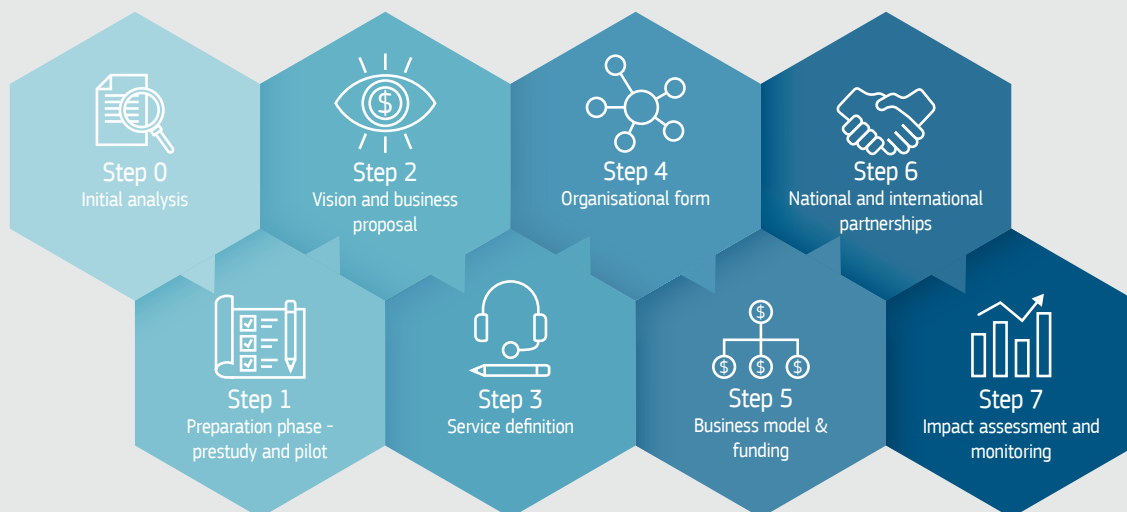




JRC SCIENCE FOR POLICY REPORT

DIGITAL INNOVATION HUBS AS POLICY INSTRUMENTS TO BOOST DIGITALISATION OF SMES

A PRACTICAL HANDBOOK & GOOD PRACTICES
FOR REGIONAL/NATIONAL POLICY MAKERS
AND DIH MANAGERS



Authors: Kalpaka A., Sörvik J., Tasigiorgou A.
Editors: Kalpaka A., Rissola G.

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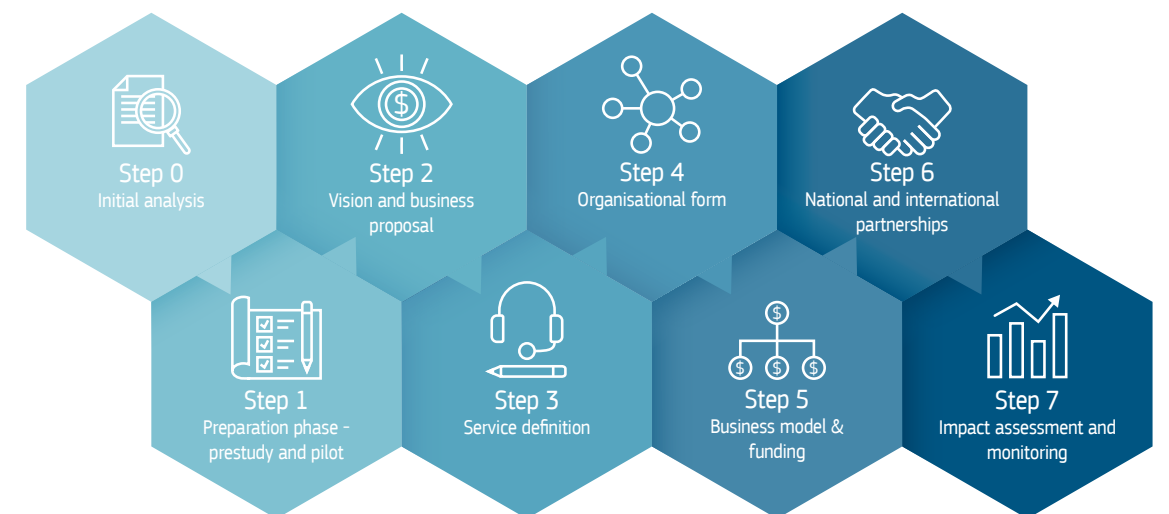
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DIGITAL INNOVATION HUBS AS POLICY INSTRUMENTS TO BOOST DIGITALISATION OF SMES

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Abstract

Building upon the knowledge gained during the last two years on how Digital Innovation Hubs (DIHs) operate in different regional socioeconomic contexts this practical handbook aims to provide national/regional policy makers and/or existing DIH managers useful and structured information on how to setup a new DIH or reinforce existing ones while benefiting from available funds with a special focus to the European Regional Development Fund (ERDF) 2021-2027. Given the urgent need of SMEs to rapidly deploy advanced digital technologies to mitigate the negative consequences of the recent COVID19 crisis to their businesses the role of DIHs is more important than ever. The Handbook introduces a step-by-step approach to provide support to policy makers that envisage strengthening DIHs in their regions/countries with a view to accelerate digital transformation of the economy and society. This approach allows to use the Handbook as a reference tool depending on the specific needs and level of implementation of DIHs. The practical character of the Handbook is enhanced with the inclusion of many examples that highlight good practices in the different steps of the proposed methodology.

Foreword

Over the last couple of months, Europe has faced one of its greatest challenges ever. Our economies have entered into recessions worse than the financial crisis of 2008 or indeed any recession since 1945. However, the economic impact of the confinement would have been much worse if it had not been for all the digital technology, which allowed many people to work from home. Indeed, while many parts of the economy shut down, some other parts continued unperturbed or thrived. As a rule of thumb, the more digital a business was before the pandemic struck, the better it fared.

The crisis made it very clear that we need to invest further in the digitalization of companies and public sector organisations. Through the Digital Europe Programme (DEP) and European Regional Development Funds (ERDF), important amounts of funding are foreseen to strengthen a network of European Digital Innovation Hubs (EDIH) that will geographically cover the whole territory of Europe. Each Digital Innovation Hub (DIH) will be at working distance of their stakeholders, speak their language, and will help organisations to become more performant by improving their business/production processes, products (and services) through digital technology.

In the coming months, the European Commission, Member States and their Regions are going to select the entities that are part of this network, and it is expected that the network will be operational by summer 2021.

The aim of this Handbook is to provide practical guidance, a step-by-step approach to regional or national policy makers on how to set-up a new or reinforce an existing DIH, while paying attention to matching the objectives and capacities of the supported DIHs with the priorities of regional Smart Specialisation strategies (RIS3). From a regional policymaker's perspective, investing in DIHs is investing in increasing the regional capacities for digital innovation and transformation of regional industry, public sector and society.

We hope this handbook will be a useful resource for the selection and operation of the network of European Digital Innovation Hubs.



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Urban Policy
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Executive Summary

The importance of digitalisation and the benefits it can bring in the EU socioeconomic landscape has been extensively analysed and stressed also in view of the upcoming financial period 2021-2027. Very recently during the global crisis caused by the COVID19 pandemic we have witnessed an explosion in the use of many digital technologies and innovations that were able to help citizens and businesses mitigate the disruptions caused. The fast shift to “digital alternatives” helped resume virtually many important social and economic activities such as: teleworking, online education, eCommerce, administrative processes, keeping ourselves informed and communicating with others, even entertainment and cultural activities, to name but a few. Advanced digital technologies are being used for public health security purposes while advanced data analytics and AI technologies are providing important insights and evaluation of proposed treatments. It is a common perception that during this recent pandemic crisis countries and regions with a higher degree of digitalisation were better able to resume many of their socio-economic activities.

It is expected that in the new post-COVID19 era the digital uptake will further expand and societies and economies will be more than ever in need of policy initiatives that will help them accelerate their digital capacities in order to overcome the negative economic consequences of the crisis. SMEs, the backbone of the EU economy, will need to introduce new innovative ways of working, new business models and more innovative products. **Digital Innovation Hubs (DIHs)** having by definition the role to support SMEs in benefiting from advanced digital technologies (including Artificial Intelligence, Cybersecurity and digital skills) are very powerful policy tools for national/regional policy makers that search ways to support the recovery of their economies.

In this Handbook we aim to provide to national/regional policy makers and/or DIH managers useful and structured information on how to setup a new DIH or reinforce existing ones while benefiting from available funds (with a special focus on the European Regional Development Fund 2021-2027). We are at the brink of the new Cohesion Policy 2021-2027 aiming at a smarter and more sustainable Europe where innovation flourishes and digitalisation is considered as a powerful tool towards that direction. During the previous programming period more than 180 regions across the EU used the **Smart Specialisation (S3)** approach as a regional innovation concept identifying priority areas for regional development where research and innovation could be reinforced. The Strategies will be updated to reflect the current needs (also in relation to the COVID19 crisis) and to define the national/regional innovation framework in the new programming period. Digitalisation services provided by DIHs to SMEs in line with the smart specialisation regional/national priorities could benefit from funding by the new ERDF Operational Programs. DIHs with a more specific profile that will be funded by the new **Digital Europe Programme (DEP)** will be labelled as European DIHs (EDIHs)¹.

The Handbook starts with an overview that aims at helping the reader understand better the policy context and then presents a step-by-step approach easy to follow and/or use as a reference either in creating a new DIH or in identifying important areas that could be improved in an existing hub's operations. There is emphasis in the funding opportunities available during the upcoming financial period and the importance of achieving synergies between DIHs and national/regional Research and Innovation Strategies (RIS3). Special attention has been given to provide practical examples so in every step there are examples of DIHs across Europe that can serve as good practices in the respective areas.

¹ The information in this Handbook refers mostly to regional/national DIHs rather than European DIHs (EDIHs). For more specific and updated information on EDIHs the reader is invited to refer to EDIH Working Document in <https://europa.eu/!xM79uP>

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1 Overview

Context

Digital technologies are increasingly changing our lives, the way we work, shop, socialise, communicate, educate and entertain ourselves. **Digitalisation, as an innovation enabler, has a proven impact on economy and society by improving productivity, quality of life and boosting access to knowledge and public services.** New business models and employment patterns are emerging thanks to digital transformation. Digital technologies have the potential to reshape entire industries and value chains and to enable smaller, innovative and dynamic businesses to develop and bring faster to market innovative products and services, thus incrementing their competitiveness. Despite the progress, however, SMEs in the EU do not appear to reap all the benefits digitalisation has to offer when compared to larger enterprises and the level of digitalisation in European SMEs remains highly uneven per country, sector or size (Figure 1-1).

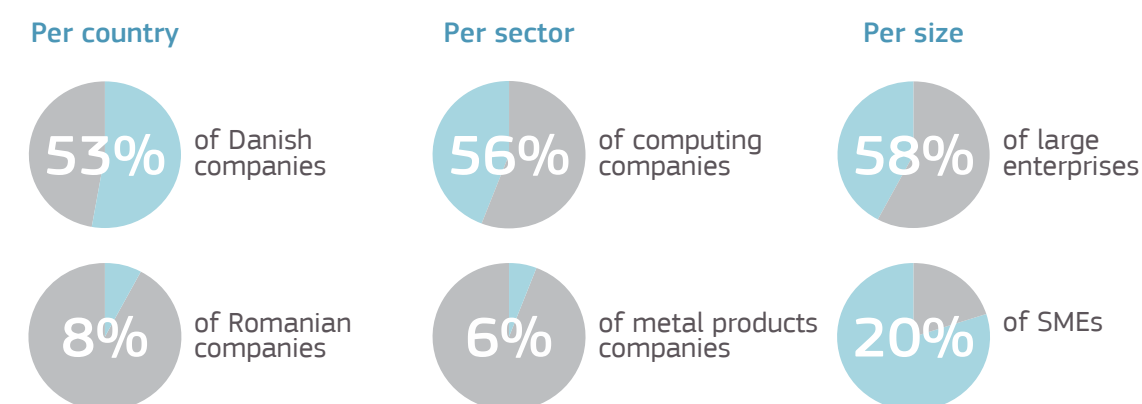


Figure 1-1: Highly uneven level of digitalisation in companies across Europe (Source: DESI, 2018)

In more recent political priorities (the so-called Green Deal) competitive sustainability has become Europe's guiding principle for the future. Only a thriving community of SMEs using digital technologies and data intensively can position Europe as a world leader with a globally competitive green digital economy. Moreover, the impact of digitalisation is territorially sensitive, and if implemented properly, has the potential to reduce disparities across EU regions and Member States. In that context the European Commission – first within the Digitising European Industry (DEI) Strategy (2016)² and more recently within the new European Industrial & Digital Strategies (2020)³ – is proposing new policy tools and initiatives with a special focus on **Digital Innovation Hubs (DIHs)** and encouraging the Member States to adopt and support them in order to accelerate the digital transition of SMEs and public sector in regional/national level.

² COM (2016) 180 final, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Digitising European Industry, Reaping the full benefits of a Digital Single Market.

³ European industrial strategy, <https://europa.eu/qD43rd>

What is a DIH and what it can do for SMEs?

Digital Innovation Hubs are **one-stop-shops** that help companies become more competitive with regard to their business/production processes, products or services using digital technologies, by providing access to technical expertise and experimentation, so that companies can “test before invest”. They also provide innovation services, such as financing advice, training and skills development that are needed for a successful digital transformation. Environmental issues will be considered, in particular regarding energy consumption and low carbon emissions. As proximity is considered crucial, they act as a *first regional point of contact*, a doorway, and strengthen the innovation ecosystem. A DIH is a *regional multi-partner cooperation* (including organisations such as *research and technology organisations [RTOs], universities, industry associations, chambers of commerce, incubators/accelerators, regional development agencies and vocational training institutes* (Figure 1-2)) and can also share strong connections with service providers outside of their region supporting companies with access to their services.

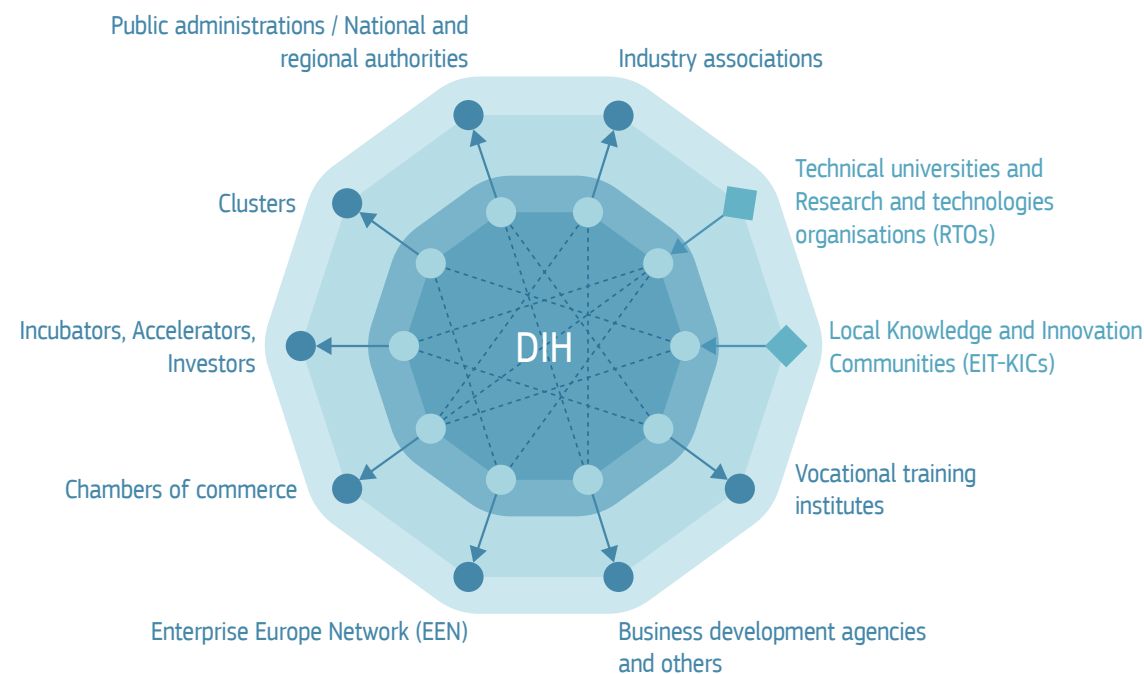


Figure 1-2: DIH ecosystem structure
(Source: Own elaboration)

The idea is that each DIH acts as the epicentre of a local/regional or even national **digital innovation ecosystem** able to provide access to services, facilities and expertise of a wide range of partners (Figure 1-3). The aim is to ensure that the individual customers (SMEs) or the public sector get the services they need; that the target regional market segments get access to innovative, scalable solutions and that DIHs cooperate with each other at regional, national and/or European level.

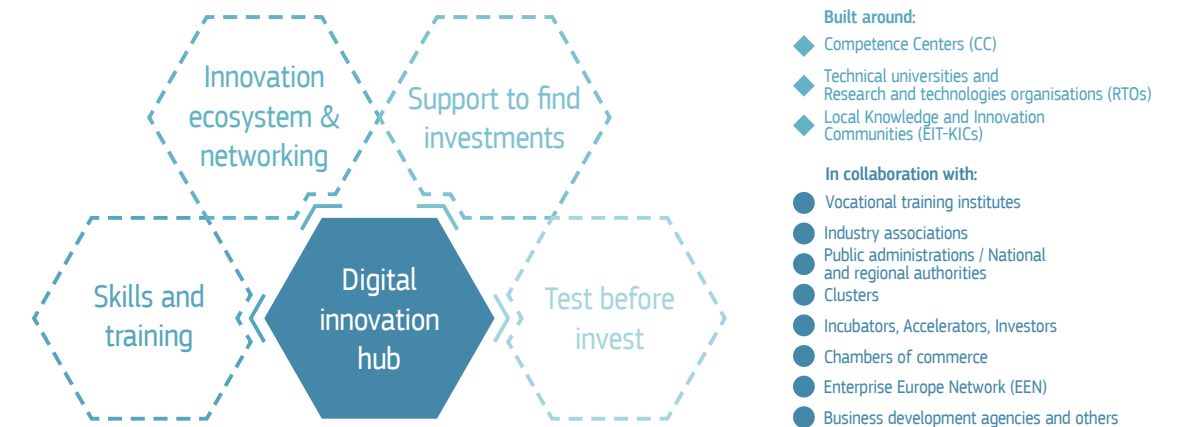


Figure 1-3: DIHs services and network collaborations
(Source: Own elaboration of DG CNECT scheme)

Some indicative examples of services offered to SMEs by DIHs are mentioned below:

- **Test before invest:** Experimentation with new digital technologies – software and hardware – to understand new opportunities and return on investments, also including demonstration facilities and piloting
- **Skills and training** to make the most of digital innovations: “train-the-trainer” programmes, boot-camps, traineeships, exchange of curricula and training material
- **Support to find investments:** access to financial institutions and investors, in order to get access to follow up finance to bring the results of testing and experimentation to the next phase, access to incubation & acceleration programmes
- **Innovation ecosystem and networking** opportunities through marketplaces and brokerage activities

Digital Innovation Hubs that will be funded by the new Digital Europe Programme (2021-2027) will get the label of European Digital Innovation Hubs (EDIHs). The main differences between DIHs and EDIHs are explained further in the Handbook. The information provided in this Handbook is relevant for all types of DIHs.

The new Cohesion Policy and Smart Specialisation for a smarter Europe

The new Cohesion Policy 2021-2027⁴ will continue its mission to strengthen EU's economic, social and territorial cohesion. Through the ERDF, ESF+ and Cohesion Fund it will support Member States and regions develop a smarter, greener, more inclusive and more connected Europe. Policy Objective 1 expresses the need to move towards *a more competitive and smarter Europe by promoting innovative and smart economic transformation*. In order to achieve that and make Europe smarter we need to reinforce research and innovation, digitalisation, SME competitiveness and skills. **Boosting Europe's competitiveness and building a stronger innovation capacity and more effective and faster innovation diffusion** across EU's Member States, requires strengthening national and regional innovation ecosystems.

Started in the financial period 2014-2020, the "**Smart Specialisation**"⁵ (S3) approach became the basis for research and innovation investments under the European Regional Development Fund (ERDF). The idea is that every region (or country for some Member States) builds upon its unique industrial and research strengths and potentials. Following a bottom-up approach and using the **entrepreneurial discovery process** (EDP), smart specialisation brings together local authorities, academia, business and civil society to design and implement long-term growth strategies in their regional innovation eco-system. More than 180 regional smart specialisation strategies (RIS3) have been developed to set a limited number of priorities with the most promising potential for competitive and innovative growth for the region or the country.

Smart specialisation also drives **interregional cooperation** in priorities of common growth potential for regions across borders such as: **Industrial Modernisation, Agri-food and Energy**. Facilitating cross-border collaboration between research, innovation and industry actors enables the development of products and process design, thus leading to new EU-wide value chains. To support this initiative the EC has setup thematic S3 platforms which currently support around 30 interregional partnerships bringing together policy makers, researchers, business, clusters and civil society in common priority areas⁶. For the 2021-2027 period, the Commission has proposed a dedicated instrument for "interregional innovation investments" with a budget of EUR 500 million.⁷

Member States and their respective regions have already invested ERDF funds during 2014-2020 towards smart specialisation, innovation and digitalisation. Smart specialisation will continue as the EU research and innovation (R&I) policy approach for territorial development for the upcoming period 2021-2027. Moreover, the good governance of national or regional smart specialisation strategies has been defined as the enabling condition for Policy Objective 1 under Cohesion Policy. Member States and regions will have to ensure that it remains fulfilled and respected, on the basis of seven fulfilment criteria, throughout the programming period in order to access funding from the ERDF. Regions will have to update their Research and Innovation Strategies (RIS3) to build upon what has been developed so far and design and implement improvements of regional and national innovation ecosystems that will be funded via ERDF. Interregional, cross-border cooperation in common smart specialisation priorities will be further reinforced. Special attention will be given in supporting regions in Industrial Transition with their efforts to diversify their economic activities to more innovative and sustainable areas.

4 "New Cohesion Policy", https://ec.europa.eu/regional_policy/en/2021_2027/

5 Smart Specialisation strategy, <https://s3platform.jrc.ec.europa.eu/what-is-smart-specialisation->

6 S3 Thematic Platforms, <https://s3platform.jrc.ec.europa.eu/thematic-platforms>

7 European territorial cooperation (Interreg) 2021-2027, EU Legislation in Progress 2021-2027 MFF, EPRS | European Parliamentary Research Service

DIHs synergies with Smart Specialisation Strategies (S3)

Smart specialisation strategies define regional/national priorities in areas where different knowledge fields, technologies, sectors and market niches cross each other. They focus efforts on a limited number of priority domains identified through a multi-stakeholder entrepreneurial discovery process (EDP), where stakeholders jointly identify and develop innovation agendas for the prioritised areas. Priorities may involve the application of ranges of technologies to specific societal and environmental challenges such as health, energy efficiency, security, ageing or mobility domains.

In many smart specialisation strategies across the EU, digitalisation is defined as a **horizontal priority** highlighting the impact of digital technologies on productivity growth and competitiveness of businesses across sectors and priorities. The new generation of digital technologies such as the Internet of Things (IoT), cloud computing, big data, artificial intelligence, automation and robotics, cybersecurity, blockchain, etc., are driving cross-sectoral innovation and can be instrumental also for regions in industrial transition.

In other cases, a **certain technology can be itself a regional priority** and the policy makers engage to support the development of the innovation ecosystem around this priority. It can also be a priority on an interregional level (i.e. Cybersecurity thematic partnership that focuses on interregional cooperation on Cybersecurity as a S3 common priority of EU regions⁸).

In any case, **digital innovation appears to be the most common denominator** of smart specialisation priorities in **regional/national and interregional/cross-border level**. Therefore, boosting digitalisation capacities in the regions is very important for implementing the strategies. **Businesses, in particular SMEs, want to benefit from these technologies and improve their innovation capabilities, but this is not always a very straightforward process.**

DIHs on the other hand have exactly that mission: to help companies (mainly start-ups, SMEs and mid-caps) to better understand and experiment on how digital technologies can improve their efficiency, effectiveness and product quality – in other words, their competitiveness. With regards to S3, DIHs can play an important role horizontally, **by providing digitalisation support to all sectors**, and vertically, by leading or taking part in processes of mobilising S3 stakeholders towards digital innovation or by supporting the specialisation of regions in digital priorities strategically set.

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.**

Very often, the specialisation areas of DIHs are in line with the smart specialisation priorities of a region. **Through the networking of DIHs, competences not available within a regional DIH may be found in another DIH based in different region or country.**

In addition, **DIHs can play several roles during the cycle of Smart Specialisation processes**; they can function as co-designers or advisors of smart specialisation, as a reference point providing information on both market and digitalisation matters, facilitating or orchestrating EDP activities, taking the lead role for development of priority areas, developing roadmaps, while they can also act as an implementation tool for policy objectives in providing digitalisation services.

8 European Cybervalleys Interregional Partnership, <https://s3platform.jrc.ec.europa.eu/cybersecurity>

More detailed information of interactions and synergies between DIHs and regional/national RIS3 with examples can be found in published JRC Technical Reports^{9 10 11} but also in other chapters of this Handbook.

ERDF 2021-2027 as a financial support mechanism for DIHs

As of 2021 the European Commission (EC) is proposing the following new elements under cohesion policy regarding digitising industry & DIH investments¹²:

- ✓ **Digital transformation as a horizontal factor in the next generation of Smart Specialisation Strategies** (either based on specific strengths or on needs for economic transformation)
- ✓ Comprehensive “smarter Europe” policy objective, allowing to combine innovation, digitalisation, SMEs support, entrepreneurship and S3 relevant skills actions
- ✓ More synergies and better-defined complementarities with other EU funding programmes incl. Horizon Europe, CEF and Digital Europe Programme
- ✓ Interregional cooperation to become “mainstream” including new interregional innovation investment instruments for project portfolios
- ✓ The following **four (4) investment areas** will be supported by the ERDF as specific objectives (SO) under the Smarter Europe policy objective:
 1. Enhancing research and innovation capacities and the uptake of advanced technologies
 2. Reaping the benefits of digitalisation for citizens, companies and governments
 3. Enhancing growth & competitiveness of SMEs
 4. Developing skills for smart specialisation, industrial transition and entrepreneurship

Investments under all specific objectives should be consistent with the smart specialisation strategy developed in line with the criteria of the enabling condition. Investments under specific objectives 1 and 4 should focus on the regional/national smart specialisation priority areas identified and developed in the entrepreneurial discovery process (EDP).

Policymakers will have to develop tailored policies and design actions that will contribute to the objectives mentioned above and are considered to be an investment priority under ERDF 2021-2027. There are several opportunities for funding DIHs and as illustration, some proposed actions, closely linked to DIHs under the four (4) investment areas, are mentioned below:

- Support the establishment of living labs, testbeds and eco-systems that bring together the demand and supply sides to promote the development and actual use of innovative solutions for public sector needs, i.e. in health care. (under **Specific Objective 1**)
- ICT uptake in SMEs; B2B, B2C; Customer to Customer, including infrastructures and services to support this (DIHs, etc) (under **Specific Objective 2**)

- Facilitating access to finance and advanced business services for SMEs (under **Specific Objective 3**)
- Specific training and reskilling for S3 areas at all levels within firms and building administrative capacity, with specific focus on digital skills and the need to address industrial transition (under **Specific Objective 4**)

Investment opportunities for DIHs and SMEs from ERDF 2021-2027 are always linked to the revised regional/national smart specialisation strategy and need to respect the scope of the ERDF as summarised below (Figure 1-4):

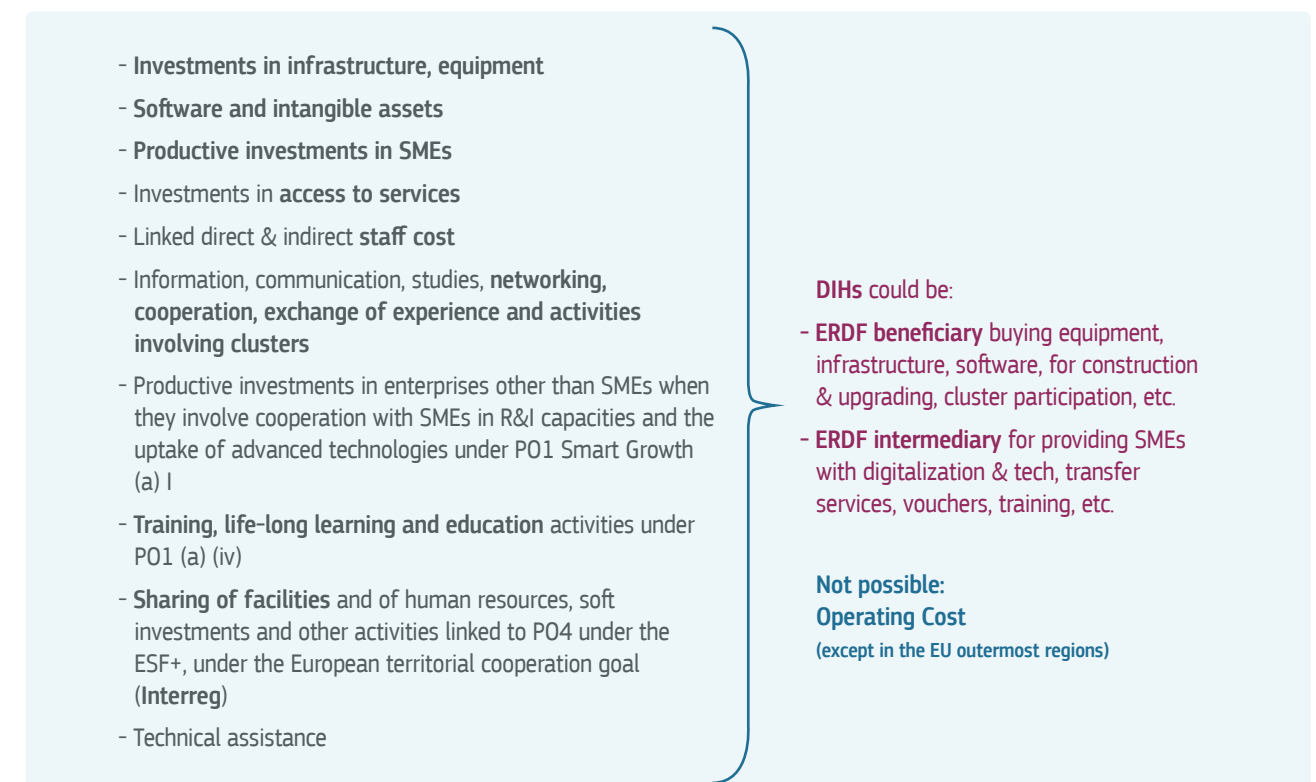


Figure 1-4: Scope of support for DIHs from the future ERDF (Source: Art. 4 ERDF/CF Regulation, Art 50 CPR and State aid rules on eligible costs)

⁹ Digital Innovation Hubs in Smart Specialisation Strategies, <https://europa.eu/Jp39Yf>

¹⁰ Exploring heterogeneous Digital Innovation Hubs in their context - Comparative case study of six (6) DIHs, <https://europa.eu/Mc39Fh>

¹¹ Putting Digital Innovation Hubs into Regional Context - A European survey, <https://europa.eu/fU97vM>

¹² See: Commission proposal for Common Provisions Regulation (CPR), ERDF & CF Regulation, Interreg, etc. <https://europa.eu/yp38PK>

European DIHs in Digital Europe Programme

The EC has proposed for 2021-2027 the Digital Europe Program (DEP)¹³ –with a proposed budget of 9.2 b€– and focus on investments in digital capacities mainly in the areas of **High Performance Computing (HPC), Cybersecurity and Artificial Intelligence (AI), related advanced digital skills** as well as **digital solutions / interoperability for the public sector**. DEP will increase the capacity of a selected number of DIHs (between 130 and 260 hubs in the EU, serving all NUTS 2 regions) to invest in facilities (hardware and software) and to employ more personnel to provide services to SMEs and the public sector. DEP will also invest in networking the hubs and promoting transfer of expertise. **DIHs funded by DEP will be called European Digital Innovation Hubs (EDIH)**. The initial network of EDIHs will be established from a list of hubs designated by Member States. EDIHs will be funded through a grant, where 50% will come from DEP and 50% from the Member States.

Characteristics of European DIHs in DEP¹⁴:

- **Focus:** support capacity building of hubs in all regions of Europe that can assist SMEs and the public sector with their digital transformation, including appropriate uptake of AI, HPC and Cybersecurity.
- **Investments:** The grants to the hubs can be used for investments in testing and experimentation facilities, including personnel offering related services. Member States can contribute in-kind or in-cash.
- **Selection:** Member States will first designate a list of DIHs they want to support. The EU will select European Digital Innovation Hubs from these lists, using a restricted Call for Proposals taking into account their individual quality and balancing regional, technological and application coverage in the network.
- **Specialisation:** Over time, EDIHs need to develop specialisation in applications and sectors that benefit strongly from the key digital technologies supported by Digital Europe - HPC, AI or cybersecurity:
 - Specialisation must correspond to the needs of the region and its smart specialisation strategy, and be based on existing strengths in the region
 - European DIHs might focus on a portfolio of services related to more than one application, sector, and technology – thus serving a range of RIS3 priority domains
 - Networking of EDIHs will allow specialised hubs to offer their competences and resources to others and, vice versa, to find missing expertise and facilities elsewhere in the network
- **Co-operation with Digital Europe Facilities and Specialist Centers:** EDIHs will closely collaborate with other centers funded under the different pillars of the Digital Europe Programme, and in particular the specialist centers on AI, HPC and Cybersecurity.
- **Skills development:** EDIHs will support skills development in collaboration with the actions under the “Digital Skills” pillar of the Digital Europe Programme, e.g. by rolling out short-term advanced digital skills training courses.

The figure below presents the technological focus and “universe” of an EDIH:

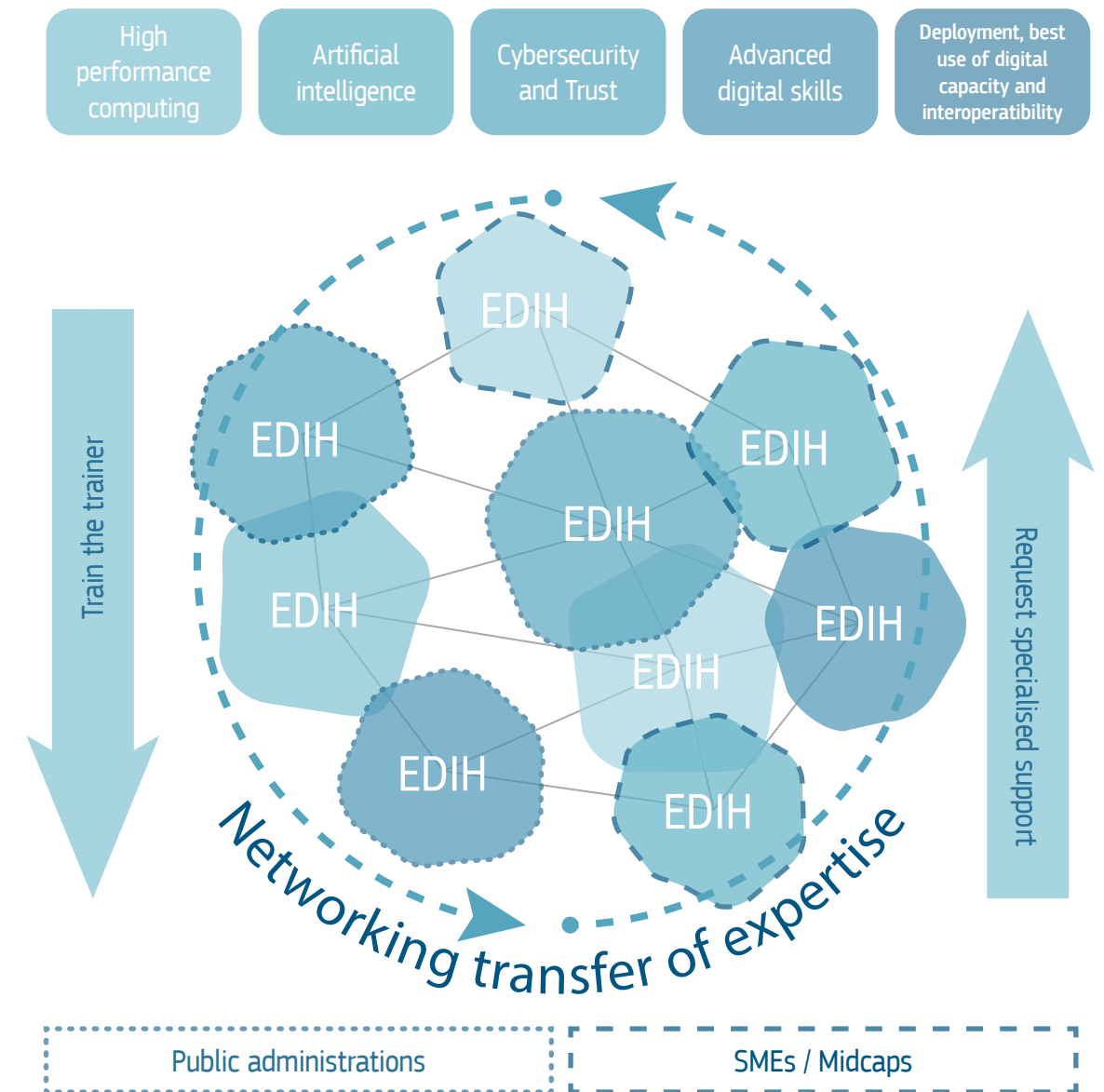


Figure 1-5: EDIHs' concept and technological focus (Source: Own elaboration from DG CNECT scheme)

The services provided by an EDIH to businesses and/or public sector are:

- test before invest,
- skills and training,
- support to find investment and
- innovation ecosystem building and networking.

¹³ <https://europa.eu/!GB77MG>

¹⁴ <https://ec.europa.eu/digital-single-market/en/digital-innovation-hubs>

Differences between DIH and EDIH

DIH	EDIH
Funded by H2020, ERDF (or other sources). In H2020 DIHs are funded to support SMEs with experimentation and testing of advanced digital technologies in their production process, products or business models. Under ERDF they are funded to provide services to help the local economy with its digital transformation.	In Digital Europe Programme a network of European DIHs (EDIHs) will be supported, covering all regions of Europe. To distinguish them from other DIHs, the label European DIH has been introduced. This programme will start in 2021. Investments are used for strengthening the capacity of the EDIH to deliver services locally, nationally and at a European level. All EDIHs will be 50% co-funded by Digital Europe Programme and 50% by national/regional funding sources, which can include ERDF.
From 2021, Horizon Europe will continue funding SMEs to experiment with advanced digital technologies, and ERDF will support DIHs to provide services that help the digitalisation of the local economy in line with the smart specialisation strategy.	Selection will take place in 2 steps: MS first designate their list of potential candidates. From these, the EC will select the EDIHs based on quality, relevance and geographical coverage.
DIHs may become EDIHs if they are selected to be part of the network supported through DEP.	The EDIH can support the digital transformation of SMEs or public sector organisations by delivering all 4 functions: Test before invest, Support to find investments, Ecosystem building and networking, Skills and Training. The hubs will be trained to include HPC, AI and Cybersecurity in their offer of services.
The DIH supports the digital transformation of SMEs. The specialisation/focus can involve any digital technology. The services are broadly defined.	-

(Source: EC DG CNECT)

Apart from the ERDF, services provided by DIHs can also be funded by Horizon Europe Programme, the Research and Innovation Framework Programme for the next financial period. It is foreseen to continue with activities started in H2020 directed towards companies that work together with DIHs to experiment and test with novel digital solutions to improve their businesses. Digitalisation initiatives will be also financed by InvestEU Programme that is currently used to mobilise public and private investments using the EU budget guarantee. It will be used to support digital transformation and especially in the technological areas of AI and blockchain.

Therefore, the funding opportunities for DIH/EDIH can be summarised in Figure 1-6:

ALLOCATED AT EUROPEAN LEVEL	
	<p>Horizon Europe:</p> <p>Support to SMEs and mid-caps to experiment with innovative digital technologies in a cross-border setting. European Digital Innovation Hubs and others may apply for these grants, and cascade a large part of the funding to SMEs.</p>
	<p>Digital Europe</p> <p>Support to the facilities and personnel of the European Digital Innovation Hubs. They will focus on broad roll-out of the digital innovations across SMEs and administrations.</p>
	<p>Invest EU</p> <p>Incentives and risk reduction programmes to help companies find follow-up investment to further complete their digital transformation. The work of the European Digital Innovation Hubs will diminish the knowledge gaps that exists</p>
ALLOCATED AT NATIONAL LEVEL	
	<p>European Regional Development Fund</p> <p>Investments allocated by the Member States to build-up or strengthen the Digital Innovation Hubs in their territories and reduce the digital divide. ERDF can be used by Member States to co-invest on EDIHs in Digital Europe</p>

Figure 1-6: Complementarity of funding programmes for DIHs
(Source: EC)

DIHs in the fight against COVID19

The fight against COVID19 requires innovative thinking and breakthrough technologies. In this context DIHs specialised in medical technologies and eHealth could be of great help to the regional/national health systems and industry's research efforts to provide better treatments and advances towards beating the virus. In the example below you will see how a specialised DIH in The Netherlands has responded timely to this health crisis with several initiatives aiming to support the health ecosystem during the fight against COVID19.



TechMed DIH¹⁵ (Netherlands) is a non-profit collaboration of partners, coordinated by the TechMed Centre of the University of Twente that stimulates the development and implementation of digital technologies to the healthcare sector.

Specialising in several digital technology sectors such as photonics, robotics, artificial intelligence, imaging, sensing and eHealth, TechMed DIH addresses the business needs of several clinical trial companies and other SMEs focusing in the healthcare sector supporting them to develop their business processes through technology and digital innovations. TechMed DIH brings together local and national SMEs with international companies thus promoting collaboration on digital technologies that aim to accelerate the development of the medical industry. With the Covid-19 situation and the concerns this has raised on a global level, the hub has taken several initiatives to fight the Corona crisis¹⁶ which has put huge pressure on hospitals and healthcare professionals having led to a shortage of medical supplies and equipment. TechMed DIH has taken a series of actions to cope with the situation ranging from fast training of care professionals to new solutions for the shortage in respiratory equipment.¹⁷ Indicatively, the hub has proposed to its collaborating hospitals to implement shared use of ventilation machines in emergency situations and only under very specific conditions in order to cope with a shortage of this equipment. In addition, medical professionals, such as medical assistants and specialists, who need further training on the immediate care of COVID-19 patients, receive targeted training courses by employees of the TechMed Simulation Centre.¹⁸

Other actions include the CHOIR initiative,¹⁹ a dedicated team of researchers assigned to help solve logistical problems in the healthcare sector caused by the corona pandemic, the Call for Robotics initiative²⁰ which aims at the production and stipulation of the right technology solutions to tackle the corona crisis, the Diving Masks initiative²¹ focused on the design and testing of a new type of ventilation mask as well as the Communication to young people,²² the VentilatorPAL Pro,²³ the Respirator Hood,²⁴ the Corona app,²⁵ and Air circulation initiatives.²⁶

How can this Handbook help me set up/reinforce a DIH?

The aim of this Handbook is to provide practical guidance to regional or national policy makers on how to set-up a new or reinforce existing Digital Innovation Hubs (DIH),²⁷ while paying attention to matching the objectives and capacities of the supported DIHs with the priorities of regional/national Smart Specialisation strategies (RIS3).²⁸ From a regional policymaker's perspective, investing in DIHs is investing in increasing the regional capacities for digital innovation and transformation of regional industry, public sector and society.

The Handbook aspires to be a comprehensive reference document for all EU regions' policy makers and a tool to support the European Commission's plans of enhancing digital transformation of businesses and society via the deployment of DIHs.

The handbook proposes a **step-by-step approach** on how to setup/reinforce DIHs. This approach should be seen as a management cycle, Figure 1-7, where in the case of a new hub the steps are taken consequently, but in the case of an existing one, this methodology could provide guidance on important missing steps.

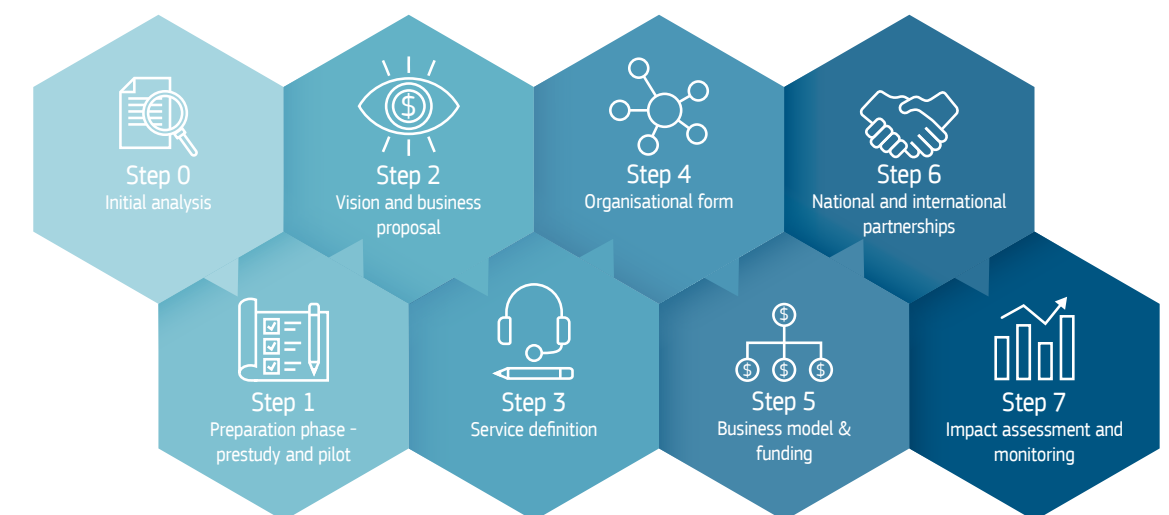


Figure 1-7: Setting up a DIH - Step-by-step approach

15 TechMed DIH Catalogue of DIHs profile, <https://europa.eu/Rn67Vc>, website: <https://www.utwente.nl/en/techmed/innovation/digital-innovation-hub/>

16 TechMed DIH's Fighting the Corona crisis initiatives, <https://www.utwente.nl/en/techmed/about/fighting-corona-crisis/>

17 Taskforce ventilation, <https://www.utwente.nl/en/techmed/about/fighting-corona-crisis/taskforce-ventilation/>

18 Scenario training courses, <https://www.utwente.nl/en/techmed/about/fighting-corona-crisis/scenario-training/>

19 CHOIR initiative, <https://www.utwente.nl/en/techmed/about/fighting-corona-crisis/choir/>

20 Call for Robotics, <https://www.utwente.nl/en/techmed/about/fighting-corona-crisis/call-robotics/>

21 Diving Masks initiative, <https://www.utwente.nl/en/techmed/about/fighting-corona-crisis/diving-masks/>

22 Communication to young people initiative, <https://www.utwente.nl/en/techmed/about/fighting-corona-crisis/communication-young-people/>

23 VentilatorPAL Pro initiative, <https://www.utwente.nl/en/techmed/about/fighting-corona-crisis/ventilatorpal-pro/>

24 Respirator Hood initiative, <https://www.utwente.nl/en/techmed/about/fighting-corona-crisis/respirator-hood/>

25 Corona app, <https://www.utwente.nl/en/techmed/about/fighting-corona-crisis/corona-app/>

26 Air circulation initiative, <https://www.utwente.nl/en/techmed/about/fighting-corona-crisis/air-circulation/>

27 Digital Innovation Hubs (DIHs) in Europe, <https://ec.europa.eu/digital-single-market/en/digital-innovation-hubs>

28 What is Smart Specialisation?, <https://s3platform.jrc.ec.europa.eu/what-is-smart-specialisation->

In a nutshell, the proposed steps are:

Step 0: Definition of regional needs and assets

This step consists of performing an initial analysis to identify if the regional needs for digital transformation in businesses/society justify investment in DIH. The regional/national smart specialisation strategy and its objectives in the area of digitalisation could be a very good starting point for this step.

Step 1: Preparation phase – pre-study and pilot

If the investment in a DIH is justified in the previous step, then a pre-study and pilot would help before taking final decisions. It consists of a pre-mapping of stakeholders to be involved, of a first estimation of resources needed, service offering, target groups, collaborations and partnerships, potential business model and initial vision. A pilot case (for example provision of experimentation services to an SME in the case of a pre-existing structure that can be reinforced to become a DIH) could provide some food for thought.

Step 2: Vision and business proposition

In this step important decisions on the identity of the hub should be taken: specialisations and relevance with smart specialisation priorities, technological focus (i.e. IoT, advanced manufacturing, AI, etc.), potential beneficiaries (SMEs, public sector, both), strategic partnership with other innovation actors, methods to communicate and reach out to beneficiaries, development of a vision.

Step 3: Service definitions

DIHs can provide services in four (4) main categories: i) test before invest, ii) skills and training, iii) support to find investment, iv) innovation ecosystem and networking. A separate category could be the provision of support to public sector, as it has different needs than businesses. In this phase, the DIH should identify the service offering from the above mentioned. This will also depend on the regional and the SMEs needs. The smart specialisation strategy and the defined priorities will be a good analytical input to help identify the needed services to facilitate digitalisation. Furthermore, pre-existing capacities and expertise of the structure to be reinforced should also be taken into consideration.

Step 4: Organisational form

There is no one-size-fits-all organisational model for a DIH. What is important is to be a non-profit organisation but the organisational form can vary from a 'single' organisation to a coordinated group of complementary organisations or it can be a virtual organisation or a multi-sided platform. In this step, the policymaker should decide which is the most effective and cost-efficient organisational model to use taking into account the pre-existing infrastructures.

Step 5: Business model and financing

In this step, all possible and feasible funding opportunities for the DIH should be considered. As mentioned earlier depending on the characteristics, focus and capacities of the hub different funding options can be considered: national/regional funds, ERDF, Horizon Europe, DEP, others. The hub should identify the potentially best hybrid business model by combining public and private financing (including commercial activities). In order to secure ERDF funding the hub should comply with the prerequisites and show how it will contribute to the objectives of the smart specialisation strategies. In addition, state aid issues for the provision of services to SMEs should be considered in this step.

Step 6: National and international partnerships

One of the main goals of a DIH is to be a critical actor of the regional/national innovation ecosystem. To achieve this goal, the DIH needs to establish and maintain partnerships with actors with complementary competencies and specialisations on a regional, national and European level. It should be able to act as a doorway providing access to knowledge and expertise not available locally but via the network of DIHs across Europe. Establishing partnerships in a wider scale will help the hub provide internationalisation services to its customers should this be required.

Step 7: Monitoring and impact assessment

Every policy initiative where public funds are used should be able to develop a monitoring and evaluation scheme. This is necessary to be done since the beginning by identifying a set of indicators to measure the outputs of the intervention towards the main objectives. In the long term, a more sophisticated framework should be used to measure results/impacts and provide feedback for updating the policy intervention.

In the following parts of this Handbook you will find further analysis of the above-mentioned steps with further areas of consideration under each step. You will notice that the relevance and alignment with the regional/national smart specialisation strategies and priorities is recurrently highlighted: this is important in order to provide to the DIH the eligibility potential to receive funding from ERDF 2021-2027. To help the reader concretise different concepts and ideas many examples serving as good practices are provided from existing DIHs across the EU and under different profiles and specialisation areas. The reader could deepen his/her knowledge by visiting the web site of each DIH and/or by contacting the relevant DIH managers to receive more information.

2

Setting up/Reinforcing a DIH - Step-by-step approach and good examples for policy makers

Step 0: Initial analysis – Do we need a DIH?

Before undertaking any commitments for regional/national investments on DIH(s), policy makers need to analyse the existence of digital challenges and opportunities for local businesses (notably SMEs and non-ICT industries) that may require an external support to their digital transformation process, and to what extent these actual or potential needs and opportunities justify the setting-up of the DIH. On an overarching level, the need for a public intervention in supporting innovation can be connected to three reasons: to *overcome market failures, government and systemic failure* issues, but also to *support the emergence of new market niches*.

Situations where public intervention could be needed

- Market failures lead to a situation where actors do not invest sufficiently in R&D, skills and training and where there is a lack of collaboration and venture capital provision. To overcome this, governments provide subsidies or tax incentives for R&D to private firms and public institutions and/or make available public venture capital. Another support measure is investment in platforms and networks to overcome distrust and information failures, carrying out match-making services.
- There can be government failures, where current provision of science and education is not working well. Therefore, new forms of intervention and collaboration with and across sectors may be needed. Before intervening, policymakers should consider additionality aspects, i.e. activities that are important for the system, which should only be taken on by public organisations in case private actors do not or cannot undertake this responsibility. Policy intervention is occasionally needed, but should not replace, duplicate, or crowd out what private actors can accomplish.
- Governments can also play important roles in supporting the development of new technologies and market domains²⁹, with more directional intervention policies that are not only addressing different failures but also by identifying possibilities, investing in research and development both by public and private actors, then procure new solutions or provided services based on these new developments.

A very good starting point on identifying the needs for intervention in setting up/reinforcing a DIH – to address any of the situations described above – could be the regional/national **Smart Specialisation Strategies (RIS3)**, developed by most EU regions/member states during the programming period 2014-2020 and moving towards a second generation (2021-2027). RIS3 is the regional/national research and innovation (R&I) strategy which sets priorities in order to build a competitive advantage by developing and matching R&I own strengths with industry's business needs. By identifying the region's unique opportunities and challenges and how to develop these could lead in avoiding going for the same type of technologies as all other regions, customising the technological offer to better support the digital transformation of the local economy while increasing its competitiveness.

Both Smart Specialisation (as a place sensitive, regional development concept) and Digital Innovation Hubs (as a tool to improve digital competitiveness) are fairly young concepts, but they build upon knowledge and experience from previous policies and actors. In many regions there are existing organisations (competence centres, research organisations, etc.) that already are or act as DIHs or can be part of a future DIH. These probably pre-existed before smart specialisation strategies were developed and very often they have participated in the design of smart specialisation strategies. DIHs can support the RIS3 design process by providing information for decision-making both by DIH staff's own knowledge and by mobilising local stakeholders and committing them to the process. A DIH can be also the outcome of a smart specialisation process.³⁰

²⁹ As different scholars have highlighted in recent years. See Mazzucato, M. (2018), Mission-Oriented Research & Innovation in the European Union. A Problem-Solving Approach to Fuel Innovation-Led Growth. European Commission, Directorate-General for Research and Innovation: Brussels, Belgium

³⁰ Rissola, G. and Sörvik, J. (2018), Digital Innovation Hubs in Smart Specialisation Strategies, EUR 29374 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-94828-2, doi:10.2760/475335, JRC113111.



The RIS3, via an extended Entrepreneurial Discovery Process (EDP), maps out and creates mechanisms to articulate industry needs and provides a mapping of the local innovation support ecosystem. The analysis should identify what are the needs and challenges to transition towards more innovative businesses, e.g. if there is a need for digitalisation support and which are the possible emerging markets that can be supported by strategic collaborative R&I investments.

The mapping and analysis of the regional innovation ecosystem within RIS3 can in broader terms identify if there is a need for a Digital Innovation Hub and what kind of digitalisation services the region needs. DIHs can channel and coordinate different support mechanisms, integrating regional, national and EU-level programmes and initiatives, and attracting forefront companies. However, the analysis should explore the role of a new DIH in relation to other regional actors, in order to avoid creating any new organisation that may duplicate existing resources and efforts instead of building upon what already exists.

If the analysis done within the context of RIS3 and EDP (or any other valid regional/national innovation or digitalisation strategy) is considered detailed enough as regards the digitalisation needs of the local industry and economy, it can lead to a decision for the policy makers to invest or not regional/national funds in order to set-up/reinforce a DIH. In many cases, more evidence (e.g. relevant research studies, deeper consultation with local stakeholders) would be needed in order to take a more informed decision – especially when there is no pre-existing structure that could act as a DIH and in cases where a new investment from scratch will be needed.



Good practices of DIHs with sectoral specialisation and/or RIS3 alignment

DIH Slovenia³¹ (Slovenia) is led by the Slovenian Chamber of Commerce and Industry in response to the increasing regional manufacturing industry demand for digital growth and business development. Slovenia is one of the 12 selected regions participating in the European Commission's 'Regions in industrial transition' initiative³² in order to receive support in gaining access to extra-regional investment, embarking upon broad industrial modernisation and fully exploiting the research, innovation and funding opportunities offered by European programmes.

The hub supports the local manufacturing and agriculture industry and its activities are fully aligned with the objectives of the national initiative, Digital Slovenia 2020,³³ and with Slovenia's RIS3 strategy with regards to Smart Buildings and Homes incl. Wood as well as Factories of the Future priority areas.³⁴ The digitalisation services offered by the hub are fully funded by the region's structural funds while its network comprises partners from the S4 specialisation platform Smart Factories Cluster, the ICT horizontal network (SRIP PMIS), universities (University of Ljubljana, University of Maribor), SME's supportive environment (Association for Informatics and Telecommunications, Technology park Ljubljana), Wood Industry Cluster, IIBA Slovenia Chapter and others.

31 DIH Slovenia Catalogue of DIHs profile, <https://europa.eu/fk44uF>, website: <https://dihslovenia.si/>

32 Regions in industrial transition, no region left behind, Pilot action, European Commission 2017-2020, <https://europa.eu/nd83UP>

33 Digital Slovenia 2020 – Development Strategy for the Information Society until 2020, Digitalisation of Slovenia by intense and innovative use of ICT and internet in all segments of society, Republic of Slovenia, 2016. <https://www.gov.si/en/policies/state-and-society/information-society/>

34 Slovenia's Smart Specialisation Strategy, RIO - H2020 PSF, <https://europa.eu/gN39vh>



Good practices of DIHs with sectoral specialisation and/or RIS3 alignment

AgriFood Lithuania DIH³⁵ (Lithuania) is a non-for-profit organisation, part of EU's Smart AgriHubs initiative,³⁶ that brings together major research, business and public stakeholders in Lithuania for the common pursuit of digital transformations in the agriculture, food and associated sectors. The hub's activities are fully aligned with EU's Declaration³⁷ of 'A smart and sustainable digital future for European agriculture and rural areas' aiming at strengthening the national and European technological infrastructure. They are also fully aligned with Lithuania's RIS3 where Agricultural innovation and food technologies are included in the national priorities.

AgriFood Lithuania DIH links stakeholders with international and cross-sector initiatives to provide all-round support in the research, development and deployment of AgriFood Tech innovations such as AI, IoT, smart sensors and electronics, aerial systems applications, distributed systems and blockchain, big data, spectroscopy and remote sensing, enterprise information systems as well as Web, cloud and SaaS services, supporting more than 50 regional and international SMEs on an annual basis.

Among their success stories are MyFoodSniffer,³⁸ a regional SME developing a tool that assesses food quality, who through access to gas sensor technology, R&D services, and consulting on commercialisation and innovation for applications in the food industry provided by the hub, were in position to develop their product to the world's first handheld consumer-level device for non-invasive determination of raw meat, poultry and fish freshness. In addition, StopFakeFood SME,³⁹ needed to develop a new service for governmental import and food control authorities, as well as for food manufacturers and supply chain companies for food product and beverage integrity assessment at various supply chain stages. AgriFood Lithuania DIH provided support through offering access to widespread applications of Raman spectrometry in the food industry by applying Machine learning and AI analytical techniques for spectral data analysis. In this way, fast, non-invasive and on-site assessment of food and beverage quality, safety and authenticity were achieved. Other services offered include hyperspectral imaging for precision agriculture, 3D LiDAR applications in forestry as well as access to farm and grain management software for several SMEs and larger agroindustries such as AgroSmart Farms⁴⁰ and Art21 AgriFood Tech solutions.⁴¹

35 AgriFood Lithuania DIH Catalogue of DIHs profile, <https://europa.eu/lwJ93FF>, website: <https://www.agrifood.lt/>

36 EU's Smart AgriHubs initiative, <https://smartagrihubs.eu/>

37 EU's declaration on EU Member States joining forces on digitalisation for European agriculture and rural areas, Shaping Europe's digital future, <https://europa.eu/!Pp96Wp>

38 MyFoodSniffer SME, <http://www.myfoodsniffer.com/>

39 StopFakeFood SME, <https://www.stopfakefood.com/>

40 AgroSmart Farms, <https://hyper.agrosmart.lt/>

41 Art21 AgriFood Tech solutions, <https://www.art21.lt/en/about.html>

Step 1: Preparation phase – Pre-study and pilot

If the initial analysis (described above in Step 0) and consultation with business stakeholders has indicated that investment in DIH(s) could be necessary in order to accelerate digital innovation of SMEs and identified the priority areas of smart specialisation or other innovation strategies a DIH could address, the next step is to start a preparatory phase consisting of a pre-study and possibly a pilot. Main suggestions and elements to be considered for the pre-study are described below:

1. The first step is to carry out an initial mapping of the digital innovation ecosystem (including available technologies and infrastructures for companies to test and upgrade), scoping target groups, needs and opportunities. This will set the initial boundaries for the pre-study. It can be based on analytical material from preparation of the Smart Specialisation Strategy (RIS3), available digital strategies and the results of Step 0 (Initial analysis).
2. Next, identify and decide who will carry out the pre-study (ex.: inhouse in the regional/national authority or innovation agency, external consultant, or other available options).
3. Setup a reference group of representatives from key stakeholders, e.g. service providers, future beneficiaries, and financiers. This group can eventually become a steering committee for the DIH when in operation.
4. The reference group in collaboration with the pre-study team would suggest a first vision for the DIH.
5. The pre-study could come up with suggestions for a pilot implementation that could be the first steps towards a fully operational DIH. The pre-study should in greater depth outline:

- a. key regional/national stakeholders, resources and test facilities to involve, target groups and needs and possibilities;
- b. existing services and new service offering;
- c. envisaged national and international partnerships;
- d. map out potential funding sources and a business model for a financially sustainable DIH;
- e. finalise vision and scope of the DIH.

To gather all the essential information the pre-study team should interview key stakeholders and take into account sound analyses of the regional economic fabric.

6. The pre-study should suggest:
 - a. who should carry out the pilot and operate the DIH (an existing stakeholder, or a consortium or a newly created structure). A Call for expression of interest could be launched for that purpose;
 - b. a line of services to be tested in the pilot phase.
7. The next step is the implementation of the pilot with indicative services from the service offering of the future fully operational DIH.
8. Throughout the process of the pre-study, the pilot and operational phases, the reference group should play a monitoring and evaluation role in order to provide informed advice on the final investment and/or suggest potential modifications.

In the case of reinforcing an existing organisation that has the potential to be upgraded to DIH the pre-study and pilot phase should focus on that institution, consider the current capacities and identify the areas for improvement. In this case, the pilot will be carried out in the said organisation (future DIH) in order to feed the pre-study with important input of the feasibility of this endeavour.

You will find two examples of DIHs with different profiles fitted to the regional priorities on the next page.



ASTER-DIH⁴² (Italy) is a non-profit consortium consisting of the regional Emilia-Romagna Government and several local innovation players (universities, RTOs, formation centres and industrial associations). ASTER-DIH acts as the point of contact for innovation-oriented actions for Italian and European regions connecting actors and services in order to cover the digital technology domains of agrifood, biomedical and energy. ASTER-DIH coordinates, supports, and is a founding member of the High Technology Network,⁴³ it coordinates the Clust-ER initiative,⁴⁴ and is responsible for training the PIDs (Digital Enterprise Points)⁴⁵ in Emilia-Romagna region, an initiative of Italy's Chambers of Commerce and Unioncamere in support of the digitalization of businesses under the National Plan for Industry 4.0, Impresa 4.0.⁴⁶

ASTER-DIH addresses the needs of the regional and cross-regional SMEs and bigger enterprises specialising in the agrifood and agro-mechanical sectors by providing access to its Agrifood platform⁴⁷ and thus offering qualified support for the development of new products and processes, the characterization and selection of new raw materials and the design and validation of equipment and plants for food processing and packaging. In addition, the hub provides access to 5 regional laboratories⁴⁸ exclusively focused on the needs of Agrifood companies offering services such as the implementation of collaborative research projects with businesses in order to develop new prototypes or demonstrators, technological consultancy, industrial exploitation of know-how and patents as well as research and innovation services for businesses, including the use of available scientific instruments.

An indicative success story of the hub is the case of the OpenFields,⁴⁹ a local technology transfer leader enterprise specialising in the Agrifood industrial sector who through access to the SITEIA laboratory⁵⁰ facilities of the High Technology Network they managed to develop innovative ingredients for food sector industries, taking into consideration strong constraints with regards to Customers' health and the environment.⁵¹

42 ASTER DIH Catalogue of DIHs profile, <https://europa.eu/IdR86Cy>, website: <https://www.aster.it/en/aster-dih>

43 High Technology Network, <https://www.retealtatecnologia.it/en>

44 Clust-ER initiative, <https://www.retealtatecnologia.it/en/clust-er>

45 PIDs (Digital Enterprise Points), <https://www.puntoimpresadigitale.camcom.it/>

46 Italy's National Industry 4.0 Plan (Impresa 4.0), <https://www.sviluppoeconomico.gov.it/index.php/en/202-news-english/2036690-national-industry-4-0-plan>

47 ASTER-DIH Agrifood platform, https://www.retealtatecnologia.it/en/thematic_platforms/agrifood

48 Agrifood laboratories, <https://www.retealtatecnologia.it/en/laboratories>

49 OpenFields, <http://www.openfields.it/en/>

50 SITEIA laboratory, <http://www.centritecnopolo.unipr.it/siteiaparma/>

51 OpenFields success story, video promo, https://www.youtube.com/watch?v=jneT21_iyyg&feature=emb_logo

BioSense Institute DIH⁵² (Serbia) is an ecosystem coordinated by the BioSense Institute, a research and technology organisation, with the aim to address the ICT-related technological challenges of the agri-food sector in Serbia and empower the next generation of technology-enabled professionals in this regard.

Vojvodina region, where the hub is based, is one of the most fertile regions in Europe, and thus the RIS3 strategy is oriented towards agriculture and food sectors incorporating the later adopted ICT priority area aiming to facilitate their digital transformation. Therefore, the hub's activities and services are shaped around these policy lines actively supporting the development of sustainable agriculture through digital technologies such as micro and nanoelectronics, communications, signal processing, remote sensing, big data, robotics and biosystems, with the ultimate goal of incorporating them into an integrated system for agricultural monitoring.

In close interaction with farmers and the agri-food sector, governmental bodies, entrepreneurs, the business community as well as international researchers, BioSense DIH has established the first *Digital Farm*⁵³ in Serbia and *PA4ALL, the Living lab for precision agriculture*⁵⁴ which takes full advantage of inter-sectoral cross-fertilization of ideas offering local SMEs possibilities to test ideas and prototypes in the real-world setting. In addition, at the hub's premises, local agri-food industry has access to the *Nano and Microelectronics, Remote Sensing and GIS, Knowledge Discovery as well as Mechatronics and Robotics Laboratories* in order to test and create a new generation of open innovations which will be readily used and are expected to bring benefits across the entire value-chain.

52 BioSense Institute DIH Catalogue of DIHs profile, <https://europa.eu/IdR94Dj>, website: <https://biosense.rs/>

53 The first Digital Farm in Serbia, video, https://www.youtube.com/watch?time_continue=1&v=aKdp0Sut4Do&feature=emb_logo

54 PA4ALL Living Lab, https://biosens.rs/?page_id=7697&lang=en

Step 2: Identify the vision and business proposition of DIH

DIHs should be built on existing strengths in a region and should address the needs of the local economic actors related to the digital and green transformation they need to make. In connection to this, DIHs can have different focuses related to technologies, sectors and types of services. DIHs across Europe could become specialised and have unique niches, if this is chosen as the best option to address different regional needs. They could be based on different competences and regional resources, such as unique testing facilities. This should go hand in hand with the regional smart specialisation strategy, which sets the R&I priorities for regional economic development. In a wider picture, alignment with the ethical, social and legal requirements in the context of digital transformation defined under the EU regulations is essential.

In this step the regional policy makers together with the local innovation stakeholders and most importantly industry should work together to finalise **a vision for digital transformation within the region and the role the DIH will play** if this does not yet exist.

Some important elements that the vision and business proposition should identify and outline are the answers to the following questions:

- What are the impacts desired with the DIH (e.g. cross-sectoral digital transformation and/or support the local tech industry to reach out in Europe)? It should identify which are the target groups to reach out in order to reach the impact (e.g. manufacturing industry, agro-food, health industry; private companies only or also public sector? SMEs, mid-caps or large companies and their interaction with smaller ones?).
- Will the DIH have a specific technology focus (e.g. will it provide Industry 4.0 technology advice, Internet of things, AI, HPS, Cybersecurity, others? Will the DIH work closer to market or also carry out early phase research, i.e. will it work in different technology readiness levels)?
- Will it provide strategic business advice, or just technological services? Will it offer forms of innovation support of a less technology-focused nature, such as design and usability support, provision of user interaction labs, or even advice on innovation management?

The business proposal should also consider: how to reach the identified target groups (in particular smaller companies which are harder to trigger), which relations are needed to achieve this, what services the DIH will provide and which is their added value to potential customers, which resources are key to deliver the services, and which partners are needed for this.

To stay informed and keep relevance, the DIH and the regional administration should regularly update their knowledge of the different stakeholders needs. In this process the DIH should engage with its partners, such as competence centres, research institutes, university departments, private companies (SMEs and larger ones), cluster organisations, industry associations, incubators and accelerators and organisations working with innovation in the public sector.

Finally, the business proposition should outline potential and viable funding models.



Good practices of DIHs with technical focus

The **Finnish Center for Artificial Intelligence (FCAI) DIH**⁵⁵ (Finland) is a nation-wide ecosystem coordinated by Aalto and Helsinki universities in close collaboration with the VTT Technical Research Centre of Finland competence centre. The hub has a clear focus on artificial intelligence fully aligned with Finland's national initiative in this regard, *AI Finland*,⁵⁶ financed by the Ministry of Economic affairs. FCAI is one of *Finland's six Flagship Academies*⁵⁷ dedicated to the promotion of active collaboration between research, business and society in each field, specifically focusing on young industrial companies such as start-ups and SMEs.

The hub supports more than 200 manufacturing SMEs and companies specialising in engineering, health, economics, environmental, natural and social sciences fields, benefit from the application of AI technology in their respective domains. In direct collaboration with several large companies, competence centres, ICT and AI ecosystems offering access to robotics and AI infrastructure and technologies such as *Analytics+*,⁵⁸ *Allied ICT Finland network*,⁵⁹ and *The Curious AI Company*, SMEs initially understand the viewpoints of artificial intelligence and assess their current AI readiness level and performance through the *AI maturity tool*,⁶⁰ developed by the hub, and consequently test AI technology as per their specific needs. In the field of medicine, for instance, SMEs realise the AI technological approach through which cognitive systems support human cognition and extend thinking beyond human limitations.⁶¹

55 Finnish Center for Artificial Intelligence (FCAI) DIH Catalogue of DIHs profile, <https://europa.eu/nj68nc> website: <https://fcai.fi/>

56 AI Finland, Finland's national initiative for AI, <https://www.tekoalyaika.fi/>

57 The Finnish Flagship programme, <https://www.aka.fi/en/research-and-science-policy/flagship-programme/>

58 Analytics+, The largest Nordic growth network of AI companies and experts, <https://www.analytics.plus/>

59 Allied ICT Finland, The largest research to business ICT network in the Nordics, <https://alliedict.fi/>

60 AI maturity tool developed by FCAI DIH, <https://ai.digimaturity.vtt.fi/>

61 BrAIIn seminar: Decoding attention states from MEG with convolutional neural networks, video, <https://www.youtube.com/watch?v=ADI4XvdPkg>




Good practices of DIHs with technical focus

HPC4Poland DIH⁶² (Poland) is dedicated in co-creating and providing HPC tools in response to the demand of Polish manufacturing enterprises. Coordinated by the Poznan Supercomputing and Networking Center (PSNC), the hub addresses the business needs of more than 300 manufacturing SMEs on a national level.

Focusing mainly on the automotive, aerospace and machinery equipment manufacturing sectors, HPC4Poland provides SMEs access to *HPC tools and technologies*⁶³ supporting them raise their competitiveness by shorter time-to-market for new products designed, new personalised products developed (e.g. companies may simulate numerous versions of a product, its shapes, materials, new applications), lower costs of new product roll-out thanks to migrating from traditional to virtual laboratories, as well as optimised logistics and manufacturing processes and testing products against extreme conditions, otherwise unavailable in traditional labs. Testing labs and facilities provide access to several HPC simulation services such as mesh modelling, constructing of dedicated HPC environments and access interfaces, as well as optimisation of computational algorithms and access to tool software, e.g. Ansys, FlexSim and Altair Hyperworks.

One of the hub's cooperating companies is Volkswagen AG who employed *HPC simulation tools*⁶⁴ in order to explore the possibility of supporting employees on the VW Crafter assembly line, before starting the process of applying protective layers. A number of alternative approaches were identified in this regard in the hub's testing facilities and a prototype proof-of-concept (TRL3/4), including key system components, was built and demonstrated in a real environment.

Step 3: Define the service offering to SMEs

DIHs are one-stop shops acting as innovation intermediaries for the matching of demand and offer of advanced digital services and technologies, in order to support digital transformation processes. At the heart of the DIHs functions is the goal of creating awareness about business or production opportunities with digital technologies and to act as trusted and neutral actors in providing relevant advice.

The DIHs are both a means to reduce search costs for appropriate solutions, by serving as knowledgeable brokers that can analyse someone's need for digitalisation, and to provide appropriate services either through its in-house expertise or through a partner. A DIH can prepare a not very technologically advanced SME realise its potential and demand suitable technologies from more advanced suppliers.

At the same time the services of a DIH should be complementary to and not replace existing commercial services. A DIH could also chose to dedicate resources to an potential niche and serve a need, by providing something additional that did not exist before. In many regional innovation ecosystems, a large variety of actors and initiatives already exist. Therefore, the introduction of a DIH should not create further fragmentation and complexity, or confusion among existing actors and potential beneficiaries as regards provision of digitalisation services already existing in the region. An important task is rather to map, structure and align different services to make it more coherent to the beneficiary-SMEs, i.e. to better coordinate the offer with a view to satisfy the latent demand previously identified.

As already mentioned earlier the four main categories of services that DIHs⁶⁵ can provide to the local SMEs/public sector beneficiaries are (Figure 2-1): **i) test before invest, ii) skills and training, iii) support to find investment and iv) innovation ecosystem and networking**. These four categories are described and enriched with good examples from existing DIHs in the following subsections (a - d), followed by a reasoning about **DIHs role serving the public sector**, which is a novelty introduced by DEP (e).

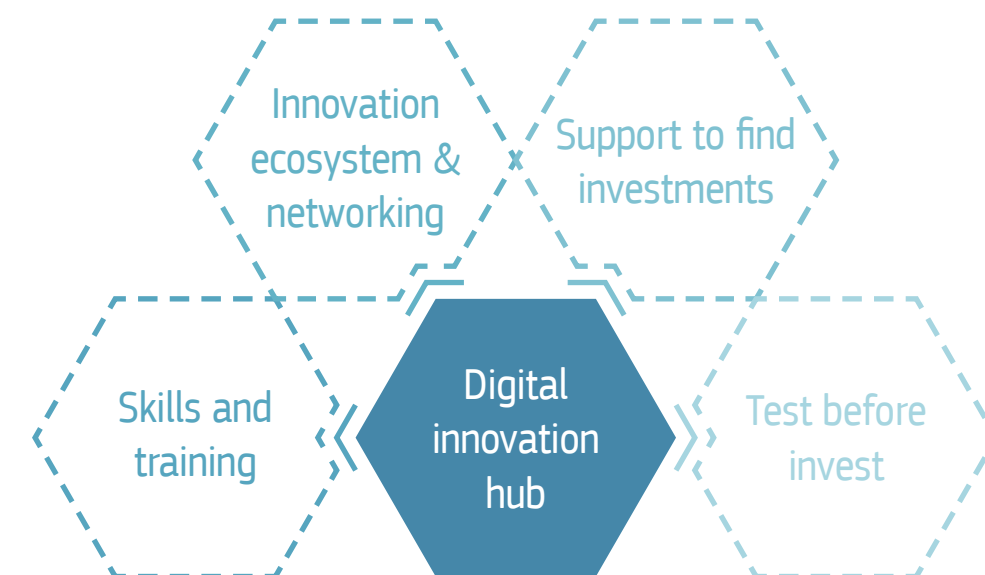


Figure 2-1: DIH services⁶⁶

⁶² HPC4Poland DIH Catalogue of DIHs profile, <https://europa.eu/Br36rw> website: <http://www.hpc4poland.pl/>

⁶³ Demo of HPC simulations for Science and Industry, video, https://www.youtube.com/watch?v=iKR_LOxswdw

⁶⁴ HPC service for Volkswagen AG, case study, <http://www.hpc4poland.pl/en/cyberphysical-workplaces/>

⁶⁵ These are the functions described for an EDIH in Digital Europe Programme. A DIH that is not an EDIH does not need to provide all of these, but the functions of an EDIH do describe a complete offer for a DIH.

⁶⁶ European Commission (2020), European Digital Innovation Hubs in Digital Europe Programme - Draft working document



Good practices of DIHs successfully reaching out to SMEs

Smart Machines and Manufacturing Centre (SMACC)⁶⁷ (Finland) is a centre of expertise focused on research and services in the areas of intelligent manufacturing and robotics. Founded and coordinated by VTT Technical research centre of Finland and Tampere universities, SMACC's mission is to support the modernisation of Finnish technology industry by utilizing *advanced research expertise and infrastructures*.⁶⁸ The hub has participated in the *'Smart Factories in new EU Member States' project*⁶⁹ managed by the EC for the European Parliament with the aim of contributing to strengthening the presence of DIHs across EU13 Member States. In addition, SMACC coordinates several European DIH initiatives such as DIH²⁷⁰ and TRINITY⁷¹ networks for robotics and L4MS⁷² hubs for factory logistics. Through VTT's partnership, the hub has also become part of the EIT KIC Manufacturing initiative⁷³.

The hub is located at Tampere region, at the heart of Finnish industry, supporting approximately 300 local SMEs, more than 50 on an annual basis. In order to better understand the companies' business needs, the hub started in 2015 approaching industrial SMEs and Mid-Caps (50-500 employees, EUR 5-60M turnover) through surveys aiming to identify development topics, the companies' growth potential and their service needs. The survey was conducted again two years later and has been established since as the hub's strategy of approaching local industry and shaping its service portfolio around the SMEs specific requests with regards to their technological support and digital transformation. Since 2017, the vast majority of local industry (more than 500 regional SMEs) showcased deep interest in their digital growth leading to the development of *23 technology testing and prototyping labs*⁷⁴ in SMACC's premises such as the Digital Factory,⁷⁵ Robot Village, Production lab, Manufacturing & Mechatronics lab etc.

67 Smart Machines and Manufacturing Centre (SMACC) Catalogue of DIHs profile, <https://europa.eu/CJ99bV> website: <https://www.smacc.fi/>

68 SMACC activities demo, video, https://www.youtube.com/watch?v=Ei80IEvTCU&feature=emb_logo

69 'Smart Factories in new EU Member States' project, <https://smartfactories.eu/>

70 DIH² project, <http://www.dih-squared.eu/about-us>

71 TRINITY project, <https://trinityrobotics.eu/>

72 L4MS project, <http://www.l4ms.eu/>

73 EIT KIC Manufacturing, <https://eitmanufacturing.eu/about-us/>

74 SMACC-Labs list, <http://wplitutorial.vahakas.fi/en/labs/>

75 SMACC Digital Factory, demo video, <https://www.youtube.com/watch?v=1FjZq5fBDHQ>

Good practices of DIHs successfully reaching out to SMEs

Industry Platform 4FVG (IP4FVG)⁷⁶ (Italy) is a wide ecosystem fostering digital innovation for the Friuli-Venezia Giulia region coordinated by *AREA Science Park*,⁷⁷ an RTO. The hub's activities are built on 4 pillars; advanced manufacturing solutions, data analytics and AI, data optimisation and simulation, and IoT.

In order to reach out to companies and realise their specific business needs, it is the hub's strategy to firstly approach an SME's CEO, CTO and/or CIO, who recognise and understand the added value of digital technologies in their businesses' digital growth and transformation, in order to directly discuss with them the matter of using such technologies in their everyday business and production activities. For this reason, IP4FVG hub has launched an *online interface*⁷⁸ requesting interested SMEs to state their main business needs and submit their specific innovation request to the hub. This information is then stored in a business tool that the hub has specifically developed for this purpose which includes the companies' profiles, contact details and requests. Through evaluation of the profiles, the hub is in position of assessing the local links and match the companies' requests with its networks' competence centres that can address them. This process has also significantly supported IP4FVG hub in enhancing not only its regional but also national and cross-regional collaborations shaping a more solid service portfolio around the business needs of SMEs, start-ups as well as large industry companies on an EU-level. This approach has led to several *success stories*⁷⁹ for the hub and its cooperating SMEs that receive significant support during their digital transformation process.

76 Industry Platform 4FVG (IP4FVG) Catalogue of DIHs profile, <https://europa.eu/luu67bY> website: <http://www.ip4fvg.it>

77 AREA Science Park, <https://www.areasciencepark.it/>

78 IP4FVG interface, companies main needs & contact form, <http://www.ip4fvg.it/le-principali-esigenze/>

79 IP4FVG Hub tech stories, indicative video from 'tech stories' series, <https://www.youtube.com/watch?v=KUvDH6ye-OM>

a. Test before invest

Examples of services under the “test before invest” category may include: **awareness raising, digital maturity assessment, demonstration activities, visioning for digital transformation, fostering the integration, adaptation and customisation of various technologies, testing and experimentation with digital technologies (software and hardware), knowledge and technology transfer.** For European DIHs (EDIHs) special focus will be on the key technologies promoted in Digital Europe Programme: HPC, AI, and Cybersecurity⁸⁰.

The provision of test facilities should be one of the primary and well-defined services of DIHs. DIHs should be able to provide services and facilities to raise awareness and provide access to digital transformation expertise and testing and experimentation facilities so that potential beneficiaries can make better decisions for investments that will help them develop improved new products and services.

The testing services include the provision of facilities for experimentation of hardware and software, where companies and public actors can come and try out new digital technologies that they may want to start utilising in their processes or incorporate in their services and products. They can also serve as environments where suppliers can showcase technologies for future users, as well as facilities where pilot scale solutions can be tested for development purposes.

It can also include costly hardware equipment for which companies only have a limited use, where they may want to carry out some development or research purposes, but it may be too costly to invest in for themselves. In this case, the DIH can be a means for cost sharing among beneficiaries. Another type of testbeds includes test environments that are copies or simulations of public sector systems, such as digital twin of a hospital digital system. In these environments, presumptive service providers can come to test and develop their solutions in a system that is almost the same with the one in reality, but without putting the real hospital system at risk of malfunctioning.

Testbed processes are complicated and there is a risk that existing testbeds could become underutilised or that they only act as showrooms rather than platforms for experimentation. Careful analysis should be done with respect to clients and business models, including ways of broadening the client base beyond borders, on a European scale.

It is envisaged that DIHs that provide “test before invest” services become part of a pan European network of advanced and specialised testing facilities, where different regions and hubs provide facilities with different offerings and niches for the benefit of SMEs on a European scale. Moreover, the brand-new Digital Europe programme puts the accent on this core feature when it plans to measure EDIHs’ performance through a number of effective tests they will run annually.



Good practices of DIHs offering “test before invest” services

Digital.Hub Logistics⁸¹ (Germany) is a cooperation between three competence Centres, the Fraunhofer Institutes for Material Flow and Logistics IML and for Software and Systems Engineering ISST, and the Technical University of Dortmund. Coordinated by the EffizienzCluster Management cluster organisation, DIH Logistics creates the structures for sustainable innovation development in the *high-tech logistics sector* applied on the local manufacturing, retail and energy industries. Building upon the solid collaboration of its members with the local industry, the hub supports more than 10 local SMEs on an annual basis.

Digital.Hub Logistics is part of the German Federal Ministry’s of Economic Affairs and Energy (BMWi) ‘*SME 4.0 – Digital Production and Work Processes*’⁸² and *de:hub*⁸³ initiatives. It hosts the *Start-in Factory*,⁸⁴ a collaboration space for start-ups and SMEs, midcaps and start-ups that team-up in digital teams, discuss their specific challenges with regards to digitalisation and receive guidance in addressing them through business development workshops, digital skills training, and access to *competitive leading-edge research and testbeds and pilot facilities*.

More than *100 demonstrators* in various testbeds provide the basis for the current industry 4.0 competence at the hub’s location. Furthermore, local SMEs benefit from *Enterprise Labs*, research and development partnerships between scientific institutions and large companies. SMEs can work closely with researchers and implement innovations in direct cooperation focusing on the common path from topic identification to the market-ready business case. In this way, SMEs and start-ups gain practical insights into the technological maturity, applicability and willingness to implement new logistics products, services and business models.

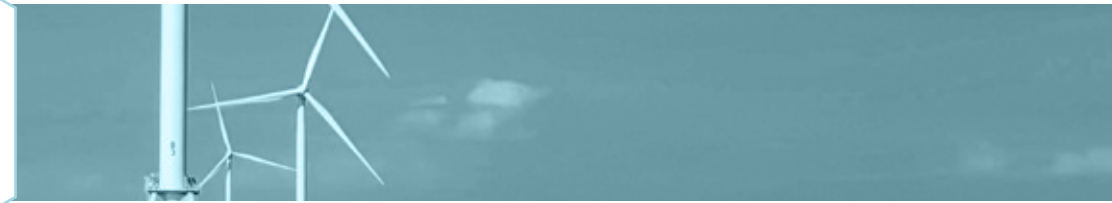
⁸⁰ The information in this Handbook refers mainly to regional/national DIHs and not to EDIHs. For more specific information on EDIHs the reader is invited to refer to EDIH Working Document <https://ec.europa.eu/digital-single-market/en/digital-innovation-hubs>

⁸¹ Digital.Hub Logistics Catalogue of DIHs profile, <https://europa.eu/lyC64Qw> website: <https://digitalhublogistics.com/>

⁸² SMEs Digital - Strategies for the digital transformation, German Federal Ministry of Economic Affairs and Energy (BMWi). <https://www.bmw.de/Redaktion/EN/Publikationen/Mittelstand/smes-digital-strategies-for-digital-transformation>

⁸³ de:hub initiative, digital ecosystems, German Federal Ministry of Economic Affairs and Energy (BMWi). <https://www.de-hub.de/en/>

⁸⁴ Digital Product Factory video demonstration: <https://www.youtube.com/watch?v=PEhs2Zzqtio&t=46s>



Good practices of DIHs offering “test before invest” services

Energy Valley⁸⁵ (Norway) is a Norwegian Centre of Expertise (NCE) specialising in the digital transformation of the local energy industry and is fully aligned with Norway's initiative for digitising industry, *Digital Norway*.⁸⁶ Its network comprises 160 members across the entire energy industry value chain, more than 130 of which are SMEs in the midst of their transition to the digital energy market.

The hub provides SMEs with *access to realistic data sets and specific sensor outputs*, a critical asset for companies developing or testing new software applications. This targets specifically start-ups and SMEs specialising in the Oil & Gas sector while data come from large industry companies such as Equinor, Statoil and Aker BP. The aim of the initiative is both to share knowledge about available data types and data sources, and to identify challenges with data access from the developers' perspective.

In addition, the Energy Valley DIH has developed the *Energy Tech Accelerator* an initiative co-financed by large energy companies, part of the hub's ecosystem, that supports entrepreneurs and SMEs in testing and commercialising the latest digital technologies applied in the energy sector. The hub's large member base and infrastructure actively supports Norwegian start-ups and SMEs into the program and attracts international companies to the region. Finally, through the recently launched *SME Digital Transformation project*, Energy Valley DIH facilitates the collaboration between its largest system integrators, such as DNV GL, Aker BP, Statoil, Kongsberg Digital and Sintef Digital, and SMEs with the aim of developing digital platforms for new digital services and technology solutions.

b. Skills and training

To contribute in the digital upskilling of labour in the regions where they operate so that the client SMEs/organisations can make the most of digital innovations technologies, DIHs' services could include advertising, hosting or providing training, boot-camps, traineeships, as well as supporting the implementation of short-term advanced digital skills training courses.

An essential part of the DIH services is training and skills development. The DIHs can coordinate with education providers the release of short-term trainings for workers and internships for students. Activities in relation to training and skills can cover the whole employment spectrum but should be based on an analysis of the regional needs.

Concerning skills development, these include training and skill development for beneficiary companies and public organisations, and/or educating and training staff with new digital skills. This could range from basic skills for how to use basic software suites, to advanced high-level university courses on Artificial Intelligence.

The rationale for the DIH to secure these types of training is to overcome incentives issues around who will pay for the training and who will receive the benefit (company or employee, or future employers), and the eventual lack of universities and other public or private training institutions able to provide educational services tailored to the specific needs of SMEs.

Digital skilled labour is in high demand. In order to meet this demand, there is both need for educating and skilling new labour, through secondary schooling and universities, but also to re-educate staff through vocational training and special training institutions (i.e. reskilling and upskilling). This type often does not necessarily fit easy with the agendas of established educational programmes. Through interaction with potential beneficiaries, a DIH can pool the need from many SMEs in order to build a critical mass for more specific training programmes that can better match supply and demand.

DIHs can diffuse knowledge for training and skills upgrading in many forms, such as seminars, events, shorter and longer courses, or funds to procure training. Many DIHs already provide educational material online with webpages presenting examples of good practices and use cases with new technologies.

Training is also strongly connected to awareness raising, i.e. to promote the use of new technologies through activities such as roadshows, showrooms, events, workshops, interactive demonstrations, factory tours, videos, commercials, online and printed media.

Most DIHs carry out analyses of companies' specific needs and possible digital solutions to improve their competitiveness, a so-called digital transformation plan. This can be done either as a consultancy service or through online maturity tests where potential beneficiaries can carry out their self-assessment before deciding to work with the DIH.

⁸⁵ Energy Valley Catalogue of DIHs profile, <https://europa.eu/ivk83Gc>, website: <https://energyvalley.no/>

⁸⁶ Digital Norway initiative, <https://digitalnorway.com/>



Advanced Manufacturing DIH
Coordinated by IntechCentras

Good practices of DIHs offering “access to training” services to SMEs

Advanced Manufacturing DIH⁸⁷ (Lithuania) has a strong focus on Lithuania’s manufacturing industry and is coordinated by Intechcentras, the SMART Manufacturing Competence Centre and industry association which is also the official representative of “German Innovation Center for Industry 4.0” in Lithuania. The hub supports more than 250 local and national manufacturing SMEs by means of robotics, artificial intelligence, cyber security, IoT and big data technologies.

Advanced Manufacturing DIH has a strong training programme with regards to digital transformation technologies, tools and services, having trained more than 3000 specialists and conducted over 600 accomplished seminars. One of the hub’s popular trainings is the ‘*digitalisation and industry 4.0 driver’s licence*’⁸⁸, a three-level training course that engages company members of all hierarchy levels and roles (CEOs, project managers, supply chain, production and business development employees etc.) into the concept, challenges and solutions of industry digitalisation. A more practical and hands-on training experience performed in a factory environment is offered through the *Engineering-Technological*⁸⁹ and *Injection-Moulding trainings*.⁹⁰ Through these, attendees are trained and test the latest innovative technologies in the several applications of engineering industry, construction management systems and tools as well as moulding methods and product development technologies.



SPACE53 > the unmanned ambition

Good practices of DIHs offering “access to training” services to SMEs

Space53⁹¹ (Netherlands) is a strong ecosystem of actors across the Dutch digital innovation value chain, coordinated by the *Novel-T*⁹² RTO offering safe development, testing and training of unmanned systems on land, air and water. Supporting annually more than 50 local and national SMEs from the industrial, technical and economic sectors, the hub covers *drone technology through AI, robotics, HPC and sensors tools and systems*.⁹³

Space53 offers drone developers and operators as well as SMEs interested in testing and training on drone technology, a *drone pilot training*⁹⁴ through a globally certified license. The training is conducted in a 10.000 m² indoor testing area (Hangar 11) and at a 200ha fenced outdoor area in close proximity to the hub’s office facilities. Companies and education institutes work and train with the police, the fire service, defense and healthcare services to develop and test new safety concepts. Especially Hangar 11 indoors area is dedicated to the SMEs to train their staff on drone technologies and test those technologies developed which are not yet ready for real life, outdoor testing or are not yet compliant with airspace regulations. All training and technology development facilities offered by the hub also serve as demonstration areas. Finally, in cooperation with the ROC van Twente educational institute, Space53 DIH is developing the Netherlands’ first-ever vocational drone training course for MBO-level students.

87 Advanced Manufacturing DIH Catalogue of DIHs profile, <https://europa.eu/!FR79dY> website: <http://intechcentras.lt/>

88 Digitalisation and industry 4.0 driver’s licence training, <http://intechcentras.lt/services/industry-4-0-training/>

89 Engineering-technological training, <http://intechcentras.lt/services/engineering-technological-training/>

90 Injection-Moulding training, <http://intechcentras.lt/services/production-efficiency-increase/>

91 Space53 Catalogue of DIHs profile, <https://europa.eu/!Jt44CX> website: <https://www.space53.eu/>

92 Novel-T, Research and Technology Organisation in the Netherlands, <https://novelt.com/>

93 Space 54 drone technology promotion, video, <https://www.youtube.com/watch?v=jgaD082FzZY>

94 Drone pilot training, <https://www.space53.eu/training> & Game of drones pilot training, promotion video, https://www.youtube.com/watch?v=yg0wQ_Uq37s

c. Support to find investment

DIHs can also offer services such as access to financial institutions and investors, supporting the use of ERDF, Horizon Europe, InvestEU, Just Transition Mechanism and/or other relevant financing mechanisms. For the public sector in particular, as one of the largest purchasers of ICT, this service could furthermore provide support to leverage the purchasing power of the public sector, transforming it into a larger innovation buyer.

Digital Innovation Hubs should support companies, especially SMEs and start-ups to access regional, national and/or European funding (i.e. ERDF and ESF) to make use of new technologies. This can also include access to public and private financial institutions and investors, including InvestEU and the Enterprise Europe Network (EEN). The support can also be directed towards the public and wider public sector.

This category of activities also covers finding funding to finance the DIHs' own support activities or to develop a tech start-up company. Financing services consist of different ways to provide funding assistance for digitalisation activities, ranging from provision of subsidised services or innovation vouchers that can help companies procure digitalisation support from external actors, to assisting companies in applying for grants and other forms of R&D support, and to connecting companies with investors.

During the current financial period (2014–2020) a wide range of funding mechanisms have been used to support the digitalisation of SMEs and the operations of DIHs as presented below (Figure 2–2):

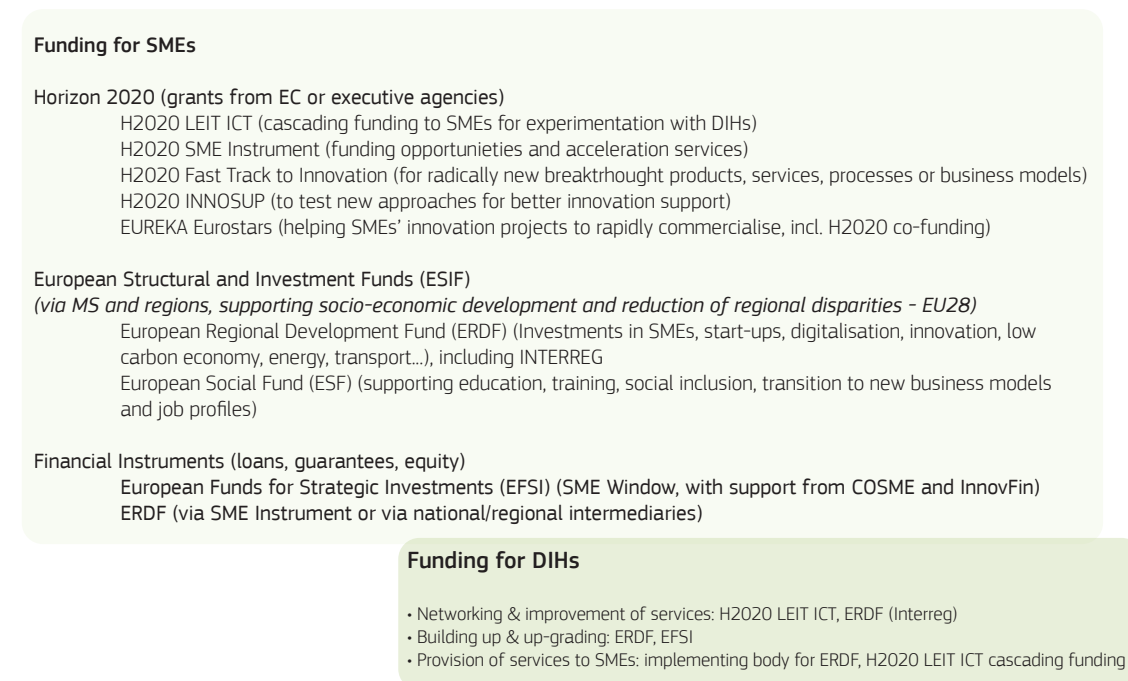


Figure 2–2: Funding mechanisms for SMEs and DIHs
(Source: EC)

DIHs should constantly monitor and keep track of the different funding mechanisms of the upcoming 2021–2027 period pointing out the opportunities they offer to SMEs. These are mainly the ESIF funds from the new Cohesion Policy (ERDF and ESF) 2021–2027, Horizon Europe, DEP and Invest EU. DIHs may also act as intermediaries in cascade funding mechanisms aimed to support SMEs' digitalisation investments.

The proposed support can be in the form of helping tech start-ups and new ventures attract funding. This help can be counselling on how to develop a business plan, provide contacts with venture capitalists, but also more formal and comprehensive incubation/accelerator programs for tech start-ups. It can also connect to the testing facilities, where start-ups can make proof of concepts in order to reduce risks for potential investors.



Good practices of DIHs offering “access to funding” services to SMEs

SuperIoT DIH⁹⁵ (Finland) is an ecosystem coordinated by the university of Oulu offering SMEs and start-ups access to a wide range of IoT and 5G solutions from sensors to data analytics seamlessly and cyber secured with latest technology innovations. It is part of the *Allied ICT Finland initiative⁹⁶* financed by the Finnish Ministry of Economic Affairs and Employment.

The hub's network includes more than 200 SMEs collaborating with assigned project leaders and receiving support from the idea conception phase to product development. This includes access to the funding sources required for the developed product/technology to reach the market. In specific, start-ups and SMEs identify with their project leader key IoT solution areas according to the specific challenges they face. Proof of concept and the basis for the tailored IoT Platform are then developed in cooperation with selected partners from SuperIoT Ecosystem for the top 3–5 business cases that derive from this process.

The new IoT solutions that are developed lead to shared investments within the SuperIoT alliance through the *HILLA acceleration and investment program⁹⁷* which aims to create new international digital business to Finnish companies and their partners in the business areas of wireless ICT, IoT services and products, automotive and traffic, industry and digital health. Through this programme, SuperIoT DIH brings start-ups and SMEs in contact with potential investors and supports them in maximising the return on their investment.

95 SuperIoT Catalogue of DIHs profile, <https://europa.eu/!KK97Qx> website: <https://www.superiot.fi/>

96 Allied ICT Finland initiative, <https://alliedict.fi/>

97 Hilla acceleration and investment program, video, https://www.youtube.com/watch?v=WQm55DGPUBw&feature=emb_logo



Good practices of DIHs offering “access to funding” services to SMEs

Centre Val de Loire DIH⁹⁸ (France) is an ecosystem supporting the digital transformation of Val de Loire region's manufacturing industry and is coordinated by DEV'UP, an economic and development agency. In 2017 the hub was awarded by the French government with the *national French Tech label*⁹⁹ thus being officially recognised as a centre of excellence that supports the digital growth of local companies.

The hub is part of the European Commission's '*Regions in industrial transition*' pilot action¹⁰⁰ and finances the services offered to the regional industry through ERDF funds, being fully aligned with the *region's RIS3 strategy*¹⁰¹ on SMEs competitiveness and ICT thematic priorities, as well as through COSME, its participation to H2020 funded projects, partner resources and memberships. With regards to the services offered to SMEs, access to funding is one of the hub's most popular service as it has developed a specific program for regional SMEs facilitating their business and digital growth through access to appropriate funding resources, the 'Scale up - access to finance' initiative. Through the hub's online business portal, *ConnectUp*,¹⁰² interested SMEs can quickly identify the right person from the hub's wide network to support them with their specific request (technological, technical or financial) and arrange appointments with VCs for their venture development.

d. Innovation ecosystem and networking

No company can innovate alone. It will help companies greatly if they are brought into contact with other companies of their value chain, with innovators, or early clients that want to test solutions. DIHs could play this brokering role and bring e.g. end-users and potential suppliers of technological solutions into contact with each other for e.g. experimentation and testing, or public administrations and GovTech companies to promote co-creation. The non-profit objective of DIHs is important in this respect, and they might encourage local companies to improve the overall economic strength of their local economy. When suitable local partners may not be found, the hubs can network with other DIHs to find a matching partner elsewhere in Europe. Hubs can only become good brokers if they do regular technology scouting, in order to map the innovation ecosystem, and understand needs and opportunities. Structured relationships with regional authorities, industrial clusters, SME associations, business development agencies, incubators, accelerators, EEN, EIT Co-location Centres and chambers of commerce will greatly help the brokering function.

Similarly to EDIHs, other Digital Innovation Hubs could act as facilitators to bring together industry and administrations that need new digital solutions, with companies that provide these solutions (or have the capacity to develop them). The DIH could provide a **marketplace and serve as a broker** that facilitates collaboration and networking between relevant stakeholders, matching firms with customers and, in absence of local suppliers, provide European connections as well.

DIHs can be seen as **platforms that facilitate transactions** between users and producers and reduce transaction costs, by making it easier to find what one is looking for, by gathering a wide range of services and goods in one place. Many platforms also have mechanisms to create secure and trusted environment.

The DIH can provide **opportunities for actors to meet and initiate collaboration**, either spontaneously or in a more directed way. It can be through information events or hands-on matchmaking. It can also include events where suppliers provide information about new solutions, but also open innovation types of meetings where an invited company or public sector actor informs about a process need or societal challenge that they want help with, eventually leading to collaborative research projects and possible public procurement.

DIHs have the potential and an excellent position to enhance the coordination among actors and initiatives in the regional support system. The DIH setup/reinforcing process can be an opportunity to better analyse digitalisation support provided in a region and put providers together in a comprehensive form. The DIH can be a **tool for coordination, but also for prioritisation of publicly available support**.

DIHs can function as platforms and one-stop shops. This places them in a central position of the innovation ecosystem related to digitalisation. It is necessary for DIHs to scan the needs of beneficiaries frequently, which provides them with market intelligence on business opportunities and technology development, as well as on who are the key actors. A DIH should interact and collaborate closely with regional authorities, industrial clusters, SME associations, business development agencies, incubators, accelerators, EEN, EIT Co-location Centres and chambers of commerce (with several of them partnering on a regular basis). Indeed, many DIHs serve the purpose of overcoming fragmentation and connecting regional actors to make their offers more visible and coherent. This includes collaboration with local, regional, national and EU level agencies.

98 Centre Val de Loire DIH Catalogue of DIHs profile, <https://europa.eu/!RU69Fd> website: <https://www.devup-centrevaldeloire.fr/dih>

99 La French Tech initiative, <https://www.gouvernement.fr/en/la-french-tech>

100 Regions in industrial transition, no region left behind, Pilot action, European Commission 2017-2020, <https://europa.eu/!nd83UP>

101 ERDF Operational Programme 2014-2020 for Centre-Val de Loire, <https://europa.eu/!Bd94FQ>

102 ConnectUp online business portal, <https://www.connectup-centrevaldeloire.fr/>

In this way DIHs become knowledgeable and informed actors that can take on different roles in the innovation ecosystems to support the orchestration. **They can provide market and technology intelligence and advice to agencies when they develop new programmes.** The DIHs can also participate in selection processes for beneficiaries from funding calls. Another form is to take on project leadership for innovation agendas or roadmaps set up by consortia of actors. The non-profit side of DIHs can make them more trustworthy in this endeavour of ecosystem facilitation.



Good practices of DIHs offering “ecosystem building” services

*Smart Industry Centre (SmartIC)*¹⁰³ (Estonia) is a DIH supporting Estonian manufacturing SMEs improve their business and production processes through ICT and robotics digital technologies and innovations. The hub's activities have been developed along the policy lines of *Estonia's RD&I Strategy 2014-2020*¹⁰⁴ and the region's RIS3 on ICT applications in manufacturing companies while it is part of *EU's I4MS initiative*.¹⁰⁵

Coordinated by Tallinn University of Technology (TTÜ) and IMECC, the key competence centre with regards to commercialisation and involvement of manufacturing SMEs, SmartIC's ecosystem comprises 18 partners addressing the business needs of more than 15 local and national SMEs on an annual level. In 2016, the hub's ecosystem building approach was based on the analysis of the regional ecosystem through electronic surveys on Estonian manufacturing SMEs in the robotics sector. Interested manufacturing SMEs were mapped and their respective CEOs were contacted for interviews. The results of the survey were introduced and discussed at SmartIC's first robotics workshop leading to the development of the hub's SWOT and objectives. The ecosystem partnerships were born, and **4 programme lines**¹⁰⁶ were developed for the manufacturing SMEs:

1. manufacturing automation line with industrial robots
2. human and environment related research
3. software for simulations and
4. the new FMS and robotics DemoCentre.

In addition, the continuous analysis of the local manufacturing industry has strengthened cooperation not only on a regional but also on a national level leading to further ecosystem initiatives in 2017 such as the Digital Plant Creation at TalTech based on the new *FMS Robotics Demo-Centre*¹⁰⁷ and the development of *SmartIC digital twins (IVAR lab)*.¹⁰⁸

103 Smart Industry Centre (SmartIC) Catalogue of DIHs profile, <https://europa.eu/!hV88jq> website: <http://smartic.ee/>

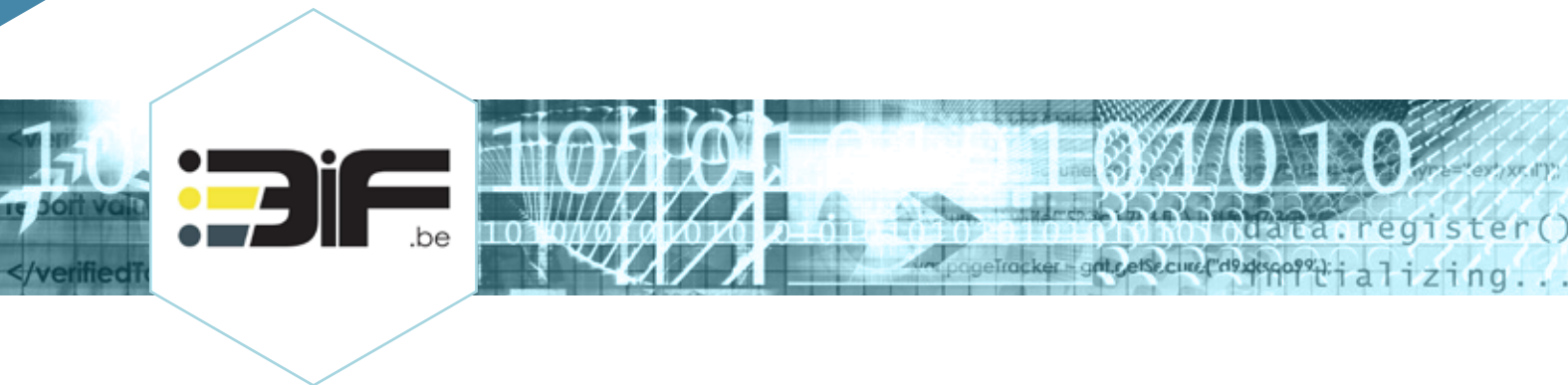
104 Estonian Research and Development and Innovation Strategy 2014-2020, Estonian Ministry of Education and Research, <https://europa.eu/!VX96Fn>

105 Innovation for Manufacturing SMEs (I4MS) initiative, The EU initiative to digitalise the manufacturing industry, European Commission, <https://i4ms.eu/>

106 SmartIC laboratories, <http://smartic.ee/laborid/>

107 SmartIC FMS Robotics Demo-Centre, demonstration video, <http://smartic.ee/meedia/>

108 SmartIC digital twins (IVAR lab), <https://ivar.ttu.ee/>



Good practices of DIHs offering “ecosystem building” services

3IF.be DIH¹⁰⁹ (Belgium) aims to support the digital transformation of local and national manufacturing SMEs through cybersecurity and IoT technologies and innovations. The hub is part of *Flanders’ Industrie 4.0 policy initiative*¹¹⁰ financially supported by the Flemish government and one of the 7 Fieldlabs running under *Flanders Make sustainable development initiative*.¹¹¹

Coordinated by *LSEC*¹¹² and Belgium’s largest industry associations, the hub addresses more than 2500 manufacturing SMEs on a regional, national and European level specialising in the fields of industrial automation and IT security, facing the challenge of protecting industrial control and production systems and networks. 3IF.be hub’s ecosystem is also actively supported by PWC and Control & Protection, business and industrial solution providers, members of its board. Additionally, an extensive list of competence centres, RTOs and universities, part of the hub’s network, are reachable through its dedicated *online search portal*.¹¹³

In close cooperation with the SMEs, 3IF.be hub has shaped its service portfolio which includes testing and prototyping of the latest digital innovation technologies through access to its *high-tech infrastructure facilities and IIoT Fieldlab*,¹¹⁴ *training on Industry 4.0*¹¹⁵ applications and technologies relevant for the manufacturing industry as well as access to innovation funding for SMEs through various funding platform such as *VLAIO* in Flanders,¹¹⁶ *AWEX* in Wallonia¹¹⁷ and *Innoviris* in Brussels.¹¹⁸

e. Support to public sector

Modernising public administrations and services through digital means is crucial to reducing administrative burden on industry and on citizens in general by making their interactions with public authorities faster, more convenient and less costly, as well as by increasing the efficiency and the quality of the services provided to citizens and businesses. Advanced digital technologies can also serve as effective means to support decision-making in the public sector facilitated by real-time and big data, evidence-informed prediction, scenario simulation and greater degree of automation.

Apart from EDIHs that will play an important role in deploying the Digital Transformation Platform Ecosystem and will contribute to the take-up of AI within public administrations, some regional DIHs will also focus on supporting the digitalisation of the public sector. Further use of advanced digital technologies in the public sector will contribute to a better business environment, fostering a market of innovative companies serving the public sector, increased productivity of the economy and more satisfied citizens. Digital transformation in the industry cannot advance if the public administrations cannot follow the same path and DIHs could be an important means to support the digital transformation of the public sector.

DIHs can help public administrations use relevant technologies, agreed standards and open source solutions. Furthermore, DIHs can help them experiment with Artificial Intelligence for real-time policy-making or improving cybersecurity. In this context, a DIH can “partner” with public authorities to procure innovative solutions and bring them into contact with technology providers to stimulate the development of the innovation ecosystem.

The DIH can also take on a role to support the development of pan-European seamless digital service infrastructures (DSIs) and the development of interoperability solutions. This includes building blocks like eID, eInvoicing, eDelivery, eSignature for administrative procedures Big Data and Context Broker for decision-making, etc. and interoperability solutions, such as eHealth patient summary and ePrescription.

For DIHs to serve the public sector, they should consider involving competence centres and actors with skills and experience dedicated to public administration, public procurement and public sector innovation in their consortium. Some areas where the DIH contribution could be particularly important are the following:

- **Clean, sustainable, and smart Communities and Mobility:** to enable stakeholders to work with real-time data in controlled spaces and access adequate computing resources for the uptake of Smart City and Mobility-as-aService (MaaS) solutions. DIHs can support innovators to develop new digital technologies (including AI) by establishing testing and experimentation facilities for smart cities and mobility.
- **Establishment of EU-wide common data spaces**¹¹⁹: developing incubators for aggregating demand for data assets and bringing together data providers, integrators, brokers, data users and service providers, especially SMEs. These will operate in coordination with the Digital Innovation Hubs network.

109 3IF.be DIH Catalogue of DIHs profile, <https://europa.eu/!MQ83VY> website: <http://www.3if.be>

110 Industrie 4.0 in Vlaanderen - Industrie 4.0 in Flanders, <https://www.industrie40.vlaanderen/>

111 Flanders Make development initiative, Fokus-Factory of the Future, <https://www.flandersmake.be/en/projects/fokus-factory-future>

112 LSEC-Leaders in security, not-for profit association & security cluster, <https://www.leadersinsecurity.org/>

113 3IF.be DIH Partners’ online research portal, <https://www.3if.be/en/2016-02-03-08-24-12/institutes>

114 Sirris high-tech infrastructure, promotion video, https://www.youtube.com/watch?v=TN_I2jEyXH4&feature=emb_logo

115 3IF.be Industry 4.0 training, <https://www.3if.be/nl/events/142-2018-04-11-12-industrie-4-0-training-gent-course-2-advanced-concepts-2-dagen>

116 VLAIO funding platform, <https://www.vlaio.be/nl>

117 AWEX funding platform, <https://www.awex-export.be/fr/contacts/centres-regionaux/devenir-client-de-l-awex>

118 Innoviris funding platform, <https://innoviris.brussels/funding>





Good practices of DIHs working with public sector entities

National Research Institute (NASK)¹²⁰ (Poland) is a DIH coordinated by Poland's Ministry of Digital Affairs specialising in cybersecurity, biometrics, ICT, IoT, AI and big data technology domains with the aim to deliver innovative solutions mainly to the government and other public sector entities as well as start-ups and SMEs.

In 2018 NASK hub developed the *BIOWIZ project*¹²¹ to serve the Polish National Police, the Polish Platform for Homeland Security and other law enforcement agencies deal with grave crime cases and perpetrators. The project designed an interactive system application tool, a face recognition library for biometric identification of persons in images and video by using face characteristics and other distinguished features of crime suspects. The library generates biometric profiles based on several integrated modules such as face detection, face tracking in surveillance recording processes and matches video recordings from various sources such as city and street cameras monitoring the subjects especially during mass events or on crowded locations (airports, railway stations etc.).

In addition, NASK hub runs the *ARAKIS-GOV project*¹²² under which an early warning system reporting threats on the internet has been developed in order to support the protection of ICT resources of state administration. *ACADEMICA*¹²³ is another project carried out by NASK with the aim to complete, and in the future replace traditional interlibrary lending systems by lending publications in digital form.

Good practices of DIHs working with public sector entities

Artificial Intelligence & Robotics for Sustainable Development Goals (AIR4S)¹²⁴ DIH (Spain) is coordinated by Universidad Politécnica de Madrid and provides innovative solutions and services to public administrations and industry through *artificial intelligence- and robotic-based technologies*.¹²⁵

AIR4S DIH has supported the Office for Public Participation and Transparency of the city of Zaragoza in improving the way in which they publish their Catalogue open data, moving from a 3-star open data sharing and API into a *5-star open data sharing*, following the open data publication model introduced by Tim Berners-Lee. To achieve this, the hub developed ontology for smart cities, employing the ontologies and vocabularies that can be used for the publication of open data in 4- and 5- star formats, thus improving the legacy source code used in Zaragoza's open data API. The City Council now uses an enriched API that allows combining different datasets that were previously isolated. In addition, AIR4S DIH developed for the Spanish National Library the *datos.bne.es system*,¹²⁶ an open data portal based on semantic technologies that integrates all data coming from authority and bibliographic records and connects the Spanish library data with other data from relevant international libraries. Finally, following the request of RTVE, the Spanish National TV, and CIVIO Foundation, a non-profit organization which monitors public authorities, the hub offers AI services in order to detect potential fake news. This is achieved through access to tools for multimedia data gathering and data lake model creation, machine learning and data analytics towards detecting image/video forgery and detection of source in fake news activities.

¹²⁰ National Research Institute Catalogue of DIHs profile, <https://europa.eu/Mf67Hu> website: <https://eng.nask.pl/>

¹²¹ The BIOWIZ project, <https://ppbw.pl/en/biowiz-a-computer-system-for-biometric-identification-of-faces-and-silhouettes-of-perpetrators-of-crimes/>

¹²² ARAKIS-GOV project, <https://csirt.gov.pl/cer/system-arakis-gov/310,System-ARAKIS-GOV.html>

¹²³ ACADEMICA initiative, video, <https://www.youtube.com/watch?v=v-52PYmV0cg>

¹²⁴ AIR4S Catalogue of DIHs profile, <https://europa.eu/ITr67wv> website: <http://www.upm.es/dih-air4s>

¹²⁵ AI & robotics services by AIR4S DIH, promotion video, <https://www.youtube.com/watch?v=E3B6j5exyHc>

¹²⁶ datos.bne.es open data portal, <http://datos.bne.es/def/ontology.html>

Step 4: Organisation – Governance of a DIH

Analysis of current models of organisation of DIHs in different socio-economic contexts point mainly to three major ways of organising a DIH¹²⁷:

1. Base the DIH on an existing organisation or networks that may already be carrying out DIH-type of services or are given new tasks;
2. Create a new virtual organisation or network consisting of several existing actors;
3. Or create a new coordinating organisation from scratch, either as a unit in a public authority, a foundation or a company (with non-profit scope)

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.

Regardless of whether one is about to set-up a new DIH or to reorganise a DIH, there is no evidence at this point that suggests that one form is better than another one. It is rather the analysis of what exists in a region and the identified needs that should guide the approach.

Hosting organisations could be **competence centres, cluster organisations, university departments, research institutes, SME innovation support organisations, chambers of commerce, science parks, or newly created dedicated DIHs.**

In practice DIHs are in most cases consortia consisting of a range of actors. It is hard for a hub to have all relevant resources for digital transformation in-house, as the SME needs range from new technological competencies to business model development or intellectual property rights (IPR) knowledge, to name a few. The role of partners varies, and it is important to have on board partners who can provide relevant technology services, such as a research & technology organisation (RTO) or university labs, or even an EIT KIC colocation centre. It is also important to engage actors who can reach out to the target group, such as cluster organisations, industry associations and chambers of commerce, as well as partners whose expertise lie on business development and public sector innovation like the European Enterprise Network (EEN), business incubators, accelerators and other forms of support organisation. Other important partners are organisations who can provide skills upgrading and training.

In an early stage when analysing the needs and resources in the region (Step 1), there should be an analysis of which regional partners to include. One approach can be to carry out a functional analysis of which actors in the region have the possibility to deliver different services in its territory. This analysis could be carried out along the line of the possible services as mentioned in Step 3, i.e. which actors have the capacity to provide what services. As EU Member States vary with regards to the set-up of which actors do what, it is not possible to point out which actors should always be involved in a DIH and which services they should be expected to carry out. Table 1 below is an attempt to outline type of actors per type of offered services to SMEs.

Table 1: Services and types of actors

SERVICES	POTENTIAL PROVIDERS
<p>Test before invest Access to facilities for testing and validation, concept validation and prototyping and pre-competitive series production</p>	Research institutes, science labs, science parks, specialised test providers, research infrastructures, pilot production facilities and technology suppliers, large companies
<p>Skills and training University level education, vocational training, awareness creation, digital maturity assessment, market intelligence, mentoring, visioning and strategy development for businesses and foresight, technology road mapping</p>	Universities, vocational training providers, business development agencies, special competence centres, technology suppliers
<p>Support to find investment Access to funding and investor services and building consortia for funding applications</p>	Trade associations, cluster organisations, chambers of commerce, science parks, venture capitalists and VC associations, business angel networks, banks
<p>Ecosystem building and networking Brokerage, networking, collaborative research, incubator/accelerator support, living labs, voice of the customer, product consortia</p>	Trade associations, cluster organisations, chambers of commerce, science parks, innovation support organisations for IPR and business model activities



BIO
NANONET
ASSOCIATION



GOVERNANCE



MADE
Manufacturing Academy of Denmark

Good practices of DIHs with regards to governance/organisation model

BioNanoNet DIH¹²⁸ (Austria), is part of the BioNanoNet association, a network specialising in the Key Enabling Technologies (KETs) of bio- and nanotechnology with international visibility in the thematic areas of health & safety (e.g. nanosafety, nanomedicine), enabling technologies (e.g. sensortechnologies) and sustainability. Fully aligned with *3 national technology platforms (NanoMedicine-Austria, SusChem-AT and Austrian Microfluidics Initiative)*¹²⁹ and the country's initiatives on industry's digital transformation (*Industrie 4.0 Oesterreich and Digital Roadmap*),¹³⁰ the hub supports more than 60 organizations.

BioNanoNet DIH's activities fully cover the 3 thematic areas mentioned above. These separate working groups are organised with the same legal structure, the BioNanoNet association, which is operated by the BioNanoNet Forschungsgesellschaft mbH (BNN), the hub's coordinator.

The association is governed by an assigned President, a board and its *members*¹³¹ comprising gold (mainly universities), silver (e.g. technology competence centres, companies, applied research organizations), standard (academic institutes/working groups, RTOs and Start-Ups) and extraordinary members (incl. governmental bodies, health research institutions, associations). Activities related to the hub's management and public relations as well as the scientific assistants' support provided to the local and national industry are coordinated by BNN. Services offered to local and international organisations are mainly financed by regional, national basic research and European funding (e.g. ERDF, H2020), private investments and memberships.

Good practices of DIHs with regards to governance/organisation model

Manufacturing Academy of Denmark (MADE)¹³² (Denmark) is a public private partnership between industry, foundations, associations and research communities with the aim to create a platform for applied research, development and innovation in Danish production companies focusing on the development of innovative world-class manufacturing solutions. MADE hub is based on the country's national research and innovation initiatives, *MADE SPIR*¹³³ and *MADE Digital*,¹³⁴ which in combination comprise over 100 research projects on 3D printing, robots, smart factories, digital supply chains, data collection and other technologies. In 2020, a new four-year program, *MADE FAST*¹³⁵, was launched focusing on flexible, agile and sustainable production

Supporting annually more than 100 local and national SMEs, MADE DIH has developed services especially for the local industry comprising *MADE demonstration, cluster and development projects*¹³⁶ running also the *Innovation Network for Future Production*¹³⁷ with events and offers such as company visits, Open Labs, conferences and cluster projects.

On a governance level,¹³⁸ the hub is coordinated by the Board of Directors that consists of five industrial representatives, three university representatives and one representative from the *GTS institutes*.¹³⁹ Dansk Industri appoints the five industrial representatives, while the universities and GTS institutes have each agreed a fixed rotation scheme for their representatives on the board. In cooperation with the Board of Directors the hub's Advisory Board advises and decides on strategic issues in relation to the development of the hub. It consists of strong industrial and research national and international profiles, and the members are appointed by MADE's Board of Directors for a period of two years. MADE hub also appoints work package managers, usually professors or lectures, who lead research and cooperate with industry on innovation projects. Finally, the hub has an appointed innovation manager with overall responsibility for the innovation activities aimed at SMEs. It is the GTS institutes in MADE who, through a rotation scheme, occupy the role of MADE's innovation manager. The person works closely with the work package managers to ensure that research results and knowledge are also shared with and tested by a wide circle of SME production companies in Denmark.

128 BioNanoNet DIH Catalogue of DIHs profile, <https://europa.eu/!jT63kP> website: <https://www.bnn.at/>

129 Austrian technology platforms in health and medicine domain, <https://www.bnn.at/national-technology-platforms>

130 Industrie 4.0 Oesterreich, <https://plattformindustrie40.at/> & Digital Roadmap, <https://www.digitalroadmap.gv.at/>

131 BioNanoNet DIH members' list and contact details, <https://www.bnn.at/members>

132 Manufacturing Academy of Denmark (MADE) Catalogue of DIHs profile, <https://europa.eu/!Bq93Db> website: <http://MADE.dk/>

133 SPIR|MADE, <https://en.made.dk/spir/>

134 MADE Digital, <https://www.made.dk/digital/>

135 MADE FAST, <https://www.youtube.com/watch?v=goQk5Qbl21A&feature=youtu.be>

136 MADE services list for SMEs, <https://www.made.dk/saerligt-for-smv/> Indicative video demonstration projects: <https://www.youtube.com/watch?v=ivKLCmmlugA>, <https://www.youtube.com/watch?v=TQ8fzBDYKNo>, <https://www.youtube.com/watch?v=tlh8y9lfxgl>

137 Innovation Network for Future Production, <https://www.made.dk/innovationsnetvaerk/>

138 MADE DIH governance structure, <https://www.made.dk/om-made/personer-i-made/>

139 GTS institutes list, <https://en.gts-net.dk/gts-institutes/>

Step 5: Business model and financing

DIHs serve multiple purposes and provide services that are mixes of public and private nature. A common way to organise the funding of DIHs could be therefore to use hybrid business models that combine public and private financing sources. Previous analysis¹⁴⁰ of existing DIHs suggest that for most hubs the base funding comes from public sources to cover offices, test infrastructure, equipment and part of salaries costs, and to some extent from membership fees. In some cases, beneficiaries pay to receive certain services while other sources could be used to fund or subsidise development projects.

It is recommended that DIHs provide SMEs with at least the basic market-entry services for free, covering the costs with a mix of private and public funding, but more advanced services, such as business model development or test-before-invest, could be provided on a pay-per-use basis. While the latter approach is compliant with state aid rules, it is also in line with established DIH experiences pointing out to the necessity of making companies/beneficiaries commit to the process.

Public funding may also be needed to engage user and supplier companies into specific experimentation projects. This can come from base funding or from applications to different competitive calls. DIHs can also have access to different forms of subsidies or digitalisation vouchers to reduce costs. Some use a membership model, where members get a range of basic services for free and then need to pay for additional services. Training, R&I contracting, testing and service brokerage are also potential revenue streams.

Public funding sources include public local, regional or national funds, as well as European funds such as the European Regional Development Fund (ERDF), the European Social Fund (ESF) and Digital Europe Programme (DEP). Private funding sources could be membership fees, usage fees, or sponsorship from private actors. Different funds can be used for different purposes, as Table 2 roughly outlines in a matrix. Again, there is no one-fits-all model and different DIHs in regions and Member States follow different patterns. It is very important to map and keep track of all potential funding sources to find the ones suitable for the long-term sustainability of a DIH.

Table 2: Funding matrix

COST ITEMS	POTENTIAL FUNDING SOURCES
Staff costs, equipment & facilities	National and regional funds, membership fees, usage fees, sponsorship, ERDF, DEP
Skills and training	National and regional funds, membership fees, usage fees, sponsorship, European social fund, ESF, DEP
International collaboration	National and regional funds, membership fees, usage fees, sponsorship, ERDF, Interreg, DEP
Research and innovation projects	National and regional funds, membership fees, usage fees, sponsorship, ERDF, Horizon Europe
Financial support of SMEs and/or DIHs	National and regional funds, venture capitalists, InvestEU

a. Funding a DIH through European Regional Development Fund (ERDF) and Digital Europe Programme (DEP)

Apart from regional/national development funds available from own budgets a regional/national policy maker that considers investing in DIHs to support digital transformation of SMEs should ponder the current opportunities for funding from EU sources, in particular the 2021-2027 European Regional Development Fund (ERDF) and the upcoming Digital Europe Programme (DEP). It is worth reminding that the DIH has to aim on improving the competitiveness of the local economy by stimulating innovation via digital technologies, and that it should have a specialisation based on local strengths and address local needs.

European Regional Development Fund (ERDF)

As mentioned earlier, within the next Cohesion Policy 2021-2027 the ERDF will be used to purchase equipment, infrastructure and software in delivering services to SMEs and public sector, provided that the objective of the concerned service falls within the following: (i) enhance research and innovation capacities and the uptake of advanced technologies; (ii) reap the benefits of digitisation for citizens, companies and governments; (iii) enhance growth and competitiveness of SMEs, by building local innovation ecosystems or (iv) developing skills for smart specialisation, industrial transition and entrepreneurship.

If ERDF is used for co-financing, the specialisation of the hub has to be in line with the smart specialisation strategy of the region.

For the upcoming programming period 2021–2027 the European Commission is planning to support innovation collaboration between different regions with common smart specialisation priorities through a new (proposed) Interregional Innovation Investment Instrument, which focuses on the commercialisation and scaling up of interregional innovation projects for the development of European value chains. This new tool aims at supporting regions with common priorities in their smart specialisation strategies (S3) to cluster together, in order to scale up innovation and bring innovative products and processes to the European market¹⁴¹. This programme should support several regions (from different Member States) to jointly invest in innovation projects, for example a distributed network of Digital Innovation Hubs.

Digital Europe Programme (DEP)

The Digital Europe Programme (DEP) for 2021–2027 will fund an initiative to set-up a network of *European* Digital Innovation Hubs (EDIH) – *European* being the label that will be given to the DIHs contributing to reach the aims of DEP and receiving funding from it. This initiative will provide financial support for the facilities and personnel costs of the EDIHs. The EDIHs will focus on broad roll-out of the latest digital innovations across SMEs and administrations. **By becoming an EDIH, the DIH will gain knowledge and capacities in technologies such as HPC, AI, Cybersecurity, Advanced digital skills and/or public sector solutions.** The networking of EDIHs will stimulate knowledge transfer, sharing of expertise and reduce duplication or redundancies by optimising investments in infrastructures. The EDIH network will be a means to promote excellence developed locally and export it to other regions in Europe.

More specifically the Digital Europe Programme grants could fund depreciation costs for equipment and facilities (hardware and software), staff costs of qualified personnel including subcontracting for specialists, and travel grants for hub personnel and local stakeholders to work with other hubs.

The Digital Europe Programme grant will fund 50% of the requested amount and Member States (or their regions) should contribute at least an equal amount, either in-kind or in-cash. ERDF and DEP funding can be combined for supporting European Digital Innovation Hubs. It will be possible to use ERDF for the co-investments that are expected to be done by the Member States or their regions, provided that this combination does not lead in ERDF funding of maintenance and operational costs of DIHs¹⁴². If the DEP grant application is approved, the local hub will become a European Digital Innovation Hub and open up its capacities to the whole of Europe. The same reasoning applies to Digital Innovation Hubs funded through interregional investments.

b. State aid considerations

For most DIHs exactly like EDIHs policymakers should consider potential state aid issues. Therefore, for more information on these issues the interested reader should access the European Digital Innovation Hubs Working Document¹⁴³ where this information will be kept updated.



The **Foundation for Research and Technology Hellas (FORTH) / PRAXI Network DIH¹⁴⁴** (Greece) is a leading innovation support and technology transfer organisation in Greece, bringing together 30 years of unique know-how. Its mission is to support Greek enterprises and research organisations achieve cross-border technological cooperation and become more competitive via the linkage between research and industry, the promotion of innovation and entrepreneurship as well as transnational cooperation. At the same time, the hub acts as a ‘one-stop shop’ helping companies and public organizations become more competitive with regards to their business/production processes, products or services in order to achieve a successful digital transformation.¹⁴⁵

FORTH/PRAXI Network offers a variety of services to companies and/or public organisations. It helps them “test before invest” by providing access to technical expertise and experimentation, so that companies can understand new opportunities and achieve return on their investments. The hub uses a business model to receive financing combining national and European funds as well as public and private financing sources. As a member of the Enterprise Europe Network, the largest European integrated business support network, and coordinator of the Enterprise Europe Network-Hellas, FORTH/PRAXI Network provides innovation and technology transfer services fostering the Greek entrepreneurial eco-system. It is also official member of the European Technology Transfer Offices (TTO) Circle. In parallel FORTH/ PRAXI Network acts as National Contact Point for the European Research and Innovation Framework Programmes, such as the current programme Horizon 2020.

In addition, the hub has a strong network of partners such as the Hellenic federation of enterprises (SEV),¹⁴⁶ the Federation of Industries of Northern Greece (FING),¹⁴⁷ the Association of Industries in Thessaly and in Central Greece,¹⁴⁸ the Science & Technology Park of Crete¹⁴⁹ and several others that provide partners resources¹⁵⁰ and private funding to cover access to all research, innovation and digital technology services offered to SMEs and the local industry.

141 For more info on current interregional collaboration partnerships: <https://s3platform.jrc.ec.europa.eu/thematic-platforms>

142 The EU outermost regions are exempt from this rule.

143 EDIH Working Document <https://ec.europa.eu/digital-single-market/en/digital-innovation-hubs>

144 Foundation for Research and Technology Hellas (FORTH) / PRAXI Network DIH Catalogue of DIHs profile, <https://europa.eu/Qw96cR>, website: <https://www.praxinetwork.gr>

145 Praxis Network DIH Services offer, <https://praxinetwork.gr/el/services/overview>

146 Hellenic federation of enterprises (SEV), <https://www.sev.org.gr/>

147 Federation of Industries of Northern Greece (FING), <https://sbe.org.gr/>

148 Association of Industries in Thessaly and in Central Greece, <http://sbtke.gr/>

149 Science & Technology Park of Crete, <http://www.stepc.gr/>

150 PRAXIclub Members, <https://praxinetwork.gr/en/login>



Good practices of DIHs with regards to business model/financing

Data Science and Computational Intelligence DIH (DaSCII)¹⁵¹ (Spain) is a non-for-profit organisation offering services to facilitate the integration of Artificial Intelligence,¹⁵² Data Science¹⁵³ and Computation Intelligence technologies¹⁵⁴ in industry and SMEs across all sectors, in order to help in the process of adoption of digital technologies across the entire value chain, from research and technology developers to end-users.

DaSCII DIH supports more than 30 regional and national SMEs on an annual basis through a wide variety of services¹⁵⁵ provided such as concept testing and validation, training and attracting talent, investment and funding, as well as ecosystem and networking. This service portfolio is financially covered through a mix of public and private funding sources including Horizon 2020, the European Social and Regional Development Funds as well as national basic research and specific innovation funding. On a regional level, DaSCII DIH is fully aligned with the RIS3 strategy for the Andalucía Region¹⁵⁶ receiving funding from its participation to Priority 8 thematic area, the Promotion of the ICT technologies and the digital economy. Furthermore, research funds have been obtained through the hub's participation to more than 30 running regional projects (research projects, FIBAO, CTA contracts, etc.) and several more on a national and EU level such as CIEN,¹⁵⁷ Retos,¹⁵⁸ FP7, H2020 projects and others.

With regards to private funding, the hub has established more than 50 direct research contracts with local and national enterprises allowing the outside world to benefit from its cutting-edge research and innovation activities and services. In addition, partner resources and paid memberships contribute significantly to the hubs business model as its network includes more than 2000 members¹⁵⁹ across all sectors of academia and industry.

Step 6: Create national and international links

Once a DIH is operational, the next step is to build connections with other hubs at regional, national, and European level in order to access additional facilities, fill missing competencies and get support in developing new services and tools. Initially the hub needs to analyse if the right expertise needed to help upgrading the digital competitiveness of local industry exists in the region, or whether external expertise/competencies should be brought in to provide local industry with highly competitive services. The DIH should also consider how it can promote the services of regional providers/SMEs to other parts of Europe (internationalisation). To this end a DIH would engage in collaboration with national and EU actors for matchmaking, to facilitate R&D projects and address joint funding opportunities.

DIHs also engage in national and European collaboration for cost sharing and to build networks where different DIHs can develop specialised expertise. While the network can focus on a certain theme (e.g. Health) infrastructure and test facilities as well as expertise are distributed and located in different sites. For example, this model is being employed in Finland on a national level related to Artificial intelligence.

A barrier to be considered when engaging internationally is language and cultural issues, taking into consideration that DIHs have reported that local companies want to interact with people that speak their native tongue. One way to overcome this is that DIHs team up and co-develop services with DIHs from other regions. This could help in overcoming language issues while also potentially contribute in creating new opportunities to pool funding across participating DIHs.

Creating interregional connections and collaborations can be challenging when funding is needed, as it may require finding other forms of funding models than the ones for local/regional services. Quite often there are regulations that may prevent the use of regional/local funds outside of the territory. To overcome this issue, there are funding opportunities from INTERREG Programmes, from the proposed Interregional Innovation Investment Instrument for interregional collaboration in common value chains (ERDF), or for networking of EDIHs under the Digital Europe Programme. The latter will support the European DIH network and EDIH collaboration to, for example, build EDIHs' local capacity to serve more than one region/country, to export a DIH's excellence, and to connect ecosystems.

EDIHs could export their specialisation to SMEs in other Member States, in the form of opening up their facilities and knowledge to clients outside of its own region. Vice versa, if an EDIH misses certain expertise or facilities to support its own regional clients they can ask the support of other EDIHs who would have this expertise. This could be done on an individual basis, starting from the needs of individual customers, but also in a more proactive way where several hubs together combine their knowledge and facilities to develop common services for their stakeholders. Member States and Regions may decide to invest together in joint EDIHs, e.g. in thematic EDIHs on eHealth technologies.¹⁶⁰

EDIHs can connect different ecosystems by identifying innovation opportunities for users and suppliers coming from different regions. This will help SMEs expand and tap into other markets, develop EU value chains, create new business opportunities for companies or help commercialise earlier innovation experiments or pilots.

The European Commission is providing several tools to support DIH networking and international partnering including the following ones:

151 Data Science and Computational Intelligence DIH (DaSCII Hub) Catalogue of DIHs profile, <https://europa.eu/Pd97ff>, website: <https://dasci.es/>

152 DaSCI Technology Applications Area, <https://dasci.es/investigacion/unidades/dasci-technology-applications-area/>

153 Data Science and Big Data Area, <https://dasci.es/investigacion/unidades/data-science-and-big-data-area/>

154 Computational Intelligence Area, <https://dasci.es/investigacion/unidades/computational-intelligence-area/>

155 DaSCII DIH services portfolio, <https://dascihub.dasci.es/en/home/>

156 RIS3 strategy for the Andalucía Region, <http://ris3andalucia.es/park/>

157 Spain's Strategic Program National Business Research Consortia (CIEN) fund large industrial research and experimental development, <http://www.investinspain.org/invest/wcm/idc/groups/public/documents/documento/mda0/njmw/~edisp/4630560.pdf>

158 Retos Investigación: Proyectos I+D+, Spanish national funding programme for RDI projects, <https://www.ciencia.gob.es/portal/site/MICINN/menuitem.dbc68b34d11ccbd5d52ffeb801432ea0?vgnextoid=437732ee7af1e410VgnVCM1000001d04140aRCRD>

159 DaSCII DIH members' list, <https://dasci.es/about-dasci/members/>

160 Potential examples of projects that are ready for such common investments by several regions are available on the Smart Specialisation Platform for Industrial Modernisation (<https://s3platform.jrc.ec.europa.eu/industrial-modernisation>). They are based on the Vanguard Initiative collaboration model (<https://s3vanguardinitiative.eu>).

- The **DIHNET.EU Community**,¹⁶¹ which is an EU funded project for direct support of Digital Innovation Hubs (DIHs). The objective is to create a pan-European network of networks, of regional DIHs. Through this initiative DIHs can meet, exchange, cooperate, learn, upgrade skills, and identify which of their missing expertise can be found in other DIHs across the EU. They offer training and learning materials and facilitate targeted Working Groups for in-depth collaboration.
- The **Online Catalogue of DIHs**¹⁶², repository or yellow pages of DIHs in Europe and beyond hosted under the Smart Specialisation Platform (S3P) of the Joint Research Center (JRC) of the European Commission. It contains factsheets with profile, contact data, service examples for regional, national, and EU-wide DIHs. The purpose of the Catalogue is to support networking of Digital Innovation Hubs and to provide an overview of the landscape of Digital Innovation Hubs in Europe, supported by Regional, National and European initiatives for the digitalisation of industry. Moreover, the JRC in collaboration with DG CNECT is developing knowledge and guidance material, case studies, good practices and more as regards the role of DIHs in Smart Specialisation Strategies.
- DG CNECT hosts a **webpage with up-to-date information** on the progress of the policy initiative of DIHs within the DEP and the DEI Strategy.¹⁶³
- There are also **several EU initiatives within Horizon 2020** that support the pan-European network of DIHs. These include the projects: Innovation for Manufacturing SMEs (I4MS)¹⁶⁴, Smart Anything Everywhere (SAE)¹⁶⁵, SmartAgriHUBs¹⁶⁶ and others.



Good practices of DIHs supporting SMEs in internationalisation and interregional collaboration

Jožef Stefan Institute DIH¹⁶⁷ (Slovenia) is a Centre for Technology Transfer and Innovation which acts as a financially independent unit within the Jožef Stefan Institute. It aims at enabling and facilitating the transfer of technologies and innovations developed in the Institute into economy and industry, focusing on initiating new industrial cooperation, establishing new spin-out companies, creating market analyses and helping protect and market intellectual property.

The efforts of the DIH result in the following fields: licensing, technical, production or commercial collaboration, joint ventures and acquisition of financing. In specific, with the aim of acceleration of internationalisation, Jožef Stefan Institute DIH offers and enables companies:

- with a provision of light technology audit to identify SME's digital needs
- search for appropriate business partners using its international partnering database,
- publish an offer/request for business collaboration in the EEN database
- participate at international cooperation meetings and missions that present an excellent opportunity for establishing contacts with potential business partners
- receive insight on market opportunities and practical advice on business transactions in foreign countries and markets as well as
- get support on access to finance and practical information on legislation and EU standards.

As the *Enterprise Europe Network*¹⁶⁸ coordinator, which supports SMEs make the most of business opportunities not only within EU but also on an international level, the hub helps local and national SMEs establish international development and business connections. As a partner of the *KET4CP EU project*¹⁶⁹, the DIH supports SMEs with the provision of technological digital solutions in cleaning up their production process by connecting them with local and EU KET centres.

161 DIHNET.EU, <https://dihnet.eu/>

162 Catalogue of Digital Innovation Hubs (DIHs), <https://s3platform.jrc.ec.europa.eu/digital-innovation-hubs>

163 Digital Innovation Hubs (DIHs) in Europe, <https://ec.europa.eu/digital-single-market/en/digital-innovation-hubs>

164 Innovation for Manufacturing SMEs (I4MS) initiative, <http://i4ms.eu/>

165 Smart Anything Everywhere (SAE) initiative, <https://smartanythingeverywhere.eu/>

166 Unleashing the innovation potential for the digital transformation of the European Agrifood Sector, <https://smartagrihubs.eu/>

167 Jožef Stefan Institute Catalogue of DIHs profile, <https://europa.eu/lxj77kF> website: <http://tehnologije.ijs.si>

168 Enterprise Europe Network, <https://een.ec.europa.eu/>

169 KET4CP EU, <https://www.ket4sme.eu/>



Good practices of DIHs supporting SMEs in internationalisation and interregional collaboration

PhotonDelta¹⁷⁰ (Netherlands) is a public-private partnership, a cluster and a DIH with strong regional presence focused on integrated photonics and consisting of a network of companies and high qualified knowledge institutes.

PhotonDelta ecosystem growth objectives are driven by developing strong collaborations with the local and national industry, defining joint roadmaps with them and meeting their business needs by maximally leveraging the hub's collective technology assets and capabilities in design, developing and manufacturing optoelectronics modules and subsystems powered by Photonics Integrated Circuits. PhotonDelta's highly qualified team operates as an agent of accelerating the development and reducing time-to-market of new applications. The hub is enhancing interregional collaboration by leading the *Photonics Interregional Partnership under S3P Industrial Modernisation*¹⁷¹ with the aim to support SMEs working in the Photonic Industry overcome the market barriers. Through the networking and technical services offered to SMEs, the running initiatives as well as collaborations activities in this regard, PhotonDelta's ecosystem enhances existing inter-regional cooperation and kick-starts new ones through building projects with inter-regional involvement such as the currently running EU-funded *EPRISE (Empowering Photonics) project*.¹⁷²

Step 7: Monitoring and Impact assessment

Evaluation and impact assessment are essential elements of any policy intervention. In order to perform simplified monitoring and evaluation to a policy intervention the following steps are required: i) set out a baseline of the current situation before the intervention, ii) define the policy objectives and the challenges to overcome, iii) setup an action plan to achieve objectives, and iv) define expected results and longer term impacts. Monitoring and evaluation are associated with a set of indicators to measure the baseline, the costs related to the interventions, and other indicators monitoring progress, results and impacts.

Digital Innovation Hubs is a new initiative with a range of potential objectives and the services provided can have direct and indirect effects, where the impact can be less tangible, with longer-term impacts that are difficult to isolate (see a list of examples in Table 3). Digital Innovation Hubs as policy tools also interact with other policies and initiatives for digitalisation, innovation and regional development, on a local, regional, national and EU level. This makes the process of monitoring and measuring impacts of DIHs more complicated.

When designing the evaluation framework, the following questions need to be considered: **why do we want to evaluate?, who is the audience?, what are the needs?**

After answering these questions it is suggested to use a mix of summative and formative evaluation. Summative evaluation is the type of evaluation that measures outcomes for accountability purposes while formative evaluation focuses on receiving feedback for learning and ongoing change. It is preferred to use an evaluation framework that serves both purposes at the same time and provides valuable insights to policy makers and the DIH management. Evaluation is often seen as a threat as it is usually associated with accountability, rather than as a learning and development tool. The key to success lies though in making it integral to the DIH process and not introducing it retrospectively.

The evaluation should also reflect and consider the real-world context, as the impacts of the DIH interventions are affected by other economic and policy circumstances. It can be hard to create a direct causality between certain types of DIH interventions and performance of the economy. So, it is suggested to create a type of basket of evidence, using mixed methods. It is also beneficial for communication purposes, to be able to tell a story. Most evaluations and assessments could benefit from considering both quantitative facts and data and more anecdotal types of stories, which are geared towards the target audience.

When developing the evaluation framework, the departure point is an intervention logic that sets out the baseline situation and what services the DIH carries out, possible and desired effects. A number of indicators will be connected to the framework. However, as the policy objective of a DIH can go beyond the direct effect on the beneficiary, the evaluation framework should gather data on both beneficiary level from direct effects, but also indirect effects such as company growth and ecosystem development. Some of the effects can be considered "softer" such as awareness of digital opportunities, but this can eventually generate "harder" results. Therefore, the evaluation needs to be able to capture these two types of effects and connect them. Some direct effects will eventually turn into indirect effects and this will take long time. Therefore, evaluations need to explore both short- and long-term effects.

¹⁷⁰ PhotonDelta Catalogue of DIHs profile, <https://europa.eu/UP66Yk> website: <https://www.photondelta.eu/>

¹⁷¹ European Photonics Alliance, <https://s3platform.jrc.ec.europa.eu/photonics>

¹⁷² EPRISE project, <https://eprise.eu/>

Table 3: Framework of effects¹⁷³

INTERVENTION AREA	DIRECT EFFECTS	EXAMPLE INDICATORS	METHODS
Test before invest: Access to test environments Awareness raising	Better capacity to innovate Higher awareness of digital opportunities Better development processes Better investment decisions	Introduction of new processes, products and services. New patents	Surveys Interviews
Skills and training	Higher competence of staff Better capacity to develop digital solutions and new business models More collaboration with academia and advanced suppliers	Higher competence of staff Better capacity to develop digital solutions and new business models More collaboration with academia and advanced suppliers	Surveys Interviews Social network analysis
Support to investment: Contacts with venture capital Access to public funding for start-ups and R&I	Better investment decisions Risk reduction More and better innovation investments	Introduction of new processes, products and services. New markets More start-ups	Surveys Interviews Data from business register
Innovation eco system and networking	Increased collaboration	More and better quality collaboration in region and outside Between firms, firms and research actors, and public sector.	Surveys Interviews Social network analysis
DIH management	Adequate services Engagement with more users	Numbers of users From desired target groups Satisfaction with services provided Budget in balance	Surveys Interviews

INDIRECT EFFECTS	EXAMPLE INDICATORS	METHODS
Firm level performance	Revenue growth Productivity growth Employment growth Export growth	Data from business registers
Competitiveness and attractiveness of ecosystem	New companies More companies using digital opportunities More growing companies More innovative suppliers Better R&I infrastructure Increased pool of skilled labour and suppliers More open innovation Spill over of knowledge Attraction of investment or talent	Data from business registers Surveys Interviews
System level	Increased regional GDP Innovation system with norms and regulations that re more digital friendly Transition to more digital economy Transition to more sustainable region	Data from business registers

173 Adaptation of Wise, E., Wilson, J. & Smith, M. (2017), Do clusters yield positive effects on firm performance? – a review of cluster programme effect analyses in Sweden and internationally, Tillväxtverket, Stockholm.

Other factors to be added in the evaluation framework could be: DIH management, staff competence, business model.

In order to gather data for this type of evaluation framework, the evaluator will need to use mixed methods, as there is no unique method or set of indicators to answer the questions. Methods include interviews and surveys sent to beneficiaries, especially for “softer issues” and sometimes control groups, but also social network analysis to understand new relations, data from business registers and national statistical offices for economic “harder” results.

Depending on who carries out the assessment, and if the purpose is more formative or summative, one should consider how questions regarding the DIH management and service provision are asked and who is responsible for this process. Beyond the type of customer satisfaction surveys that should be used after finished projects, it can be useful to carry out interviews and surveys on a general basis on the quality of services the DIH provides. Sometimes it is preferable that these types of questions are asked directly to a beneficiary through an independent part.

From the part of the policymakers, an investment to DIH is costly and a cost-effective monitoring and evaluation system should be used in order not to increase costs and complicate procedures, at least in first steps.

As regards DIHs that will be selected to receive a grant to become an EDIH they will have to set out targets to be achieved and to develop or adopt a monitoring system that can produce an activity report and a report on the extent to which they fulfil the set KPI targets. The European Commission proposes a common set of indicators that include: the number of businesses and public sector entities which have used the EDIHs' services (with focus on “test before invest”), by user category (businesses of different sizes, public sector entities, etc.), sector, location and type of support received. The report should also include data on the outcomes of DIH interventions expressed as gains in the level of Digital Maturity of beneficiaries, where the data will be generated through a questionnaire passed to beneficiaries before and after DIH intervention.

3

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