DIGITAL REGIONS

I4.0 POLICY WHITE PAPER

Research and innovation

Interreg Europe

European Union | European Regional Development Fund

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DIGITAL REGIONS initiative, regions involved and methodology used within the project

The common challenge addressed by DIGITAL REGIONS initiative is **how to best adapt innovation policies to support smart specialisation in the manufacturing sector as a result of the emergence of INDUSTRY 4.0.**

The main objective of the DIGITAL REGIONS partnership is to achieve, by 2022, a 15% increase of the number of SMEs from manufacturing sector cooperating with other innovation actors in the participant regions to implement Industry 4.0 (I4.0) solutions as a result of improved innovation policies.

Sub-objectives helping to achieve the overall objective, are:

1) Better utilise/improve policy measures to increase the level of cooperation taking place between I4.0 innovation actors in different regions, particularly between centres with complementary I4.0 technologies (e.g., IoT, Artificial Intelligence, Data Analytics) or serving the same smart specialisation sector, in this case manufacturing. This will contribute to the overall objective by increasing the range and quality of I4.0 solutions available to SMEs in a particular region;

2) Improve the participation of SMEs in I4.0 innovation programmes by introducing support measures to enhance I4.0 skills development, participation in testbeds/field-labs and global value chains. The lack of such support measures are identified as barriers to uptake of I4.0 by SMEs;

3) Develop policy guidelines and recommendations (output as an "I4.0 Policy White paper") aimed at regions not participating in the project, but with a smart specialisation in the manufacturing sector. This can be applied in regions not participating in the project and adapted for particular smart specialisation manufacturing niches and regional needs.

The 8 participant regions are Oberfranken (DE), Slovenia (SI), Espace Mittelland-Canton of Bern (CH), BMW (IE), Centro (PT), Cantabria (ES), Varna (BG) and West (RO).

They are distributed across the 4 IE zones with a mix of central/peripheral areas and innovation levels (leader, strong, moderate and modest).

All have manufacturing as a smart specialisation priority and are represented by an appropriate mix of partners from each region's innovation value-chain including managing authorities, universities, INDUSTRY 4.0 Centres of Excellence and business development intermediaries.

The project seeks to improve 7 ERDF policies addressing the Thematic Objective "strengthening research, technological development and innovation" and 1 Swiss-equivalent policy.

The DIGITAL REGIONS partners involved stakeholders in each region's innovation ecosystem, i.e. innovation policy makers, SMEs that use I4.0 solutions, suppliers of I4.0 services, universities and innovation centres into an exchange of experience and learning process leading to the definition of concrete actions to facilitate improved I4.0 policies in the 8 regions.

Thus, 8 regional action plans were developed and received the validation and commitment of the regional innovation ecosystems and funding authorities. The action plans propose measures to facilitate improved I4.0 policy cooperation between regions, increased SMEs participation and availability of I4.0 skills. This will result in instruments which better meet the needs of I4.0 in smart specialisation manufacturing regions, taking into account revised 2021-2027 Investment for Growth and Jobs priorities and the new Horizon Europe and Digital Europe policies.

The action plans respond to the challenges identified through a context analysis carried out in the eight European regions involved to identify current gaps and opportunities related to the regional and national innovation policies. The regional context analysis and its benchmarking among the participating regions provided the foundations to improve the regional innovation policy and to better exploit the potential of Industry 4.0 in the manufacturing sector of the participant regions.

B. MAIN CHALLENGES FOR THE UPTAKE OF I.40

A survey has been conducted in the 8 regions and its conclusions reflect the main challenges for the implementation of the Industry 4.0.

The main conclusions of the Interregional Assessment Report across the 8 regions involved are:

1. Knowledge on I4.0 concept: **The concept of Industry 4.0 is still not commonly understood.**
2. Challenges: The majority of the 280 respondents face challenges related to Industry 4.0 or digital transformation. One major challenge is a **lack of qualified staff and competence within the companies.**
3. Digital Strategy: Whether a company has a digital strategy varies between the regions. But in all regions **the majority do not have a digital strategy yet.**
4. Awareness of support: **Approximately half do not know about any initiatives which can support Industry 4.0 / digital transformation.**
5. Lack of knowledge of all the available support and funding:
- Awareness of support: **Up to 73% do not know about any regional or national facilities/initiatives/ecosystems to support the company regarding the challenges connected to Industry 4.0/digital transformation.**
- Awareness of funding: **All regions expect Switzerland has even a higher lack of knowledge for funding than supporting initiatives.**

A thematic workshop and debate on "Skills development in Industry 4.0" carried out as part of the interregional learning process emphasized the needs and challenges in I4.0 skills development.

The main conclusions having arisen during the debate:

- There is a pattern which can be observed in the partner regions: need for **efficiency** and **time to train**
- Industry 4.0 requires **more know-how for a faster and continuous transition**
- Missing **link between academia and industry training**
- Life-long learning needed, from very early ages
- **Companies are not always aware of their needs and how to deal with the challenges**

Some possible solutions arose:

| sync Academia with industry training | → | share commitment and motivation through collaborative dynamics with the suppliers in order to achieve a faster learning | → | use support services and access financing from external sources to implement Industry 4.0 solutions |
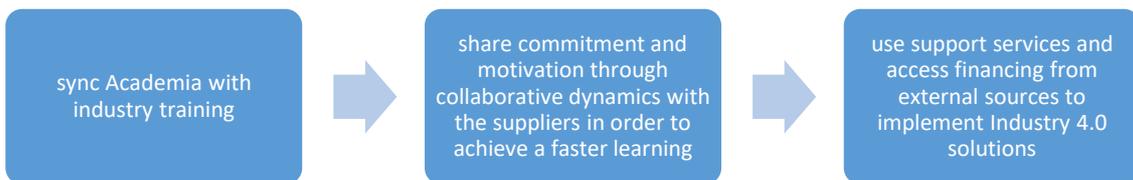
C. AREAS OF ATTENTION AND OPPORTUNITIES TO ADDRESS THESE CHALLENGES

Different levels of solutions have been identified in the 8 European regions, through a process of interregional learning and exchange of experience. Also, several best practices identified created the basis for the development of new projects and pilot activities in other partner regions. As Industry 4.0 is a new and challenging field, there are different regional and national policies to face these challenges.
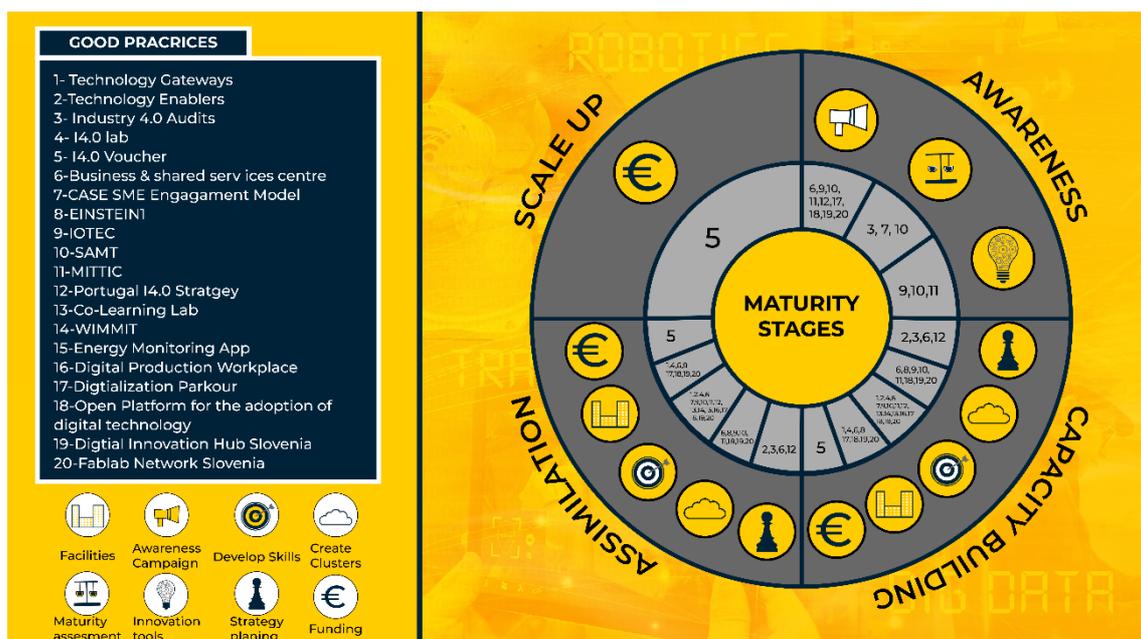
Due to the interdisciplinary nature of digital geographies, we need to broaden our perspective on economic geography. The developments not only cover pure technological endeavors but also create new societal surroundings.

Industry 4.0 comprises technologies that connect physical and virtual spaces via smart networks and sensor systems and thus have a fundamental impact on different levels of the value chain, in addition to generating and analyzing large volumes of data.

This impact will have a reflection on the regions and the different stakeholders of the industrial ecosystem, with a global or more specific approach and support to the Industry 4.0 policies and measures.

C1. FORMING AN I4.0 FOUNDATION

Establishing an Industry 4.0 Policy/Strategy at national level has been a response in many countries around Europe and around the globe to improve readiness for Industry 4.0. A few examples in Europe are Spain, Germany, UK, Italy, Portugal and Ireland. Potentially Industry 4.0 can assist economies that are lagging behind either regionally or nationally in industrial digitalization to leap ahead, but it could also result in an increase in that gap. There is however the opportunity to review the I4.0 strategies already adopted in other countries. National strategies are shaped by multiple factors due to different situations on economies, sectoral prioritization, public-private partnerships and the level of supporting industrial, innovation, digital infrastructure. The implementation of these strategies requires shared leadership, improved industrial-innovation policy co-ordination across government and sustained efforts from a wide range of stakeholders, both public, private and governmental.

Examples of policies creating the foundations for Industry 4.0 supports and initiatives from Portugal & Ireland were analyzed by the Bulgarian partners, who used the knowledge to roadmap and plan an I4.0 Strategy. Also, Spain has developed in the past months a new digital Strategy relaunched by the Recovery Funds.

Portugal's National Strategy for Digitising Industry

The Portugal national strategy for Digitising industry is included as a Digital Regions Good Practice. The strategy is outlined in this report from the European Commission.

The effort for the Portuguese national strategy Industry 4.0 Programme started in 2016 via a bottom up approach and stakeholder consultation involving companies, universities, associations and national authorities. The outcome of this was a set of proposed measures feeding into the Programme. The Programme was introduced in early 2017. It contains public and private measures across six main pillars. It was intended that the measures would impact over 50,000 companies and in its initial phase would support re-skilling and upskilling of over 20,000 workers. The Programme was overseen by COTEC Portugal8 , a Portuguese business association for innovation and apolitical.

Phase I mainly focused on awareness about industry 4.0 in Portuguese firms and society and it completed in 2018. A monitoring tool, to link policy to impacts, found that of the 64 measures, 95% were implemented and through these, over 24,000 companies and over 550,00 people were impacted.

Phase II of the Programme, launched in spring 2019, has a more of a focus on innovation and knowledge development to stimulate transition to industry 4.0. In this phase, the aim is to stimulate economic and social growth via a mass digital transformation of business models. The Programme design again used a bottom-up approach supported by public and private entities and to the shaping of 3 axes which are Generalise, Capacitate, and Assimilate.

GENERALISE i4.0: This concerns the promotion, sharing of knowledge, experience, and benefits to stimulate a mass transition to i4.0. Involved is Digital Maturity Assessment for digital maturity self-diagnosis and for roadmap development for i4.0 transformation. It also encompasses experiencing i4.0 by sharing and spreading the knowledge from I4.0 piloting, implementing I4.0 technologies and practices. It also includes stimulation of innovation in university students in entrepreneurship for technological and industrial areas.

CAPACITATE i4.0: This axes is about enhancing people's knowledge to allow adoption of I4.0 by enterprises and ensure that it is an inclusive transition. Here Learning Factories are involved as training mechanisms for specific needs of SME's.

ASSIMILATE i4.0: This axes is aimed at supporting and financing access of firms for testing of i4.0, and supporting scale-up of transformation. A collaborative national Digital Innovation Hub network is invloved to support experimentation and learning. Also included is supports to stimulate the digitalisation and integration of providers included in the supply value chain of firms.   Another area is coaching of I4.0 through technological investment for empowerment of organisations and to facilitate organisational transformation. Risk management brings in Support for an infrastructure to support the challenges of cybersecurity. Also in this axes is access to finance – to disseminate and facilitate access to investment for i4.0 projects and to create or adapt funds and credit lines for i4.0 transformation and scale up projects.

Ireland's National Industry 4.0 Strategy for Manufacturing

Ireland's national strategy for Industry 4.0 2020 to 2025 of December 2019 is "Supporting the Digital Transformation of the manufacturing sector and its supply chain".

The vision is for Ireland to be a competitive, innovation-driven manufacturing hub at the frontier of I4.0 by 2025. It is a response to the challenge of new digital technologies transforming manufacturing value chains, digitizing manufacturing and facilitating advances in manufacturing operations, process innovation, more efficient flexible production. Related concerns are jobs and disruption of labour markets as firms of all sizes face the same challenges for new skill sets and remaining competitive.

Goals of the strategy are to stimulate firms to adopt and build capabilities in I4.0 and to harness related new opportunities and to facilitate workforce skills development for delivery of I4.0 transformation. Other goals are to become a global leader in RD&I in the technology underpinning I4.0, to establish a world class business environment for I4.0 (regulatory, legal, standards related, international ecosystems).

Actions include coordination via a new control mechanism Future manufacturing Ireland, awareness and understanding of concepts via clusters and supports, guidance for firms. Additional actions are: support for exploring and planning for firms through demonstrators, supports for in-house pilots, and access to expertise.
Firm level I4.0 actions encompass financial support for I4.0 implementation, for I4.0 skills development and for consortia around I4.0 initiatives. A Stakeholder forum appears in an action to oversee the strategy implementation. Framework conditions are also in the planned actions to support SME's and researchers on I4.0 standards engagement and for international RD&I collaboration activities.

The document notes that manufacturing is a central pillar of the Irish economy employing 227,000 people, in 16,700 firms and generating 140billion euro (2017/2018) in export revenues. The adoption of I4.0 is consequently regarded as critical in maintaining a competitive sector. The key role of R&D is recognized due to rapid change and development intrinsic to I4.0 technologies. In the strategy the new control mechanism, *Future manufacturing Ireland*, is to ensure that publicly funded centres develop the capacities needed to support I4.0. Programmes to support clusters are also included via mechanisms such as the Disruptive technologies Fund.

Spain´s digital strategy 2025

Spain Digital 2025 is the agenda for the digital transformation of Spain. A strategy that includes a set of measures, reforms and investments, articulated in ten strategic axes, aligned to the digital policies set by the European Commission for the new period.

Spain Digital 2025 includes nearly 50 measures grouped into ten strategic axes with which, over the next five years, it is intended to promote the country's digital transformation process, in line with the digital strategy of the European Union, through public collaboration -private and with the participation of all economic and social agents in the country. More than 15 ministries and public bodies and more than 25 economic, business and social agents have participated in the elaboration of this digital agenda.

This agenda is articulated around **ten strategic axes**:

1. Digital connectivity
2. Continue to lead the deployment of 5G technology in Europe and encourage its contribution to increasing economic productivity, social progress and territorial structuring.
3. Strengthen the digital skills of workers and the general public.
4. Strengthen the Spanish capacity in cybersecurity.
5. Promote the digitization of Public Administrations, particularly in key areas such as Employment, Justice, or Social Policies by updating technological infrastructures
6. Accelerate the digitization of companies, with special attention to micro-SMEs and start-ups.
7. Accelerate the digitization of the production model through digital transformation driving projects in strategic economic sectors such as Agri-food, Mobility, Health, Tourism, Commerce or Energy, among others.
8. Improve the attractiveness of Spain as a European audiovisual platform to generate business and jobs, with a goal of increasing the audiovisual production in our country of 30% by 2025.
9. Move towards a data economy, guaranteeing security and privacy and taking advantage of the opportunities offered by Artificial Intelligence with the aim that, at least, 25% of companies use Artificial Intelligence and Big Data within five years.
10. Guarantee rights in the new digital environment, and in particular, labor, consumer, citizen and business rights.

C.2 WHERE IS YOUR REGION ON I4.0?
Assessing what is already available in the regions & the business I4.0 maturity

In Cantabria, Spain, instruments for assessing a region's capability to face the challenges of Industry 4.0 as well as tools to help the digitalization process of SMEs have been developed and shared as best practices within the partnership.

Cantabria has started with this process with the FACTORIA DE FUTURO Plan (Factory of the Future Strategy) in 2017. Global targets of the plan are the following:

- Accelerating the Digital Transformation of SMEs
- Boost regional digital entrepreneurship
- Boosting the international projection of regional companies when using Industry 4.0 resources.
- To support innovation projects related to Industry 4.0.

Tech Enablers, Cantabria Spain - Good Practice

The region of Cantabria in collaboration with the University of Cantabria has developed an analysis of the regions capabilities to face the Industry 4.0 Challenges. This analysis has been developed following these points, in the main areas of the Industry 4.0 sector:
A) Capture, sharing and cybersecurity of the data through sensors, wearables, digital labels, Big Data and Analytics, Cloud Computing and cybersecurity;
B) Robots and Artificial Intelligence, through the use of autonomous robots, the Internet of Things, cyber-physical systems, intelligent systems / neural networks and embedded systems; and
C) Virtual reality and prototyping, through simulators, additive manufacturing and 3D printing and augmented reality.

The study has conducted a SWOT analysis of the regional environment when implementing 4.0 technologies and the different actions developed by regional SMEs.
At the same time, it has also identified good practices of companies in the region that, due to their size and sector, can be a reference for the rest of the regional enterprises.
This Technology catalogue is published and actively updated with different actions and possibilities to interact with the companies and the industry.

Industry 4.0 Audits, Cantabria Spain - Good Practice

The technology audits are an important tool in order to help SMEs in their digitalisation process. There are a number of SMEs already involved in the different programmes existing at regional level (industry 4.0 Cantabria, Factory of the Future Cantabria.
With this first phase involvement at regional level, we give the opportunity to participate in the technology audit process. The companies interested in the technology audits they have to engage with the technology audit group and to follow different instructions and activities with its guidance.

The companies, having in consideration the results of the audits, have implemented industrial technology plans in base to these results. Some of the companies have developed new R&D projects because of the recommendations of the audits. All the participants in the audits have received the studies in a very positive way and all the proposed aspects have been implemented. The requisite to be part of the technology audits are based on the interest of the companies, to be part of the Industry 4.0 programme in previous project calls, and the commitment to develop the whole project with the experts.

C.3 LEVERAGING UNIVERSITIES AS I4.0 INNOVATION ENGINES
Approaches to increase I4.0 innovation skills centered on Universities and Research Centers in the regions

An enabling approach to increase the capability of a region to grasp the opportunities of Industry 4.0 innovation and to mitigate associated risks is to leverage the university/research capabilty in the region's higher level education facilities and research centres in a targeted and strategic manner.

The rationale for this approach is that the pace of change of disruptive and digital technology involved in I4.0 is increasing and so too are the risks to businesses, industry sectors and regions of being "left behind". Leveraging a region's I4.0 university and research capacity is strategic as it increases local cutting-edge expertise that can keep up with technological change and provides a talent pipeline with the advanced skills needed to face current challenges. Collaborative I4.0 research conducted in collaboration with key local sectors, can increase the capacity of companies to innovate and become more resilient and better equipped to grasp new opportunities from the digital revolution. It can also strengthen the university capabilty with the experience and learning of close industry collaboration.

In the experience of Digtial Regions, several approaches were identified as Good Practices which are centred on such facilities and their collaboration with manufacturing businesses. These are highlighted below and include:

- I4.0 Lab from West Romania
- Einstein1 Start-up Centre from Hof University Bavaria
- Technology Gateways from Ireland
- The CASE approach from IT Sligo, Ireland
- Co-Learning Lab from Hof University Bavaria

- WIMMIT workshops from Hof University Bavaria
- Digital Production Workplace from Hof University Bavaria

I4.0 Lab Romania - Good Practice

An initiative of the Faculty of Engineering Hunedoara (part of Politehnica University from Timisoara) is a fully equipped laboratory with flexible lines for students and researchers to test Industry 4.0. application in the manufacturing industries.

The lab is designed by the Faculty of Engineering from Hunedoara and funded by a private company. Although a privately funded initiative, the lab is owned by the university and it is currently used by students for testing and research. The lab is a modular production line comprising distribution / conveyor, joining and sorting stations. The entire system is networked and additionally equipped with several RFID sensors for both writing and reading data. The system processes the work orders generated by the MES (Manufacturing Execution System) software.

The lab comprises three modules all connected to a computer and each other connected to a PLC, where students can do testing in the field of control. Each module can accommodate up to 10 projects. The other part of the laboratory is a 4.0 generation plant including the flexible lines. The Flexible Line Stand provide students with the ability to observe an entire automated flow of technology from the time it is programmed to delivering end products to customers.

Following the testing phase, the lab will be used for providing services to companies from manufacturing industries in the region.

Einstein1 Start-Up Center Bavaria Germany -Good Practice

Founded in 2017 and supported by the Bavarian Ministry of Economy, Media, Energy and Technology and its "Gründerland Bayern" (Founder's land Bavaria) initiative, this start-up centre in a decentralised structured low mountain region has been successfully raised due to its planning and location next to the university of applied sciences in Hof, where young people interested in starting a business are supported – in cooperation and exchange with the start-up centre.

The Digital Start-Up Center *Einstein1* is located directly ar the campus of Hof University of Applied Sciences. It is the contact point for founders and start-ups from Upper Franconia and the Vogtland region. The focus lies in Big Data and its potential applications for industry as well as in the energy and healthcare sectors.

Einstein1 provides many services for upcoming new Start-ups in the digital sector:
Start-Up consultancy, Coworking Space with 30 work stations, fully furnished offices á 30qm providing up to 4 workstations each, rooms for seminars, meetings and conferences, a modern Business-Event location for i.e. Networking events or conferences as well as offering rentable business addresses. In addition, Einstein1 proactively promotes networking opportunities with key players in business, science, education and politics through events and networking activities.

Beneficiaries are digital entrepreneurs, who want to start their business in the Upper Franconia region. Einstein1 has close ties with the Patent Center in Hof, the Institute for Information Systems and the Volkshochschule (Adult Education Centre) Hofer Land and is working on enlarging its network across the region, including other centres. In addition, relevant and established companies in the region are supporters of the Einstein1, which also serve as possible cooperation partners for newly founded companies.

Overall, Einstein1 ensures and enforces the goal to make the Upper Franconia region and the city attractive locations for starting and successfully establishing a business.

From April 2017 until November 2020, Einstein1 screened about 170 start- up ideas. About 50 startups are in an incubation-phase and 23 startups were funded and founded. The centre provides 60 events per year and there are about 500 people in the community.

Technology Gateways Ireland - Good Practice

Enterprise Ireland Technology Gateways works in partnership with Institutes of Technology and Technological Universities across Ireland. 16 specialised Gateways and 3 sectoral clusters deliver innovation expertise and solutions for Irish industry. They provide close-to-market technology solutions that allow companies to develop new products, processes and services by leveraging the research expertise available within each Institute and University. Each Gateway offers specialised expertise and provides innovative technology solutions aligned to individual industry needs.
The Technology Gateway network is also home to three unique clusters which optimise the skills, knowledge and experience available.

Companies all over Ireland are using the Gateways to develop new or better products and services and smarter ways of doing things. Through the Technology Gateway Network, they are leveraging the expertise of over 300 industry-focused researchers, together with the specialist equipment and facilities of the 11 institutes of technology, to access near-to-market innovation and solutions.

Currently 16 specialist technology gateways form the network. Each gateway focuses on key technology areas aligned to industry needs. The following are located in the Border, Midland and Western region:
• WisarLab (Letterkenny): wireless solutions
• PEM (Sligo): Precision Engineering & Manufacturing
• MET (Galway): Medical & Engineering Technologies
• APT (Athlone): Polymer Technologies

Each Gateway acts as a portal to the industry focused capability across the network and beyond to the wider research infrastructure in Ireland. To optimise the power of the Network 3 clusters were established to deliver market lead innovation solutions for Irish companies, in the areas of Applied Internet of Things, Engineering, Materials & Design and Food and Beverages.

More information can be found here https://www.technologygateway.ie/publications/

CASE SME Engagement Model Ireland -Good Practice

This Good Practice comes from IT Sligo, now a part of the Atlantic Technological University, ATU, in Ireland and is a step by step approach to develop innovation in an SME.

It is an approach formulated by the Contract Research Unit (CRU) of IT Sligo. It is dedicated to SME engagement to deliver innovation with practical, hands-on interventions, starting with smaller projects and, through understanding of the SME context, opening up possibilities of further innovation and building the innovation capacity of the SME.

The engagement begins via small scale problem-solving funding to gain introductions to companies, and then, in tandem carries out an audit of other potential support and initiatives that could help to build their capacity. The ultimate aim is to build a knowledge generation and valorisation ecosystem in the region, with strong interlinking collaboration, that would provide it with effective resilience and a strong foundation for future success.

The approach is based on CASE engagement model:
• Connect (recruit SME's)
• Assess (understand the innovation needs)
• Support (develop project/prototype)
• Encourage (agree next steps, build SME collaboration, regional capacity and ambition).

Digital Production Workplace of Bavaria Germany - Good Practice

This practice is a technology transfer project where the university plays a key role. It addresses the digitisation of the production environment in the workplace but the approach can be applied to other I4.0 areas. The objectives were addressed by two groups with different tasks: SMEs (application partners) and the University and IT Technology providers.

Even though the office workplaces are largely digitalised, production workers typically still use a paper-based system. However, the same technologies (web-based solutions) employed in the office environment can be used in the production environment.
The solution for the problem is developed by the University and the IT Technology partners are involved in the project from an early stage in order to be ready to support the application partner beyond the project's term. Any solution, which has been produced by the University is made Open Source.

The main stakeholders and beneficiaries are:

1. SMEs in the manufacturing sector:
Because their software technologies are often not up-to-date, the project strengthens the SME with additional know-how which would otherswise often not be possible. Also by involving several companies in the project, a community is created and the solution becomes more market-ready.
2. IT Technology partner: They become digitalization-multipliers for the region, because they are able to support other SMEs as well.
3. Hof University: Improves its state of research and the skillset of their employees with each project.

WIMIT workshops Bavaria Germany - Good Practice

Through the project "WiMiT: Economy 4.0 in SMEs", SMEs are encouraged to start their digitisation process with the help of the research capacities, that Hof University provides. Within interactive Workshops organised by Hof University, SMEs can get to know the University's research capacities, the WiMiT-project funding opportunities as well as develop ideas for their own digitalisation projects.

A typical Workshop-timeline:
1.Presentations by the research institute (Hof University in this case) on the following topics: The University's research capacities, examples of successful digitalization projects, giving impulses and taking away common fears.
Therefore both basic and theoretical knowledge is provided and the transfer into the SME's working practice is made possible.
2.Teamwork sessions: Participants are divided into groups (participants should ideally have a similar background), based on the SME's questions, ideas for feasible project ideas are developed while making clear, what Hof University can provide and what the SME needs to bring in to the project.

SMEs are the target group of the workshop. They benefit from the University's knowledge on digitisation and their experience in implementing solutions with other SMEs. Through these workshops, possibilities for a joint project can be teased out. Also through this meeting, SMEs can join forces and develop a project together.

Co-Learning Lab, Bavaria Germany - Good Practice

This Good Practice aims to give medium-sized companies in a region a jump-start in their their digital transformation. By upskilling employees in digital processes and digital solutions, medium-sized companies can gain more efficiency and competitiveness. Through the Co-Learning Lab, companies can enter the world of digitalisation and the issues in the field of Industry 4.0 in a playful and researching manner. They can experience and understand technologies and transfer them into ideas and rapidly generated physical prototypes.

As a preparatory step, a learning platform teaches the participants basic concepts in methods and tools of digitalisation.

To prepare the workshops, the organisers (in this case Hof University of Applied Sciences & Kronach Innovation Centre) collected questions from the participating companies in order to answer them in corresponding thematic blocks during the workshop. Based on the principle of "blended learning" the following presence-workshop provided opportunities for further training, tinkering and developing concepts. Methods used during workshop: Information visualization, prototyping, robotics, web technologies, 3D printing.

C.4 REGIONAL I4.0 PROGRAMMES

Programmes to increase regional uptake of Industry 4.0 by business via sectoral/tech innovation programmes

Industry 4.0 is increasingly presented as the new paradigm for improving productivity, ensuring economic growth, and guaranteeing the sustainability of manufacturing companies.

A great challenge lies in the transfer of Industry 4.0 expertise and technologies in small and medium sized enterprises (SME).

Although the high potential of Industry 4.0 in SMEs, the main limit lies in a lack of concrete models for its implementation and application in small and medium enterprises.

Different approaches supporting the application of Industry 4.0 in small manufacturing companies are reflected in several good practices identified in Portugal.

Advantage Portugal 4.0 - Integrated approach to growth and innovation 4.0 for Portuguese SMEs

The Project of national scope has as its main objective to train SMEs for structured and integrated processes to approach innovation and business transformation in the context of global value chains contributing to the benchmarks of strategic targets of Phase II of the Industry 4.0 Programme.

Main Activities:
-Organization of availability of 4.0 services
-Tools for an integrated approach to business growth for innovation
– Activation of COTEC training service distribution networks
-Strengthening collaborative relationships with international innovation hubs

Advantage i4.0: https://cotecportugal.pt/en/projects/advantage-i4-0/

Vale Indústria 4.0 (Industry 4.0 Voucher) Portugal - Good Practice

This is part of the Vale Inovação (Innovation Voucher) modality of the SME Qualification under the Portugal's 2020 programme, Competitiveness and Internationalisation axis, managed by Operational Programme Competitiveness and Internationalisation (COMPETE 2020), and applies to the entire Portuguese territory with specific calls for the operational programs of each region.

It supports individual SME projects, for a maximum period of 12 months, aimed at acquiring consultancy services to diagnose the current situation and identify a strategy leading to the adoption of technologies linked to Industry 4.0.

This GP has as its main objective the promotion of technological strategies that lead to the digital transformation of SMEs, through the adoption of Technologies that allow disruptive changes in the business models of SMEs through the acquisition of consulting services to identify a strategy leading to the adoption of technologies and processes associated with Industry 4.0, namely in the areas of design and implementation of strategies applied to digital channels for managing markets, channels, products or customer segments; design, implementation, optimization of Web Content Management (WCM) platforms, Campaign Management, E-Commerce, etc.

C.5 OUTREACH FACILITIES FOR I4.0
Building digital competence in communities via FabLab networks & Digital Innovation Hubs

Another enabling approach facilitating the uptake of Industry 4.0 is through outreach facilities. FabLab networks and Digital Innovation Hubs facilitate digital transformation and Industry 4.0 uptake through testing, innovation services and training as well as the development of new digital skills for businesses, public organisations as well as for entire communities.

DIHs stimulate the uptake of AI, HPC and Cybersecurity as well as other digital technologies by companies and public organisations. They are one-stop shops that help companies become more competitive with regard to their business/production processes, products or services using digital technologies, by providing access to technical expertise and experimentation, so that companies can "test before invest".

A fab lab is a small-scale workshop offering digital fabrication. It is typically equipped with an array of flexible computer-controlled tools that cover several different length scales and various materials, with the aim to make "almost anything". This includes technology-enabled products generally perceived as limited to mass production.

In the experience of Digital Regions, two good practices have been identified in Slovenia, they are presented below.

FabLab Network Slovenia - Good Practice

FabLab Network is a platform for learning, intergenerational integration, creativity and support to creative makers, startups and companies. The national reference FabLab Network Slovenia is a technologically supported environment for innovation, prototyping and invention, but is also aimed at encouraging circular economy and local entrepreneurship.

Approximatelly 20,000 EUR per FabLab is needed for equipment, and 1 full time job. Moreover, additional funding of approximately 50,000 per year is needed for programmes and mentors.

The strategic partner network is a diverse ecosystem of 76 organisations (excluding the FabLabs) ranging from higher-education and research institutions, business support organisations, municipalities, small, medium, mid-cap, large enterprises. The public database of FabLab's existing technical and expertise offer provides 40 training items and, more importantly, 114 high-tech non-trivial equipment items, that are listed to support sharing and, in case of production requirements, renting etc.

Further information: https://fablab.si/en/

Digital Innovation Hub Slovenia -Good Practice

DIH Slovenia is an Industry Digital Transformation one-stop-shop serving Slovenia and beyond. It creates awareness and provide services to grow digital competencies, share digital experience and case studies locally, regionally and internationally. Additionally, it aims to influence the government to adapt regulation and open public administration data to foster entrepreneurship.

The aim of the operation is to become a single entry point for digitization and digital transformation, in particular through the following activities:
- Creating a digital ecosystem
- Direct support to SMEs (mentoring)
- Integration at national and EU level
- Promotion of digitization
- Overcoming the barriers to digital transformation
- Raising the digital economy index in Slovenia
- Increasing the number of companies involved in global value chains
- Raising the competitiveness of the Slovenian economy.

DIH Slovenia provides, connects and supports knowledge, business, technology expertise, technologies, experimental and pilot environments, best practices, methodologies and other activities necessary to fully enable Slovene Industry in building digital competencies, innovation models and processes.

Further information: https://dihslovenia.si/en

The Swiss Espace Mittelland region, part of the Digital Regions' initiative is showcasing the best example of innovation ecosystem with advanced research systems, intellectual assets, an ecosystem supporting the uptake of Industry 4.0 through an integrated approach.

The Swiss Smart Factory (SSF) has established itself as the first test and demonstration platform for Industry 4.0 in Switzerland. It has become a supermarket of ideas where companies of all sizes are welcome to learn and find what technology fits the needs of their company and product. Furthermore, with more and more innovation projects successfully entering the market, the testing and demonstration infrastructure is continuously updated.

Visitors to the SSF can track the entire production along the production ecosystem – from product design to packaging – the entire product life cycle through t**he lighthouse project,** which is intended to work like an idea supermarket for companies that would like to digitalise. This is because many technologies in the digitalisation field are invisible due to software components and the final result seldom if ever tells you anything the individual functional steps. The big challenge here is to show this networking in production. This is being made possible through virtual reality and augmented reality as well as floor marking and light effects.

The Swiss Smart Factory

Swiss Smart Factory (SSF) is Switzerland's leading and internationally recognized competence centre in application-oriented research on „Industry 4.0" and „Internet of Things". The SSF has been created in May 2017 as the first Digital Innovation Hub (DIH) in Switzerland. SSF acts as a regional and national multiplier and facilitator for digital innovations. It supports technology development and transfer from the first idea to the market introduction. Special focus is set on supporting SMEs and start-ups with the uptake and introduction of ICT innovation – both from technology and business perspective:

Website: www.sipbb.ch/ssf

Main Activities:
- Training and coaching activities to develop digitalisation strategies
- Innovation support through consulting projects
- Test lab to implement technology and perform feasibility studies
- R&D capacities to support companies innovation
- Public demo space to promote digital innovation on a regional level
- Co-working space to facilitate collaboration
- Open network covering regional and national stakeholder (over 30 companies

Partners: SSF is operated and partially funded through a membership model of more than 50 paying partners from industry and research:

Research Partners: Switzerland Innovation Park Biel/Bienne AG (SIP BB), Bern University of Applied Science (BFH), Haute école spécialisée Suisse (HE-ARC), École polytechnique fédérale de Lausanne (EPFL)

Industrial Partners: SIEMENS, Schneider Electric, DASSAULT Systems, GF Machining Solutions, Fraisa, Balluff, Fanuc, SAP, SICK Schunk, Swisscom, Festo, PWC, etc.

Infrastructure: SSF operates a 600m2 laboratory for developing, testing, demonstration and education of advanced IoT with a strong focus on Industry 4.0 concepts in Biel. With a quarter of all industrial jobs in Switzerland located in the greater area of Biel, one of its objectives is to provide infrastructure and services that help the local industry with the challenges related to the digital transformation.

Industrie 2025 platform

The Industrie 2025 platform is an initiative of the three associations asut, Swissmem and SwissTnet. The platform has the aim to contribute to strengthening the competitiveness of the Swiss workplace. Industrie 2025 is open to partners and sponsors who want to actively support the goals and activities of the platform.

Main Activities:
Establishment of a one-stop-shop for questions concerning Industry 4.0 in Switzerland
Operating the online platform www.industrie2025.ch
Knowledge building in relevant topics through national working groups
International market, trend and activity observation
Coordination of various networking events

Partners:

Website: http://www.industrie2025.ch/

Open Platform for the Adoption of Digital Innovation Canton of Bern Switzerland -Good Practice

An open platform for technology adoption coordinates the collaboration of technology / service providers and end-users to showcase, test, customize and/or develop new digital technologies in an inter-organisational network, addressing the needs of the technology users. The platform helps SME to become more competitive due to the use of digital technologies. The platform is coordinated by a neutral instance (e.g. non-profit research organisation), which acts as facilitator for the collaboration providing:
• confidence among the partners
• increasing visibility and support public relations, and
• providing specific service for demonstration, test and development of technologies in an interorganizational network.

The platform supports:
• exchange of best practices between technology / service providers and technology end-users
• support the ideation process using workshop and showcasing the state-of-the technology available on the platform
• support for the design, customization and testing of digital technology in a step-by-step approach: from the idea to the proof-of-concepts / digital experiment to the prototyping and the industrialisation.
• During the course of this development process, the role of the neutral instance will be steadily reduced, while commercial, industrial partners will overtake more and more responsibilities until the state of commercial industrialisation is reached.

https://www.sipbb.ch/en/forschung/swiss-smart-factory/

D. ELEMENTS OF I4.0 POLICIES

In response to the challenges identified in the regions, developing I4.0 policies to increase awareness and competitiveness of SMEs through the uptake of I4.0, improve the high-tech skills of the workforce is a prerequisite.

Main elements of effective I4.0 policies:

1. **Set up clear objectives with measurable targets supported by qualitative and quantitative indicators**
    -   *Increase awareness of Industry 4.0 impact and potential*
    -   *Increase SME innovation capacity and uptake of Industry 4.0 by manufacturing SME's*
    -   *Reduce the skills gap needed for Industry 4.0 in manufacturing*
    -   *Provide access to resources and skills for Industry 4.0*

2. Ensure private funding along with public funding as well as close to market funding instruments in order to increase sustainability of the initiatives

3. Industry driven approaches or bottom-up participation can better ensure the more active involvement of industry stakeholders.

4. Types of policy actions

Policy action can be characterized typically by the following:

- **Research on regional needs:** e.g. Mapping of regional Industry 4.0 resources and gap identification
- **Regional strategy & planning:** Build a regional strategy for Industry 4.0
- **Initiatives**
  - **Industry 4.0 assessment and roadmap for SMEs**
  - **Capacity building methods:** I4.0 workshops, peer learning workshops
  - **Industry 4.0 innovation programmes by sector or by technology focus or functional area**
  - **Schools Industry 4.0 outreach programmes**
- **Facilities (or networks of facilities):** e.g Digital Hubs, Fablabs, I4.0 Demonstration facilities
- **Ecosystems:** e.g Regional I4.0 Stakeholder groups, I4.0 Manufacturing cluster
- **Funding Support Programmes:** e.g I4.0 Voucher for SME innovation

5. Key targets and stakeholders involved

- Businesses: Business management, Operational staff, heads of IT, etc.

6. Provider: What kind of organisation designs and implements the action?

National & regional government agencies, Higher education institutions, business, innovation and regional development agencies

7. Maturity/Level

Another factor to consider is the current level of digital maturity amongst the target audience.

8. Geography: Focus of a policy intervention can be local, regional, inter-regional, national.

9. Sector: Which are the key sectors in the region most in need of I4.0 innovation.

10.Technology: A policy could focus on a key technology area of I4.0 such as IoT, 3d Printing, AI, Robotics, Blockchain

11. Area/Functional Focus: e.g. Supply chain, Ordering process, marketing, new product development, Production, Quality assurance etc**.**

E. DIGITAL REGIONS ACTION PLANS

The inter-regional learning and transfer of practices between the 8 regions involved in the Digital Regions initiative, which created the basis of the regional action plans' development is illustrated below:

The regional action plans developed in the 8 Digital Regions areas reflect how the lessons learnt and exchange of experience from the interregional cooperation will be exploited in order to improve the regional policy instruments.

D.1 Border Midland and West Region Ireland Action Plan
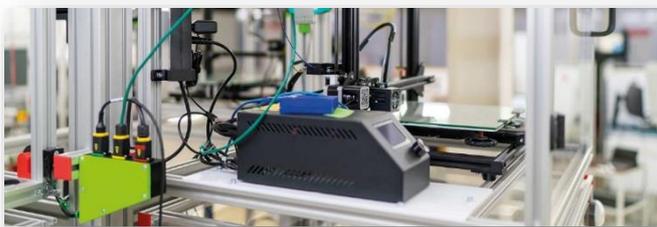
The action plan in the **Border Midland and West Region Ireland** has identified the need to develop services that can create more effective linkages between I4.0 innovation agencies/applied research centres within the higher education sector to accelerate the flow of I4.0 technology to businesses in the region.

The programme to be delivered in the action combines technology diffusion, skills development for industrial transition and university-industry collaboration.

The added value of the action for the region lies in a better understanding, resources and tools among managers to appreciate the impact that continued evolution of I4.0 is having on the competitiveness, innovation potential and market position of their business and the capacity to uptake I4.0 in a strategic way.

D.2 Upper Franconia Action Plan

German project partners iisys and Hochschule Hof have developed a Regional Action Plan to introduce various prototypical IT-solutions to the manufacturing SME partners in **Upper Franconia**.

The four actions included in the regional action plan are:

1. Moonrise Project - Mass customisation for the introduction of production - related IT systems in corporate networks

2. Consolidation of the Digital Regions' regional stakeholders' group via Transferraum Nordostbayern or Research & Transfer Network.

3. PUMA Project: Ubiquitos Mobility Service for better access of rural border regions.

4. Focused R&D transfer effort in the Kronach region.

D.3 Canton of Berne, Switzerland, Regional Action Plan

The action developed by the Swiss partners - Network of Networks is meant to be a platform, a one-door-principle for SMEs, to provide a clear overview of available offers of different existing innovation initiatives. The idea is to have a search tool for Switzerland's SMEs to find the right support which boost their understanding of digitalization /I4.0. The NoN should ease the first steps to find appropriate support within the digitalization transformation process. It is a place, where SMEs and innovation initiatives can meet and exchange knowledge. To our knowledge, no such platform exists currently in Switzerland.

D.4 Ljubljana, Slovenia Regional Action Plan

'Based on the knowledge and experience gained from examples of good practices of the Digital Regions project: Portugal i4.0, Co-learning Lab (Germany) and Open Platform for Adoption from Digital Innovation (Switzerland), we will develop concepts and apply the methodologies and approaches used in the above examples of good practice to develop EDIH consortium that will consist of the key players in Slovenia when it comes to digital transformation of the industry. All potential partners are well recognized at home and abroad, have rich experience and already established local and international networks of partners and stakeholders. EDIH will be organized sectoral and managerially, as well as linking both, the public and the private sector, to fully underpin vision of the EU digital ecosystem.'

D.5 Bulgaria Action Plan

Business Agency Association in Bulgaria developed a national Action Plan to stimulate the adaption of Industry 4.0 measures and boost the conditions for additional uptake of I4.0 solutions among Bulgarian SMEs.

'With the 1st action, we aim at the creation of Open Platforms for the Adoption of Digital Innovation. It will be a specific form for collaboration of technology / service providers and end-users to showcase, test, customize and/or develop new digital technologies in an interorganisational network, addressing the needs of the technology users for specific industries related to the priorities in RIS3 of Bulgaria – 4 vertical and 1 horizontal one.

With the 2nd action, we'll set up a network of Demonstration Centers for Digitalization. These centers will complement the existing DIHs and eDIHS with interactive demo stations that help to explore and analyse new technologies in a tangible and practise oriented way. Each demo station allows the visitor to experience in quick and easy manner how the showcased technology functions and the benefits it offers, but also shows its potential shortcomings. It helps to raise awareness and provides inspiration and ideas to test and introduce the technologies in the context of the visitor's company, e.g., through pilot projects.'

D.6 Cantabria, Spain, Regional Action Plan

The action plan for **Cantabria Region, Spain**, is an integral tool and perspective into an open innovation ecosystem. The aim of the FAST TRACK TOOL FOR DIGITALISATION OF SMES (FTFDS) is to increase the number of innovative and more digitalised companies at regional level, especially SMEs. The main activities of the project are to use four different actions at different levels in order to accelerate and to increase the level of digitalisation of the regional companies in different industrial areas.

The project will bring the following value for the region:

· Development of training plans promoting digital transformation.

· Increase the basic and advanced digital capacities of companies and workers.

· To increase the image of regional industry and the added of digitalization processes.

· Promote and position the action plan in the main national and international forums through the development of specific actions, attendance to specific fairs and international events.

· To identify the most important trends in relation with digitalization actions and activities using technology foresight tools.

· Launch of new projects and activities related to Industry 4.0, improving the specific regional call about supporting Industry 4.0 projects.

· To update and improve the regional map of technological enablers that serve to know the potential of Cantabria when offering services related to industry 4.0 at national and international level.

· Promotion of activities carried out by companies and research centers in Cantabria in the field of Industry 4.0 and advanced manufacturing through international networks.

· Promotion the business development of regional technology enablers increasing the interaction between clusters and business associations at national and international level.

## D.7 Centro Region Portugal Action Plan

The overall objective of the action plan of **Centro Region Portugal** is to influence and improve public policies at local and regional level to tackle challenges of digital transformation and lack of qualified staff and digital competences within the companies, with the main focus on micro, small and medium-sized enterprises.

The following activities will be developed:

I. Diagnosis on digital skills training needs in micro and SMEs and development of training plan for the strengthening of workers' digital skills.

II. Organisation of a workshop involving relevant players such as Clusters, players of PTCentroDiH's consortium, business managers, academia, digital experts and other interested

public and private sector organizations. The aim of the workshop is to analyze and discuss in more depth the results of the questionnaire and collect inputs from the speakers and participating players, in order to prepare a report of recommendations/suggestions on digital strategy, digital skills training needs, modernisation of business models and production processes of SMEs to be delivered to the managing authority, so that the suggestions can be properly evaluated and CIEBI could (effectively) have an opportunity to improve and influence the policy instrument addressed.

D.8 West Region Romania Action Plan
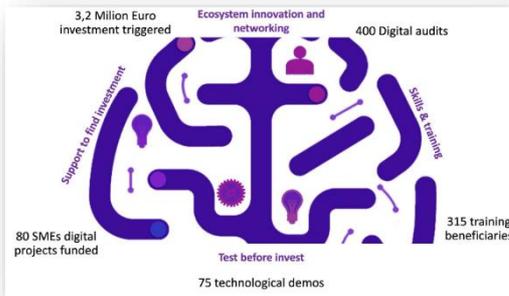
Envisaging the new EDIH in development, the Action Plan developed for West Region Romania contributes to the consolidation of this hub in the first 6 months of existence.

'We intend to tackle the barriers to digital transformation by learning from our Slovenian partners experience'.

This plan will have 3 main activities as follows:

1. Mapping of digital and technological infrastructure of universities, companies, clusters and research institutes (based on questionnaires)

2. Meeting with the above organizations (mainly companies and clusters) with the scope to build the service delivery design

3. Promotion of EDIH, draft communication concept created

F. CONCLUSIONS

The main objective of this white paper is to provide insights into the current state of best practices and regional policies approaches of the fourth industrial revolution.

While implementation of different measures on this issue becomes more dispersed in terms of regional and national policies, there has yet to evolve a comprehensive understanding and differentiation of the industrial support and interdisciplinary approaches.

The white paper identifies main areas that policies focus on: Research on regional needs, Regional strategy & planning, Build Capacity building methods, Industry 4.0 innovation programmes Facilities (or networks of facilities), Ecosystems and Funding Support Programmes.

In conclusion, research on the different best practices and policies of Industry 4.0 offers a thriving but understudied issue that connects several aspects of the debate around digital geographies and their impact on society.

Complementary to a techno-centric or business-oriented understanding of the fourth industrial revolution, regional action plans and strategies, should play a central role in the debate as Industry 4.0 renegotiates policy relations on different scales and can create new industrial support as well as unfold new potential for regional development.

G ANNEXES

G.1 MATRIX of Good Practices documented within Digital Regions

Good Practice	Country	Awareness	SME Innovation capacity & Uptake	Skills gap	Access resources & skills	Research/mapping regional needs	Regional strategy/ planning	Assessment/ roadmap	Capacity Building method	Innovation programme (tech/sector)	Outreach programme for schools/students	Support Facilities	Ecosystems	Funding programmes	Focus (technology sector or function)	Target	Provider	Maturity level	Geography
Technology gateways	IE		v		v						v					SME	University	All	National
Technology Enablers	ES		v		v	v	v								All	SME	Regional authority & University	All	Regional
Industry 4.0 Audits	ES					v	v								All	SME	?	All	Regional
I4.0 lab	RO		v		v				v		v					Student SME	University	Low Medium	Local Regional
I4.0 Voucher	PT		v											v		SME	Tech sector	All	National
Business & shared services centre	PT	v	v	v	v		v				v	v	v		IT sector	All		All	Regional
CASE SME Engagement Model	IE		v		v			v	v							SME	University	Low Medium	Regional
EINSTEIN1	DE		v									v	v			Startups	University		Regional
IOTEC	PT	v	v		v					v				v	Technology: IoT	SME (Traditional)	University/tech centres		Regional Inter-regional
SAMT	PT	v	v		v				v	v				v	Sector: Plastic & Mould technology: 3D printing, Advanced materials	SME	University/tech centres		National Regional
MITTIC	PT	v	v	v	v	v				v				v	Technology: ICT e.g. QR-codes	SME (Traditional)	University/tech centres	Low Medium	Regional
Portugal I4.0 Stratgey	PT	v	v	v	v		v								All	All	All	All	National
Co-Learning Lab	DE		v	v	v				v						All	SME	University	Low Medium	Regional
WIMMIT	DE		v	v	v				v						All	SME	University	Low Medium	Regional
Energy Monitoring App	DE		v	v	v				v						Smart App development	SME	University & tech sector		Regional
Digital Production Workplace	DE		v	v	v				v						Function: production	SME	University	Low Medium	Regional
Digtialization Parkour	CH	v	v		v							v			All	Compnaies	Tech centre	All	Regional
Open Platform for the adoption of digital technology	CH	v	v	v	v							v	v		All	Compnaies	Tech centre	All	Regional
Digtial Innovation Hub Slovenia	SI	v	v		v							v	v		All	All	Innovation Hub	All	Regional
Fablab Network Slovenia	SI	v	v		v							v	v		All	All	Netwrok of Innovation centres	All	Regional National

DISCLAIMER

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