end, the Joint Research Centre of the European Commission has developed a [Digital Maturity Assessment](#) tool which can be used by all EDIHs to measure the progress of Digital Maturity of their customers. The Digital Maturity Assessment tool is available in the section of the web portal reserved for registered EDIHs.

Inside the EDIH network, several [Thematic Working Groups](#) have been created and the “**Data in Manufacturing**” TWG is currently led by AI REDGIO5.0 beneficiaries (CARSA MADE POLIMI). The thematic working group on Data in Manufacturing will provide an active community for EDIHs to agree on areas of collaboration, investment as well on effective mechanisms for cooperation and support to drive AI and data economy of manufacturing SMEs. The thematic working group brings together stakeholders to define

efficient processes to lower the barriers to access high quality data and cutting-edge methodologies and technical assets to increase the digital maturity of data-driven and AI powered manufacturing services and solutions. The thematic group discusses upon best practices and methods to align with AI/Data in Manufacturing flagship initiatives and incentivise SMEs in the use, sharing and (re)use of data to increase competitiveness, sustainability and circularity of manufacturing services. A webinar session was held on 24 January 2024. The focus was on exploring Best Practices from EDIHs providing Data-driven predictive maintenance services while also holding an open interactive discussion on Topics of Interest for future Data in Manufacturing Thematic Working Group (TWG) meetings.

Moreover, before the birth of EDIHs a bottom-up, informal, cross-regional, multi-country collaborative network of 23 EDIH candidates and 25 regions from 14 countries sharing a smart manufacturing specialisation have been created and coordinated by the MADE Competence Center in Milano (MADE). The mission of the **EDIH4Manu network** is to drive the digital and sustainable transformation of small and medium-sized manufacturing enterprises in the EU through a bouquet of complementary, interoperable and composable services.

EDIH Manufacturing Network



25 EDIH 15 COUNTRIES 25 REGIONS

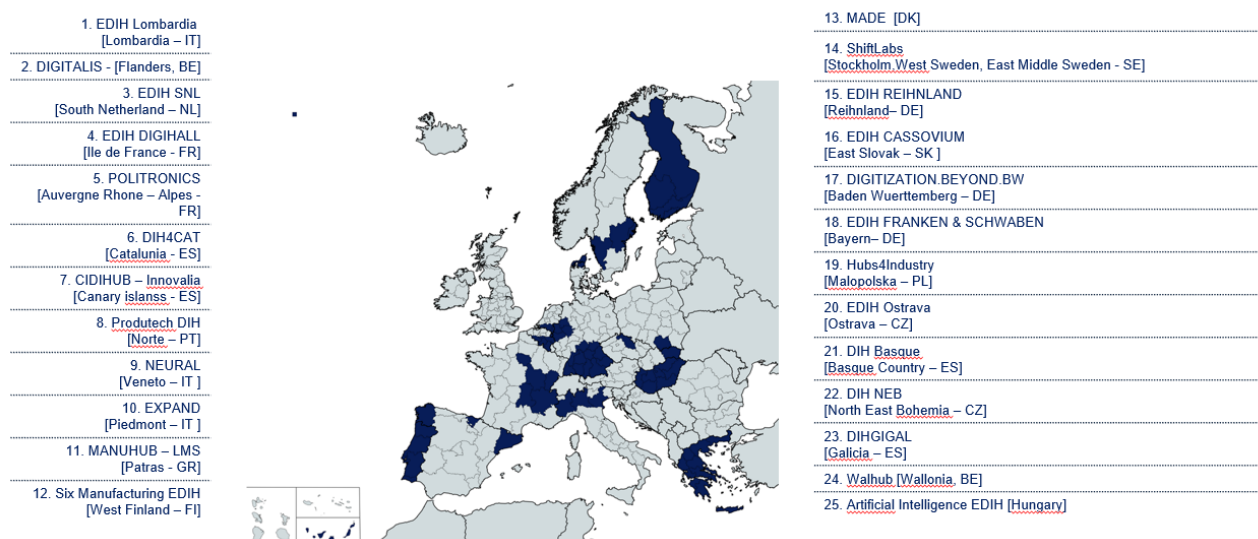


Figure 13- EDIH Manufacturing Network

Finally, in the Industrial Symbiosis and Process Industry domain (Processes4Planet), [Hubs for Circularity](#) have been created to accelerate the transition to industrial symbiosis, industrial-urban symbiosis and circular economy. Hubs4Circularity are socio-technical ecosystems for full scale industrial symbiosis, industrial-urban symbiosis and circular economy closing energy, resource and data loops at regional scale. They are an important building block for achieving the climate neutrality targets by 2050.

Many partners of AI REDGIO 5.0 are actively involved in the **EDIH network** as indicated by the EC Catalogue. The AI REDGIO 5.0 marketplace and innovation platform, the DIH4Industry marketplace and the DFA portal will be the three main instruments to implement a pan-EU ecosystem of EDIHs specialized in Manufacturing, artificial Intelligence at the edge and Industry 5.0.

3.2. The DIH4INDUSTRY Marketplace

DIH4INDUSTRY, in close collaboration with the European Commission Digital Innovation Hubs tool, aims at creating, nurturing and governing an Ecosystem of Digital Innovation Hubs with a regional Smart Specialisation in Manufacturing. DIH4INDUSTRY is a single access point for DIH practitioners and policy makers to identify which EC DIHs are active in the Manufacturing domain, where they are located, which experiments they are supporting and, last but not least, which services they are providing for the Digital Transformation of EU Manufacturing Industry.

The objective is to create an extensive and connected network of Digital Innovation Hubs that interact through a platform, sharing solutions and services that respond to local needs for industrial digitalization. The mission is to facilitate the exchange of skills, assets, knowledge, technologies and data between the DIHs to provide an effective and efficient response to the technological and digital needs of SME in their digital transformation.

The vision of DIH4INDUSTRY is to boost innovation and digitalization by a platform where opportunities of collaboration between DIHs can arise, sharing assets and needs in an innovative approach driven by knowledge and experience, within a single access point.

The DIH4INDUSTRY platform offers:

- a **Community**: a collaborative environment that DIHs may use to foster innovation by forming new projects and supporting the networking among members. DIH4Industry provides a three levels taxonomy for classification and clustering of DIH services.
- a **Marketplace**, in the form of a showcase of D-BEST (Data, Business, Ecosystem, Skills and Technology) digitalization support services made available by the DIHs for the benefit mainly of other DIHs;
- an **Ecosystem**, enabling the creation of hubs for all DIHs focused on Industry 4.0.

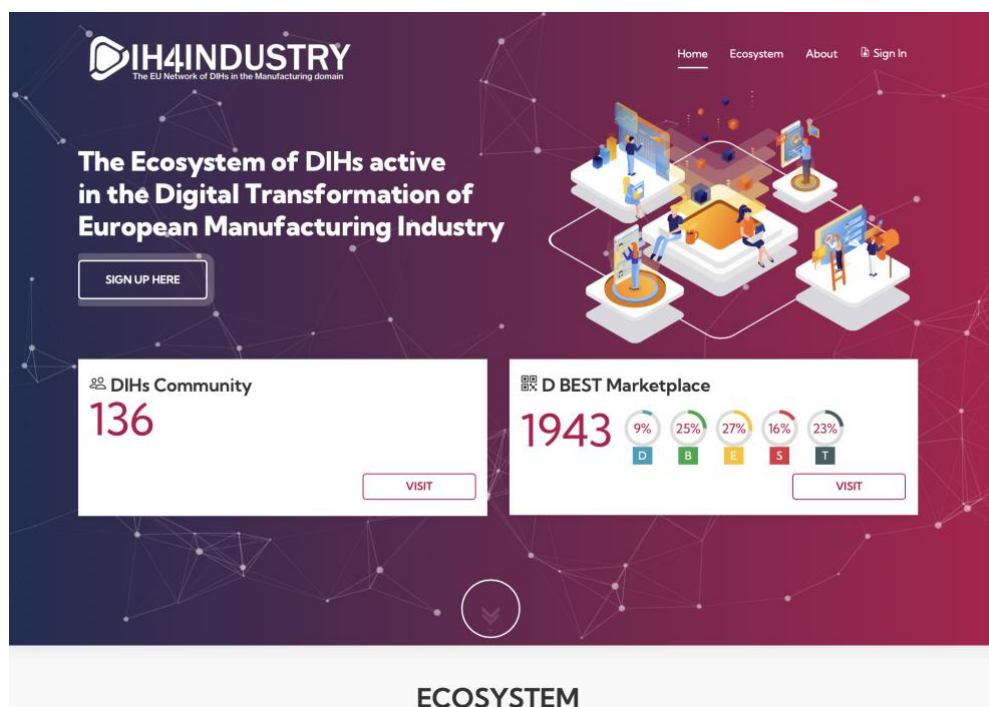


Figure 14- The DIH4INDUSTRY Platform

The present configuration of DIH4INDUSTRY consists of a public area and a private area, with the following contents.

In the public area:

- a DIHs Community, where DIHs are shown in a map and in a list, that can be filtered by DIH's Name, Initiative, Project, Country, Sectors, Technologies; 136 DIHs have registered, at present.
- a D BEST Marketplace, where services are classified according to the new DBEST taxonomy, which is fundamental to facilitate the collaboration among DIHs; services can be filtered by Initiative, Project, DIH and Country. This standardisation of services greatly facilitates the exchange of information, communication and collaboration between DIHs and helps enhancing the collaboration among providers and consumers of digital technologies (DIHs, SMEs...). This structure has been adopted by the DIH4INDUSTRY platform and can be considered a prerogative of the platform that makes its value proposition unique.
- a dedicated section for each Initiative participating in the platform, by which DIHs are grouped according to the Initiatives in which they participate; the creation of Initiatives within the platform favours the strengthening of relations between DIHs within their group of origin, respecting the identity of each one; at the same time, Initiatives are integrated in a context of other Initiatives, allowing DIHs to widen their experience at European level.

Additionally, in the private area:

- a knowledge space (publish, organize and access community information in one central location) and resources cataloguing (managing information by the use of powerful metadata, so enabling the cataloguing of resources and their dynamic modelling and visualization).

AIREDGIO 5.0 is working to enhance the **DIH4Industry marketplace** with specific services and solutions for AI-at-the-edge and targeting Resilience Sustainability and Human centricity. The expansion of the portal will be enhanced by new models for collaboration and for doing business together. An intelligent matchmaking tool will support DIHs to find complementary partners and to open collaborations

4. Cooperation with other initiatives at EU level

4.1. Made in Europe Partnership

Made in Europe is the manufacturing partnership with the European Commission under the Framework Programme Horizon 2021-2027. The Made in Europe partnership will be the voice and driver for sustainable manufacturing in Europe based on joined expertise and resources. It will boost European manufacturing ecosystems towards global leadership in technology, towards circular industries and flexibility. The Partnership will contribute to a competitive, green, digital, resilient and human-centric manufacturing industry in Europe. It will be at the centre of a twin ecological and digital transition, being both a driver and subject to these changes. We have analysed 2021 and 2022 **Horizon Europe calls** regarding:

- i) **Green, flexible and advanced Manufacturing** (new manufacturing technologies addressing sustainability – green – and resilience – flexible – requirements);
- ii) **Advanced digital technologies for manufacturing** (with particular emphasis on AI technologies and their applications embedded in production systems or deployed at the edge).

In the **Green, flexible and advanced Manufacturing** call, we collected inputs from **two** twin transition topics in **2021**

- **01 AI enhanced Robotic systems** 4 projects (Fluently, Converging, AI Prism, Cogniman) also in collaboration with **ADRA Partnership**, where AI at the edge plays a fundamental role for Robotics and Human Robot Interaction.
- **02 Zero-defect Manufacturing** 6 projects (ZDZW, Turbo, Flash-Comp, Engine, Open-ZDM, Platform-ZERO), where embedded AI is improving the quality of the production, aiming at the First Time Right paradigm

and **three** other twin transition topics in **2022**

- **01 Reconfigurable process chains** 3 projects (Flex4Res, RaRe2, R3Group), where the Resilience aspects of Industry 5.0 are emphasized, like Flexibility, Agility, Redundancy, Awareness, Proactiveness
- **03 Distributed control and modular manufacturing** 4 projects (Modapto, Modul4r, Mars, One4All) especially focusing on AI at the edge applied to improve production flexibility and to develop “plug & produce” mechanisms and tools
- **04 Intelligent work piece handling** 4 projects (AgileHand, Masterly, SmartHandle, Hartu) where AI is used in robotics applications addressing complex products in harsh production environments

for a total of **21 projects** analyzed, 10 in the 2021 call and 11 in the 2022 call.

In the **Advanced digital technologies for manufacturing** call, we collected inputs from **two** twin transition topics in **2021**

- **07 AI for sustainable agile manufacturing** 3 projects (Aldeas, CircularTwAI, S-X-AIPI) continuing the activities of the H2020 cluster “AI for Manufacturing” in close collaboration with the **ADRA partnership**;
- **08 Data-driven industrial environments** 3 projects (Zero-SWARM, RE4DY, 5G-Timber) where the challenges of highly distributed data spaces in manufacturing are also addressing AI at the edge

and **two** other twin transition topics in **2022**

- **06 ICT Innovation and I4MS2** 4 projects, this is our topic, as previously described

- **07 Digital tools for Circular manufacturing** 5 projects (Circ-uits, Dacapo, Auto-twin, Alicia, Dicim) where AI tools applied to Sustainability and Circularity are addressed

for a total of **15 projects** analysed, 6 in 2021 and 9 in 2022.

AI REDGIO 5.0 is closely connected to Made in Europe partnership and the above projects related to Digital Manufacturing. We are actively participating in the yearly Manufacturing Partnership Days (7-8 May 2024 this year) and the European Manufacturing Conference (24-25 September 2024).

4.2. [AI, Data and Robotics Partnership](#)

The [AI, Data and Robotics Partnership](#) is one of the European Partnerships in digital, industry and space in Horizon Europe. To deliver the greatest benefit to Europe from AI, Data and Robotics, this Partnership will drive innovation, acceptance and uptake of these technologies.

The Partnership will boost new markets, applications and attract investment, to create technical, economic and societal value for business, citizens and the environment. By 2030, European sovereignty is expected in the development and deployment of trustworthy, safe and robust AI, Data and Robotics, compatible with EU values and regulations.

As already described above, in 2021 two common MiE and ADRA topics have been awarded (Twin Transition 01 and 07) and **7 projects** funded.

Closer collaboration has been set up with **Circular TwAI**n and **S-X-AIPI** projects, due to the presence of common partners, especially regarding the extension of the network of Didactic Factories for circularity and the validation of the 6P model to process industry.

ADRA is also organising its [ADR Forum conference](#). The **ADRF 2023** edition was held in Versailles (8-9 Nov) and AI REDGIO 5.0 attended and animated the session about "Innovation, deployment and uptake of ADR technologies: Offer from different instruments supported by the EC" where the role of EDIHs in the uptake of ADR technologies were debated.

Next ADRF edition will be in November 4-5 2024 in Eindhoven.

Finally, AI REDGIO 5.0 is collaborating with the [ADRA-e CSA](#) especially organizing and supporting a manufacturing community in it. On June 28th the event "ADR Convergence in Manufacturing" will be held where the BDVA SMI group will be presented by POLIMI.

ADRA represents the technological Partnership for AI REDGIO 5.0, especially with the aim to build a community of EDIHs specialized in AI Data and Robotic technologies. Closer collaborations are also set with AI for Manufacturing projects funded under the Twin Transition 2021 07 topic. ADRA-e CSA also represents a convenient channel for disseminating our outcomes.

4.3. [Industry 5.0 Community of Practice and HUMAN Destination collaboration](#)

The Industry 5.0 provides a vision of the future of European industry, which aims to achieve societal goals beyond jobs and growth. Industry would become a resilient provider of prosperity, by making production more sustainable and placing the wellbeing of the worker at the centre of the production process.

Industry 5.0 Community of Practice (CoP 5.0) brings together a broad range of European innovation ecosystem stakeholders to share good practices, co-create actions to implement Industry 5.0 and provide a platform for members to network and establish new collaborations. It helps create a value proposition for stakeholders at the local, regional, national, and European levels to promote and apply Industry 5.0 principles and practices. It facilitates an opportunity for stakeholders to foster synergies and receive support in the ongoing process of green and digital transitions with a focus on human-centricity, sustainability and resilience.

In a recent **Industry 5.0 event** (May 29th), organized by the HUMAN projects **PROSPECTS5.0** (Drivers and success factors for progress towards Industry 5.0 (RIA) HORIZON-CL4-2023-HUMAN-01-52, 14 use cases, led by Flanders Make), **SEISMEC** (Pilots for an innovative human-centric industry (RIA) HORIZON-CL4-2023-HUMAN-01-51, 17 pilots led by Erasmus University Rotterdam) and **BRIDGES5.0** (HORIZON-CL4-2021-HUMAN-01-26 - Workforce skills for industry 5.0 (RIA), led by TNO), the EC (DG RTD Laura Roman) presented more in detail the CoP and AI REDGIO 5.0 was invited to present its TERESA approach to Industry 5.0 experimentations.



Figure 15- INDUSTRY 5.0

In this context, AI REDGIO 5.0 is proposing a collaboration framework based on the following three pillars:

- **SUSTAINABILITY.** AI REDGIO 5.0 proposes the 7Ps method (online survey, interviews, analysis report) where we analyze the impact of the most advanced ICT to the Environmental Sustainability of a manufacturing company or of a supply chain. For instance we can analyse Data Spaces and AI along the 7 dimensions of Product Process Platform (3 technical dimensions), People Partnership Performance (3 socio-business dimensions) and PLANET. Moreover, we also have a specialized tool for CIRCULARITY (based on the 10 R loops), which is a specific aspect of SUSTAINABILITY.
- **RESILIENCE.** AI REDGIO 5.0 proposes a specialized 6-dimensions version (newly developed in the MAASive project) with a further analysis of **FRANCA** capabilities (Flexibility Redundancy Agility Nearness Cybersecurity Awareness) of a company to prevent possible disruptions (internal external, technical business political, short term medium term long term) in the value chain
- **HUMAN.** AI REDGIO 5.0 just tackled one specific aspect of the **CAPS** (Collaboration + Creativity, Autonomy + Automation, Privacy + Productivity, Safety + Satisfaction) in the factory workspaces aiming at identifying possible Wellbeing Inclusiveness Safety Ergonomics issues (**WISE** workspaces). We promote the development of **TERESAs** (TEchnology REgulatory SAndboxes) in

didactic Factories (or TEF Testing and Experimentation Facilities), pre-commercial lower TRL environments where to conduct our experiments. For the other aspects of CAPS we can adopt your methods and tools while developing together something merging CAPS and TERESA

In the Industry 5.0 domain, and especially in the Human centric aspects of it, AI REDGIO 5.0 aims at creating strong liaison with the Industry 5.0 Community of Practice and with the I5.0 HUMAN cluster of projects (BRIDGES5.0, PROSPECTS5.0, SEISMEC) and their industrial pilots

4.4. AI-at-the-edge and EUCloudEdgeIoT Initiative

AI at the edge challenges imply a close relationship with the [Cloud Edge IoT cluster](#) of projects, especially those funded under the three HEP topics below:

- **HORIZON-CL4-2021-DATA-01-05 Future European platforms for the Edge: Meta Operating Systems** (RIA). Proposal results are expected to contribute to the following expected outcomes:
 - **Next generation of higher-level (meta) operating systems** for the smart Internet of Things with strong computing capacity at the smart device, system and edge-level, embedded in a compute continuum from IoT-to-edge-to-cloud. Such Operating system should be device independent and implement advanced concepts such as ad-hoc clouds, time-triggered IoT, and decentralised intelligence.
 - **Increasing European autonomy in data processing** required to support future hyper-distributed applications by building open platforms and an open edge ecosystem including business models, driven by European actors. Achieving trust in these (meta) operating systems among actors in diverse industrial ecosystems by leveraging open standards and - where applicable - open source.
- **HORIZON-CL4-2022-DATA-01-02 Cognitive Cloud: AI-enabled computing continuum from Cloud to Edge** (RIA). Highly innovation cloud management layer making the best application of artificial intelligence techniques and AI models with automatic adaptation to the computing resources (i.e., connectivity, computing & storage) in cloud and edge to optimize where data are being processed (e.g. very close to the user at the edge, or in centralised capacities in the cloud). Seamless, transparent and trustworthy integration of diverse computing and data environments spanning from core cloud to edge, in an AI-enabled computing continuum. Automatic adaptation to the growing complexity of requirements and the exponential increase of data driven by IoT deployment across sectors, users and contexts while achieving optimal use of resources, holistic security and data privacy and credibility. Interoperability challenges among computing and data platform providers should be addressed and cloud federation approaches (based on open standards, interoperability models and open platforms) should be considered where appropriate.
- **HORIZON-CL4-2022-DATA-01-03 Programming tools for decentralised intelligence and swarms** (RIA). Develop agile and secure architectures, dynamic programming environments and tools for the compute continuum from the device and edge perspective, including energy-efficient, lightweight AI-based approaches, tools for decentralised device and edge intelligence, innovative mesh architectures with mixed topologies to support concepts like tactile internet and swarm intelligence. This should support a paradigm shift from programming environments for individual devices to dynamic groups of devices like swarms. Research should include actionable data

streams, contextual interaction and data fusion between the users and the objects as well as. analytical model distribution, delocalized computation and new mesh architectures.

AI REDGIO 5.0 is closely monitoring the evolution of these low TRL technologies (RIA). If suitable, we could try to validate and experiments some of them in our Didactic Factories, establishing an Edge to Cloud continuum which could be very useful for the Data Spaces in Manufacturing.

5. International Cooperation and World Manufacturing Forum

Regarding International Cooperation, AI REDGIO 5.0 is alerting its beneficiaries to follow initiatives which could allow AI REDGIO 5.0 to properly disseminate its results as well as some more institutional events like the International Manufacturing-X Council and the International Smart Factory Summit (§5.1).

Moreover, we pay particular attention to the World Manufacturing Forum event (§5.2).

5.1. International Cooperation from Beneficiaries

ART-ER-SOCIETA CONSORTILE PER AZIONI (ARTER). Wednesday 17 April 2024 ART-ER presented the regional ecosystem related to the so-called local Data Valley to a **Tanzanian** delegation. The presentation focused on the High Technology Network of industrial research laboratories, digital innovation hubs, fab labs, data centres that has become an international benchmark for supercomputing, big data, cutting edge data centres, and climate data analytics. Emilia-Romagna is home to the European supercomputer Leonardo, the European Digital Innovation Hub of the Emilia-Romagna (ER2Digit), the ECMWF data centre (for weather forecasting and Copernicus Climate Change Services) and soon a AI-dedicated centre of the United Nations University. Furthermore, a few projects, along with AIREGIO5.0, were presented. **Tanzania** has an ambitious agenda of public reforms to build an inclusive, resilient and competitive digital economy. Its vision set out in the Digital Economy Framework draws the directions to leverage on digital technologies and R&I to foster economic modernisation, industrialisation and growth. This requires robust policy and regulations, strategic investments, multi-stakeholder partnerships, with a stronger role of the private sector, and enhanced regional and international cooperation. The study visit was part of TAIEX, the European Commission's Technical Assistance and Information Exchange Instrument.

ALMA MATER STUDIORUM - UNIVERSITA DI IT BOLOGNA (UNIBO). The Advanced Control and Technologies for Enhanced Mechatronics and Automation (ACTEMA) research group has some collaborations with international research groups, on topics related to the project. For example, a group member involved in the project has received an MSCA postdoctoral fellowship for innovative methodological control and estimation techniques that combine analytical and data-driven hybrid approaches. He is currently hosted at UCSB (**University of California Santa Barbara**), dept. Of Electrical and Computer Engineering under the supervision of an internationally distinguished professor in control systems, and will later spend his secondment at LAAS_CNRS in Toulouse. Since 2016/17, the group has also interacted with the Dept. of Mechanical and Aerospace Engineering at **Ohio State University**, specifically focusing on adaptive control/estimation techniques with constraints.

UNIVERSITEIT TWENTE (UTW). We will participate in the 22nd IEEE international Conference on industrial information (INDIN) in this August. Our experiment part of AI REDGIO 5.0 will be introduced, and we will discuss the technology and potential cooperation. The INDIN conference provides a forum for industry experts, engineers, academics and researchers to discuss state-of-art industrial information technology. The participants can exchange ideas, innovations and experiences well. Our paper mentions parts of our experiment in the project, our industrial IoT smart box experiment is well suited to the scope of INDIN conference. Our experiment aims to design and implement a lightweight industrial smart box system and relevant applications for SMEs with low-cost, autonomous, plug & play etc. features. During the conference, we will share and discuss our experiment with international experts and look for some potential international cooperation.

FORENINGEN MADE (MADE). An obvious international partner for AI-REGIO 5.0 would be Ngen (Next Generation Manufacturing **Canada**). NGen is an industry-led, not-for-profit organization leading Canada's Global Innovation Cluster for Advanced Manufacturing. NGen is dedicated to building world-leading advanced manufacturing capabilities in Canada, for the benefit of Canadians. Ngen bring together advanced

manufacturing and technology to drive digital transformation in Canada and their projects are securing supply chains, protecting the environment, improving healthcare, and supporting technology adoption across Canada. Ngen also claims that international engagement is crucial for NGen to deliver on its mission of supporting the development of world-leading advanced manufacturing capabilities, encouraging the adoption of cutting-edge technologies, and facilitating the pursuit of operational excellence for Canadian companies. Among several technology expertise areas, AI Ngen has for several years been present at the Hanover Messe and has also hosted European Cluster delegation visits. MADE shall be glad to extend the relation to CEO Jayson Myers.

POLYMERIS (POLY). From March 11-15, 2024, a Polymeris delegation visited **Japan** to explore collaboration opportunities and strengthen ties with Japanese partners in the frame of the Smart Manufacturing Summit 2024. Led by Innovation Director Jean Jacques Legat, the mission was organized by the Auvergne-Rhône-Alpes region and various French business organizations. Participants included Microlight 3D and Addiplast representatives. Key activities included attending the Smart Manufacturing Summit in Nagoya, visiting the French Chamber of Commerce and Industry in Japan (CCIFJ), and engaging with JETRO, the Japan External Trade Organization, which provided an overview of economic and investment opportunities. Highlights were visits to NTN Corporation and Musashi, focusing on energy-efficient manufacturing. The mission fostered future collaborations in hydrogen and artificial intelligence, setting the stage for continued commercial development and expansion of activities of EU companies in Smart Manufacturing topics in Japan.

FLANDERS MAKE (MAKE). Flanders Make as coordinator of EDIH DIGITALIS continues to maintain connections with different (potential) EDIHs. We participated in the EDIH4MANU Network with 26 participating EDIHs managed by MADE in Lombardia. Also 16 bi-lateral contacts were established with individual EDIHs. Over the past 18 months DIGITALIS developed relationships with 3 of the 5 Dutch EDIHs. We exchanged ideas, challenges, and opportunities. DIGITALIS and EDIH Boost Robotics East NL were involved in two events together (European Week of the Regions and EURADA Winter School). Flanders Make and local partner Howest are involved in collaboration with GreenPowerIT in the Nord Pas de Calais Region on cybersecurity and sustainability events. DIGITALIS is also an active member of the EPoSS Corridor of EDIHs. With the Flemish, Brussels, and Walloon hubs there are regular meetings to discuss collaboration potential. As an example, Walhub and DIGITALIS organised a webinar related to cascade funding, showcasing the Open Calls within the AI REDGIO 5.0 project. Although there are regular and, in some cases, quite intense contacts with other EDIHs on an international level, these contacts are currently still limited to organizing mutual events, exchanging experiences, ideas and challenges. These initiatives have led to peer-to-peer learning which supports the development of the EDIHs, but we expect in the mid-term future to focus also on connecting the industrial ecosystems.

CESKE VYSOKÉ UCENÍ TECHNICKÉ V PRAZE (CVUT). Since its opening in 2022, the RICAIP Testbed Prague has seen the organisation of a wide programme of events and visits of high-level representatives involving both European and international countries at CIIRC CTU premises. Whenever thematically related, CIIRC CTU uses opportunities to co-host conferences and large forums, often co-organised with high-level partners, such as embassies or Czech Ministry of Foreign Affairs. This effort contributes to strengthening the relations with the ministry and also creates new ties with embassies (Israel, France, Germany). These activities usually include guided tours in testbed, presentation of the RICAIP research centre and formal or informal discussions on possible collaboration with the main invited speakers or co-chairs of the conferences and events. Such visits included for example delegations from the **US, India, Taiwan or Mexico**, along with delegations from EU countries (Germany, Latvia, Netherlands...). Multiple international synergies and opportunities are also facilitated by CIIRC CTU's involvement in projects such as EIT Manufacturing or Digital Innovation Hub application experiments. Especially the EIT Manufacturing projects focusing on the creation of the programmes for SMEs toward their digitalisation transformation often use testbeds as the core of learning and teaching factories. Within these projects, research institutions from mainly so-called RIS countries (e.g.

the Regional Innovation Scheme) intensively cooperate. Recently, CIIRC CTU has been involved in a close cooperation with the NIMS university in **Jaipur, India**, and is supporting the creation of a similar testbed there.

AALBORG UNIVERSITET (AAL). We have been collaborating with Sustainable Manufacturing Research Centre at Aston University (UK) for years. In 2023, we visited their Learning Factory within GBSIoT Hub houses the largest Cyber Physical Manufacturing Rig in Europe. During our visit, we presented several research projects, highlighting our IoT experiment with AI REDGIO 5.0. The Centre's commitment to driving innovation in digital solutions to tackle sustainability challenges aligns perfectly with our mission. Their focus on facilitating the digital and green transition of industry and society is deeply related to our projects and experiments. We are excited to embark on future collaborations, focusing on developing data-driven digital solutions that support the digital and green transition of industry and society. Together, we will harness our combined expertise to pioneer advancements in smart and sustainable manufacturing, contributing to a more sustainable and technologically advanced future. This partnership will enable us to explore new frontiers in IoT, AI, and data analytics, ensuring that our joint efforts make a significant impact on the industry's digital and environmental goals. Through this collaboration, we aim to contribute to sustainable manufacturing, driving positive change and innovation on a global scale.

SOFTWARE COMPETENCE CENTER HAGENBERG AT GMBH (SCCH). Beyond SCCH's mainly regional and national fields of actions covered, e.g., by the Austrian competence center funding programme COMET, other FFG funding programmes and further regional projects and funding schemes, SCCH strives to increase its impact on an inter-regional, European and international scale. On the international level, SCCH is (currently) focussing on the Eureka network and bilateral research partnerships. Within Eureka, SCCH is targeting Eureka Clusters for contributing and extending our know-how in international and primarily industry-driven research and development efforts. At the moment, SCCH is partner in the EURIPIDES2-PENTA cluster project "Ecological Motor Control and Predictive Maintenance with AI (ECOMAI)"¹ coordinated by Infineon Munich, and the CELTIC-NEXT project "Collective intelligence supported by security aware nodes (CISSAN)"² on AI-aided cybersecurity of IoT networks coordinated by the University of Jyväskylä. On the level of international bilateral research partnerships, we refer to our partnership with the Binhai Industrial Technology Research Institute of Zhejiang University, China, in smart water management and the Pak-Austria Fachhochschule: Institute of Applied Sciences and Technology (PAF-IAST) and the Sino-Pak Center of Artificial Intelligence (SPCAI) for the exchange of PostDocs in Haripur, Pakistan.

SUITE5 DATA INTELLIGENCE SOLUTIONS LIMITED (SUITE5). Suite5 will aim to present advancements of the project in specific events that are organised by the CCCI (Cyprus Chamber of Commerce and Industry), as well as EBEA, the Athens Chamber of Commerce and Industry, promoting the relevant methodologies of the project and the tool it offers for stakeholders of the domain.

POLYCOM PREDELAVA PLASTICNIH MAS SI INORODJARSTVO SKOFJA LOKA DOO (POLYC). The AI REDGIO5 project and our experiment were presented to visitors and our customers from Serbia, the United Kingdom, **China, Mexico** and other partners from the NAFTA regions. Customers have shown interest in our AI solutions during business visits and assessments of our implemented quality and environmental systems. Our featured solutions represent advantages for all elements of the supply chain. By introducing AI solutions such as ours, we can reduce production costs, energy consumption, the generation of waste. As a business entity, Polycom can greatly contribute to AI concepts such as AI Redgio 5.0 through our supply chains on both the supplier and customer sides. By organizing various workshops, visits to trade fairs, exchanges of good practices, as well as visits to different buyer and supplier delegations, we can further spread knowledge and ideas to

¹ <https://ecomai.eu/>

² <https://www.celticnext.eu/project-cissan/>

different parts of the world. One of the possibilities of sharing good practices and examples are also numerous economic organizations that organize a number of thematic meetings and conferences.

GPALMEC S.R.L. (ALMEC). GPALMEC learned about AIREDDGIO 5.0 project thanks to “HIT - Hub Innovazione Trentino” - the DIH supporting us. Thanks to AIREDDGIO 5.0 GPALMEC wants to seize the opportunity to boost its technological product portfolio and its technological knowledge thanks to the collaboration with competent parties. With the aim to increase the safety of work in the agricultural field, we want to attract machine manufacturers’ attention by visiting the OEMs and showing them the result once the project is finished. According to a small survey we conducted in 2023, there is in fact a lot of interest in this application.

KATTY FASHION (KATTY). The AIREDDGIO project experiment has been presented to regional and international collaborators and interested parties as part of our transition strategy in several workshops and events organised by REGINNOVA NE and FabLab (March and May 2024) at a local level, with the regional development agency at a national level, but also during other competitions like the EITM Teaching Factories Competition where we fosters further development and utilisation of the base technology for an international aspect. We contributed with our knowledge in developing workshops together with Reginnova NE on smart business models and innovating technology, held at the University of textiles in Iasi. We continuously promote activities to showcase the available technology via our social media channels, where we also seek to spark an open discussion regarding digitalization and innovation in textile manufacturing and beyond. Romania is focused on supporting the transition to innovative and digital technologies in the manufacturing industry. There is increasing discourse on sharing best practices, with additional attention being put on sustainable smart manufacturing. Furthermore, a key focus of many organisations is the collaboration on Research and Development Projects, as a way to enhance international cooperation and adopt innovative solutions more effectively. Finally, another initiative increasingly popular was the participation in international forums, as many companies are keen to engage in dialogue and cooperation among the manufacturing sector’s key players, and has been promoted by the EDIHs and development bodies with great success, with many Romanian companies participating in European and global events and economic missions like Digital Fashion Summit 2024 (Denmark), EFFRA Thematic Work Groups, EITM SE Event and more

BRAINPORT INDUSTRIES COOPERATIE UA (BPI). The AI-REDGIO 5.0 project and experimentation has been presented to visitors of the Brainport Industries Experience Centre ‘Factory of the Future’ and referenced to as part of several Networking Events. Therefore, we show SMEs the types of technologies available and how they can apply to industrial applications in manufacturing (use cases). We have presented the project and its network, tools, and portfolio of (E)DIH services to visitors from the Brainport Industries & EDIH SNL ecosystems, international partners, local SMEs, and other project partners in NL. The Netherlands is keen to drive innovation in Digital Manufacturing, AI in Manufacturing, Digitization of industries. Our demonstrations at events and webinars have supported the growing interest of SMEs who want to investigate, understand, and adopt new technologies. We have presented the project and its planned objectives at international conferences including MADE (Denmark), Hannover Messe (Germany), and **Singapore**, as well as at other European Project Consortium Meetings (TECNALIA Spain, AI-Matters). Hence, we are continuously forming future collaborations with new partners who are keen to work together to develop new strategies in their own regions. Locally, we continue to provide training and SME engagement to showcase the project and its technologies to the SME community and look for opportunities to exploit the projects’ results including AI tools and Datasets.

C2K, CAP & DMIW (Wales UK). The AI REDGIO5 project and experimentation has been presented to visitors to the Waterton Technology Centre and demonstrations given on the technology being developed as part of SME Experiment 6 (Contextualised Vision System) and DF8 (IWOK Industreweb Operational Knowledgebase); to show SMEs the types of technologies available and how they can apply to industrial applications in

manufacturing. We have presented the project and its network, tools and portfolio of (E)DIH services to visitors from Cardiff University, local SMEs International corporations and other project partners in the UK. The UK is keen to drive innovation in Digital Manufacturing and Digitisation of industry and our demonstrations at events and webinars have supported the growing interest from SMEs who are looking to understand and adopt the technologies. We have also presented the project and its planned objectives at international conferences including I-ESA (Greece), ICE (Madeira) and MADE (Denmark) and as a result of this we are forming future collaborations with new partners who are keen to work together to develop new strategies in their own regions. Locally we will continue to provide training and SME engagement events to showcase the project and its technologies to the SME community and look for opportunities to exploit the projects' results including AI tools and Datasets.

5.1.1. International Manufacturing-X Council

International Manufacturing-X (IM-X) will implement a federated, decentralized and collaborative data ecosystem for smart manufacturing. It aims to enable open, global and cross-sector international operation of cost-effective data networks.

This will result in:

- **Resilience:** Reorganize and increase flexibility and autonomy of industrial value chains and networks.
- **Sustainability:** Increase efficiency and enable data-driven solutions for CO2 balancing and circular economy.
- **Competitiveness:** Accelerate digital innovations and enable new data-driven business models to create new value for manufacturing

The IM-X Mission is to realize this vision through three main lines of activity:

- Facilitate use cases on the collaborative use of industrial data for all manufacturing industries.
- Develop the requirements, influence international standardization and framework development for basic infra-structure to deploy federated data-ecosystems for manufacturing.
- Provide guidelines to leverage easy to-use applications and dynamically scale the ecosystems.

IM-X will build on a foundational framework, which serves as a common guideline for activities and international stakeholders:

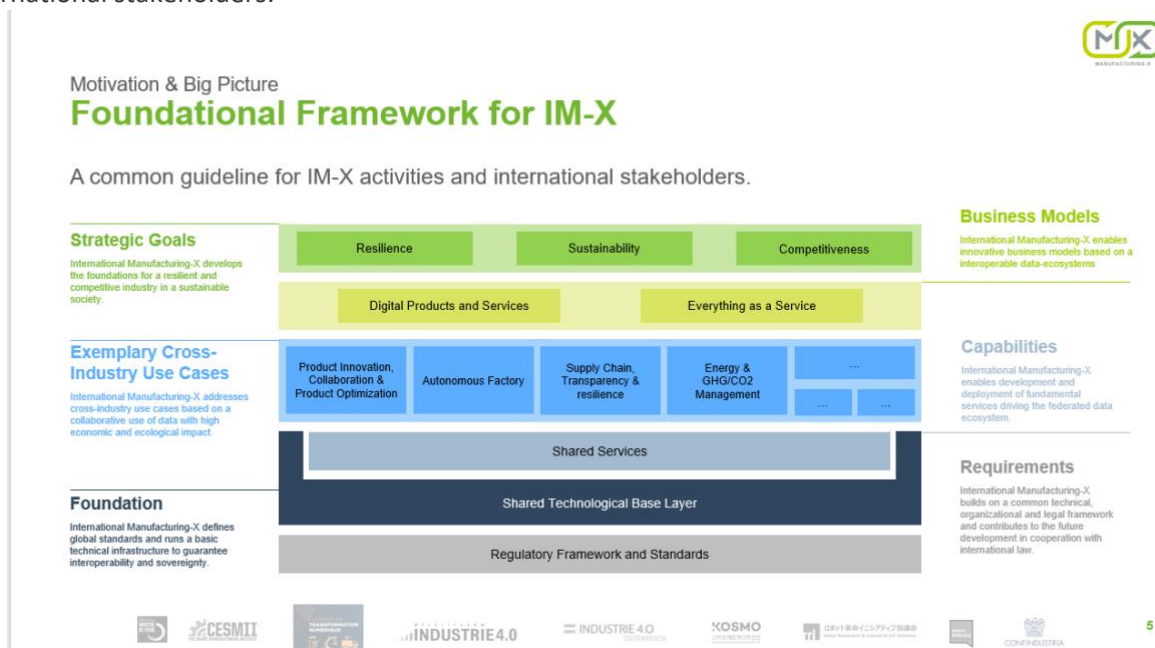


Figure 16- IM-X Framework

Strategic Goals: IM-X develops the foundations for a resilient and competitive industry in a sustainable society.

Business Models: IM-X enables innovative business models based on an interoperable data ecosystems (digital products and services; Everything-as-a-Service; etc.).

Exemplary Cross-Industry Use Cases: IM-X addresses cross-industry use cases based on a collaborative use of data with high economic and ecological impact (product innovation, collaboration and product optimization; autonomous factory; supply chain, transparency and resilience; energy & CO2-management)

Capabilities: IM-X enables development and deployment of fundamental services driving the federated data ecosystem.

Foundation: IM-X defines global standards and runs a basic technical infrastructure to guarantee interoperability and sovereignty.

Constraints: IM-X builds on a common technical, organizational and legal framework and contributes to the future development in cooperation with international law.

IM-X Council is the initiative to manage and govern IM-X, at the moment the following non-EU Countries are involved: **US, Korea, Japan and Canada.**

Who?

Initiatives Involved in Establishing the IM-X Council



PARTICIPANTS				
Country	Initiative	Surname	Name	On-site/Remote
CAN	Next Generation Manufacturing Canada	Myers	Jayson	On-site
CAN	Ministère de l'Économie et de l'Innovation du Québec (MEI)	Leblanc	Alexis	On-site
CAN	Ministère de l'Économie et de l'Innovation du Québec (MEI)	Freier	Peter	Remote
DEU	SIEMENS AG	Hahn	Thomas	On-site
DEU	VDI Technologiezentrum GmbH	Serff	Daniel	On-site
DEU	Federal Ministry for Economic Affairs and Climate Action	Stoeckl-Pukall	Ernst	On-site
DEU	I4.0 GmbH	Biegele	Fabian	On-site
DEU	IMI 4.0 - SIEMENS	Rohrmus	Dominik	On-site
DEU	SAP	Kube	Georg	On-site
DEU	DAGS MORI	Schneider	Sebastian	On-site
DEU	Trumpf	Sawilla	Ingo	On-site
DEU	Open Industry 4.0 Alliance	Princigallo	Anna	On-site
ESP	Innovalia - Data Space 4.0	Lacort	Oscar	On-site
FRA	CEA, Manufacturing X France co-lead	Jerraya	Abmed	On-site
FRA	Schneider Electric, Manufacturing X France co-lead	Rita	Jean-Pascal	On-site
ITA	Politecnico de Milano	Guarnieri	Gerardo	On-site
JPN	RII	Nakachima	Kosun	On-site
KOR	KOSMO	Hong	Sung-Ho	On-site
NLD	TNO	Punster	Matthijs	On-site
NLD	Smart Industry	van Harten	Peter	On-site
USA	CESMI	Dyck	John	On-site
USA	CESMI (Clemson University, formerly Dep. of Energy)	Johnson	Mark Alan	On-site
USA	CESMI (Axial Global Advisors)	Ramey	Douglas	On-site

Figure 17- IM-X Council

AI REDGIO 5.0 is not directly building Data Spaces in its SME experiments, but some Didactic Factories with a solid Edge to Cloud Continuum infrastructure could be taken as champions for the implementation of the Manufacturing-X foundational framework in pre-commercial didactic environments

5.1.2. International Smart Factory Summit ISFS

The **International Smart Factory Summit (ISFS)** has recently taken place for the 4th time at the Switzerland Innovation Park in Biel/Bienne, Switzerland. Around 60 participants from different countries join the summit every year. The summit is designed as a focused event of the international **Smart Factory** community. It highlights the value created by smart-factory labs and focuses on implementation strategies for sustainability, human-centricity and resilience in manufacturing worldwide.

ISFS has welcome outstanding keynote speakers, e.g. from the International Centre for Industrial Transformation (INCIT), the World Economic Forum and ZF Commercial Vehicles. Interactive sessions will allow us to collect valuable input and prepare follow-up actions on the relevant topics of:

- Next-Generation Smart Manufacturing Systems for a Green Transition
- Skill Development for an Augmented Workforce
- Global Crisis: An Opportunity for Reshoring Manufacturing and Smarter Supply Chain

5.2. The World Manufacturing Forum

The [**World Manufacturing Forum**](#) stands as a prestigious gathering where industry leaders, influential policymakers, distinguished academics, and research pioneers converge to address the challenges and trends shaping global manufacturing. This event encompasses keynote sessions, roundtable discussions, and parallel events, focusing on the pivotal trends shaping the evolving manufacturing landscape and their implications:

- exploring the new skills for the future of manufacturing
- embracing a new age of manufacturing based on artificial intelligence and intelligent automation
- digitally enabling the emerging circular manufacturing paradigm
- supporting the redesign of supply chains for resilience
- helping innovate new business models for the sector

The **2023 edition** of the World Manufacturing Forum centred its attention on new business models for the manufacturing of the future. It aimed to depict the key trends that are characterising the current economy and thus, indirectly, the manufacturing sector. To address this purpose, a deep analysis has been conducted on both scientific and grey literature involving an international panel of experts in the field. As a result, the identified trends suggested the establishment of six potential business models by manufacturing companies. Through the analysis of the six business models, 10 Key Recommendations have been delineated to suggest how to be competitive in this changed economy while covering the nine building blocks of the business models.

In the ever-evolving global manufacturing business landscape, manufacturing firms stand at a crucial juncture. To thrive in the face of technological advancements, changing consumer demands, and environmental considerations, manufacturers must individually and collectively embrace business model innovation. It is time to reimagine and reshape the way the manufacturing sector operates to ensure sustainable growth and resilience in the long run.

Among the key economic trends that the manufacturing sector is experiencing, it is worth mentioning digital transformation. This transformation is leading to a widespread use of data and artificial intelligence algorithms supporting the decision-making process in delineating the value propositions of manufacturing companies. In this changed context, mass customisation is also spreading as a means of addressing customer needs. In the same vein, servitisation is gaining momentum in manufacturing companies, supported by the increase in circularity principles which are helping to outline sustainability-oriented business models.

Finally, the 10 Key Recommendations proposed have the intention of suggesting actions to be undertaken to face the trends that are currently characterising the manufacturing sector. More precisely, the suggestions cover all nine building blocks of business models. Among them, it is recommended that customer-centric innovation be embraced, by relying on both sustainability principles and mass customisation to define the value proposition. It is also suggested that new sales channels be created, customer relationships be improved by expanding partnerships beyond today's value chains, balancing key resources and exploiting AI and data analytics for new revenue streams.

The **2024 edition of the World Manufacturing Forum** will delve into innovative pathways shaping the future of manufacturing, paving the way for progress and growth till 2030.

Indeed, the World Manufacturing Forum has spent the last years in discussing several vertical topics. In 2018 the focus was on exploring the new skills for the future of manufacturing, in 2019 the attention was moved towards to embracement of a new age of manufacturing exploiting artificial intelligence and intelligent automation, then in the next years it was paved the way towards the employment of digital technologies to create circular systems, the redesigning of supply chains to enhance resilience and last to innovate business models in the manufacturing sector. More in detail, these topics were covered during the Forum and through the published reports with the intention to provide recommendations to assist governments and industries to identify and prioritise key actions for sustainable industrial development ensuring economic, social, and environmental prosperity for the future of our society. This year, the World Manufacturing Forum has the goal to move forward delineating significant manufacturing trends and potential challenges for the future based on the knowledge generated in the last years. Moreover, through a series of interviews with experts and research in the extant scientific and grey literature, a list of challenges for the future of manufacturing together with key actions to be undertaken will be developed with the intention to support companies in facing issues like resources scarcity, increased emissions generation, digital technologies diffusion (e.g. the adoption of artificial intelligence for several purposes in manufacturing processes, from the design, to the delivery) and related skill gap.

AI REDGIO 5.0 is carefully following the **WMF** annual themes and aims at actively contributing in the 2025 edition, promoting Industry 5.0 and Human centric manufacturing

6. Conclusions

POLIMI coordinated one of the two H2020 Innovation Actions, I4MS Phase IV, about AI Innovation for Manufacturing: AI REGIO. The project is now over, but its heritage is still alive and taken as starting point for AI REDGIO 5.0:

- The H2020 I4MS – AI REGIO partnership between Vanguard EU regions and DIHs has been updated and expanded as part of AI REDGIO 5.0 in order to enable competitive AI-at-the-Edge digital transformation of Industry 5.0 Manufacturing SMEs, involving an increasing number of regions and promoting synergies and collaborations among ESM and AI Pilots and Partnerships and with the new arising initiatives.
- The AI REGIO project has made significant contributions to the AI-on-Demand platform by expanding its resource base and making it more accessible to SMEs. AI REDGIO 5.0 is working on the delivery of a library of Edge AI reference implementations (trained models, preconfigured pipelines) that address specific problems of Industry 5.0, in order to ensure interoperability with the AI-on-demand platform at different levels, bringing forward and contributing to the Manufacturing vertical.
- METHODIH is one of the most relevant KERs (Key Exploitable Results) of AI REGIO in the methodological category. In AI REDGIO 5.0 has been further expended towards more structural collaboration among EDIHs in Digital Europe Program.
- AI REDGIO 5.0 is also exploring different extensions of the 6Ps method according to the Industry 5.0 three pillars. A 7th Sustainability P is Planet and concerns with the twin transition digital-green of an enterprise; another 7th P is under study to measure the resilience of a supply chain with respect to potential risks of disruption. The Human-orientation is currently not part of the 7th P method but at the moment is mostly implemented in TERESA and Human-Robot Interaction analysis.
- In AI REDGIO5.0 Digital Factories Network and Virtual Factories experimentations will be further enhanced following the AI REGIO DR BEST methodology on the one side and the TERESA / Virtual Factory experiments. Collaborations and liaisons will be opened with other running projects like RE4DY and DACAPO, running very similar initiatives. This is also quite interconnected with the servic3es to be provided in EU by the AI MATTERS project, the AI TEF for Manufacturing network.
- In AI REDGIO 5.0 Project the Consortium, through some of its Didactic experimental facilities within the AI REDGIO 5.0 DF Network, closely associated to the VANGUARD Pilot Plants and Regional / National Industry 4.0 initiatives, is developing 13 TERESA experiments.

Regarding I4MS2, the projects aimed at reciprocally communicating news and events, but without a real “cluster” feeling. Major activities have been to keep aligned the **first waves of Open Calls** especially between AI REDGIO 5.0 and AIRISE. There is a strong communality of intents between AIRISE and AI REDGIO 5.0 especially concerning the industrial pilots and the maturity assessment tools. AI REDGIO 5.0 and WASABI address different aspects of AI: AI at the Edge and Cloud Edge IoT Continuum for AIREDGIO5.0 and Generative AI based Digital Assistants for decision making in WASABI. A common playground for collaboration will be the DFA and in particular the DIH partner programme, where both projects are expected to heavily contribute.

Participation in common I4MS2 dissemination events and conferences has already been started and brought to interesting results during the Manufacturing Partnership days beginning of May under the EFFRA patronship. This will continue in Madeira DT Week which is debating the role of I4MS2 and EDIHs in the digital

transformation of manufacturing SMEs. From a more technological perspective (data spaces and digital twins) the EBDVF24 event in Budapest will discuss the role of Data Technologies in the Digital Transformation of Manufacturing SMEs in Europe.

Many partners of AI REDGIO 5.0 are actively involved in the EDIH network as indicated by the EC Catalogue. The AI REDGIO 5.0 marketplace and innovation platform, the DIH4Industry marketplace and the DFA portal will be the three main instruments to implement a pan-EU ecosystem of EDIHs specialized in Manufacturing, artificial Intelligence at the edge and Industry 5.0.

AI REDGIO 5.0 is working to enhance the DIH4Industry marketplace with specific services and solutions for AI-at-the-edge and targeting Resilience Sustainability and Human centricity. The expansion of the portal will be enhanced by new models for collaboration and for doing business together. An intelligent matchmaking tool will support DIHs to find complementary partners and to open collaborations.

AI REDGIO 5.0 is closely connected to Made in Europe partnership and the above projects related to Digital Manufacturing. The project is actively participating in the yearly Manufacturing Partnership Days (7-8 May 2024 this year) and the European Manufacturing Conference (24-25 September 2024).

ADRA represents the technological Partnership for AI REDGIO 5.0, especially with the aim to build a community of EDIHs specialized in AI Data and Robotic technologies. Closer collaborations are also set with AI for Manufacturing projects funded under the Twin Transition 2021 07 topic. ADRA-e CSA also represents a convenient channel for disseminating our outcomes.

In the Industry 5.0 domain, and especially in the Human centric aspects of it, AI REDGIO 5.0 aims at creating strong liaison with the Industry 5.0 Community of Practice and with the I5.0 HUMAN cluster of projects (BRIDGES5.0, PROSPECTS5.0, SEISMEC) and their industrial pilots. AI REDGIO 5.0 is closely monitoring the evolution of these low TRL technologies (RIA). If suitable, we could try to validate and experiments some of them in our Didactic Factories, establishing an Edge to Cloud continuum which could be very useful for the Data Spaces in Manufacturing. AI REDGIO 5.0 is not directly building Data Spaces in its SME experiments, but some Didactic Factories with a solid Edge to Cloud Continuum infrastructure could be taken as champions for the implementation of the Manufacturing-X foundational framework in pre-commercial didactic environments

AI REDGIO 5.0 is carefully following also the World Manufacturing Forum WMF annual themes and aims at actively contributing to the 2025 edition, promoting Industry 5.0 and Human centric manufacturing.