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Digital Innovation Hubs in Smart Specialisation Strategies

Early lessons from European regions

Gabriel Rissola, Jens Sörvik

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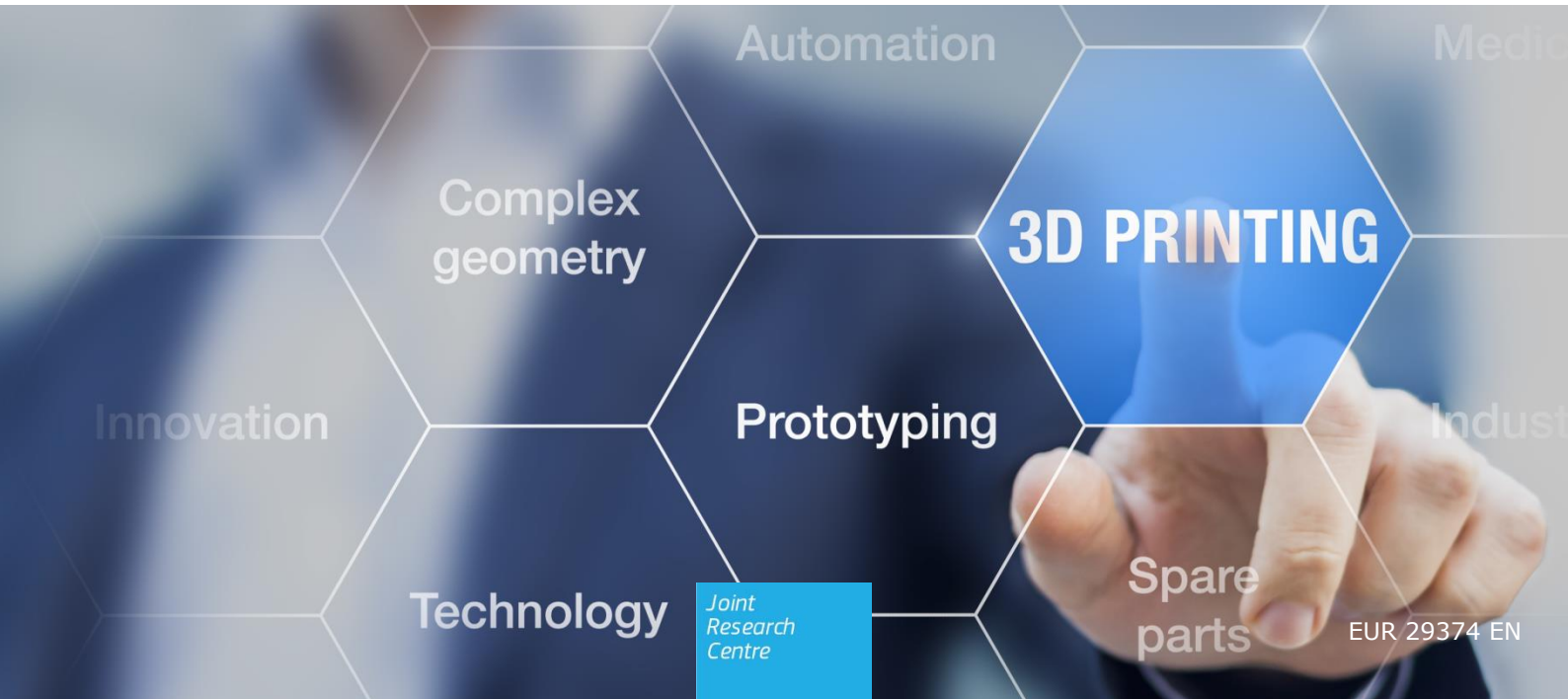

Joint Research Centre

EUR 29374 EN

Contact information
Name: Gabriel Rissola
Address: Edificio Expo, c/Inca Garcilaso 3, 41092, Seville, Spain
Email: gabriel.rissola@ec.europa.eu; JRC-DIR-B-SECRETARIAT@ec.europa.eu
Tel.: +344.954.488.423; +34.954.488.289

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Contents

Abstract

This report examines the synergetic place-based relationships of *Digital Innovation Hubs* (DIH) and Smart Specialisation Strategies (S3) in selected European regions, with DIHs being the policy outcome of a S3 process or an active actor participating in S3 entrepreneurial discovery processes (EDP) and implementing parts of a S3. By supporting the digitisation of the local industry DIHs also enhance the regional innovation ecosystem, either with the provision of horizontal digitalisation support or by leading a S3 priority area. One clear role of DIHs is to make available support easier to find for local SMEs and industry. DIHs work according to different business models and a targeted funding mix plus a matrix of different funding instruments for the digital transformation of SMEs are required for their sustainability. The report compiles 7 relevant examples (1 national and 6 regional).

Foreword

The digital revolution brings opportunities for big and small companies across Europe, but many of them, especially SMEs, still find it difficult to make the most out of it. On average in the EU, only about 1 out of 5 companies is highly digitised, and there are still large disparities between regions in the take-up of ICT technologies.

To address these differences, it is important that every region responds to the specific needs of their industry to go digital. Regions should build on the strengths identified in their smart specialisation strategies, and align their efforts with the capabilities of companies to use digital innovations, the sectors where they are strong, and the support structures they have available.

At the same time, aligning smart specialisation strategies with the overall policies of the European Union is crucial to increase impact. The European Commission launched the Digitising European Industry (DEI) initiative in 2016[1], coordinating with Member States and regions towards common goals.

One of key elements of the DEI initiative are Digital Innovation Hubs (DIHs). DIHs act as one-stop-shops where SMEs and mid-caps can test the latest digital technologies and get training, financing advice, market intelligence and networking opportunities to improve their business through digital innovations.

Digital Innovation Hubs are rooted in their regional ecosystem and can be orchestrators of digital transformation. However, collaboration and networking between the different DIHs are also essential to ensure best practices can be exported to other regions, and missing expertise can be imported, ensuring an efficient innovation ecosystem.

The EU is supporting that networking with €100 million per year from 2016 to 2020. A very practical result is the DIHs catalogue established under the S3 Platform[2], which aims to help, on the one hand, DIHs to exchange best practices, and, on the other hand, companies to find DIHs that offer the services they need.

The catalogue is also a good proof of how DIHs are flourishing across Europe (currently mapping more than 170 operational hubs) and how we are progressing towards the goal of having one DIH in every region by 2020.

With initiatives like the network of DIHs we are therefore setting the basis for European industry to succeed in its digital transformation. Now is the time to keep working together with national authorities, regional actors, and industry to ensure that every company - whichever the sector, wherever the location, whatever the size - can draw full benefits of digital opportunities.

This report presents best practices coming from regions investing in Digital Innovation Hubs. I hope other regions that want to invest in Digital Innovation Hubs will find it inspiring, and will find their way to set up Digital Innovation Hubs in their regions.

Max Lemke

Head of Unit
Technologies and Systems for Digitising Industry
Directorate General for Communications Networks, Content and Technology (DG CNECT)
European Commission

[1] https://ec.europa.eu/digital-single-market/en/pillars-digitising-european-industry-initiative
[2] http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool

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Authors

Gabriel Rissola (JRC), Jens Sörvik (independent expert)

Executive summary

Smart Specialisation Strategies (S3) is a place-based approach addressing a region's unique development potential by means of targeted efforts devoted to support the emergence of new domains that may foster regional growth through structural change. It consists both of horizontal measures addressing the regional innovation ecosystem, regardless of economic domains, and vertically targeted efforts focused on a limited number of priority domains identified through a multi-stakeholders process of entrepreneurial discovery (EDP). While *digital growth* is a transversal priority and recurrent aim of most regional S3 across Europe, *Digital Innovation Hubs* (DIH) is a policy instrument that can contribute to that goal by boosting the digitisation of the industry in every European country or region. This report examines the virtuous relationships of DIHs and S3 in selected regions, illustrating DIHs that are the policy outcome of a S3 process or an active actor participating in EDP and implementing parts of a S3.

Policy context

This report seeks to inform national and regional policy initiatives targeted at boosting the digitisation of the local industry (in particular small and medium size enterprises) by creating or improving the capacity of their place-based supporting ecosystems (the so-called digital innovation hubs) through regional smart specialisation strategies for research and innovation and associated funding instruments (notably the European Structural and Investment Funds).

Key conclusions

Conceived as ecosystems formed by RTOs, universities, technological companies and governmental institutions that provide services for the digitisation of the local industry, Digital Innovation Hubs can also support the development of the regional innovation ecosystem as well as the business growth and upgrading of local suppliers. With regards to S3, while some Hubs focus more on horizontal digitalisation support, others are leading a S3 priority area or alternatively carry out a mixed portfolio of activities designed in interaction with stakeholder partners.

One clear role of DIHs in many regions is to make available support easier to find by making the system more transparent and communicating it more clearly to its potential beneficiaries, for example offering one-stop shops where a DIH help and guide SMEs through the innovation support system. While some DIHs assist start-ups who are based on digital technologies, others support the development of new products and services by more mature companies that are not fully exploiting the digital opportunities yet.

The DIHS work according to different business models, combining public funds, membership fees and commercial incomes. A targeted funding mix and a matrix of the different funding instruments for the digital transformation of SMEs are required for their sustainability. Part of the funding might come from ESIF.

Main findings

Developing a consistent, comprehensive and coherent approach for a productive RIS3-DIH interaction is crucial. The smart specialisation process can identify and articulate the industry needs and the supporting place-based ecosystem (including the role of DIHs in relation to other regional actors), avoiding when possible to create any new organisation that may duplicate existing resources and efforts while building upon what already exists. DIHs can channel and coordinate different support mechanisms, integrating regional, national and EU-level programmes and initiatives, and attracting forefront companies. Regional development agencies and the DIHs should join forces and analyse together if their region has the right expertise needed to help upgrading the local industry and, eventually, bring in external expertise/competencies. DIHs can also be important partners for strategy development and feedback to RIS3 processes, sourcing industry needs and knowledge into the RIS3 entrepreneurial discovery process where all key stakeholders jointly set RIS3 priorities.

Building a complementary mix of partners in the consortium running a DIH is a pre-requisite for its success, both to set-up a comprehensive offer (one-stop shop) and to try keeping prices down by sharing costs with existing actors such as science parks, cluster, incubators, etc. Going beyond borders is also a good practice, drawing upon international expertise in order to provide local industry with highly competitive services.

Trustful relationships with actual and potential clients are essential to DIH business, and can only be built from actual market needs. A DIH to be successful needs to engage also with SMEs that may be outside the remit of the companies it has frequently been working with, or SMEs that are not used to work with this types

of innovation support organisations; this requires considering new means to engage with them. Most DIHs have a fixed range of services they provide; at the same time a DIH should be flexible and work with experimentation and co-creation to meet the complexity of company needs, adapting itself to new company needs over time.

Most DIHs count with a bit of base funding from public sources to provide some elementary services, usually supplemented with additional revenue sources such as delivering more complex services or initiating and managing projects. For the long-term sustainability of a DIH it is essential to keep track and actively identify and use different funding sources.

Related and future JRC work

This report is the first one of a series of analytical works produced by the Territorial Development Unit of the JRC under a formal collaboration with the Directorate-General of Communication Networks, Content and Technology (DG CNECT) of the European Commission. This analytical effort is aimed to improve the evidence base for sound policies in the area of digital regional growth by providing examples of how Digital Innovation Hubs (DIHs) participate in Research and Innovation Strategies for Smart Specialisation (RIS3) development and implementation, how DIHs network, and different strategies of DIHs depending on their socio-economic context.

Quick guide

This report start by setting the context in which it is produced, continues with a presentation of its methodological approach, then develops in separate chapters different analytical dimensions, to finalise with a summary of detected issues and good practices, and conclusions and policy recommendations. It compiles 7 relevant examples (1 national and 6 regional) in Annex.

1 Introduction

The concept of *Digital Innovation Hub* (DIH) as a policy initiative is recent and was formally launched by the European Commission (EC) in its Communication on "Digitising European Industry" (European Commission, 2016a). In this Communication, a DIH is defined as helping "*... companies in the region become more competitive by improving their business/production processes as well as products (and services) by means of digital technology.*" DIHs are conceived as ecosystems of actors involved in digitalisation but the term is also used to refer to policy initiatives to support digitalisation in existing industry. In this report, we emphasise the use of DIH as actors or initiatives that support digitalisation and the development of the surrounding innovation ecosystem (Goetheer & Butter, 2017) *in concrete territorial contexts*. DIHs are initiatives set-up to support digital transformation of existing industry across the European Union, and can be hosted by many types of organisations, such as cluster organisations.[3]

In the European Commission context, the design of a DIH should be based on regional needs and existing capabilities, which connects it to the regional strategies for *smart specialisation* (S3): "*... every DIH will have its own specialisation, in line with the smart specialisation priorities of a region. Through the networking of DIHs, competences not available within the regional DIH may be found in another DIH*" (European Commission, 2017). At the same time, the policy guidance material recognises that most Hubs do not have all necessary or relevant knowledge available in a region and therefore it is important to connect DIHs from different regions that can provide companies the complementary knowledge they need.

S3 is a place-based approach addressing a region's unique development potentials through targeted efforts to support the emergence of new domains to foster regional growth through structural change (European Commission, 2012; Foray, 2015; Gianelle, Kyriakou, Cohen, & Przeor, 2016). S3 consists both of horizontal measures addressing the regional innovation ecosystem, regardless of economic domains, and vertically targeted efforts focused on a limited number of priority domains (McCann and Ortega-Argilés, 2014). To identify vertical domains, entrepreneurial discovery is central: *"an entrepreneurial discovery is a new area of structural change that opens up, into which a whole segment of an industry can move to explore it and generate numerous innovations*" (Foray, 2015). This *entrepreneurial discovery process* (EDP) aims at identifying areas of discovery and mobilising market or entrepreneurial knowledge, research and development (R&D)-based knowledge and users to know where the greater potential for regional growth is.

A DIH can play a role both horizontally, by providing digitalisation support to all sectors, and vertically, by leading or taking part in processes of mobilising stakeholders towards *digital innovation*. A DIH can be the policy outcome of a S3 process, or an actor implementing parts of a S3. Many organisations that host DIHs, such as clusters, have worked cross-sectorial, organising multi-stakeholder projects and have participated in regional development processes, which supports the idea of them taking a role in S3 processes – both in their design and implementation (European Commission, 2013, 2016b).

For example, a DIH can support the S3 design process by providing information for decision-making, both by the DIH staffs own knowledge and by mobilising stakeholders and committing them to the entrepreneurial discovery process. It can also secure stakeholder commitment to the S3 implementation after the first rounds of design has been carried out in a continuous design process (Sörvik & Midtkandal, 2017).

[3] Many Hubs were originated by cluster organisations but do not coincide. The focus of a cluster organisation is to stimulate the future growth of the industries represented by the cluster, where a DIH draws on these resources to stimulate digital growth of industries that are external to the cluster. The European Commission has created a catalogue of Digital Innovation Hubs, which can be found at the following website: http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool. In this catalogue, many DIHs are hosted by cluster organisations.

2 Methodology for identifying the DIHs in RIS3

This report builds on data gathered through an interactive process led by researchers of the Smart Specialisation Platform (S3P)[4], who carried out a process of identifying a representative sample[5] of Hubs and S3 regions to be engaged in a workshop exploring the role of DIH in S3 processes and the implication of S3 for DIHs. This workshop has been central to prepare this report: its preparatory phase led to the selection of cases and scoping interviews, while the workshop itself brought rich stakeholder presentations and further discussions, supplemented by a subsequent data gathering after the workshop.

In order to identify relevant regions and DIHs, a number of sources were explored. The research work verified that *Digitalisation*, *Industrial Modernisation*, *Industry 4.0* or *Digital Innovation* were prioritised themes in the regions' Smart Specialisation strategies (RIS3), and that the region was a location with a developed *information and communication technologies* (ICT) sector willing to contribute (or actually contributing) to the digitisation of the local, non-ICT industries – in particular *small and medium enterprises* (SMEs). Having secured that a representative sample of regions was selected, the S3P team reviewed to this end the following sources:

- Priorities in the Eye@RIS3[6] related to ICT/DIH – an online database created by the Smart Specialisation Platform that gathers information on all regions' smart specialisation priorities. Reviewed in order to identify regions that had a priority in *Digitalisation*, *Industrial Modernisation*, *Industry 4.0* or *Digital Innovation*.
- The European Media Monitor (EMM) news[7], which tracks in the media different keywords evoking Digital Innovation Hubs. Browsed to identify regions whose work with Digital Innovation Hubs was frequently mentioned on the news.
- The ICT monitoring tool[8] –another S3P online tool that in this case keeps track of planned European Structural and Investment Fund (ESIF) investments in ICT. Regions with investments in ICT were identified, in particular regions investing in:
    - 082 – ICT Services and applications for SMEs (including e-Commerce, e-Business and networked business processes, living labs, web entrepreneurs and ICT start-ups)
    - 066 – Advanced support services for SMEs and groups of SMEs (including management, marketing and design services)
- The same tool also includes a database built up from keyword searches of (National and Regional) Operational Programmes where they explain what they will finance. From this, regions that frequently used the following terms were identified: *Hubs*, *Clusters*, *innovation ecosystems*, *living labs* and *test labs.*
- The EIPE (European ICT Poles of Excellence)[9] – a Composite Indicator that brings together 42 indicators to evaluate three elements in all EU regions (business activity, R&D and Innovation in the ICT sector). Consulted to identify which of those Hubs are connected to many partners, distinguishing from those who have links that only allow few exchanges. Used as a proxy to identify regions with a potential to develop strong place-based ecosystems for the digitisation of the industry, and not only the leading ones.
- The Regional Innovation Scoreboard (RIS)[10] – a regional extension of the European Innovation Scoreboard which assesses the innovation performance of European regions on a limited number of indicators. Used to expand the sample of regions in order to capture a variety of leading and moderate innovating regions.
- The European Regional Development Fund (ERDF), which classifies regions into *More Developed*, *In Transition* and *Less Developed* regions. Used to balance the sample.
- The Digital Innovation Hubs catalogue[11] – a dataset that gathers data on more than 500 Digital Innovation Hubs, out of which over 150 are fully operational. It contains data on aspects such as *technical competences*, *services provided*, *TRL focus* or *market sectors*. Used to identify DIHs that

[4] http://s3platform.jrc.ec.europa.eu
[5] Being this a qualitative research exercise, we do not mean here that the sample is *statistically* representative
[6] http://s3platform.jrc.ec.europa.eu/map
[7] http://emm.newsbrief.eu/NewsBrief/alertedition/en/DigitalInnovationHubs.html
[8] http://s3platform.jrc.ec.europa.eu/ict-monitoring
[9] https://ec.europa.eu/jrc/en/scientific-tool/european-ict-poles-excellence-composite-indicator-interactive-web-visualization
[10] http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_sv
[11] http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool

matched the regions identified in the previous searches of the other datasets. The DIHs were also scrutinized on whether they were interacting with the regions' smart specialisation strategy; whether they received funding from ERDF or ESF; whether they were part of regional or national industrialisation programmes.

Through this process, a number of DIHs and regions hosting them were selected and invited to the workshop, which was held at the EIT House in Brussels on 28th November 2017. They came from Wallonia, Lithuania[12], East Sweden, Baden-Württemberg, North-West Romania, Catalonia (all them presented at the workshop) plus Lombardy, Malopolska, Norte and South Moravia. In addition, a Hub from Linares in Andalusia joined the workshop at the last minute. Upper Austria region could not attend it but contributed at distance through interviews and information provided on demand.

Before the workshop took place, the S3P team conducted some scoping interviews to better understand the issues related to DIH in S3. These formed the ground to select the issues to address at the workshop. It also formed the basis for the templates provided to the participants prior to the workshop.

The data and presentations gathered before, during and immediately after the workshop are the main inputs for this report, and the research findings are divided into a number of major chapters focusing on main issues, namely chapter (3) leadership and governance; (4) contribution to regional development; (5) organisation; (6) funding; (7) collaboration. Chapter 8 is devoted to a transversal analysis, highlighting detected Issues and good practices; while chapter 9 provides conclusions and policy recommendations. The report is completed with selected case presentations of the following regions and their related DIHs: Baden-Wurttemberg (Germany), Wallonia (Belgium), Norte (Portugal), Lombardy (Italy), Lithuania, South Moravia (Czech Republic) and Catalonia (Spain).

[12] A few EU member states (among which Lithuania), because of their size and limited decision power of the sub-national level, have adopted a unique Smart Specialisation Strategy at national level.

3 Leadership and governance

Digital Innovation Hubs (DIHs) are a heterogeneous group of actors and constellations and so is their relationship with regional smart specialisation strategies and processes (S3). DIHs can be both the policy outcome of a S3 process and an active actor participating in S3 entrepreneurial discovery processes (EDP).

Coming to S3 implementation, while some Hubs focus more on horizontal digitalisation support, others are leading a S3 priority area or alternatively carrying out a mixed portfolio of activities designed in interaction with stakeholder partners.

There is not a single relational model between the regions and their Hubs that might be applicable, as these depend on whether the DIHs are an outcome of the S3 process or the DIHs preceded the RIS3 and eventually were an interested party contributing to its design. Because of our sampling choice, all DIHs in this study have a relation to the S3 process; some are more involved and take part also in steering the S3 process, whereas others are providing knowledge in consultations for the RIS3 process.

In Upper Austria, Lithuania and Norte the DIH's hosting organisations preceded the S3 and the DIH or the organisation leading the DIH initiative have contributed to the S3 development process. For instance, "*The Lithuanian DIH took active part in forming the S3 strategy. Experts, academia and business representatives, participated in: Working group activities; Created a study ANALYSIS OF THE FUTURE PRODUCTION BUSINESS ENVIRONMENT, describing possible directions of 4 technologies; Prepared an R&D&I report and Lithuanian business experience; Action plans for priorities of the priority area 'New production processes, materials and technologies'*".

The host of Norte DIHs and associated organisations were actively participating in the S3 development, not as leaders of the process but as proactive contributor in surveys, thematic workshops and meetings that led to the definition of the Norte S3, and they are continuously providing feedback via meetings and interviews. In South Moravia, North West Romania and East Sweden, instead, the DIHs are an outcome of the S3 process.

The South Moravian Smart Specialisation Strategy is led by the regional development agency JIC; as part of their strategy they have a plan to upgrade the regional industry through Internet of Things and Industry 4.0 activities. In their working group on these topics it was suggested to set-up a DIH called DIGIMAT.

In Baden Württemberg, DIHs are not an outcome of the S3 process, even though there are links between the two. In general, most DIHs are related to the S3 processes as knowledgeable speaking partners who provide information to RIS3 development (like in the Belgian, Czech, German, Italian, Lithuanian, Portuguese and Romanian cases). For instance, the Wallonia DIH orchestrated by Digital Wallonia is part of the regional Marshall Plan 4.0, to which it provides regular feedback and reports on *key performance indicators* (KPIs) formally twice per year. The Baden-Württemberg DIH is not officially related to the regional S3, but participates regularly in networking workshops under the auspices of the Ministry of Economics, Labour and Housing BW (WM) on *Dialogue-oriented Economic Policy*, *High-level Economic Dialogue*; *Sector Dialogue*; *Thematic Dialogue*; and *Regional Dialogue*. In Lithuania, some DIHs are even more involved and part of the RIS3 steering process.

The Hubs also differ regarding how they participate in the implementation of S3. Some are focusing more on horizontal digitalisation support (like in sample regions from Belgium, Czech Republic and Germany), e.g. in South Moravia the DIGIMAT Hub is a delivery mechanism to support the digitisation of mature industry, while in Wallonia the *Digital Agenda* is seen as an horizontal priority of the cluster policy.

Some Hubs are leading a S3 priority area or alternatively carry out a more mixed portfolio of activities that are being designed in interaction with stakeholder partners (in Lithuania and Italian, Portuguese and Swedish consulted regions). For instance LINPRA, the DIH coordinator in Lithuania, prepared the S3 strategy guide for the implementation of the priority "Flexible technological systems of product creation and manufacturing" (2012-2013), and it also organises continuous activities with member companies and provides advise and support to prepare R & D projects according to the guidelines for that priority. Another example is AFIL Lombardy, which has been officially recognized by Lombardy Region as a counterpart for the effective implementation of RIS3 in the area of Advanced Manufacturing. Thanks to its working groups, AFIL periodically provides S3 updates to Lombardy Region mainly concerning Advanced Manufacturing. Indeed, the cluster established a Road mapping group that gathers inputs from AFIL members and translates them into guidelines for the update of RIS3. DIH visual Sweden, in turn, is leading the S3 priority area on Visualisation & Simulation (including image analysis).

Whether the DIH takes a lead or merely carries out horizontal support seem to depend on the origins of the DIH and the host organisation. For example, part of clusters and industry associations' mission consist of developing their industry, which is more naturally connected to the role of the DIH than a policy initiative set-up ad hoc to support digitisation of (mature) industry.

4 Contribution to regional development

One clear role of DIHs in many regions is to make available support easier to find by making the system more transparent and communicating it more clearly to its potential beneficiaries, for example offering one-stop shops where a DIH help and guide SMEs through the innovation support system.

While some DIHs assist start-ups who are based on digital technologies, others support the development of new products and services by more mature companies that are not fully exploiting the digital opportunities yet.

The DIHs have been envisaged by policymakers to play several roles in connection to the regional innovation strategy. As per definition, their main purpose is to support the digitisation of industry. However, through their efforts they can also support the development of the regional innovation ecosystem as well as the business growth and upgrading of local suppliers.

The workshop participants highlighted that they have aimed to design their Hub and its services based on the needs of industry, and emphasised that a key success factor is to also focus on outreach and provide services to SMEs and companies that are not yet in their networks.

Taking a lead of a priority area – articulate needs and opportunities

Several DIHs are connected to a cluster, and it is their role to lead the development of the priority area or a specific domain. They organise actors to identify needs and opportunities in their economic domain and deliberate about industry needs.

In Norte, the PRODUTECH cluster and the two DIHs it hosts perceive as a very important function the articulation of stakeholders needs and opportunities for regional actors. Through interaction with regional stakeholders they identify issues and needs that the stakeholders may have with regards to manufacturing and activities that can support this. They then work with promotion of capacitation, networks animation and other cross-cutting initiatives (within thematic domains and cross thematic), in the promotion of R&D and Innovation projects and support services.

Many DIHs have been given the role to support all Smart Specialisation areas and enhance digitalisation of companies within these areas. This encompasses the support to cross-clustering / cross sectorial innovation in S3 to find new ways of integrating digitalisation in other more mature domains. It can also mean to identify needs for competence development and internationalization in order to help companies access other markets.

As an example, in Lithuania, LINPRA (DIH coordinator) has prepared a roadmap for the S3 strategic priority area "New production processes, materials and technologies". The strategic objective of their smart specialisation is to increase, through research, development and innovation (R&D&I) solutions, the impact of high added value, knowledge and high-skilled labour intensive economic activities on the country's GDP and on structural economic changes. They have also taken the lead in developing action plans for the different sub-domains of the S3 priority area:

- Photonic and laser technologies;
- Functional materials and coatings;
- Structural and composite materials; and
- Flexible technological systems for product creation and production.

These areas are also the key areas for their DIH. Following the S3 strategy, companies were recommended to specialize in certain priority areas that are at the same time the key areas at DIH. Therefore, companies submit applications according to DIH recommended directions. DIH and RIS3 are directly and closely interacting. To support the development LINPRA has taken a lead in setting-up the VIPKC, a virtual database of the R&D service providers and the engineering industry companies; and the INTECHCENTRAS – smart manufacturing competence centre. They are also setting-up field labs and help with subcontracting and consultancies.

Upgrading and support to innovation

Many of the DIHs have a horizontal support mission to enhance digitalisation independently of which sector companies belong to; to upgrade industry broadly and provide horizontal digitalization support.

This takes the form of enhancing efficiency of production process by supporting the adoption of new digital production technologies. It also means supporting the development of new business models and innovation, which will allow companies to move into market segments where higher value is added. For example, in South Moravia the DIGIMAT DIH supports regional companies to increase their competitive edge by increasing productivity (due to lower labour costs / greater automation, lower inventory costs, lower maintenance costs and better asset utilisation) and savings (due to improved quality).

Several DIHs also assist start-ups who are based on digital technologies, e.g. Wallonia.

Additionally, DIHs support the development of new products and services, for which they promote new cross-sectorial activities, e.g. encouraging companies in more mature sectors to adopt new digital technologies. In some places, e.g. in Upper Austria, this is done through cross-cluster collaboration where the ICT cluster works closely with clusters representing more mature industries. In North West Romania the specific purpose of the DIH is to push a modernisation agenda. The cluster has been growing and quite successful in different forms of subcontracting work to carry out contract programming. But there has been a realisation in the region of a potential to upgrade and develop higher value products of more proprietary content.

In some regions, the DIHs have showrooms for local technologies. Their purpose is to show opportunities for innovation and upgrading for local companies, while at the same time attracting foreign direct investments (FDI) by making local technologies and capabilities more visible.

Linking actors

One clear role of DIHs in many regions (and notably in Catalonia, the main purpose of the regional DIH initiative) is to better organise the innovation support system in the region, and make available support easier to find, by making the system more transparent and communicating it more clearly to potential beneficiaries. For instance, in South Moravia the purpose of the DIGIMAT DIH is to make the extensive expertise that exists in the different departments and faculties of the local Brno Technical University more visible to the companies in the region. In addition, running projects and inviting actors to the platform, they made actors meet and start collaborating.

In many places, the regional innovation ecosystem is complex, so it can be hard for companies to identify whom to work with or to approach for assistance. To overcome this complexity it is useful to offer one-stop shops, where a DIH help and guide SMEs through the innovation support system, as well as “no wrong door” policies, where all the actors in the regional innovation support system are provided maps and information about what other actors are doing to help the SMEs in the right direction.

Matchmaking is another DIH common function, either directly by organising or participating in events, or through information on the web. Additionally, some DIHs are developing networks of suppliers to team them up and enable them to take larger orders than they could do by themselves.

Catalonia is a particular case. It has at least 21 major organisations or networks aimed at supporting the digitalisation of local industries and SMEs. For the region it is of strategic interest to organise them in a regional ecosystem that connects all these initiatives, harmonise their combined services and make easier to coordinate efforts for satisfying complex customer needs. However, the regional government does not want to set-up any new organisation or introduce a new concept but, as it perceives there are enough support organisations on the ground; it is rather thinking to use DIH as an umbrella concept to organise such ecosystem (DIH-CAT in Figure 1).

There are also DIHs that aim at connecting actors, both by promoting complementarities of existing organisations (like in Norte) and by supporting them to collaborate, so that they can provide better services. This is for instance the case of AFIL Lombardy, where the mission of the DIH is to improve the connections between all key relevant regional stakeholders able to boost the Industry 4.0 revolution: competence centres, companies, users and suppliers, technology experts and investors.

In some other regions, the DIHs have been given a mission to improve possibilities to form better consortia that are more competitive in winning EU calls for funding innovation activities.

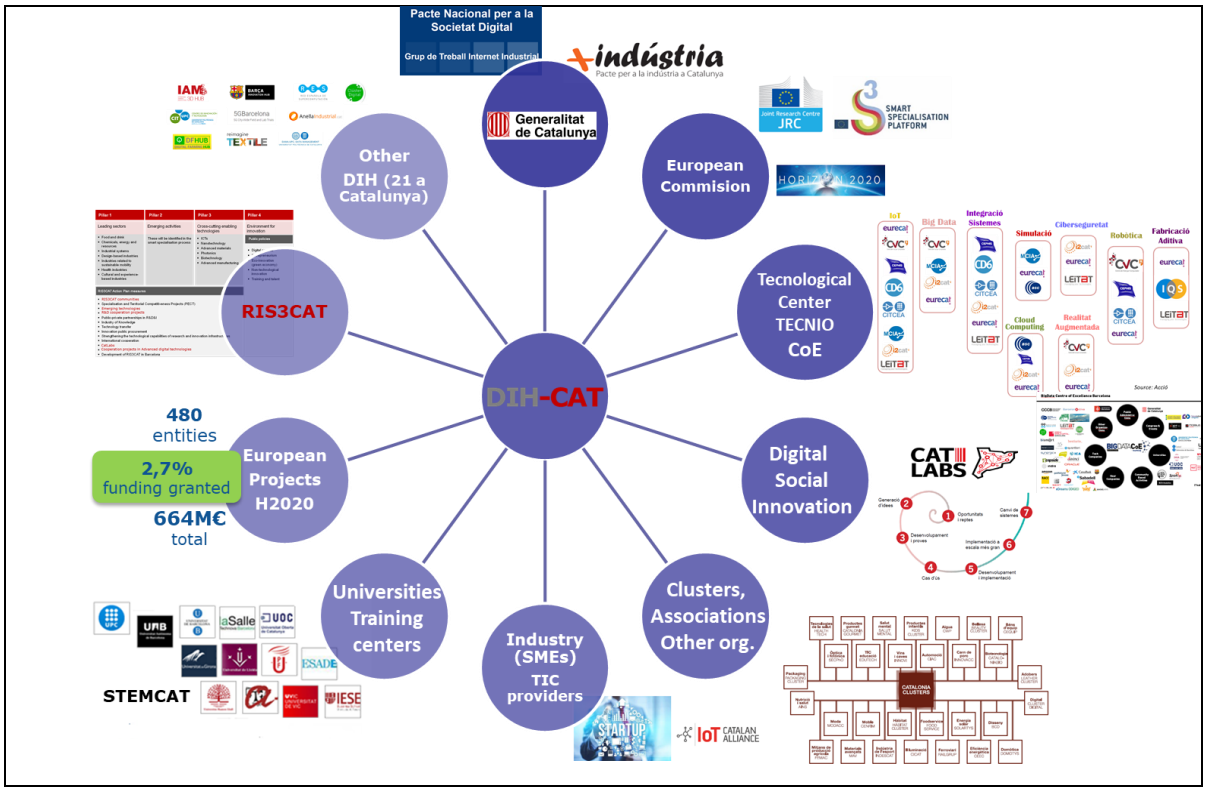

Figure 1: Catalan Ecosystem and DIH (source: DIH & S3 workshop presentation)

At the workshop, participants stressed that:

— the DIH concept helps in the communication between national and regional strategies, and between regional initiatives in different regions (for instance, in Upper Austria regional cluster/DIH activities are coordinated with national smart specialisation strategy lines);

— the DIHs/host organisations are capable to support multilevel governance initiatives since they have the time and resources to engage in these types of processes, while single companies may not have;

— for a fruitful collaboration between Hubs (as desired by the Commission) national authorities might help in setting a strategy by providing guidelines, funding and a framework.

5 The organisation of a DIH

DIHs are diverse in terms of organisation – from regional bodies to clusters or research centres. They differ also in their geographical coverage – regional or beyond.

The competences that are available in-house vary from business development skills, start-up support or technical skills to communication and engagement competences; however, these can be easily expanded through their networks since DIHs draw upon many external partner skills – either located in the region or further away.

To engage successfully with new customers, DIHs need to provide services that are relevant to local SMEs and industry needs, and build trustful relations.

Host organisation

In our sample, the DIHs are being hosted by a diversified sample of organisations. In Upper Austria, Wallonia and South Moravia the regional development agency hosts the DIH; in Lombardy, Norte and North-West Romania this is a cluster organisation; in Lithuania, this is a professional association; in Baden Württemberg, this is a research centre while in East Sweden it is a university; finally in Catalonia, it will most likely be a special public entity or body.

Geographical scope

They differ also in their geographical coverage: some focus only on their own region (like in Baden Württemberg), others on the national level (Lithuania, Finland) or both (Norte), or work EU-wide.

In-house competences

Depending on the type of host organisation, the most common types of in-house competences the DIHs have developed vary from business development skills, start-up support or technical skills to communication and engagement competences.

External partner competences

DIHs draw upon many external partner skills that are either located in the region or further away.

In general, DIHs count with technology partners like research centres, universities, technical universities, training providers, vocational training, special competence centres and technology suppliers; and collaborate with innovation support organisations for intellectual property rights (IPR) management and business model activities.

Holding a network of long-term partnerships between complementary organisations such as knowledge institutions, industry clusters, incubators and innovation agencies in the region/country is a good basis to become a DIH. Several of the DIHs haver reported to be connected to/collaborate on a regular basis with:

- Clusters, to better reach out to SMEs and industry.
- Research centres and universities, to be able to provide relevant technical support skills.
- Technology-using companies, to mobilise needs and provide development opportunities
- Private tech suppliers, top provide solutions
- Private consultants, to provide knowledge
- Public innovation support actors (incubators, accelerators, etc.)
- Community based labs
- Training centres
- Professional associations
- Congress and events
- Public administration

— Regional/national development agency

DIHs should also network with each other to be able to give companies in their region the possibility to work with the best experts/technologies addressing their needs. However, it is necessary to build trust between DIHs and to develop business models able to support such cross-EU cooperation.

What type of services are provided

While most DIHs offer a fixed range of services (in Romania these are only tentative, as this Hub is in preparation), a DIH should be flexible enough to work with experimentation and co-creation.

Services that DIHs offer typically include access to test facilities, experimentation and piloting, business model development, skills training, access to knowledge and experts, workshops and matchmaking events, financing, project initiation and management, internationalisation and IPR assistance. In particular:

— Awareness raising, i.e. to promote the use of new technologies and DIH services (through activities such as roadshows, showrooms, events, workshops, interactive demonstrations, factory tours, videos, commercials, online and printed media). This is an important mission for DIHs, since highlighting the opportunities brought by digital transformation is essential to promote the expected upgrading of industry. And this is a task that all DIHs engage in, in some kind of form, either through direct contacts with potential beneficiaries or through marketing or public events.

— Diagnosis, since most DIHs carry out analysis of the company's specific needs and possible digital solutions to improve their competitiveness. This is done in different forms, one of the most common being an online maturity test where customer companies can carry out a self-assessment to prepare themselves before proceeding to work with the DIH. Some offer free consultancy time (shorter or longer) to identify needs, while others charge for more in-depth analysis. Some offer analysis for free and then charge for solutions, while others offer subsidised solutions as well.

— A transformation plan, which is the outcome of the diagnosis and proposes possible technologies, new solutions or new business models to the analysed company. In effect, not all DIHs solely offer different forms of technological solutions but quite a few also connect these to new business model developments and innovation in the strategic direction of the company (e.g. in Baden-Württemberg and Wallonia).

— Experimentation, testing, piloting (or realisation as shown in Figure 2)

— Collaborative research projects, which is the case of few DIHs (e.g. Visual Sweden and PRODUTECH Norte). Wallonia's DIH instead works with demonstrators, start-up boosters, specialised workshops, living labs, assistance to the development of research projects. Others try to stimulate R&I project initiation by mobilising partners to form consortia and apply for different calls, also helping out in writing national and EU funding applications (e.g. in East Sweden and Catalonia). Depending on the type of host organisation and partners the DIH counts with, technology solution implementation and/or support can be provided with internal resources or through partners, as well as using either off-the-shelf solutions or more customised ones.

— Matchmaking, which is quite common and may refer to favouring the encounter between supply and demand, including universities and research institutes as providers, or less frequently between companies with similar needs or complementary solutions (which is closer to DIH ecosystem building role).

— Training and skills development, which is also quite a common feature despite not provided being by every DIH (e.g. Wallonia's organises Digital Bootcamps, others like AFIL and LINPRA offer education and mentoring).

— Promotion and marketing: some DIHs help companies to promote and market themselves (e.g. Wallonia's).

— Internationalisation (e.g. Wallonia, Norte and South Moravian Hubs).

— Financing, which is a common feature and consist of different ways to provide funding assistance for digitalisation activities, either by providing subsidise services or innovation vouchers to purchase services, but also facilitating contacts with venture capital and other types of investors. Additionally, a few keep track of and suggest opportunities with different forms of public innovation support calls.

— Economic studies and analytical insights, both for private actors and the public sector (e.g. LINPRA in Lithuania).

— Transversal initiatives to favour digitisation, e.g. the Walloon DIH is active in processes of developing and implementing the high-speed Internet infrastructure while at the same time it stimulates open innovation and the use of open data.

Many of the DIHs have developed a framework of the services they provide; however, these are not uniformly detailed. Out of those reported here, the one which is probably most comprehensive is that of the Digital Wallonia platform, which covers 28 actions in an integrative framework for support according to the five dimensions of the Industry 4.0 accompaniment by the Walloon DIH (see Figure 2 below).

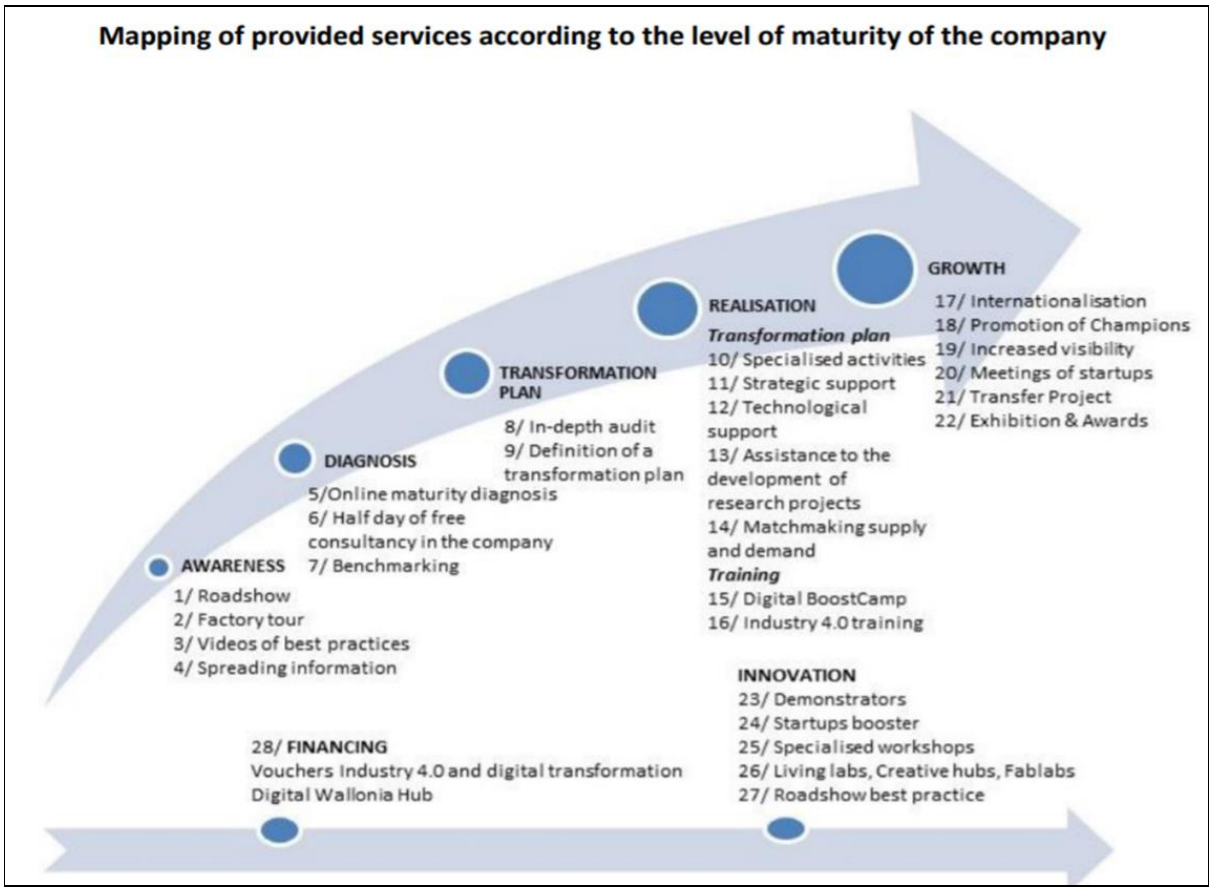

Figure 2: Services provided by DIH Wallonia (source: DIH & S3 workshop presentation)

Approaches to engage with SMEs

To engage successfully with SMEs and industry, DIHs need to provide services that are relevant and build trustful relations. The challenge to reach out to the SMEs is significant and a lot of commitment and high-quality expertise is required to address the business needs of the local SMEs. Creating opportunities for demand-side companies to work together with supply-side companies and organisations in a trusted environment is a critical aspect of it. Using a language that SMEs can understand and propose them service procedures that keep bureaucracy to a minimum are also critical factors to approach SMEs effectively.

A DIH needs to communicate its offer and raise awareness about itself using both online and offline strategies, such as having a web-page, using social media channels and newsletters. Furthermore, to make tutorial-type videos is also useful. As many of the companies that the DIHs want to reach are less tech-savvy and not yet so digitised, it is equally important to use non-digital channels to reach them. Offline marketing includes printed presentation material, tech event, trade shows and conferences. For example, Baden-Wurttemberg Hub markets itself through local radio, TV and in video channels in super-markets. Many Hubs use their own networks as communication channels, such as clusters and chambers of commerce.

Furthermore, communication should both be about engaging with potential beneficiaries of the DIH services, but also to diffuse knowledge about different steps that companies can take themselves to digitise. Communication resources proposed by workshop's participants encompassed:

- Actively seeking contact with SMEs
- Factory tour – open-up study in company
- Adds in traditional media
- Events
- Workshops
- Trade shows
- Show rooms
- Best practise diffusion videos
- Best practices diffusion web
- Best practise diffusion printed brochures

6 DIH funding

The DIHS work according to different business models, combining public funds, membership fees and commercial incomes. A concrete funding mix of public and private funding and a matrix of the different funding instruments for the digital transformation of SMEs are required for a DIH to remain financially sustainable.

The DIHS work according to different business models. There are those with a base funding coming either from public funds (e.g. from European Regional Development Funds; from the H2020-based programmes for Digital Innovation Hubs or, more broadly, for the development of the ecosystem of innovation support to SMEs "INNOSUP"[13]; from local, regional or national funds) or from membership fees. Others do not count with base funding coming from public budgets but receive funding for their digitisation-related services. Public funds are also granted to fund certain targeted activities or targeted calls for specific services, or delivered through innovation vouchers that can be used for digitisation services provided by the DIH. The DIHs themselves also look for different calls and public funding opportunities. Many also charge for their digitisation services except those more basic, which are kept free-of-charge for their customers, while others commercialise all their services.

Workshop participants agreed that, ideally, DIHs should provide SMEs with the basic market-entry services (raising awareness, market place etc.) for free, covering the costs with a mix of private funding and public funds (e.g. ERDF). More advanced services, such as business model development, should be provided on a pay-per-use basis. A concrete funding mix of public and private funding and a matrix of the different funding instruments for the digital transformation of SMEs are required for a DIH to remain financially sustainable. It was also considered hard to establish a DIH without seed financial support, which is the case of NW Romania that is hesitating to set-up one.

Many DIHs keep track of funding opportunities and calls to finance their activities and to mobilise actors to respond to calls. Others also gather actors to initiate joint projects and are knowledgeable about different forms of funding opportunities. However, while H2020 grants are good to bootstrap a project they do not ensure the financial sustainability of the DIH ecosystem over time.

Indeed sustainability is not static, as it develops with the increasing market and industry requirements. A DIH needs to adapt itself accordingly and provide the right type of services needed, so its business model needs to be customer demand-driven and flexible enough to address different scenarios. Regional DIHs remain responsible for identifying the SMEs' industry needs within their respective constituencies, and some of the workshop participants argued in favour of charging for their services in order to make SMEs committing to the process.

[13] Generally, INNOSUP actions are designed to provide opportunities to Member States and regions to enhance their services to SMEs through collaboration, peer-learning and uptake of new approaches. Examples of this that are relevant to DIHs include Cluster facilitated projects for new industrial value chains or European Open Innovation network in advanced technologies. More info available at https://ec.europa.eu/easme/en/horizon-2020-innosup

7 Collaboration

DIHs coordinate the collaboration between actors in the ecosystem, either by matching supply and demand or by matching complementarities and fostering synergies. No Hub has all relevant resources in-house for the digital transformation of SMEs, which can be palliated by partnering with other DIHs. Some DIHs bring in resources from outside of their country while others collaborate in EU-wide projects. A pan-European network of DIHs could be the platform for knowledge exchange and learning where DIHs can share good practices and engage in benchmarking.

Business models, target sectors, services provided, geographical scopes and focus vary across DIHs. At the same time, no region can provide all the resources needed for the digital transformation of all companies in their region, implying always a certain level of specialisation that prevents DIHs to have the relevant competences for clients with needs that differ from their specialisation.

Many of the DIHs at the workshop argued that it is hard for a Hub to have in-house all relevant resources for digital transformation, as the SME needs range from new technological competencies to business model development or IPR advice. The lack of adequate services could be palliated by partnering with other DIHs, which is a type of collaboration the Commission aims at supporting with devoted initiatives.

At the workshop, there were a number of examples of ongoing collaboration presented. This happens primarily within the country or the region, where the DIH is coordinating the collaboration between actors in the ecosystem, either by matching supply and demand or by matching complementarities and fostering synergies. There are some examples of DIHs aiming at bringing in resources from outside of their country to strengthen the local industry (e.g. in Lithuania) and also of DIH hosts collaborating in EU-wide projects through H2020, COSME, INNOSUP, IoT4Industry and Interreg for benchmarking and learning (e.g. Norte, Lombardy, Baden-Württemberg and Catalonia). There are also examples of DIHs involved in S3 thematic partnerships on Industrial Modernisation and Agrofood[14].

At the workshop there was also a discussion on possible areas of collaboration between Hubs, being said that collaboration probably works better when there are similar needs, but that target groups are different and available competencies are complementary.

There was an interest in setting-up a general network of DIHs, with a platform for knowledge exchange and learning where DIHs can share good practices and engage in benchmarking. Such a platform could also be used to identify common issues that can be raised to EU policy making. There was also interest in accessing expertise and competence centres from other regions, in order to help local industry, but possibly also to develop joint services. Through collaborative innovation voucher schemes, this could possibly facilitate financing of services. In a similar fashion, bring in and promote technology and solutions from other regions to local industry as well as promote regional suppliers to other regions could be relevant, and could partly be done through inter-regional demonstrator networks and business-to-business matchmaking.

There was also an interest in forming partnerships for different projects, to apply for funding proposals and to set-up consortia for more elaborated value chain developments[15]. A particular interest was expressed for promoting cross-sectoral collaboration to develop new solutions.

Some participants expressed an interest in exchanging global analyses of new technologies and markets, in a kind of network for joint market intelligence. In a similar fashion of knowledge building and diffusion, there was a suggestion for exchange of competence and people through secondments.

[14] For instance, the European Photonics Alliance is an S3 Industrial Modernisation partnership led by the region of Southern-Netherlands that is also an active network of Digital Innovation Hubs and clusters; the Traceability & Big Data is an S3 Agri-food partnership led by Andalusia and Emilia Romagna regions that explicitly counts on DIHs to fulfil its mission.

[15] An example of this is the *De- and Re-manufacturing demo case* (a *Vanguard pilot network* led by Lombardy) that is aimed to recover, re-use and upgrade functions and materials from industrial waste and post-consumer high-tech products, under a new producer-centric Circular Economy perspective.

8 Detected issues and good practices

From the preliminary interviews conducted before the workshop, the presentations at the workshop and subsequent interactions with DIH representatives, several issues and good practices emerged. Among them, the more prominent ones were the need to build trust by providing the adequate support; to count with a proper service delivery network; and to manage multilevel governance, funding and communication.

Trust building – adequate support

For a DIH to succeed it must build trust and keep trustful relations with actual and potential clients. To manage this, a DIH must start from industry needs, identifying who its target groups are, and what kind of services offer is needed to digitise them. For example, this was the basis of the Lithuanian DIH process. At this scope, it is recommended that early in the project phase an analysis of regional industry needs is performed. Also piloting can be a good practice, as South Moravia did by testing their services with three companies. This helped them to refine the relevant target groups, appropriate services and delivery modalities.

Such analysis can and should connect to the analytical side of the S3 process, which is seen as a good practice. Norte in Portugal highlighted the interplay between the cluster, the smart specialisation process in identifying and articulating the industry needs, and the organisation of the DIH in addressing this need.

A DIH also needs to be knowledgeable about good and useful technical opportunities, technology providers, other types of potential partners, and also about different forms of funding options, including the submission of applications to H2020 and national calls.

A DIH to be successful needs to engage also with SMEs that may be outside the remit of the companies it has frequently been working with, or SMEs that are not used to work with these types of innovation support organisations. This requires considering new means to engage with them; for example, most of the DIHs at the workshop agreed that a good practice was to provide SMEs with at least the basic market-entry services (raising awareness, market place etc.) for free, which might be a way of attracting/engaging them.

Adequate service delivery network

A DIH should build the right type of service offer adapted to the needs of its target beneficiaries, clarifying what its role is in relation to other regional actors that might be offering similar services. Seen from a regional angle, this should not lead to create any new organisation duplicating resources and efforts but to build upon what already exists.

Building a complementary mix of partners in the consortium running a DIH is a pre-requisite for its success, both to set-up a comprehensive offer (one-stop shop) and to try keeping prices down by cost sharing with existing actors such as science parks, cluster, incubators, etc. Once the Hub starts to deliver services it will also become a focal point for suppliers to connect and interact and will improve ecosystem relations.

Going beyond borders is also a good practice, for example LINPRA identified regional needs not only exploring possible service providers within the country, but also drawing upon international expertise in order to provide local industry with highly competitive services.

Developing a consistent, comprehensive and coherent approach for a productive RIS3-DIH interaction revealed to be crucial. Indeed, regional development agencies and the DIHs should join forces and analyse together if their region has the right expertise needed to help upgrading the local industry. If the answer is negative, they might consider whether regional funds can be used to bring in external expertise/competencies.

Attractive services

Most DIHs have a fixed range of services they provide; at the same time a DIH should be flexible and work with experimentation and co-creation to meet the complexity of company needs, adapting itself to new company needs over time. For instance, South Moravia has successfully provided services through a twin team in interaction with the customer – one academic and one professional consultant – providing in this way complementary knowledges and perspectives to companies.

A few DIHs also provide online tools to leverage the support provided – e.g. a self-assessment tool for raising digital awareness. In this way, companies can assess their own needs while becoming more knowledgeable about digital opportunities and are better prepared to engage with the DIH.

Several DIHs have also engaged with companies to exploit attractive opportunities by jointly delivering innovative digital solutions through public and private procurement. For example, a DIH organises an open innovation event where a company describes a need it has, for which it is seeking a solution, and expresses its interest to procure a solution if this is developed. There are also other DIHs which have organised events where they present societal challenges that they seek solutions for; the solutions to these needs are often connected to the use of digital technologies, and suppliers of solutions form teams at the events with other suppliers or research institutes to design, develop and deliver the new digital solutions. This approach facilitates digitalisation both with customer and supplier companies.

Multilevel governance

DIHs can channel and coordinate different support mechanisms, integrating regional, national and EU-level programmes and initiatives, and attracting forefront companies.

For example, some regions report as a challenge that many public efforts to support innovation and digitisation are running in parallel, causing confusion with companies who do not know who to contact for, risking duplicating efforts; in these cases the DIHs can help in the communication between national and regional strategies, and between regional initiatives.

DIH can be important partners also for strategy development and feedback to RIS3 processes, sourcing industry needs and knowledge into the RIS3 entrepreneurial discovery process where all key stakeholders jointly set RIS3 priorities.

Financing models

Most DIHs count with a bit of base funding from public sources to provide some elementary services, usually supplemented with additional revenue sources such as delivering more complex services or initiating and managing projects.

For the long-term sustainability of a DIH it is essential to keep track and actively identify and use different funding sources. DIH managers need to consider carefully how to build up a proper funding mix for planned activities. However, mixing funding sources up and aiming for synergies at the same time can create complications, not to mention the issues related to state aid and different administrative requirements from different financing sources that need to be overcome.

Communication

In order to engage successfully with SMEs, most respondents suggested using a multi-channel strategy, combining a mix of traditional channels (like print-media, radio, local TV, leaflets, going to trade shows) and online means (social media, video streaming material showing good practices). While some argued that it is important to use online media and put up video material of how to implement good practices, since Hubs should put in practice what they preach and make knowledge available in digital format, others argued that in order to reach companies that are yet not so digitalised, communication through non-digital channels should prevail.

9 Conclusions and policy recommendations

Digital Innovation Hub (DIH) is a new concept that builds upon previous experiences and organisations, having different origins and serving different purposes. Therefore, the configuration and governance of DIHs is heterogeneous; for the long-term sustainability and success of these organisations, their differences need to be acknowledged and built-up on.

As per definition, their main purpose is to support the digitisation of industry. However, through their efforts they can also support the development of the regional innovation ecosystem as well as the business growth and upgrading of local suppliers. With regards to regional Smart Specialisation Strategies (RIS3), DIHs can either be an outcome of the S3 process or have preceded the S3, eventually being an interested party contributing to its design by helping to steer the S3 process or providing knowledge for it. The Hubs also differ regarding how they participate in the implementation of S3, with some focusing more on horizontal digitalisation support, others leading a S3 priority area or alternatively carrying out a mixed portfolio of activities designed in interaction with stakeholder partners.

Central to the concept is that the DIHs are ecosystems (formed by RTOs, universities, technological companies, governmental institutions, etc.) that provide services for the digitisation of the local industry. The design of the latter should start by analysing the needs of the regional industry – not only through the industry with which the Hub has already established collaboration but also entering in contact with more mature industry that haven't put their main focus on digitalisation issues so far and/or may not have strong ties with competence centres or other types of innovation supporting facilities – as well as with other small enterprises which can be representative of the local SME landscape. This may help with another key aspect, how to reach out and provide services to SMEs and companies that are not yet in their networks.

As Industry 4.0 and Digital Innovation Hubs are currently fashionable concepts, the DIHs should try to benefit from the current buzz to engage with potential beneficiaries. The latter should become aware that the digitisation services offer is not limited to enhancing efficiency of products or production process by supporting the adoption of new digital production technologies but also encompasses support for the development of new business and innovation models that can allow companies to move into market segments where higher value is added. Indeed, services that DIHs offer typically include access to test facilities, experimentation and piloting, business model development, skills training, access to knowledge and experts, workshops and matchmaking events, financing, project initiation and management, internationalisation and IPR assistance.

One clear role of DIHs in many regions is to better organise the innovation support system in the region, and make available support easier to find by making the system more transparent and communicating it more clearly to potential beneficiaries. In many places the regional innovation ecosystem is complex, so it is useful to offer one-stop shops where a DIH help and guide SMEs through the innovation support system.

DIHS are geared towards both start-up support and innovation in more established companies. While some DIHs assist start-ups who are based on digital technologies, others support more mature companies with the development of new products and services that are not fully exploiting the digital opportunities yet.

Several DIHs are cluster organisations and have a role to lead the development of a priority area of the regional innovation strategy. They organise actors to identify needs and opportunities in their economic domain and deliberate activities related to industry needs. Other DIHs have been given a role to support all Smart Specialisation areas and enhance digitalisation of companies within these areas. This encompasses the support to cross-clustering / cross sectorial innovation in S3 to find new ways of integrating digitalisation in other more mature domains. It can also mean to identify needs for competence development and internationalization in order to help companies access other markets.

Matchmaking is a common DIH function, either directly by organising or by participating in events, or through information on the web. Additionally, some DIHs are developing networks of suppliers to team them up and enable them to take larger orders than they could do by themselves. There are also DIHs that aim at connecting actors so that they can provide better services or can form more competitive consortia for getting funds and organise digital innovation activities.

The DIHs work according to different business models. Some count with a base funding coming either from public funds (e.g. from European Regional Development Funds; from the H2020-based programmes for Digital Innovation Hubs or, more broadly, for the development of the ecosystem of innovation support to SMEs "INNOSUP"; from local, regional or national funds) or from membership fees. Others do not count with base funding coming from public budgets but can receive funding for the services related to providing the

DIH's digitation services. A concrete funding mix of public and private funding and a matrix of the different funding instruments for the digital transformation of SMEs are required for a DIH to remain financially sustainable.

Business models, target sectors, services provided, geographical scopes and focus vary across DIHs. At the same time, no region can provide all the resources needed for the digital transformation of all companies in their region, implying always a certain level of specialisation that prevents DIHs to have the relevant competences for clients with needs that differ from their specialisation. It is not always possible for a single Hub to get from its ecosystem all the relevant resources required for the digital transformation of the local industry, as in particular the SME needs range from new technological competencies to business model development or IPR advice. While in the long run this may require the Hub to further develop its competences and adjust its offer to those needs, the lack of adequate services could be eventually palliated by partnering with other DIHs – a type of collaboration the Commission aims at supporting with devoted initiatives. Also geographical unbalances in Europe (e.g. the fact that many Central and Eastern Europe Hubs are less developed) open up an opportunity window for collaboration between less and more advanced DIHs. As the DIH concept encompasses building up a network at European scale and there is a great interest in many regions, now is good time to engage in EU-wide activities and build up EU-wide links.

10 Cases

Baden-Wurttemberg (DE)

Baden-Württemberg (BW) [16] is in the southwest of the Federal Republic of Germany and has borders with France, Switzerland and within Germany with Bavaria, Rhineland-Palatinate and Hessen. The number of inhabitants is 10.9m and the surface area is 35.751 km^2. The capital city is Stuttgart. 4.8 % R&D Investment (2015) thereof 81.4 % private investment.

- EIPE composite index value of 80 out of 100.[17] BW is 4th ranked region in Europe, after Munich, London and Paris out of 1303 European NUTS 3 regions.
- RIS scoreboard 139[18], Stuttgart being ranked 18th of European regions (first one is Zurich with a score of 178)
- ERDF to TO1+TO2+TO3 (R&I, ICT and SME support): 215 m Euro[19]
- ERDF classification: More developed region

BW is composed of four NUTS2 districts: Stuttgart, Karlsruhe, Freiburg and Tübingen. According to the Regional Innovation Scoreboard 2017, two of the regions (Karlsruhe and Freiburg) are ranked as "Innovation Leader" and the other two (Stuttgart and Tübingen) as "Innovation Leader +". All four districts have outstanding performance in terms of expenditure on research and development. For instance, Stuttgart's BERD represents 216% of the European average. All four districts have excellent results in terms of EPO patent applications. For example, Tübingen's number of EPO patent applications amount to 183% of the European average. Karlsruhe's has an outstanding performance also regarding public-private co-publications (158% of the European level). The comparative results show that regions perform above the German and European averages for most of the indicators except in terms of SMEs collaboration.

The region has a long tradition of Strategic Innovation Policy, resulting in a closely tied net of innovation infrastructures and clusters. The research and technology policies are characterised by longstanding close co-operation of people and institutions from the science, business-enterprise and political sectors. The state government funds research in universities and in non-university research institutions, throughout a great diversity of fields, and with a focus on both breadth and depth. Establishing dialogue processes among the various stakeholders is an important element of Baden-Württemberg's economic and innovation policy.

Smart Specialisation

The Ministry has developed a strategy for the region ("Regional-Dialog"), which is implemented with the multiple players in the region. The innovation priorities in the region regarding the regional Smart Specialisation Strategy are related to the region's growth fields and efforts related to Key enabling technologies, see Figure 3, these include: [20]

- Aerospace;
- Biotechnology;
- Creative industry;
- Environmental technologies, renewable energies and & resource efficiency;
- ICT, Green IT, intelligent products, cloud computing, open source software, energy and resource efficiency, sustainable mobility and e-health;
- Health and care;

[16] Information obtained from the RIM monitor: https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/

[17] European ICT Poles of Excellence (EIPE) are geographical agglomerations of best performing Information and Communication Technologies production, R&D and innovation activities, located in the European Union, that exert a central role in global international networks. The EIPE Composite Indicator (EIPE CI), is composed of 42 individual indicators that covers ICT R&D, Innovation and Business activities. http://is.jrc.ec.europa.eu/pages/ISG/EIPE.html

[18] Information obtained from the Regional Innovation scoreboard 2017 that covers 220 regions across 22 EU countries, Norway, Serbia, and Switzerland. In addition, Cyprus, Estonia, Latvia, Lithuania, Luxembourg, and Malta are included at country level.: http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_sv

[19] Information obtained from the ESIF-viewer: http://s3platform.jrc.ec.europa.eu/esif-viewer

[20] Information obtained from the Eye@RIS3 database: http://s3platform.jrc.ec.europa.eu/map

— Logistics;

— Micro- and nanotechnology;

— Photonics;

— Sustainable mobility.

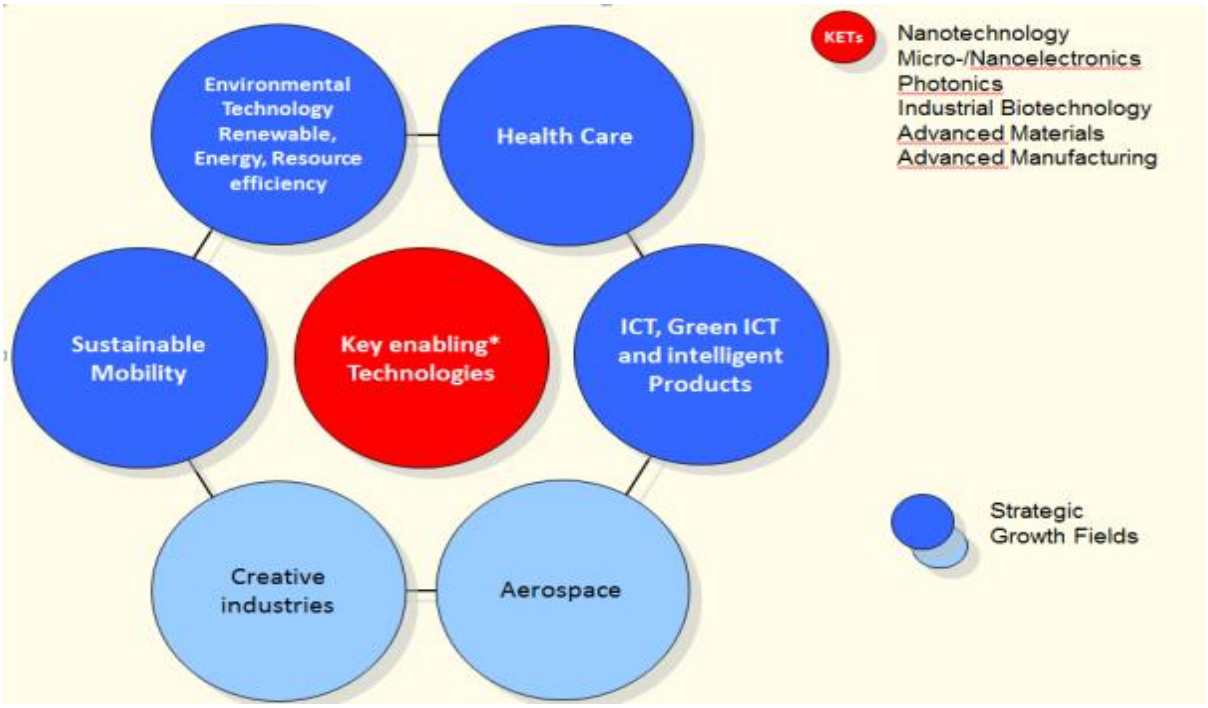

Figure 3: Baden Württemberg Smart Specialisation areas (source: DIH & S3 workshop presentation)

BW puts a high emphasis on different forms of stakeholder participation and carries out several dialogue processes to guide the different forms of research and innovation support activities of the region, something they call a dialogue oriented economic policy. This can be seen as the BW approach to Entrepreneurial Discovery Processes. There are i) high-level economic dialogues that are overarching the other dialogues, ii) sector dialogues, iii) thematic dialogues and iv) regional dialogues. Businesses, chamber of commerce, associations, trade unions, research organisations and municipalities participate in these dialogues.

Digital Innovation Hubs

In this region, many different Hubs are the outcome of various Initiatives:

— Hubs as a tool for technology transfer, individually initiated by various BW institutions of higher education, applied science and R&D-institutions

— DE-HUBs: network of 12 thematic Hubs aiming at international visibility, federal initiative (2016-17), regionally financed.

— Mittelstand 4.0-Competence Centres: federal initiative (2015), network of 20 (mostly) production-oriented Hubs

— BW Regional Hubs: current call for proposals, financed by region, aims at cross-sectoral working institutions addressing the needs of SMEs in their vicinity

In this report, the focus is on the Digital Innovation Hub Mittelstand 4.0-Kompetenzzentrum Stuttgart.[21]

[21] http://www.digitales-kompetenzzentrum-stuttgart.de and http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool/-/dih/1041/view

This is a technology transfer project established in 2016, which aims at information, demonstration, qualification and support of micro and macro projects regarding the implementation of digitalized processes and/or business models for SMEs. It is a consortium of associations (A) and research institutes (RI) hosted by Fraunhofer IAO. The partners include Fraunhofer (RI), FZI Karlsruhe (RI), Steinbeis (RI), VDMA (Mechanical Engineering Industry Association of Germany) (A), IHK (Chamber of Industry and Commerce) (A), BWHM (business development agency for craft trades and medium-sized companies) (A). The workshop participants brought up the mix of partners associations and research institutes in the consortium as a good practise.

It has a regional focus on businesses in Baden-Württemberg, having the competence centre two contact points in Stuttgart and Karlsruhe. It assists SMEs in effectively integrating digital applications in their value chain by offering information and practical training about technological, organizational and work-design related questions. SMEs can also apply for the mentoring of the implementation of their digitization project.

The DIH organises specific workshops and events for SMEs, open lab days and specific events in various demonstration labs and showcases, multi-channel PR strategy.

The main challenge of the Hub so far is to reach out to not-yet-involved SMEs, so they are testing many different forms of communication channels.

DIH and Smart Specialisation

The Mittelstand 4.0-Kompetenzzentrum Stuttgart did not participate in the development of the regional innovation policy and Smart Specialisation related strategies, as this was in place before the establishment of the DIH.

It does however participate in the continuous dialogue processes of BW, and provides input to their EDP, networking workshops under the auspices of the Ministry of Economics, Labour and Housing BW.

It is also implementing activities that are under the Smart Specialisation strategy framework. The Ministry in charge of the RIS3 try to support awareness in the Hub about opportunities and actively encourages the development of activities / projects / institutions supporting the RIS3 goals by all actors also drawing upon all possible funding sources (federal, regional, EU, private).

The partnership structure of the DIH is a way of seeing to that the DIH is relevant and meets the regional needs in providing DIH services that connect to RIS3.

The principal funding for the DIH comes from the Federal Ministry for Economic Affairs and Energy BMWi; funding priority “Mittelstand-Digital”, Initiative “Mittelstand 4.0”.

In order to achieve synergies, there are regular meetings and exchange between all competence centres and agencies within the initiative “Mittelstand 4.0”, a nationwide network of over 20 competence centres and agencies. There is collaboration on topics like Industry 4.0, IT Security, and development of business models for SMEs. There is also an overall management and PR support with a common PR strategy by a specific agency for project management (*Projektträger*) and accompanying research. The DIH representative thought as a good practise this support and networking among the centres and agencies involved, i.e. close coordination within professional the groups. However, it is a challenge to organise a synergetic and continuous collaboration of different Hubs and initiatives.

Wallonia (BE)

Wallonia (3.58m inhabitants in 2015) is one of the three regions of the Federal State of Belgium. The country also has three 'linguistic communities' (Flemish, French, and German). Each type of entity has specific and autonomous competencies with no hierarchy of powers, which, for R&D policy implies a complex multi-level governance system. Gross expenditure on R&D (GERD) in Wallonia in 2011 stood at b Euro 2.176, 2.51% of GDP. As regards business R&D in Wallonia, expenditures are concentrated in a small number of big companies. The importance of companies with more than 500 employees has increased over the period 2002-2009, and in 2009, this category of business financed more than half of business R&D expenditure (55.9%). There is a decline of traditional industrial sectors but progressive growth of innovative sectors and new specialisation (life science /health); and a high level of labour productivity and education but high level of (structural) unemployment.

- EIPE composite index value of 17 out of 100[22] for Arrondisment de Namur, capital of Wallonia, and of 21 for the whole region
- RIS scoreboard 106[23] (first one is Zurich with a score of 178)
- ERDF to TO1+TO2+TO3 (R&I, ICT and SME support): 202 m Euro[24]
- ERDF classification: Transition region (with Walloon Brabant, one of its five provinces, classified as More Competitive)

In the latest Regional Innovation Scoreboard (2017), Région Wallonne is a Strong Innovator, and innovation performance has increased over time. The region has relative strengths in Innovative SMEs collaborating, while public R&D expenditures are lower than EU average (this is related to the model of financing R&D, where a large amount of public financing expenditure, classified as business expenditure, goes to collective research centres while few R&D is directly performed in public owned research centres).

Smart Specialisation

Smart Specialisation Strategy (S3) in Wallonia has been a continuous process, with its origins in 2000. In 2000 up to 2010, there was a progressive development of the Regional Innovation Strategy called the Marshall Plan (2006-2009) and Marshall Plan 2.Green, where there was a focus on creation of business clusters and Competitive Poles (6 poles), with a mix of top-down and bottom-up approaches, for current landscape see **Error! Reference source not found.**.

In 2012 and 2013, the region was engaged in a peer review with the S3 platform and an OECD Innovation policy peer review, which provided input to the region and an evaluation of policies and a renewed industrial value chains analysis. This served as an input to the Marshall Plan 4.0 and Smart Specialisation Strategy (for 2015-2019). In these strategies there has been a consolidation of the regional industrial innovation policy and a translation into policy tools (New research and innovation Decree, Competitive Poles policy, Structural funds, Digital agenda.) and improvement of the policy mix. The Marshall Plan 4.0 includes sub strategies for Human capital, Industrial and innovation policy, Attractiveness, Energy and circular economy, Digital economy. Axis II, the most important for Smart Specialisation and the relation to Digital Innovation Hubs, is about the deepening of Smart Specialisation through Competitive Poles. It is a new RDI Strategy to support the growth of enterprises.

[22] European ICT Poles of Excellence (EIPE) are geographical agglomerations of best performing Information and Communication Technologies production, R&D and innovation activities, located in the European Union, that exert a central role in global international networks. The EIPE Composite Indicator (EIPE CI), is composed of 42 individual indicators that covers ICT R&D, Innovation and Business activities. http://is.jrc.ec.europa.eu/pages/ISG/EIPE.html

[23] Information obtained from the Regional Innovation scoreboard 2017 that covers 220 regions across 22 EU countries, Norway, Serbia, and Switzerland. In addition, Cyprus, Estonia, Latvia, Lithuania, Luxembourg, and Malta are included at country level.: http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_sv

[24] This information comes from the ESIF-viewer: http://s3platform.jrc.ec.europa.eu/esif-viewer

Figure 4: Walloon competitive poles and clusters (source: DIH & S3 workshop presentation)

This is done through efforts through clusters and competitive poles, directly to support SMEs, targeted efforts through the creative economy and high-potential SMEs, support to engage in H2020, internationalisation through collaboration in the Vanguard Initiative. There is also an effort to stimulate the emergence of new innovative value chains. The ambition is to build up a thorough support framework with an efficient policy mix.

Within the Digital Wallonia strategy, the Walloon government aims to enhance the regions competitiveness through efforts to improve broadband network coverage, to transform the business models of companies and reindustrialising Wallonia through digital technologies, and to raise digital skills through education and lifelong learning and to engage in Open Government approach and developing innovation using open data. The Digital agenda is also a horizontal priority of the cluster policy aiming at supporting clusters and industry.

Digital Innovation Hub

DIH Digital Wallonia[25] was established in 2015 with the objective to provide the support needed to companies to transform their activities following the principles of industry 4.0, as promoted by the Region (Marshall Plan 4.0). The Hub is a networked organisation, without formal structure, but the Agence du Numérique (Digital Wallonia), play a role of orchestrator of this landscape, but it builds upon the resources and efforts of different actors such as: clusters, research centres, training centres and professional federations. The DIH draws upon coherent mechanisms to support digital transformation and the creation of companies open to all sectors of the industry, e.g. business vouchers. The Walloon DIH covers 28 actions in an integrative framework for support according to the five dimensions of the Industry 4.0, accompaniment by the Walloon DIH.

The idea is to better structure the industry 4.0 ecosystem in Wallonia (as a means to implement the priorities of the Region in that domain) and that it will contribute to a better visibility of the actors involved in the digitization process. The DIH has a regional scope and is funded by regional funds and ERDF.

Services offered correspond to the level of digital maturity of the enterprise. They cover awareness activities, diagnosis of digital maturity, definition of a transformation plan and its implementation.. They also tackle needs for scale-up, finance and innovation. This initiative is open to all sectors of the industry.

[25] http://www.digitalwallonia.be/

Figure 5: Walloon policy mix (source: DIH & S3 workshop presentation)

Digital Innovation Hub and Smart Specialisation

Through the Digital Wallonia Strategy, the DIH is a part of the Marshal Plan 4.0 (theme 5). It provides regular feedback and Key Performance Indicators to the S3 (twice a year). The DIH is embedded in the S3 and its implementation and the DIH stakeholders and actions are embedded in the S3 policy mix. The S3 main stakeholders (clusters and research centres) are also integrated into several DIH programs.

The Digital Agency has a coordinating role of the process, but effective coordination is a challenge, as they draw upon other actors. They have specific funding to operators on a contract-based approach (Brand – Boost – Build); competitive calls limited to targeted audiences (e.g. clusters or Creative Hubs); open horizontal support measures for companies (vouchers); and W.IN.G, Wallonia Innovation and Growth, an equity platform for financing the growth of digital start-ups

The digital agenda is both a horizontal issue in cluster policies, focused efforts towards priority sectors of S3 and cluster organisations are also involved in Industry 4.0 actions. There are also efforts of cross-cluster collaboration: ICT-Infopôle cluster meets Competitive Clusters. There is also a strategy to support start-ups to feed the innovation dynamics in the clusters

Collaboration

Through the policy framework, there are quite a lot of different forms of collaboration going on, such as involvement of stakeholders in VI pilots, EU clusters collaboration projects (COSME, INNOSUP), INTERREG A, Partnership with French Tech, clusters as facilitator for collaboration, notably for SMEs

There are some challenges they perceive, such as little EU funding for cluster collaboration, as well as cross-sector/cross-cluster collaboration. There is a need to develop new financing solutions/mixes for interregional demonstration networks, and of a better articulation between regional strategy and EU policies.

Norte (PT)

The Northern Region of Portugal (regional capital: Porto) accounts for 23% of the country's total surface area and approximately 35% of the population, with 3,603,778 inhabitants (2016). The regional economy encompasses both traditional sector industries and medium and high-tech sectors such as automotive components, pharmaceuticals, machinery, precision and communication equipment and computers. Businesses are the main players regarding R&D activities in the region: 52.2% of the expenditure in R&D:

- EIPE composite index value of 16 out of 100 for Grande Porto.[26]
- RIS scoreboard 82 (first one is Zurich with a score of 178) [27]
- ERDF to TO1+TO2+TO3 (R&I, ICT and SME support): 2216 m Euro[28]
- ERDF classification: Less developed region

In the Regional Innovation Scoreboard 2017 (RIS 2017), Norte has been classified as a Moderate + Innovator region with an increase of the regional innovation performance over time. Norte has its relative strengths in non-R&D innovation expenditures and design applications (both higher relative to both Portugal and the EU), and SMEs introducing product/process innovations and SMEs innovating in-house (higher relative to the EU, like Portugal). The region's challenges lie in employment in medium-high/high-tech manufacturing and knowledge-intensive services, exports of medium-high/high-tech manufacturing, public-private co-publications and EPO patent applications.

Smart Specialisation

Launched at the end of 2012, the "Norte 2020" initiative was developed in the framework of EU's Europe 2020 growth strategy. It has been the basis to establish a regional action plan, a smart specialisation strategy (RIS3 Norte) and a new regional operational programme (ROP) for the period 2014-2020. The work carried out during the preparation of the smart specialisation strategy had significant involvement of relevant stakeholders and experts through the organisation of surveys, thematic workshops and individual meetings. The key principle guiding the process was to identify a limited number of priorities based on regional strengths and international competitiveness to which they would steer funding. They have aimed at fostering both inter regional linkages between innovation related stakeholders, also from different sectors, but also to international partners. The aim has been to support the adoption of a collaborative understanding of innovation in a quadruple helix sense.

It was the regional authority for the Norte region, CCDR-N, that has been responsible for the strategy development and implementation; but they have involved other actors in the development process, like the PRODUTECH cluster organisation. An important feature has been to connect to other regions, through joint cross-border activities with the Spanish region Galicia (a joint RIS3 strategy), and in the Vanguard initiative.

The following priority areas have been selected during the smart specialisation strategy development:

- Life and health sciences;
- Culture, design and fashion;
- Sea-related economic activities;
- Human capital and specialised services;
- Mobility and environment industries;
- Advanced manufacturing;
- Agriculture environmental systems and food;

[26] European ICT Poles of Excellence (EIPE) are geographical agglomerations of best performing Information and Communication Technologies production, R&D and innovation activities, located in the European Union, that exert a central role in global international networks. The EIPE Composite Indicator (EIPE CI), is composed of 42 individual indicators that covers ICT R&D, Innovation and Business activities. http://is.jrc.ec.europa.eu/pages/ISG/EIPE.html

[27] Information obtained from the Regional Innovation scoreboard 2017 that covers 220 regions across 22 EU countries, Norway, Serbia, and Switzerland. In addition, Cyprus, Estonia, Latvia, Lithuania, Luxembourg, and Malta are included at country level.: http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_sv

[28] This information comes from the ESIF-viewer: http://s3platform.jrc.ec.europa.eu/esif-viewer

— Symbolic capital, technology and tourism services.

Digital Innovation Hub

The focus in this report is on the two Digital Innovation Hubs related to the cluster organisation PRODUTECH,[29] which is coordinator for both. The two Hubs are called PRODUTECH Digital Innovation Hub Platform[30] and iMan Norte Hub.[31] The first one has a national scope and gathers regional initiatives, whereas the second one has a regional scope. PRODUTECH was established in 2008 and iMan in 2016. For the relation between the two DIHs, see Figure 6.

The mission of the PRODUTECH Digital Innovation Hub Platform's is to foster the digital transformation of the manufacturing industry, via the gathering of a critical mass of capacities, the networking of stakeholders and the nurturing of the ecosystem, towards the deployment of added value support services that enables, potentiates and furthers industry modernization.

PRODUTECH Cluster's DIH Platform gathers regional initiatives and stakeholders in a one-stop gateway for digitalisation support and further levering cooperation at European scale (e.g. networking of pilot initiatives and services under Vanguard Initiative).

The PRODUTECH Digital Innovation Hub Platform comprises Competence Centres and Labs, R&D organizations, Sectoral technology centres, Industry Associations, Production Technology Providers, leading users from the manufacturing industry, SMEs, Start-ups, Education/Training Centres and Incubators/Science parks and civic societies, and the articulation with National and Regional Authorities, Venture Capital organizations and public agencies.

As a support gateway for industry digitisation, this Hub gathers a comprehensive set of services ranging from visioning, strategy development and road mapping to the deployment of large scale initiatives in R&D and Innovation; from awareness actions to matchmaking (e.g. for maturity assessment, access to specialist expertise and infrastructures, solution deployment, advanced training, mentoring…); from visibility actions (national and international) to priority definition, exploitation of opportunities (innovation, integrated offers, solutions take-up, deployment and diffusion, cross-fertilization and business) and access to funding and financing.

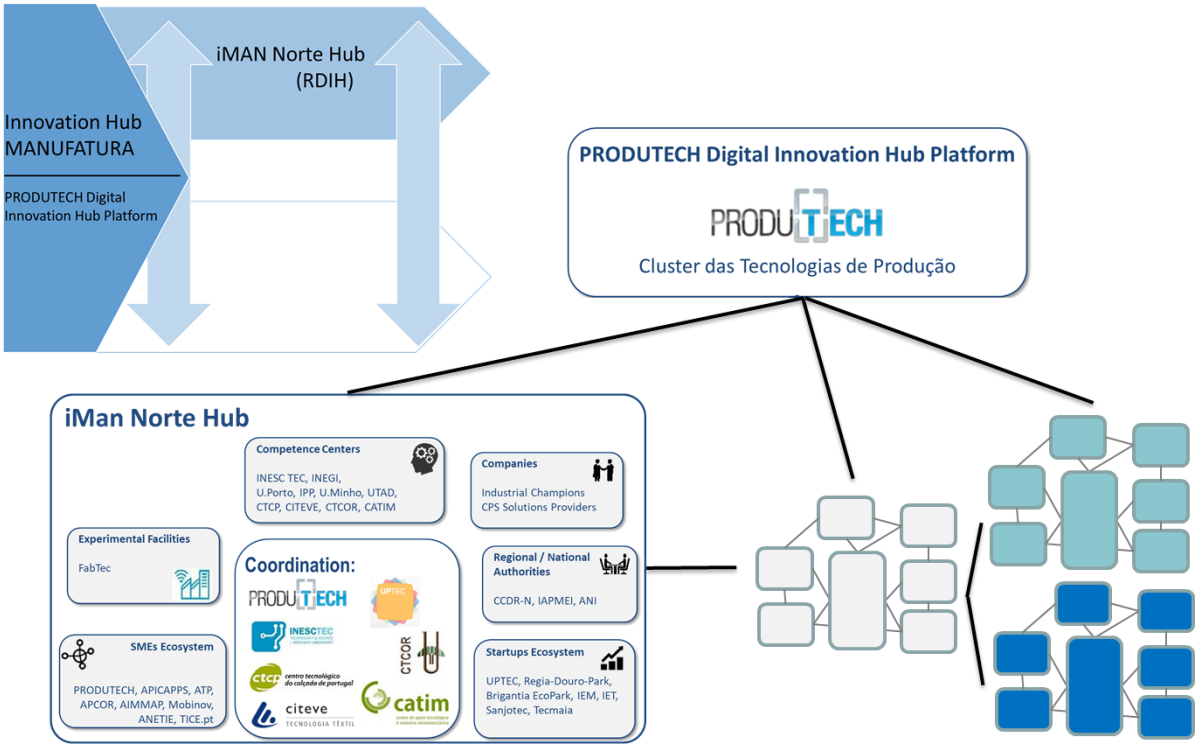

Figure 6: Relation between two PRODUTECH DIHs (source: DIH & S3 workshop presentation)

[29] http://www.produtech.org
[30] http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool/-/dih/1345/view
[31] http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool/-/dih/1535/view

PRODUTECH's base funding comes from membership fees and then different forms of funding sources to carry out different projects, such as European Regional Development Fund, national basic research funding, regional funding, private funding.

The mission of the Digital Innovation Hub for Customer-Driven Manufacturing @ Norte (iMan Norte Hub) is to foster the digital transformation of manufacturing companies in Region Norte and to nurture the innovation ecosystem; especially in the areas of cyber-physical production systems (CPPS) and robotics. The iMan Norte Hub organizes dissemination and matchmaking activities (workshops, open days, …), offers coaching and connection to funding sources, and promotes the services offered by its service providers group, such as research and development, feasibility studies, technology roadmaps, consultancy on technology selection and implementation, and training.

DIH and Smart Specialisation

PRODUTECH has participated in the regional S3 development and implementation, in surveys, thematic workshops and meetings that led to the definition of the Norte S3. After initial process they have provided continuous feedback via meetings, interviews (including with EC representatives). They see themselves to some extent as a think tank that provides input to both regional and national strategies, articulating industry needs in their domains, trying to provide feedback to policy processes to make these relevant. This stakeholder involvement process and articulation of industry need is the primary good practices expressed by the PRODUTECH DIH.

In implementation they are active through the promotion of capacitation, networks animation and other cross-cutting initiatives (within thematic domains and cross thematic), in the promotion of R&D and Innovation projects and support services.

PRODUTECH has also participated in the national S3 process, under the themes "Production Technologies and Product Industries" and "Production Technologies and Process Industries", among others.

They have also been involved in the Centro regions S3 process, in the definition, implementation and feedback in the setting up of the priorities under the thematic platform "Sustainable Industrial Solutions".

Good performance in Norte is partially due to a consistent and coherent approach towards S3 definition and implementation (which includes the interaction between DIH-Stakeholders-Programme Authorities). Also, to a comprehensive and consistent strategy in the DIH development, leveraging existent capacities, competencies and relational capital of the ecosystem, further exploring the regions' endowed and/or to be fostered potential, while supported in a cluster-based approach, strategy and intervention, that aims to leverage cooperation and outreach at European scale (e.g. networking of pilots and initiatives under Vanguard Initiative).

The challenges that the DIH is running into now is to overcome gaps and limitations within the framework of current instruments (considering all levels), in order to further leverage synergies and make projects happen. As an example, the projects run under the Vanguard initiative and the thematic Smart Specialisation Platforms have problems securing financing to make them happen. There is also a need to improve joint policy articulation and learning between actors at different policy levels, e.g. National, Inter-Regional at European level and EC.

The cluster/DIH is involved in a number of projects related to digitalisation and Smart specialisation on European level, e.g. they are partners in the two Vanguard Initiative working groups High Performance Production through 3D printing and Efficient and Sustainable Manufacturing; they are also part of the BEinCPPS project for Regional Manufacturing Digital Innovation Hubs; and EIT KICs.

Lombardy (IT)

Lombardy is a north-western region of Italy. It covers an area of about 23,864 km^2 and the inhabitants in the region amounted to app. 10m. It borders with Switzerland and with the Italian regions of Trentino-Alto Adige/Süd Tirol, Veneto, Emilia-Romagna and Piemonte. Lombardy is the most populated region in Italy, while Milan is the capital of the region, the second-largest city and the largest metropolitan area in Italy. The role of Lombardy in relation to the national RTDI effort is central, about 21% of the total Italian R&D investments are currently concentrated in the region, the expenditure for Research and Development (R&D) in Lombardy amounted to 1.33% of the GDP. The private R&D expenditure of Lombardy is 70.2%.

- EIPE composite index value of 59 out of 100, Milano ranked 14 in Europe.[32]
- RIS scoreboard 80[33] (first one is Zurich with a score of 178)
- ERDF to TO1+TO2+TO3 (R&I, ICT and SME support): 394 m Euro[34]
- ERDF classification: More developed region

According to the Regional Innovation Scoreboard 2017, Lombardy is a moderate innovator, with relative strengths in Product & process innovations and weaknesses in Public Sector R&D expenditures. Even if Lombardy is for sure one of the best performing region in Italy and in Europe, practically all the factors composing the RIS are deteriorating.

Smart Specialisation

Through the Smart Specialisation Strategy, the region aims to design an "integrated trajectory" for its development, with the identification of priority domains of greater potential, with existing resources/skills and innovative potential, on which it will concentrate its investments. For the programming period 2014-2020, the region concentrates its efforts on:

- synergistic interaction and inter-sectoral cooperation between entrepreneurial and research worlds (districts, clusters, networks, research centres) and across industries;
- use grand challenges and other demand-pull factors (e.g. active ageing, specialised health care) to anticipate societal needs and guide research and innovation efforts;
- foster innovation support conditions (in particular eco and social innovation);
- support internationalisation of regional actors and attract knowledge and investments;
- designing integrated action in the framework of smart cities.

Lombardy Region has built on previous programming periods experiences and used a combined top-down and bottom-up approach, which has resulted in the identification of 7 Specialisation Areas. These are:

- Aerospace
- Agri-food
- Eco-industry
- Creative and cultural industries
- Health industry
- Advanced manufacturing
- Sustainable mobility

[32] European ICT Poles of Excellence (EIPE) are geographical agglomerations of best performing Information and Communication Technologies production, R&D and innovation activities, located in the European Union, that exert a central role in global international networks. The EIPE Composite Indicator (EIPE CI), is composed of 42 individual indicators that covers ICT R&D, Innovation and Business activities. http://is.jrc.ec.europa.eu/pages/ISG/EIPE.html

[33] Information obtained from the Regional Innovation scoreboard 2017 that covers 220 regions across 22 EU countries, Norway, Serbia, and Switzerland. In addition, Cyprus, Estonia, Latvia, Lithuania, Luxembourg, and Malta are included at country level.: http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_sv

[34] This information comes from the ESIF-viewer: http://s3platform.jrc.ec.europa.eu/esif-viewer

In the Lombardy strategy there is an ambition to stimulate cross innovation between the different domains and their clusters and research centres of excellence, which they hope will support the emerging industries and transformation of the mature industry. As the manufacturing industry is very significant in Lombardy, the Region has made it the priority for its policies. And there is a strong interest in supporting the transformation process from mature into emerging industries.

Digital Innovation Hub

In this report the focus is on the Lombardy Intelligent Factory Association (AFIL).[35] It was founded in 2013 as a non-profit association by the university Politecnico Di Milano (POLIMI), ITIA-CNR, Consorzio INTELLIMECH and Innovhub, and then officially recognized in 2014 by the Lombardy Region as the technological cluster focused on Advanced manufacturing.[36] AFIL facilitates research and innovation in the manufacturing sector, by promoting best practices and enabling technologies, in order to foster connections between all key relevant regional stakeholders (competence centres, companies, users and suppliers, technology experts and investors) able to boost Industry 4.0 revolution and facilitating Lombardy SMEs access to EU-wide markets. Through this it aims to increase employment and competitiveness of Lombardy manufacturing industry. It has a regional focus but participates in European wide collaborative activities, through this they collaborate with more than 20 regions, within the topic of DIH the most active regions are Baden-Wurttemberg, Catalonia, Auvergne-Rhone Alpes, Norte (e.g. H2020 projects, such as BE-in-CPPS Regional Manufacturing Digital Innovation Hubs, with among others Norte (PT)).

The AFIL cluster aims to:

- establish a stable community connecting companies, universities, research institutions and associations, favouring cooperation by promoting R&I projects;
- support developing regional innovation strategies for the manufacturing sector;
- support the development of a R&I interregional network; through the national network and different European regions with similar interest in their smart specialisation strategy;
- be a one-stop-shop for the latest digital technologies for actors from anywhere in Europe.

AFIL aspires to be a one-stop-shop to the latest digital technologies accessible for any business across Europe. Taking into account the specific regional specializations and peculiarities, AFIL translate its value proposition into a comprehensive service offer that addresses the specific needs of the companies involved in the hub, summarized in the table in next page.

DIH and Smart Specialisation

AFIL has been officially recognized by the Lombardy Region as a counterpart for the implementation of RIS3, related to Advanced Manufacturing. Indeed, the cluster established a Road Mapping Group that gathers the input from AFIL members and translates them into guidelines for the update of RIS3. The Region highly relies on the AFIL and its activities to gather an understanding of companies' needs. AFIL supports the revision of the Lombardy Work Programme, where it involves its associates in working groups to understand real company needs mainly concerning Advanced Manufacturing. This activity has a strong impact on the regional funding design.

Digitalization is a key topic in the Advanced Manufacturing specialization area and is one of the ways to increase the regional economic development and the employment rate. AFIL is not only assisting with strategic guidance, but also provides DIH services that connect to the smart specialisation strategy. AFIL provides actions that support the usage and diffusion of ICT technologies to foster innovation in companies, in particular, with direct or indirect impact on SMEs.

AFIL is not directly financed as a DIH, but the cluster leverages on both private financing (members' fees) and public financing (H2020, INTERREG). In order to deal with the lack of funding, the association is looking for calls that offer financial support both to the DIHs and end users (i.e. INNOSUP, Open Calls, etc.). However, different funding sources can cause a challenge of fragmentation.

Funding opportunities coming from regional and EU level do not support the same DIH scheme. AFIL has had a challenge in aligning requirements from the national ministry and their schemes, with the requirements for

[35] http://www.afil.it/
[36] http://www.polimi.it/en/home

the European scheme of DIHs (e.g. I4MS, SAE). They perceive a need to better clarify the role of DIHs in the RIS3 and their relationship with all the already existing key actors in the innovation ecosystem. Also, funders need to clarify the eligibility of DIHs, i.e. to define criteria for being entitled and receive funding. Funding is a topic that needs to be addressed properly. DIHs need funding to operate the network, but according to AFIL most of the amount should be allocated to companies so that they can access the services offered for the adoption and exploitation of enabling technologies (i.e. INNOSUP, Open Calls, etc.).

SERVICE	SERVICE DESCRIPTION	SERVICE PROVIDER
Awareness creation	Workshops and events focused on specific themes in order to raise awareness on Industry4.0 technologies and related advantages.	AFIL, Competence centres
Training and education	Technical and management training in order to increase Industry 4.0. Training are not only addressed to the workforce, to be able to deal efficiently with the newly digitized products, processes or business models, but also to management, in order to overcome the cultural barriers	Competence centres, science and technology parks, industrial associations
Digital needs/maturity assessment	Company's needs and readiness assessment in relation to digital technologies, combined with a useful roadmap, feedback on the action to be perceived to increase their current status.	DIHs, Industrial Associations
Interactive demonstrations/access to infrastructures	Practical demonstration and technology testing in available infrastructures and demo lab.	Competence centres, experimental facilities/pilots
Matchmaking/Ecosystem building	Direct contact and physical events that bring stakeholders (e.g. digital IT SMEs, user SMEs, supply chains, investors, other regions) together to network, access information, share experiences, and/or tackle innovation-related problems.	AFIL
Accessing/overview on private and public funding	Monitoring of the available opportunities at a regional, national and/or European to help SMEs and start-ups to access funding to implement digital technologies	AFIL
Consultancy on technology implementation	Support companies on technology implementation, ensuring they targeted the right combination of digital technologies and digital services in their products.	Competence centres
Feasibility studies/best practices	Success stories of companies having successfully implemented digital technologies to show SMEs and start-ups how they can digitalize their processes, products or business models. According to this, AFIL initiated an Initiative "Cento4.0: the Excellence of Lombardy Intelligent Factory", to collect innovative industry 4.0 solutions developed or adopted by companies (www.cento4punto0.it).	AFIL, Competence centres
Mentoring	Once a successful experiment has been carried out, provide support on how to roll it out to the next level	AFIL, Competence centres, industrial associations
Project ideas support generation	Stimulation of the creation of new innovative networks through which members can develop project ideas. These ideas can either be presented through public calls or developed privately amongst the network members.	AFIL

Table 1: AFIL services and service providers (source: AFIL)

Lithuania (LT)

Lithuania is a country in the Baltic region of northern-eastern Europe. One of the three Baltic states, it is situated along the south-eastern shore of the Baltic Sea, to the east of Sweden and Denmark. It is bordered by Latvia to the north, Belarus to the east and south, Poland to the south, and Kaliningrad Oblast (a Russian exclave) to the southwest. Lithuania has an estimated population of 2.8 million people as of 2017, and its capital and largest city is Vilnius.

Traditional sectors form the backbone of the economy, and competitiveness still relies on the exploitation of cheaper factors of production and not on innovation-based growth. The Lithuanian R&I system is centralised when it comes to funding allocation and governance. R&I policies remain highly dependent on EU funds, which partly replaced national R&D funds at the end of the previous programming period (the share of the EU funds in GOVERD increased to 92.38% by 2013). R&I landscape is dominated by the public sector when it comes to both performance and funding. [37]

- EIPE composite index value of 11 out of 100 for Vilnius.[38]
- European Innovation scoreboard 79[39]
- ERDF to TO1+TO2+TO3 (R&I, ICT and SME support): 1460 m Euro[40]
- ERDF classification: Less developed region

Within the European Innovation Scoreboard Lithuania is ranked as a Moderate Innovator, with Relative strengths of the innovation system in an Innovation-friendly environment, Human resources, and Linkages and Relative weaknesses are in Sales impacts, Attractive research systems, and Intellectual assets.

DIH and Smart Specialisation[41]

The Lithuanian Government approved the programme on the implementation of the RDI priority areas and their priorities (Smart Specialisation Programme) in April 2014 and Action plans for implementation of the priorities in the first half of 2015. These documents cover the implementation of six priority areas and their twenty specialisations – specific priorities. Each priority area has had a roadmap and strategy developed through in-depth interaction with relevant stakeholders, see Figure below

The S3 is coordinated and monitored by the coordination group that consists of key stakeholders. Two institutions are responsible for monitoring and evaluation of the S3 – MOSTA and the Ministry of Economy. The Programme includes the possibility to modify priorities. The dialogue among all actors involved in the RIS3 design shall be continued in the strategy implementation phase. This includes dialogue with the teams/institutions that conducted the entrepreneurial discovery process (EDP) exercise, as well as actors involved in the management/implementation of the Operational Programme.

The six over-arching priority areas are:

- Agricultural innovations and food technologies
- Energy and sustainable environment
- New production processes, materials and technologies
- Health technologies and biotechnologies
- Transport, logistics and ICT
- Inclusive and creative society

[37] Information obtained from the Rio report on Lithuania: https://rio.jrc.ec.europa.eu/en/country-analysis/Lithuania/country-report

[38] European ICT Poles of Excellence (EIPE) are geographical agglomerations of best performing Information and Communication Technologies production, R&D and innovation activities, located in the European Union, that exert a central role in global international networks. The EIPE Composite Indicator (EIPE CI), is composed of 42 individual indicators that covers ICT R&D, Innovation and Business activities. http://is.jrc.ec.europa.eu/pages/ISG/EIPE.html

[39] Information obtained from the Euroepan Innovation scoreboard 2016 http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en

[40] This information comes from the ESIF-viewer: http://s3platform.jrc.ec.europa.eu/esif-viewer

[41] Information obtained from the Rio report on Lithuania: https://rio.jrc.ec.europa.eu/en/country-analysis/Lithuania/country-report

The objective of the smart specialisation strategy is to increase, through R&D and innovation (R&D&I) solutions, the impact of high added value, knowledge and high-skilled labour intensive economic activities on the country's GDP and structural economic changes.

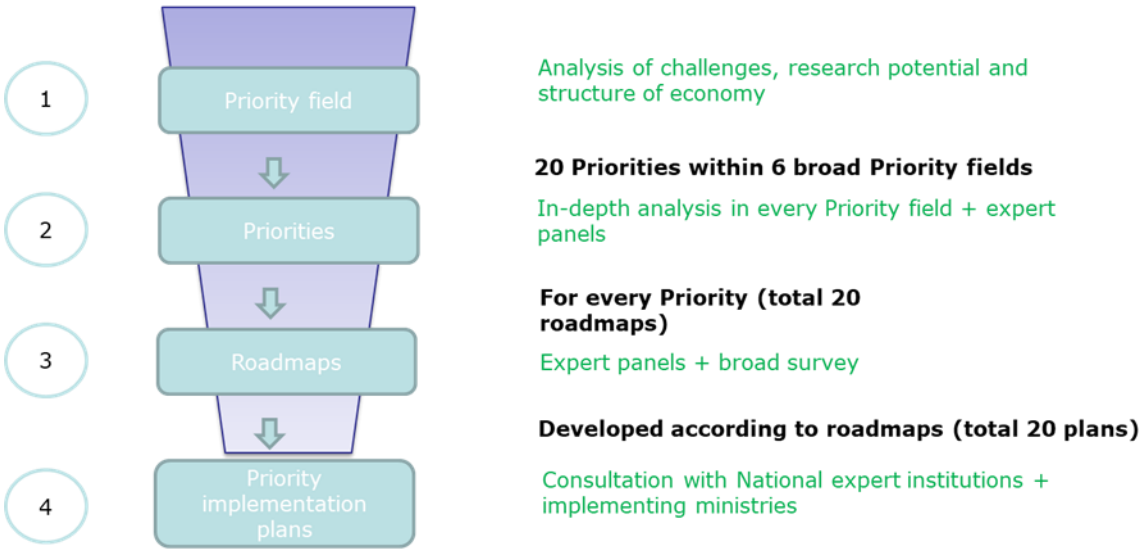

Figure 7: Lithuanian S3 priority process (source: DIH & S3 workshop presentation)

Digital Innovation Hub

In this report the focus is on the Advanced Manufacturing Digital Innovation Hub (AM-DIH),[42] which is hosted by the Engineering Industries Association of Lithuania (LINPRA).

The beginning of DIH development began in 2009, with the setting up of the VIPKC – virtual database of the R&D service providers and the engineering industry companies; and the initiation of the INTECHCENTRAS – smart manufacturing competence centre. At the same time, they also began to implement the Intelect and Innocluster projects, which has been the background of the two main service areas: i) field labs and ii) subcontracting services.

The mission of the DIH is to integrate Lithuanian ecosystem stakeholders, to increase the usage of digital technologies to increase the competitiveness of Lithuanian enterprises. It builds both on the bottom-up ecosystem of: SMEs/field labs, networks, cluster organisations, universities, R&D organisations, incubators/accelerators and start-up companies; and the partners/supporting organisations: large enterprises – partners, industry associations, economic development agencies, VET Educational institutions and national /regional governments.

To achieve its objectives the DIH provide:

- *Fieldlab Contracted Services*: Practical Digitization; Technology design / installation services; Demonstration, testing, production of prototype small quantities, including 3D printing methods; Testing of new functional materials for the engineering industry; Identification and harmonization of related and interactive activities; Collection and processing of data for statistical analysis of characteristics; Quality control of products, validation of produced batches, characterization; Safety tests and assessment of environmental and health impacts; the preparation of the technical documentation required for CE marking under the Machinery Directive; Finance attraction service / EU project preparation and initiation.
- *Consulting services*: Search for innovations; establishing the company's digital level and providing recommendations; Preparation of company's digital strategic plans and necessary investments; Training and consulting in the field of digitization and innovative technologies; Mediation between science and business and business and business; Studies.

The funding for the DIH comes from Horizon 2020, European Social Fund, COSME, National basic research funding, Private funding, Partner resources and Membership fees.

[42] http://www.manufuture.lt

The DIH is working in European networks to accelerate the technological levels of Lithuanian companies to aim for higher added value products and remain in the European chain of higher value-added products.

Challenges identified by the DIH include:

- How to consolidate the community and invest in common projects while community members act in their specific interest and are not fully aware of the value of common projects. The challenge – learning to maintain companies' independence while collaborating.
- Developing soft competences for DIH members.
- The creation of a self-assessment tool that would allow enterprise to prepare for digitization. The challenge – a lack of a common strategy for different approaches of all the companies.
- One-stop-shop principle and its management. Selling services to potential customers, maturing their need of services.

DIH and Smart Specialisation

The AM-DIH was actively involved from the beginning of the preparation of the Lithuanian Smart Specialisation strategy in 2012. Its experts, academia and business representatives, participated in working group activities that formed the S3.

It participated in developing a roadmap and setting priorities; prepared a report on the future production business environment describing possible directions of 4 technologies; prepared an R&D&I report and Lithuanian business experience; and in preparing the strategy plan to implement the priority area "Flexible technological systems of product creation and manufacturing". It has been part of developing the action plans, and in particular for the specific priorities of Photonic and laser technologies; Functional materials and coatings; Structural and composite materials; and Flexible technological systems for product creation and production.

Following the S3 strategy, companies were recommended to specialize in certain priority areas that are at the same time the key areas at the DIH. Therefore, companies submit applications according to DIH recommended directions. The DIH also organizes continuous activities with member companies: consultations and support to prepare R & D projects according the guide to the same priority. The DIH and RIS3 are directly and closely interacting. The feedback to the S3 is ongoing, through LINPRA, the DIH coordinator.

The DIH has been successful in different initiatives related to developing new technologies, development of staff skills (using Erasmus) and in collaboration with the German Innovation Centre Industry 4.0 raised staff skills in Industry 4.0; it has facilitated opportunities of international R&D projects and contributed to the smart specialisation strategy for engineering industries through strategic input and several studies.

South Moravia (CZ)

South Moravia Region has 1.1 m inhabitants and the main city Brno, and its metropolitan area is the second largest economic centre in the Czech Republic, the rest of the region includes predominantly rural areas with substantially less progressive economic structures. The region has many institutions and infrastructure supporting innovative businesses, with an important role played by the JIC (South Moravian Innovations Centre). The South Moravia region scores high in comparison with the EU but is pulled down in rankings as it is grouped with the Vysočina region. South Moravia is well above the EU average investing 3.8% of regional GDP into R&D (50% private). There are over 400 companies with their own R&D. In the last years 1700 jobs have been created in more than 100 technology start-ups. There has been over 10 million EUR invested in start-ups in the region through venture capital in the last 5 years and new R&D infrastructure thanks to structural funds (more than 700 million EUR)

- EIPE composite index value of 13 out of 100.[43]
- RIS scoreboard 82 (first one is Zurich with a score of 178) [44]
- ERDF to TO1+TO2+TO3 (R&I, ICT and SME support): 708 m Euro[45]
- ERDF classification: Less developed region

According to the Regional Innovation Scoreboard 2017, the region is ranked as a moderate + innovator with an innovation performance below the EU average. The massive development of large research infrastructures, business incubators and science-technology parks has, together with proactive regional innovation policy, caused the gradual enhancement of the innovation performance. Several indicators score above the EU average, such as public R&D expenditures and private R&D expenditure, design applications and employment in high-tech sectors and export of these products. These strengths arise from a specific mix of regional universities and innovation firms on the one hand, and the proactive innovation environment encouraged by the activity of the regional government on the other hand. On other indicators the region lags behind the EU average on EPO patent applications, although many innovation firms including research centres of multinational companies are located in the region.

Smart Specialisation

The regional RIS3 is part of the National Smart Specialisation Strategy (RIS3). The National RIS3 was prepared under the responsibility of the Ministry of Education, Youth and Sports in co-operation with the representatives of the operational programmes, representatives of regions and institutions responsible for the management of research, development and innovations in the Czech Republic and entrepreneurs. During the process, the leading role for RIS3 was overtaken by the Office of the Government that remains responsible for the RIS3 agenda until now. The preparation of the RIS3 was coordinated by the National Coordination Council for Smart Specialisation (RIS3 National Coordination Council) while the implementation of the RIS3 is the responsibility of the Government notably the RIS3 Management Committee. The RIS3 National Manager chairs the RIS3 Management Committee and is responsible for managing and coordinating the RIS3. To support the activities of the RIS3 National Manager, an analytical team has been established. Regional RIS3 managers are part of the analytical team of the RIS3 manager. In practice the processes have been less straightforward. The National RIS3 has 14 regional annexes for all the Czech NUTS III regions. The quality of the regions RIS3 differs significantly. In the case of South Moravia, their first innovation strategy was published in 2001 – earlier than any similar effort at the national level. In South Moravia, the RIS JMK Steering Committee is responsible for overseeing the implementation of the RIS3 and its design and implementation is led by the South Moravian Innovation Centre (JIC), supported by four permanent Working Groups composed of representatives of business sector, academia and public sector. DIH is a project that has been approved by both the Working group and the Steering committee and has got funding for 3 years.

[43] European ICT Poles of Excellence (EIPE) are geographical agglomerations of best performing Information and Communication Technologies production, R&D and innovation activities, located in the European Union, that exert a central role in global international networks. The EIPE Composite Indicator (EIPE CI), is composed of 42 individual indicators that covers ICT R&D, Innovation and Business activities. http://is.jrc.ec.europa.eu/pages/ISG/EIPE.html

[44] Information obtained from the Regional Innovation scoreboard 2017 that covers 220 regions across 22 EU countries, Norway, Serbia, and Switzerland. In addition, Cyprus, Estonia, Latvia, Lithuania, Luxembourg, and Malta are included at country level.: http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_sv

[45] Information obtained from the ESIF-viewer: http://s3platform.jrc.ec.europa.eu/esif-viewer

The JIC has a central role in South Moravian innovation system; its mission is to facilitate collaboration between businesses and businesses with academia, support new start-ups, help companies grow and innovate and to nurture the innovation ecosystem.

South Moravia region is often quoted as an exception to the rule by Czech standards, a region representing the national role-model of regional innovation policy with a clearly defined governance model, implementation structures and a functional partnership between public sector, academia and industry.

South Moravia focuses on a number of application sectors like Advanced production and manufacturing technologies; precision and scientific instruments; SW and HW development, cognitronics and cybersecurity; Pharma, medical care and diagnostic; and technologies for aerospace, drawing on different generic knowledge domains New production processes, materials and technologies: photonic and laser technologies; functional materials and coatings; structural and composite materials; flexible technological systems for product development and fabrication.

Out of this process has come that Industry 4.0 and IoT are important areas in the region, which they partly will address through a DIH.

Digital innovation Hub

The South-Moravian Digital Manufacturing Hub is coordinated by the South Moravian Innovation Centre (JIC) and is a partnership with Brno University of Technology, the research institute INTEMAC Solutions and the Industry Cluster 4.0. It has a national scope of its activities. The DIH is run as a collaborative project, where the JIC acts as the facilitator of the project and as the interface with the regional government, Intemac provides methodology and expertise to the clients, Brno University of Technology also provide expertise and the Industry Cluster 4.0 provides competences in education of companies and expertise in needs analysis. The cluster also mobilise the industry interest.

DIGIMAT DIH provides a complex set of services, to meet the wide variety of needs in industry, but is builds upon a custom-made analysis of the company and its needs. It follows a process where consultants from Intemac (with academic and industry backgrounds). They make a need-analysis of the visited company and provide a first draft of solutions based on the needs analysis. Then there is a workshop where the company meets the expert and there is an opponent review that can propose changes, which then is reviewed by the client. The final proposition includes suggested changes, potential benefits and estimated costs of carrying it out. After this, if the company is interested the implementation of the changes starts. The first part of the process is free, where the implementation is charged for.

Digimat has been part of the European Commission training programme I4MS (ICT Innovation for Manufacturing SMEs) to support the European leadership in manufacturing through the adoption of ICT technologies.

DIH and Smart Specialisation

DIGIMAT was proposed by a group of academic partners and business representatives and subsequently presented and approved in the RIS Working group of Innovative companies. It is a tool to implement the strategy, a policy instrument addressing the knowledge gap of manufacturing SMEs and support the ICT upgrading of industry.

The DIH is represented – via a representative of Intemac – in RIS Working group of Innovative companies and as such provides a direct input to the regional smart specialisation strategy. Also other partners of the Hub are engaged in different forms in the RIS process, both the Working groups (Chamber of Commerce) and the Steering Committee (Brno University of Technology).

It is the first example of a Czech regional initiative aiming at practical implementation of an Industry 4.0 agenda for local manufacturing enterprises. It will help companies in South Moravia maintain and increase their competitive edge, through increased productivity due to lower labour costs / greater automation, lower inventory costs, lower maintenance costs and better asset utilisation, savings due to improved quality. The ambition is to provide a delivery mechanism for bringing digital technologies to manufacturing firms while creating a platform of all relevant partners. There is also a complementarity with the Czech national strategy for Industry 4.0.

To succeed with this the partners have decided that they need a complex, multidisciplinary approach. They decided to create a platform that can provide customised solutions to a wide spectrum of problems faced by a diverse group of companies, small and large, across several manufacturing sectors. They have pin-pointed a

need to be able to reach SMEs (with awareness raising and support in implementing existing solutions), as well as work with established, larger firms (need to respond to the new digital technologies early enough, be early adopters, ready to accept new standards etc.).

The platform approach can support match-making between, expertise that exists in the different departments and faculties of Brno University of Technology and the companies in South Moravia. And one positive outcome of the project has been better collaboration between project partners.

They were familiar with each other before but had not collaborated in a structured way. They all agreed on the need to work on ICT and digitalisation. In the beginning, there was a discussion in the RIS3 working group on research and innovation. The companies were sceptic to have a generic approach. They doubted it could serve all companies and their needs. Despite this they decided to have ago at it. Now they have a generic diagnostic approach, with the aim of being able to provide specific solutions that are relevant.

In designing the DIH they have run an initial test with three companies, from this they learned that they need to be selective in whom to support, so that they can take on suggestions for change, for this they need to have a certain level of know-how and focus to motivate the effort.

Catalonia (ES)

Catalonia is located in the northwest of Spain and occupies a territory of 32,107 km^2. Catalonia has 7.4 m inhabitants, the second most populated region in Spain. Catalonia's economy is based on a long-standing industrial tradition, which has experienced a progressive transition to a new economic model. For instance, in the metropolitan area of Barcelona there is a dense and innovative industrial community of SMEs and an active presence of large multinationals, particularly in the biomedical, agro-food, automobile and telecommunication sectors. In addition, Catalonia has a long tradition of scientific research. It currently stands out in the bioscience field, although all fields of research are represented in Catalonia to some degree, both in the generation of knowledge and in its application. In 2015, the R&D expenditure reached €3.1b, this represents 1.5% of the regional gross domestic product (GDP); private companies have contributed 57% of the total expenditures. In 2015 there were 3,798 companies that performed innovative activities in the region. The region has a strong industrial tradition and industrial base, highly diversified and internationalised, with a strong cluster tradition. There is a strong R&D system. However, the research system has financial difficulties; there are many companies (SMEs) with difficulties to compete in the global market; high unemployment rate and a low tradition of cooperation between the R&D system and the business fabric.

- EIPE composite index value of 39 out of 100 for Barcelona.[46]
- RIS scoreboard 91[47] (first one is Zurich with a score of 178)
- ERDF to TO1+TO2+TO3 (R&I, ICT and SME support): 1174 m Euro[48]
- ERDF classification: More developed region

According to the Regional Innovation Scoreboard 2017, Catalonia is ranked as a "Moderate + Innovator", but its innovation performance has been decreasing. The region has its relative strengths in the following indicators: Tertiary education, International scientific co-publications, Most-cited scientific publications, Public-private co-publications, Trademark applications, Design applications, Employment in medium-high-tech (MHT) manufacturing and KIS services, Exports of MHT manufacturing and Sales new-to-market/firm innovations. The weaknesses are related to non-R&D innovation expenditures; Innovative SMEs collaborating with others, EPO patent applications, R&D expenditures business sector, SMEs introducing Product/process innovations and Marketing/organisational innovations.

Smart Specialisation

In 2013, Catalonia began the work to designing its smart specialisation strategy (RIS3 CAT) based on its specific strengths and with a focus on activities with high levels of innovation and added value. The RIS3CAT has four strategic objectives and a goal of internationalisation:

- improving the efficiency of production processes,
- reorienting companies towards segments of greater added value
- promoting new economic activities.

The RIS3CAT focuses on seven priority domains:

- Agri-food industry and other
- Energy and Natural Resources
- Industrial systems;
- Design-based industries;
- Industries based on sustainable mobility;

[46] European ICT Poles of Excellence (EIPE) are geographical agglomerations of best performing Information and Communication Technologies production, R&D and innovation activities, located in the European Union, that exert a central role in global international networks. The EIPE Composite Indicator (EIPE CI), is composed of 42 individual indicators that covers ICT R&D, Innovation and Business activities. http://is.jrc.ec.europa.eu/pages/ISG/EIPE.html

[47] Information obtained from the Regional Innovation scoreboard 2017 that covers 220 regions across 22 EU countries, Norway, Serbia, and Switzerland. In addition, Cyprus, Estonia, Latvia, Lithuania, Luxembourg, and Malta are included at country level.: http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_sv

[48] Information obtained from the ESIF-viewer: http://s3platform.jrc.ec.europa.eu/esif-viewer

— Health industries;

— Cultural and experience-based industries.

The main challenge for the RIS3CAT is to transform knowledge and technology into economic and social value.

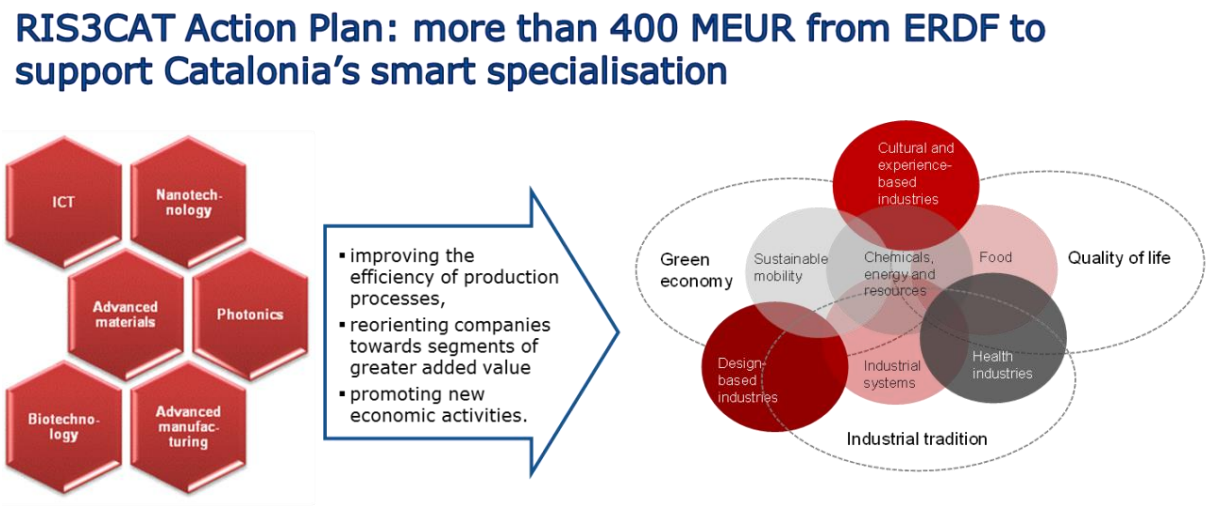

Figure 8: RIS3CAT Action Plan in a nutshell (source: DIH & S3 workshop presentation)

In Catalonia, Digital Innovation Hubs are considered as a regional ecosystem of diverse and multiple stakeholders or is it an articulated structure with a mission and providing a catalogue of digital services. Their definition is an ecosystem with multiple stakeholders contributing to improve the competitiveness of the Catalan economy through digital technologies. Many of these stakeholders participate actively in the RIS3CAT (in the definition, the implementation though the different instruments, the monitoring, the revision through public consultations, etc.), which is being implemented through an EDP.

Through DIHs, companies have access to specialized support to understand how digital technologies affect them, and how to define and implement their digital transformation plan. The core elements of DIHs are the competence centres, which act as connectors of all the regional agents involved. These are spaces for training and experimentation in digital technologies for companies. The other agents of the DIH focus on intangible infrastructure, aimed at offering business services, both for technological advice and for financing. SMEs, large companies, emerging companies, accelerators, investors and researchers are also part of the DIH.

Many of these stakeholders participate also in European DIH efforts (there are 21 Catalan actors listed as DIHs in the DIH catalogue[49]) actively collaborating with European partners. The multiple initiatives existing in Catalonia around DIHs are financed by own funds, by ERDF (under the RIS3CAT) and by Horizon2020.

The challenge in Catalonia is not about how to finance or design the services, which are already being provided by many diverse entities. The challenge is how to visualise the multiple initiatives and services provided as a first step to promote synergies and easy access to all kind of companies.

The Catalan DIH (DIH-CAT) will have a common coordination structure (see Figure 1) to facilitate that stakeholders work in a network, to provide a *one*-stop-*shop* for industry and also to provide showrooms for technologies developed in Catalonia. This structure would be financed by ERDF (50 %) and by own funds of the entities participating.

Because of the multiple initiatives and stakeholders, it is necessary to have a comprehensive mapping of the regional DIH ecosystems. Based on this mapping it will be possible to define a complete catalogue of capacities and services and to promote synergies (in the region and with other regions). The EU Catalogue is a first step to help them with this. Also employing open data analytics and visualisation tools can support the elaboration of dynamic DIH maps, showing networks of collaboration among the multiple stakeholders, catalogues of services, funding opportunities, best practices, etc.

[49] http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool

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List of figures and tables

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