Roundtable on Digitising European Industry

Working Group 1

Digital Innovation Hubs: Mainstreaming Digital Innovation Across All Sectors

Second Report

February 2017

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Executive Summary

Digital Innovation Hubs within the DEI

DEI Working Group 1 focuses on Digital Innovation Hubs (DIHs) as a means of supporting businesses, and notably SMEs and non-tech industry, in their digital transformation under the Digitising European Industry (DEI) initiative. It brings together stakeholders with interests in running and operating Digital Innovation Hubs as well as potential beneficiaries in industry.

To date, the WG1 has held two meetings in Brussels, together with a series of phone conferences. A further meeting was organised within the context of the DEI Stakeholder Forum in Essen. The discussion at these workshops has focused on four key issues:

- What are the needs of industry with respect to digital transformation?
- What are the characteristics of a Digital Innovation Hub?
- How to develop a network of Digital Innovation Hubs in Europe that reflects these needs?
- Which investments are necessary to successfully build the network of DIHs?

The WG1 meetings have also showcased a number of ongoing initiatives and projects at EU and national level and facilitated networking between practitioners 'on the ground'.

The DEI Strategy aims to ensure that any business in Europe should have access to a Digital Innovation Hub at 'a working distance' (i.e. within a form and location convenient for their day-to-day business). Hubs should also play a key role in assessing skills needs and in skills delivery, and foster synergies between digital and other key enabling technologies.

What is a Digital Innovation Hub?

A Digital Innovation Hub (DIH) is a support facility that helps companies to become more competitive by improving their business/production processes as well as products and services by means of digital technology. DIHs act as a one-stop-shop, serving companies within their local region and beyond to digitalise their business. They help customers address their challenges in a business-focused way and with a common service model, offering services that would not be readily accessible elsewhere.

The services available through a DIH enable any business to access the latest knowledge, expertise and technology for testing and experimenting with digital innovations relevant to its products, processes or business models. DIHs also provide connections with investors, facilitate access to financing for digital transformations, help connect users and suppliers of digital innovations across the value chain, and foster synergies between digital and other key enabling technologies (such as biotech, advanced materials, etc.).

The Digital Innovation Hub Model

Digital Innovation Hubs as Tools for Digital Transformation

Digital Innovation Hubs hold significant potential to support and assist SMEs and start-ups and could become key actors in bringing digitisation within the reach of all industry sectors. The WG1 community strongly supports the proposed European network of Digital Innovation Hubs as a means of supporting businesses, and especially SMEs and non-technology intensive industry, in seizing the opportunities of digital transformation.

Key messages from the WG's discussions so far in terms of achieving this goal are:

- **Europe has a wealth of knowledge and experience in hub-type initiatives** on which to draw in implementing such a network. Solid examples are evident at European, national and regional levels and further instances are set to emerge as a result of policies designed to accelerate and give direction to digital transformation. At present, however, the available and emerging provision is not sufficiently visible either to industry or to other hubs and initiatives. Much greater transparency is required, so as to facilitate both access for companies and mutual learning between service providers.

- Digital Innovation Hubs must **cater for a wide spectrum of needs and as such will have multiple facets**. They must be agile and demand-led, and build sustainable innovation ecosystems, not just gateways to services. While there can be no one-fit-all approach, Hubs should be united by common values based on independence, a commitment to excellence and customer service, and a proactive, innovative approach.

- Digital Innovation Hubs should offer **a broad range of services accessible through multiple entry points**. Core services should include: awareness creation around the business potential of digital technologies; innovation scouting; visioning and strategy development; working with companies to assess their digital maturity and develop appropriate plans; brokering relationships with service providers; mentoring and training; and cost-effective access to specialist experimentation, testbeds and production facilities. The available services should complement rather than compete against existing public and private service offerings.

- **Digital Innovation Hubs have to pioneer a new and distinctive approach**. They must be evangelists for digitisation within their constituencies. They must be highly client focused while having collaboration and networking as a defining characteristic. They must instil entrepreneurial thinking and embed a digital culture in companies while being firmly rooted in practical business solutions. They must have a strong physical presence while also operating effectively in the digital space. And they must have flexible business models that are able to adapt and evolve over time as circumstances and funding regimes change.

- **Establishing and strengthening a European network of Digital Innovation Hubs** will require, among other measures: mapping service provision and sharing information; building capacity and skills in both breadth and depth; building collaboration between digital and other high tech innovation hubs; and creating incentives for SMEs and others to engage with the network. A 'light touch' governance is foreseen with minimal central coordination. Recognition of hubs on the basis of national/regional funding and adherence to a lean and flexible set of network guidelines are envisioned as the key elements of the quality assurance regime.

- **Mobilising the many investment tools and funding programmes available represents a major challenge.** The aim should be to create an 'investment triangle' between region-technology-funding, with the three elements being co-located. Further consideration is required on the roles of national/regional versus European funding, mechanisms for combining and scaling different funding sources, and investment approaches for regions with little or no existing infrastructure. In general, the approach should be **stay local where possible and go European where necessary**.

An Agenda for Action

A Europe-wide network of Digital Innovation Hubs able to support any business at 'working distance' is ambitious but thoroughly achievable. The Working Group 1 recommends the following as areas for priority actions in realising this objective. Certain actions are already underway or are planned, others require further elaboration:

- **Action Lines 1-3: Continue to build consensus between stakeholders over the nature and direction of the European network of Digital Innovation Hubs**. Actions should aim to: improve and grow the information base on and for DIHs beyond the initial DIH Catalogue; network stakeholders across Member States and regions, building on the WG1 and DEI Stakeholder Forum; and ensure high-level political support for DIH investments through the DEI Roundtables and other policy forums.
- **Action Line 4: Launch pilot actions aimed at developing synergies and building larger initiatives**. These pilot actions should be varied in their scope and intent, aiming to demonstrate mechanisms for: upgrading existing competence centres to Digital Innovation Hubs; facilitating knowledge transfer within the DIH network; combining different funding sources within scalable projects; creating synergies with hubs active in other advanced technologies; and federating existing projects funded by different agencies into larger initiatives.
- **Action Line 5: Intensify outreach to regions with few DIHs**. Partnering/sponsorship programmes should be established, where regions work with others with successful Hubs to understand what they are and the benefits they can bring. New Hubs would draw on guidance and support from these other regions and might even set up formal relationships (i.e. become satellite hubs). Regions could use ESIF, EFSI or other sources of funding to set up DIHs and to generally foster collaboration between Hubs.
- **Action Line 6: Utilise H2020 investments to enhance EU added value.** Horizon 2020 (together with COSME) will be a powerful catalyst in seeding and growing the DIH ecosystem. EU funds should be used to network EU, national and regional infrastructures; facilitate converge of EU-schemes under the DEI and broad innovation umbrella; promote cross-border experiments; make DIH business models more sustainable; and pool resources across programmes. By focusing on actions that enhance EU added value, H2020 (with contributions also from other EU programmes) will become the linking pin in the DIH and other high-tech hub initiatives.
- **Action Line 7: Mobilise investment by the Member States**. Continuing investment at national and regional level will be essential to realising a truly pan-European DIH network. As well as developing digitisation policies and providing investment for Digital Innovation Hubs, national and regional authorities must stimulate and animate their own local ecosystems and foster synergies with other enabling technologies. This means, for example, showcasing how DIHs may be setup and run; engaging local/regional hubs and competence centres in the DIH concept; showcasing how European funding could be used to create DIHs; and generally creating space for bottom-up initiatives.
- **Action Line 8: Activate the European network of Digital Innovation Hubs**. Building on the solid foundations established through Working Group 1, European stakeholders should take immediate action to operationalise individual DIHs and start down the path towards a European network. This should include concerted effort in relation to: hub business models; common systems, methods and tools; and collaboration and governance structures.

The message from industry is that speed is of the essence: the benefits for the European economy and society from digitisation are huge and our international competitors are already setting their own course. **Europe must act now to make Digital Innovation Hubs a reality**. The discussion continues and the WG1 will report further in future reports.

1. Introduction

1.1 Background to DEI Working Group 1

Digital technologies are dramatically changing the way we design, produce and commercialise all types of goods and services. They will shape the markets of the future. To reap the potential of digital technologies across the European economy, industry in all sectors and everywhere in Europe needs to integrate digital innovations as an essential part of value creation in their business strategies.

Digitisation offers impressive new opportunities to strengthen the position of European industry. According to reports by PwC[1] and Boston Consulting Group[2], digitisation of industry would offer benefits that could generate for industry in Europe additional annual revenue of €110 billion. As opportunities of digitisation are recognized around the world, triggering a corresponding level of investments across the globe, digitisation can be either an opportunity or a threat, depending on the timeliness and the adequacy of one's response to it.

Against this background, the Digitising European Industry (DEI) initiative aims to ensure that any industry in Europe, large or small, wherever situated and in any sector can fully benefit from digital innovations to upgrade its products, improve its processes and adapt its business models to the digital age. This requires not only a dynamic digital sector in Europe but also the realisation of full access to digital innovations across all industrial sectors. This policy is set out in detail in a Communication adopted in April 2016.[3] The DEI initiative aims towards:

- Coordination of initiatives for digitising industry;
- Co-investing in Europe's digital innovation capacities;
- Providing the appropriate regulatory framework conditions;
- Providing human capital with the necessary skills for the digital transformation.

The DEI initiative requires ambitious collective effort involving public and private stakeholders across Europe at regional, national and EU level. A key element of the DEI is Digital Innovation Hubs (DIHs), which aims at supporting businesses, and notably SMEs and non-tech industry, in their digital transformation. The implementation of the DEI initiative is being supported by a Roundtable of High-Level Representatives of Member States' initiatives, industry leaders and social partners, which meets twice a year. The first Roundtable was held on 20 September 2016 in Brussels.

To support its work the Roundtable has set up two Working Groups (WGs) in order to make progress on aspects of the implementation of the DEI Action Plan. The focus of the two WGs is as follows:

- Working Group 1: Mainstreaming digital innovations across all sectors;
- Working Group 2: Strengthening leadership in digital technologies and in digital industrial platforms across value chains in all sectors of the economy.

Each WG has been asked to produce a report supporting the implementation of specific DEI actions. The WGs will perform fact finding, collect best practices and formulate recommendations, e.g. on policy matters and mobilisation and leveraging of investments, addressed to the High-Level Representatives attending the Roundtables. This report concerns the results of WG1.

[1] *Opportunities and Challenges of the Industrial Internet*, PwC (2015)
[2] *The Future of Productivity and Growth in Manufacturing Industries*, Boston Consulting Group (2015)
[3] Digitising European Industry (DEI): Reaping the full benefits of a Digital Single Market. Communication (COM(2016)/180)

1.2 Mandate of Working Group 1

The Roundtable has issued the Working Group 1: Mainstreaming Digital Innovation Across All Sectors with the following mandate:

- Describe current approaches and best practices and **elaborate in more detail the Digital Innovation Hub approach** and the plans for their further development.
- Reflect on how **Member States, regions and the private sector could fund the expansion of Digital Innovation Hubs** from sources such as the ESIF[4], EFSI, or other national and regional funds, mobilising at least €5bn from different financial sources.
- Reflect on how to best support the **proposed mapping of Digital Innovation Hubs in Europe**.
- Reflect on how to foster synergies and collaboration **between DIH and relevant competence centres**, such as KETs Technology Centres/Pilot Lines.
- Reflect on how **the objectives of Smart Specialisation and the Digital Innovation Hubs schemes** put forward in H2020, such as I4MS, could be mutually reinforcing, and in particular to reach out to less developed regions.
- Advise on specific actions needed to **mobilise all levels of policy and decision makers**, including investment by the private sector and connecting to the investment community.
- Identify areas where **wider use of public procurement of innovations** would support the further development and scaling up of digital technologies.

The WG was tasked to develop a report on approaches, best practices and plans for the roll-out of Digital Innovation Hubs according to the following schedule:

- A first draft of the report before the end of December 2016;
- Revised draft for the DEI Stakeholder Forum (end of January 2017);
- Final version for Hannover Fair, April 2017.

1.3 Methodology

WG1 held a first meeting in Brussels on 20 October 2016. Around 80 representatives from industry (including SMEs), Member States, regions, and social partners attended and addressed a series of questions related to the above mandate. The meeting included a series of scene-setter presentations and more focused discussions and exchanges within smaller discussion groups.

This first meeting focused on three key issues, each of which was broken down into a series of sub-questions:

- What are the needs of industry with respect to digital transformation?
- How to develop a network of Digital Innovation Hubs in Europe that reflects these needs?
- Which investments are necessary to successfully build the network of DIHs?

Following this meeting four phone conferences were held that explored specific topics in greater depth, namely: industry needs, investing in digital innovation hubs and networking digital innovation hubs. The discussions were recorded using the Groupmaps tool.

Building on the results of the first workshop and the phone conferences, a second meeting was held on 9 December 2016, also in Brussels.[5] The discussion there further elaborated on the characteristics of a digital innovation hub and showcased a number of ongoing initiatives and

[4] This includes for example the development of the required high-level master plan for Digital Innovation Hubs supported bottom-up through the ESIF programme (Structural Funds).

[5] Report available at https://ec.europa.eu/futurium/en/node/1750. Presentations available at: https://ec.europa.eu/futurium/en/content/dei-wg1-presentations-workshop-9-december-2016

projects at EU and national level. A further meeting was organised within the context of the DEI Stakeholder Forum in Essen on 1 February 2017, involving the wider stakeholder community.[6]

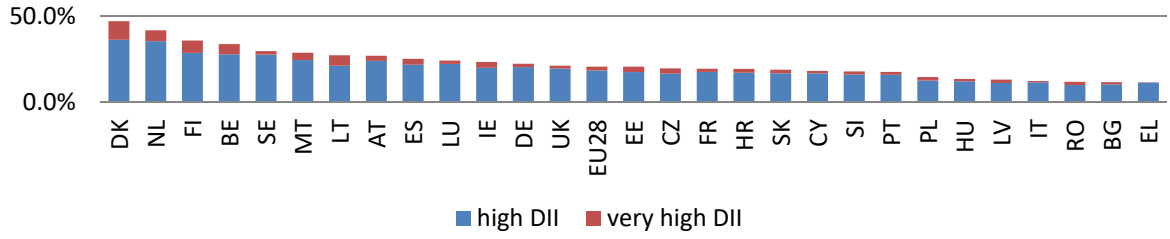
This report presents the Working Group 1's achievements so far. Section 2 summarises the digitisation challenge facing industry in Europe and the benefits to be gained from wide scale digitisation. Section 3 describes how Digital Innovation Hubs respond to this challenge, offering a key agent for mainstreaming digital innovation across European industry irrespective of sector or location. Section 4 briefly reviews existing initiatives and policies in this direction being pursued at European, national and regional level, as well as by industry itself. Sections 5-7 get to the heart of the discussion, setting out in turn: the DIH value proposition, services and characteristics; the key challenges in establishing an effective network of such hubs at European scale; and issues relating to investment and financing. Finally, Section 8 draws the arguments together into a series of targeted recommendations for priority actions ('Action Lines') necessary to make the European network of Digital Innovation Hubs a reality.

2. The Digitisation Challenge

The use of digital technologies in industry varies across sectors and Member States, particularly between high-tech areas such as aerospace and more traditional areas such as construction. There are also significant disparities between large companies with the capacity to invest in innovations and SMEs that struggle to keep pace with fast technological development. With many countries lagging behind in the creation of favourable conditions for digital entrepreneurship, the progress among Member States also reveals a scattered picture.[7]

The Digital Intensity Index (DII) is a micro-based index that measures the availability to firms of twelve digital technologies.[8] Only in five EU countries is the percentage of firms with a very high DII (i.e. possessing at least 10 out of the 12 monitored digital technologies) above 5%: DK, NL, FI, BE and LT. In the first four countries at least one third of firms also have a high or very high DII (i.e. firms have at least 7 out of the 12 monitored digital technologies). At the end of the tail (IT, RO, BG and EL), less than one firm out of eight has invested heavily in digital technologies (i.e. has a high DII).

Figure 1: Percentage of enterprises with a high (>6) or very high (>9) Digital Intensity Index across EU countries (2015)



Looking at the breakdown per type of company, we see that 54% of large enterprises are highly digitised (i.e. use more than seven of the digital technologies mentioned above), whereas this is the case for only 17% of SMEs.

The breakdown per sector shows that the most digitised sectors are computer programming, consultancy and related activities (63%), telecommunications (59%), and publishing (54%), whereas

[6] Presentations available at https://ec.europa.eu/futurium/en/content/stakeholder-forum-essen-presentations-workshops
[7] See, for example, Digital Entrepreneurship Scoreboard: http://ec.europa.eu/growth/tools-databases/
[8] The Digital Intensity Index is part of the Digital Entrepreneurship Scoreboard.

the least digitised sectors are construction (4%), basic metal manufacturing (9%), and food manufacturing (13%).

In surveys, close to two-thirds of managers in industry say they:

- have difficulties in assessing the Return on Investment in digital innovations;
- have problems with trusting the technology;
- are not sure about the maturity of the latest technologies (Big Data, AI, robotics, …);
- are not clear about compatibility/interoperability with legacy systems;
- are afraid of being locked in with one vendor.

For SMEs, the proportion is even higher. Thus, there is a clear need from industry not just for information but also to be able to assess and understand the practical implications of digital innovation, and then to test and experiment before implementing it.

With economies in Europe ever more closely connected and industry building ever stronger cross-border value chains, the digitisation of industry needs to be comprehensive all across Europe. We have to do more, therefore, to focus efforts on helping those regions and economic sectors that have yet to fully engage with the digitisation agenda.

Under the DEI, it is proposed to make the latest digital technologies available for all industry anywhere in Europe through networks of Digital Innovation Hubs.

3. Digital Innovation Hubs: A Key Agent for Mainstreaming Digital Innovation

3.1 What is a Digital Innovation Hub?

A Digital Innovation Hub (DIH) is a support facility that helps companies to become more competitive by improving their business/production processes as well as products and services by means of digital technology. DIHs **act as a one-stop-shop**, serving companies **within their local region and beyond** to digitalise their business. They **help customers address their challenges** in a business-focused way and **with a common service model**, offering services that would not be readily accessible elsewhere.

The services available through a DIH enable **any business** to access the latest knowledge, expertise and technology[9] for testing and experimenting with digital innovations relevant to its products, processes or business models. DIHs **provide connections** with investors, facilitate access to financing for digital transformations, and help connect users and suppliers of digital innovations across the value chain. They also **foster synergies** between digital and other key enabling technologies (such as biotech, nanotechnologies, and advanced materials). These services are of particular relevance to **companies which currently have a relatively low level of digitisation** and which do not have the resources or personnel to address the digitisation challenge, for instance SMEs and mid-sized companies.

Apart from a focus on technologies, a DIH may focus as well on certain sectors, for instance on agriculture, textiles, or construction. Proximity between DIHs and companies is an important factor and the first point of contact for companies will often be a DIH in the same region.

[9] Key technologies driving the digitisation agenda, to which DIHs may provide access, include: robotics, photonics, high performance computing (HPC), data analysis, simulation, Internet of Things, cyber-physical systems, and cybersecurity.

Figure 2: The Digital Innovation Hub Model[10]

As **an innovation ecosystem** that provides access to the services, facilities and expertise of a wide range of partners, Digital Innovation Hubs ensure that different customer segments get the services they need; that DIHs co-operate effectively with each other; and that the supporting competence centres create solutions that are easy to scale.

Under the DEI initiative, **the goal is to ensure that any business in Europe should have access to a Digital Innovation Hub at 'a working distance'** (i.e. within a form and location convenient for their day-to-day business)**.**

Competence Centres and the added value of Digital Innovation Hubs

Initiatives with certain of these features are already evident in many parts of Europe and across various sectors. Generally known as 'competence centres' (CCs) or 'centres of competence' (CoCs), they have proven to be very valuable in helping companies tackle their digitisation challenges.

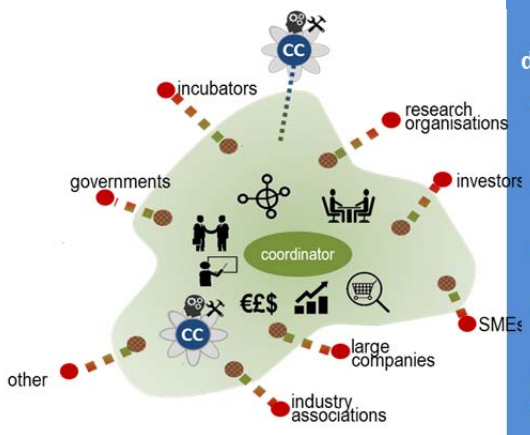
Existing CoCs usually have a strong sectoral or regional focus. They offer help to companies through: providing access to infrastructure and technology platforms; providing digitisation and application expertise; supporting experimentation in real-life environments; supporting fabrication of new products; demonstrating best practices; and showcasing technologies in pilot factories and fab-labs. Some CoCs offer only technical services without business, financial and training aspects, whereas others offer the wider range of services associated with a Digital Innovation Hub.

Figure 3: Competence Centres as the Core of Digital Innovation Hubs

Digital Innovation Hub

Organised to provide services to industry

- Access to competence centres
- Development of innovation ecosystem
- Brokerage
- Access to finance
- Market intelligence
- Training and education
- Incubator/mentoring services



Competence Centre

Competencies in digital technologies

- Provide access to infrastructure and technology platforms
- Provide digitisation and application expertise
- Support experimentation in real-life environments
- Support fabrication of new products
- Demonstrate best practices
- Showcase technologies in pilot factories, fab-labs

[10] Diagram by Tapio Virkkunen, Ministry of Economic Affairs and Employment of Finland

Universities, research technology organisations (RTOs), private consultants, design houses, and private research organisations may all be involved in competence centres. The resulting CoCs can be very different in nature, for example:

- Contract research institutes that are specialised in applying innovative technologies to solve challenging problems brought to them by enterprises and SMEs.
- Demonstration factories/showcases that show advanced technologies integrated in manufacturing processes.
- Testbed facilities, for instance a factory, hospital, farm, urban area, test-house, power plant, that are open to (potential) users for solving their problems and accompanying them during the whole process, from requirement to testing phases.
- Pilot lines, offering production facilities for companies that have developed new products based on advanced technologies (e.g. nano-electronics, photonics, new materials).
- 'Maker labs' or 'fab labs' that offer introductory courses to help companies understand new technology and offer services for using specialised equipment.

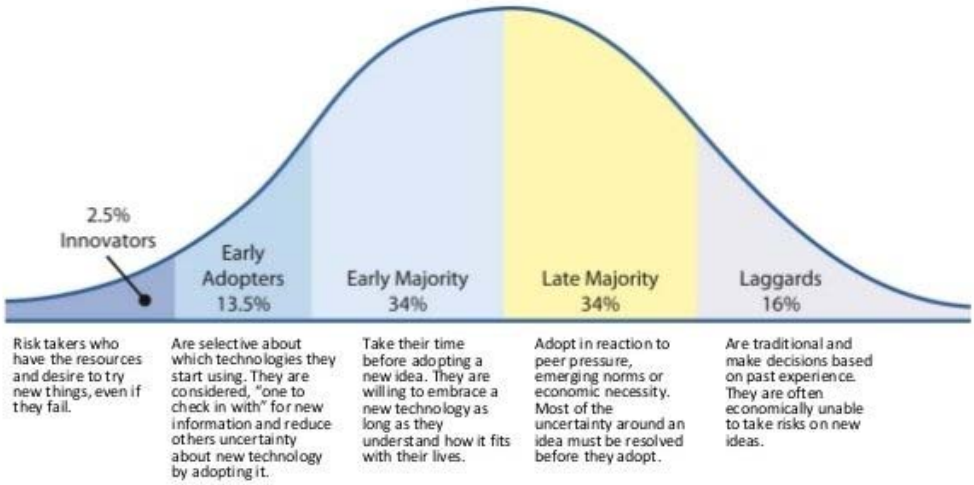
In comparison with competence centres, where the focus is primarily on technology transfer, DIHs take a more holistic view. They encompass a wider range of services, in particular around the business, management and financial dimension to digital innovation (see diagram above), and place a greater emphasis on networking and collaboration. The services available through DIHs enable companies not just to identify technical solutions but to finance and nurture the innovations to a level that they may actually be implemented within the business and contribute to improved competitiveness.

It is important to recognise that these definitions are fluid: in practice there are no distinct boundaries between competence centres and digital innovation hubs. **It is a continuum**, with all such initiatives sitting somewhere between 'pure technical services' at one extreme and 'pure business services' at the other.

3.2 Meeting Industry Needs

To be successful, it is essential that Digital Innovation Hubs address the needs of industry in responding to the digitisation agenda. This means that they must cater for many different types of companies. Potential clients range from 'early adopters' keen to climb the technology ladder, to the 'early majority' and 'late majority' who wait for teething troubles to be ironed out before adopting an innovation, to 'laggards' who may need some convincing about the benefits of new digital technology (see diagram). Thus, the client base spans a wide spectrum, from the digitally 'mature' to 'immature'. Services will need to be equally broad and accessible to companies through multiple entry points.

Figure 4: Technology Adoption Lifecycle[11]



More specifically, in digital manufacturing enterprises and SMEs are seeking:

- Process optimisation based on ICT;
- Improvement and development of ICT-based products and business models;
- General support on ICT usage within business and manufacturing process.

At some parts of the adoption lifecycle the demand is already established, but even these companies do not know where to turn at present. There is a lack of trust in information on digital innovation. Hubs need to be 'honest brokers', facilitating exchange of information and access to services in a trusted way. They should be 'one-stop-shops', offering a single point of contact for trusted and consolidated advice, funding and expertise.

Awareness raising alone is not enough: companies will be looking for a clear and demonstrable business case. So as well as information, the Digital Innovation Hubs will need to demonstrate (not just explain) the benefits of the technologies and work with individual SMEs to transform and change their business models. They should show clients how to build the business case, covering the industrial process and the commercial process, and offer them the opportunity to engage in pilots with user communities (using specialist DIH testbeds).

All of this has to be communicated in a language that SMEs understand; for example, in terms of solutions that increase profitability, competitiveness or customer satisfaction rather than hard technologies. Abstract terms such as 'Industry 4.0' or 'digital transformation' are likely to be especially unattractive.

3.3 Closing the Digital Skills Gap

Digitisation brings an associated need for upskilling of the workforce across the new digital economy. The situation in Europe is critical in this respect and is the subject of numerous reports and studies. Some headline figures serve to illustrate the point:[12]

- 37% of the EU workforce has insufficient digital skills; 13% have no digital skills at all;
- Employment of ICT specialists has grown by 2.9 million in the EU over the last 10 years;

[11] Based on work by Joe M. Bohen, George M. Beal and Everett M. Rogers, Iowa State University. The area under the curve represents the size of the customer group affected.

[12] Digital Economy and Society Index (DESI), https://ec.europa.eu/digital-single-market/en/desi and European Digital Progress Report 2016, https://ec.europa.eu/digital-single-market/en/european-digital-progress-report

- 40% of enterprises trying to recruit ICT professionals have difficulty doing so;
- The number of ICT vacancies in the EU is predicted to rise from 337k in 2015 to 756k by 2020. Such an increase is a clear sign of market failure.

The New Skills Agenda for Europe aims to address the digital skills gap.[13] Adopted in June 2016, it foresees digital skills in all actions, in particular under:

- A Skills Guarantee to help low-skilled adults acquire a minimum level of literacy, numeracy and digital skills and progress towards an upper secondary qualification.
- The 'Blueprint for Sectoral Cooperation on Skills' to improve skills intelligence and address skills shortages in specific economic sectors.

Building on the achievements of the Grand Coalition for Digital Jobs, the Digital Skills and Jobs Coalition will build multi-stakeholder partnerships (spanning education, business, social partners, Member States) to tackle the digital skills challenge with concrete actions.

Digital Skills for Advanced Machine Tools

The machine tool industry is a key enabling and advanced manufacturing sector supplying major European industries. The competitiveness of the sector is based on the knowledge, skills and competences gained through vocational and work-based learning which are needed to design, produce, operate and maintain highly-customized, innovative and high-quality machines.

Funded under the Erasmus+ programme, the Machine Tool Alliance for Skills (METALS) is aiming to develop the skills necessary to maintain the sector's competitiveness. It is developing a new curriculum in areas such as additive manufacturing, building digital learning materials, and generating an e-learning platform.

See: www.metalsalliance.eu

Digital Innovation Hubs should play a strategic role in assessing skills needs and in skills delivery, ensuring that there is seamless access within and across the DIHs to relevant education and training offers and providers. The DIHs can link local and regional training providers, and also connect with other DIHs in brokering and channelling training offers and capacity-building across different industrial sectors in Europe. Furthermore, the same technologies that drive the digitisation of industry (e.g. artificial intelligence, data analytics, AR/VR simulation, robotics) can be used to build digital solutions for up-skilling and re-skilling of the workforce, either through online training courses or on-the-job training. Access to digital training solutions will be especially important for SMEs.

4. Taking Stock: Existing Initiatives and Policies

Many initiatives and policies relevant to the proposed Digital Innovation Hubs exist at regional, national and European levels and span the public and private sectors. Key activities are summarised below, but this is by no means an exhaustive list.

Industry needs to be better informed about the availability of these initiatives and what they offer in order to make best use of them. As yet, however, there is no comprehensive listing of what is happening 'on the ground', especially outside of European initiatives.[14] The recently-launched Digital Innovation Hubs Catalogue aims to provide this more comprehensive picture (see Section 6).

[13] http://ec.europa.eu/social/main.jsp?catId=1223

[14] The Commission background paper *Stock taking on initiatives supporting the development of Digital Innovation Hubs: Lessons learned from EU and national actions* provides an initial mapping.

4.1 European Initiatives

Measures similar in character to competence centres and/or Digital Innovation Hubs are supported under several European programmes, primarily related to the framework programmes for research and innovation. Examples include:

- **Digital Innovation Hubs in Horizon 2020**: The European Commission is programming €500m in H2020 (through the work programmes covering the 2016-20 period) towards Digital Innovation Hubs. Concretely, H2020 is funding projects in which competence centres are providing the desired services and facilities to industry using to a large extent the 'cascading grants' model, which has well proven its applicability in running initiatives like I4MS and Smart Anything Everywhere (SAE). The model allows centres to respond rapidly and with simple contracting mechanisms to industry needs which is essential for SMEs and start-ups. Proposals are short (10 pages) and thus are affordable for SMEs. The contracting mechanisms are simple and lean, allowing for a very short time from idea to hands-on experimentation and development. This is an enormous asset in particular for SMEs.

  I4MS consists of 11 large Innovation Actions funded by FP7 and H2020.[15] It supports SMEs active in the manufacturing sector to improve their products and processes by letting them experiment with digital technologies, such as HPC cloud-based simulation/analytics services, industrial robotics systems, laser-based manufacturing, smart cyber-physical systems, and Internet of Things. A network of competence centres provides access to competences and technology transfer to SMEs through competitive calls for experiments. Successful candidates receive funding for the experiment, from which both technology suppliers and user SMEs may benefit. So far €110m of European funding has been invested in I4MS since 2013. A further €28m has been invested through a similar network of competence centres supported under **SAE**, which supports SMEs to improve their products through the inclusion of advanced ICT components and systems.[16]

- **FIWARE Accelerators and Hubs**: a series of business incubators and accelerators for start-ups and SMEs that make use of the FIWARE technologies developed under the Future Internet PPP (see box).

Good Practice Example: FIWARE Accelerators

The Future Internet PPP has developed an open source platform (FIWARE) offering APIs to developers. In order to make these technologies (enablers) better known the European Commission funded 16 accelerators to promote their deployment in real-world applications. Around €100m was invested in FP7.

The accelerators organised open calls on specific domains, such as health, media, smart cities, agrifood, and Industry 4.0. SMEs, start-ups and web developers were able to apply for up to €100k to develop their application. The initiative attracted over 10,000 submissions, from which more than 1000 SMEs and start-ups were selected to be part of the FIWARE business acceleration programme.

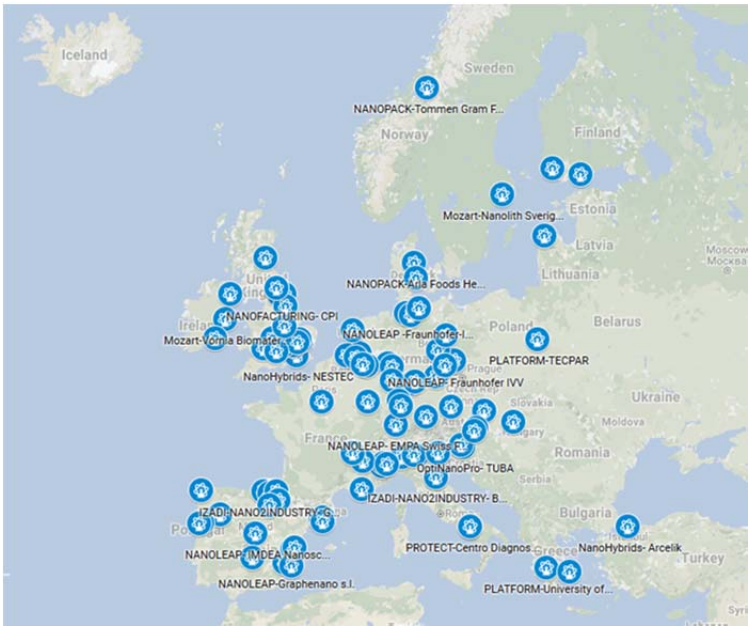
Each of the 16 accelerators has developed its own partner network, linking offices and innovation hubs sometimes in distant countries, connecting tutors, mentors, developers and entrepreneurs, building bridges between people and places, assembling an open community around technology. The accelerators collaborated to exchange experiences and were also linked to European regions in order to take advantage of local ecosystems and regional smart specialization.

See: www.fiware.org/fiware-accelerator-programme

[15] ICT Innovation for Manufacturing SMEs (I4MS, www.i4ms.eu)
[16] Smart Anything Everywhere (SAE, www.smartanythingeverywhere.eu)

- **Data Experimentation Incubators**: A series of incubators being set up under H2020 ICT 14 WP 2016-17 (Big Data PPP: cross-sectorial and cross-lingual data integration and experimentation). The objective is to foster exchange, linking and re-use of data, as well as to integrate data assets from multiple sectors and across languages and formats. This should lead to the creation of secure environments where researchers and SMEs can test innovative services and product ideas based on open data and business data, and should lead to new innovative companies and services for the data economy.
- **ECHORD++**: an initiative to bring robots from the lab to the market. Activities include: the Robotics Innovation Facilities (RIFs), which allow SMEs to try out new business ideas and make field tests at zero risk. It also helps manufacturing SMEs with small lot sizes and the need for highly flexible solutions to try out innovative robotics technologies. ECHORD++ also supports public authorities that are looking for robotics technology at competitive prices for tender processes.
- **Pilot Lines in Nanotechnology and Advanced Materials.** The PILOTS call activities under the NMBP[17] work programmes in Horizon 2020 and FP7 have resulted in 30 projects with a combined funding of €150m. These PILOT projects aim to help transfer new technology developed under Horizon 2020 into industry by providing open access for upscaling and pilot testing to SME users. Additional investments by Member States, public or private organisations have contributed to establishing a variety of pilot upscaling facilities across Europe, mainly in the EU-15 countries. The locations of the 107 pilot lines are shown in the map below. The pilots use many different raw materials, processes, and products, and address diverse sectors and markets, from automotive, aerospace, defence, energy storage, construction industry to cosmetics, health and packaging. The aim, together with the European Pilot Production Network (EPPN), should be to establish a strategic approach to promote technology take-up and the use of these services in particular for SMEs and across regions (access to technology and support for upscaling).

Figure 5: Locations of NMBP Pilot Lines



[17] *Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing*

4.2 National, Regional and Industry Initiatives

Several EU Member States have launched initiatives relating to digital transformation of industry, some with a policy focus, others concerned more with research and innovation. Around ten policy-level initiatives or platforms are already active and more are planned (see map below).[18] Most EU countries are likely to develop a national strategy within the next few years.

Examples of industry digitisation activities being supported under existing national initiatives include:

- **Mittelstand-Digital Competence Centres (Germany)**: An initiative of the German Ministry of Economy and Technology under Plattform Industrie 4.0. Six centres are already operational, with five more launched in 2016, and a further five planned for 2017, providing information, training and support in the implementation of digital technologies in mid-caps and SMEs covering a wide range of manufacturing technologies. Funding is €56m over three years.
- **Alliance d' Industrie du Futur (France)**: Organises and coordinates digital transformation activities of its members (research institutions, public authorities and associations) on national level. Around 1200 SMEs are involved. Four showcases have been developed with Air Liquide, Bosch, SNCF and DAHER on advanced technologies.
- **High Value Manufacturing Catapult (UK)**: The HVMC's Manufacturing Technology Centre (MTC) assists UK companies in applying advanced manufacturing system solutions. Focusing on TRLs 4-6, the MTC helps companies to bridge 'the valley of death' in deploying new solutions in their businesses. Around £40m has been invested in four specialist centres, each of which includes match funding from industry. The MTC funding is split roughly equally between core public funding, commercial funding and competitively won R&D. An independent evaluation has shown that for every £1 of core public funding received the MTC produces £15 in net benefits to the UK economy.

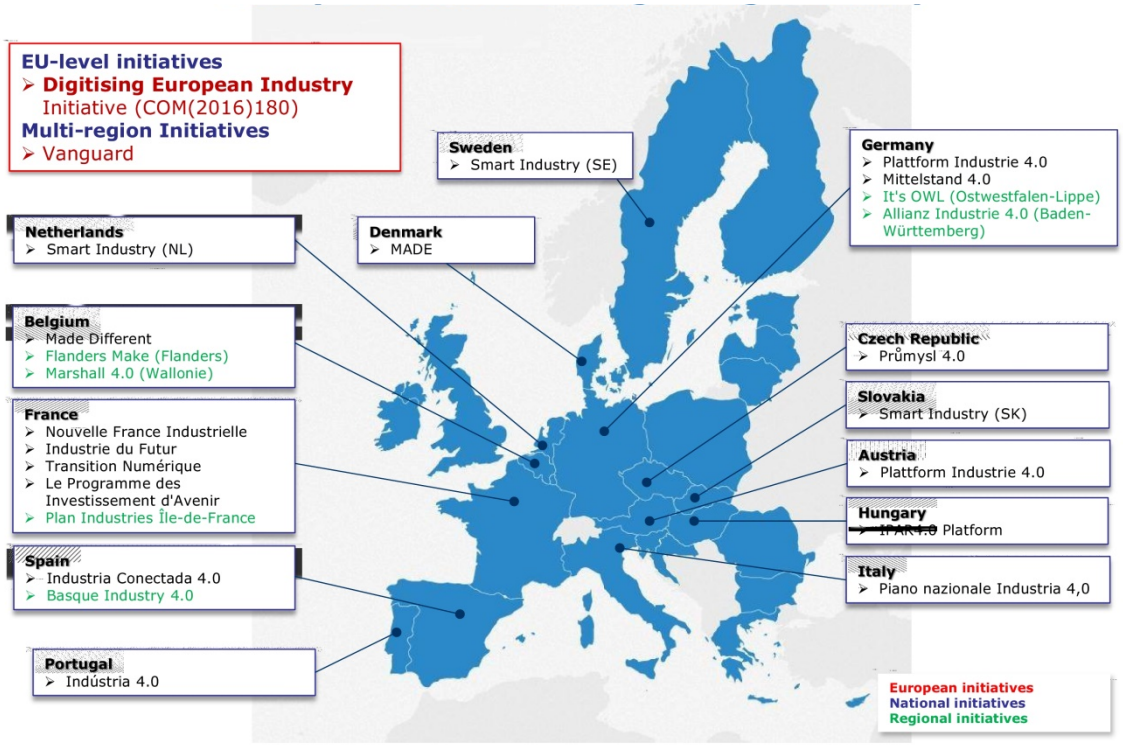
Figure 6: The Manufacturing Technology Centre Ecosystem *(courtesy of MTC)*

- **Intelligent Factories Technology Cluster (Italy)**: Groups large enterprises and SMEs, universities and research centres, entrepreneurial associations, technological districts, and other stakeholders operating in the sector of Manufacturing and Smart Factory. Activities include: research, technology transfer, sharing of research infrastructures and mobility, support to a smart and sustainable entrepreneurship, and support to the growth of human capital. Total funding of €43m is foreseen.

[18] Current and planned initiatives are listed, with live web links, at the Futurium website, http://ec.europa.eu/futurium/en/content/digitising-european-industry-catalogue-initiatives.

- **Tyndall National Institute (Ireland)**: is partnering with a number of regional and national clusters to: launch needs-driven regional and national initiatives; coordinate with public authorities and local government; build European partnerships; and provide B2B match-making and brokerage. For example, Tyndall is part of Ascent, a European project providing SMEs with access to state-of-the-art facilities in nanoelectronics.[19] It is also a partner in PIXAPP, a H2020 project offering the world's first open access photonics packaging pilot manufacturing line. Other activities apply advanced ICT in sectors as diverse as medicine and agriculture, including support for IoT SMEs in accessing funding. It is helping to create innovation networks with multidisciplinary translational competences.
- **Fieldlabs (Netherlands)**: An initiative under the national Smart Industry strategy, translated to the regional level. Supports a wide spread of technologies (mainly manufacturing) and activities (e.g. business coaching), access to regional funds, with five more hubs planned. Total funding of €100m over five years.

Figure 7: National Policy Initiatives for Digitisation of Industry, 2016



As is evident from the map, in certain countries (Belgium, France, Germany, and Spain for instance), regional initiatives have been launched.

Private initiatives are also in evidence. In Barcelona, for example, the I4AM[20] initiative aims to create an ecosystem for 3D printing (3DP) and digital manufacturing with a mixture of private and public funding. Led by leading players such as HP, Renishaw, Leitat Technological Center and others, I4AM aims to accelerate the development and adoption of additive manufacturing and 3DP technologies as an alternative way to design, develop and manufacture new competitive products and services.

[19] www.ascent.network
[20] International Institute for Industrial Innovation in Additive Manufacturing and 3D Printing

Relevant national, regional and industry initiatives are being documented in the Catalogue of Digital Innovation Hubs that has recently been launched (see below).

4.3 Related Policies

Digital transformation is high on the agenda and several new policies are emerging to accompany, to accelerate and to give direction to this transformation. They converge in building new capacities and establishing new connections to adopt key enabling technologies for creating value. They can greatly contribute to establishing a network of Digital Innovation Hubs all over Europe. These policies include:

Regions and Cities of Digital Transformation

In order to leverage regional economic growth and jobs, the Strategic Policy Forum on Digital Entrepreneurship developed a *Blueprint for Cities and Regions of Digital Transformation*: effectively this is a smart policy guidebook for regions and cities to build-up successful local innovation ecosystems.[21]

The Blueprint was based on the comparative analysis of thirteen European cities and regions that have pioneered in digital transformation and restored spectacular economic growth amidst the current economic downturn. The Forum identified four main attributes characterising the most successful regional and local initiatives and shaped relevant policy recommendations, addressed to all local stakeholders, so that they can effectively help their cities and regions, notably through:

1) Leadership and collaboration for a smart governance of the local digital ecosystem;
2) Digital skills and entrepreneurs to accelerate the digital transformation process;
3) Access to data and technologies for applied solutions to local challenges;
4) Key infrastructures and investments for digital launch pads.

In addition, in September 2016 the Commission launched the action *Transforming Regions and Cities into Launch-pads for Digital Transformation and Industrial Modernisation*. It will provide professional advice and support to regions to shape their local digital ecosystems. They will intensify experimentation and networking, help their companies and organisations to innovate, and boost investments in industrial modernisation. DG REGIO and the Committee of the Regions have launched a Call for Expression of Interest for participation (closing April 2017), with promotion through the Watify campaign[22] and the European Enterprise Network (EEN).

Smart Specialisation Platform for Industrial Modernisation and the Vanguard Initiative

The thematic Smart Specialisation Platform for Industrial Modernisation (SSP-IM) was set up by the European Commission in June 2016.[23] This initiative offers support to interregional cooperation based on matching regions with similar smart specialisation priorities related to the modernisation of industry. It is inspired by the Vanguard initiative on regional smart specialisation strategies (see box) and is hosted by the Commission's Smart Specialisation Platform located in Seville. The first thematic networks were launched in October 2016.

SSP-IM is a powerful means for positioning, aligning and integrating funding investments for innovation projects. It enables to focus on joint demonstrations, bridging between the early R&D phases and later industrial investments. SSP-IM aims to create an investment pipeline across the EU,

[21] *Blueprint for Cities and Regions as Launch Pads for Digital Transformation*, Strategic Policy Forum on Digital Entrepreneurship (May 2016), www.digitallytransformyourregion.eu

[22] Watify is a campaign of events and other activities to promote the technological transformation and modernisation of industry that will run until the end of 2018. See www.watify.eu

[23] See: http://s3platform.jrc.ec.europa.eu/industrial-modernisation

by mapping regional strengths and needs, matching them within a value chain, and providing tailored advice and support services. The platform could help regions develop or share infrastructure such as testing facilities, pilot plants, data centres, and fab-labs and develop joint investment projects.

The SSP-IM could be a key platform for developing innovation hubs across Europe and facilitate sharing and networking between hubs. Experience with science parks, for example, shows that the best parks are not simply landlords but complex organisations that play an increasingly important part in local innovation ecosystems. They work extensively with knowledge-based SMEs and start-ups and make valuable contributions to foreign direct investment by high-tech companies. The SSP-IM could support DIHs through facilitating investment in both 'hard' and 'soft' infrastructure, and investment in projects, often as part of a financing mix (multi-level, multi-instrument). The S3 partnerships could be utilised to define user requirements for DIHs and for networked demonstration, again mobilising mixed funding.

Good Practice Example: Vanguard Initiative

The Vanguard Initiative was established in 2014 and is a coordinated effort by 30 EU regions to better align their regional smart specialisation strategies. It has pioneered a new approach to support internationalisation and competitiveness of EU industry by bringing regions (and clusters) together to:

- discuss common objectives and find complementarities;
- map and better understand regions' industrial competencies and capabilities;
- develop joint strategic action plans (building critical mass and complementary specialisations); and
- align strategic investments arising from these roadmaps.

The goal is to create 'inter-regional smart specialisation platforms' and to explore how the combination of different strengths can lead to a faster deployment of new technologies.

The methodology is currently being tested in five pilot actions in the areas of: innovative use of biomass; efficient and sustainable manufacturing; high performance production through 3D-printing; components for marine renewables and offshore energy applications; and new nano-enabled products. These pilots will be further supported by the Smart Specialisation Platform on Industrial Modernisation.

See: www.s3vanguardinitiative.eu

Key Enabling Technologies

Key Enabling Technologies (KETs) are a group of six technologies – micro and nanoelectronics, nanotechnology, industrial biotechnology, advanced materials, photonics, and advanced manufacturing technologies – that have applications in multiple industries and help tackle societal challenges. Three of the six KETs have a strong digital dimension (micro- and nanoelectronics, photonics, and advanced manufacturing). Countries and regions that fully exploit KETs will be at the forefront of creating advanced and sustainable economies.

Actions undertaken within the KETs include assistance to small businesses in accessing KETs technology platforms, and activities on trade, skills, and on the facilitation of large industrial projects. Actions on facilitating cooperation between technology centres and industry have very similar objectives to those proposed for Digital Innovation Hubs. It is envisaged that the two should work very closely together, especially in fostering synergies with other advanced technologies (e.g. sustainable manufacturing, advanced materials, industrial biotech, nanotech). Some KET competence centres already have digital expertise.

Figure 8: KET Competence Centres

The initiative is supported by the KET Catalogue, a mapping tool that provides an overview of the services available through (so far) 187 digital and other KETs-related technology competence centres selected according to a set of qualitative and quantitative criteria.[24] They provide services to enterprises, such as help with prototyping, testing, upscaling, first production and product validation. In addition, the KETs Observatory provides EU, national and regional policymakers with statistical data on the deployment of KETs within both the EU and other world regions (e.g. patenting, production, trade, turnover, and employment).

EIT Knowledge and Innovation Communities

The EIT's Knowledge and Innovation Communities (KICs) are partnerships that bring together businesses, research centres and universities. They allow innovative products and services to be developed in a wide range of fields; new companies to be started to commercialise these innovations; and a new generation of entrepreneurs to be trained. KICs activities cover the entire innovation chain: training and education programmes, reinforcing the journey from research to the market, innovation projects, as well as business incubators and accelerators.

EIT Digital – one of five current KICs – is mobilising a pan-European ecosystem of over 130 European corporations, SMEs, start-ups, universities and research institutes, organised around 13 Co-location Centres in nine countries. These Centres will provide a very important basis for Digital Innovation Hubs in these places. The Centres **act as a networked DIH** by supporting: the development and validation of innovative solutions based on cutting-edge digital technology; the internationalisation of companies and products; and access to qualified ICT talents and/or improving the ICT skills of existing personnel. Furthermore, EIT Digital's ARISE Europe programme is extending the network benefits to regions/countries where there are no Co-Location Centres present.

Monitoring the Digital Transformation

In order to monitor the many national initiatives on digitisation of industry the Commission has launched the Digital Transformation Monitor (DTM) initiative.

The DTM aims to provide concise information on national policy initiatives of EU countries for the digitisation of industries and enterprises covering: policy objectives, budget, implementation, drivers, challenges, lessons learned, etc. DTM reports provide policy-makers with hints and priorities for future gaps that are likely to emerge and highlight synergies between national policies to support the digitisation of industries and enterprises. To date, policy reports for seven Member States have

[24] See https://ec.europa.eu/growth/tools-databases/kets-tools/kets-tc/map. Mapping is currently being updated with additional centres, technologies and services.

been published and more are being developed. A DTM Scoreboard, presenting comparative data in graphical format, is also being launched.[25]

5. Finding Common Ground: Digital Innovation Hubs Explored

Working Group 1 has debated the nature and characteristics of Digital Innovation Hubs at length during the course of discussions that have embraced both potential providers and users of DIH services. These discussions have focused on three key aspects: the value proposition; the service offer to industry; and how the DIH model could be made to work in practice.

5.1 Defining the Value Proposition

The value proposition for Digital Innovation Hubs should reflect the industry needs. This amounts to more than simply a list of solutions and services: it goes to the heart of the Hubs' mission and how they operate.

More specifically, Digital Innovation Hubs need to be able to:

- **Speak the language** of SME businesses and understand their needs;
- Market themselves and **actively identify relevant customers** for their services;
- Possess **significant know-how** in both technical areas and business management;
- **Understand business models and business transformation** and be able to help companies transform;
- Broker between the needs of industry and relevant technology providers in an **independent and unbiased way**;
- Work with companies at **all levels of digital maturity**, including offering low-tech transfer to companies lower down the maturity curve.
- Equip companies with **the necessary skills**, from technical training at various levels, to coaching and mentoring the workforce on how to deal efficiently with the newly digitised products, processes and business models.
- Provide **a gateway** to specialist platforms and infrastructures.
- Provide **funding or facilitate access to funding** from external sources.

These aspects are reflected in the definition of the DIH offer in the next section.

Hubs as ecosystems, deeply embedded within their communities. As the Mittelstand-Digital centres, MTC, and other successful cases show, Digital Innovation Hubs have to build sustainable ecosystems, not just buildings. Rather than being just gateways to services, hubs must be – as the name implies – deeply embedded within their communities. They are physical locations, where SMEs, corporations, start-ups, investors and RTOs work together and are able to engage with the wider network of hubs across Europe.

First and foremost, DIHs work as facilitators, orchestrating an ecosystem around the needs and requirements of their region. Elements of this ecosystem include: universities and RTOs; chambers of commerce; vocational training centres and schools; supply chains; consulting companies and advisors; digital IT SMEs; clusters, networks and associations; and funding agencies and programmes. Hubs will have to stimulate, nurture and animate this stakeholder network in a way that meets the needs of client businesses (enterprises, SMEs, entrepreneurs) while also delivering added value themselves. They must be part network, part marketplace, a combination of accelerator and incubator.

[25] http://ec.europa.eu/growth/sectors/digital-economy/index_en.htm

Core focus on technology validation and demonstration. In terms of innovation level, the focal point for DIH services should be around TRLs 4-7, i.e. technology validated in a lab scenario through to system prototype demonstration in an operational environment. A focus on TRLs 8-9 may also be justified in some cases. Hubs will not generally address TRLs 1-3 – basic and applied research – except where there is a clear and unmet need from within the client base (see below).

Variable geometries operating according to common values. No one organisational model will fit all: variable geometries could exist and, indeed, should be encouraged. Some Hubs will be sector and/or application oriented, whereas others will have an orientation towards particular technologies, users or locations. What should be common to all Digital Innovation Hubs are *their values and ethos*: independence, a commitment to excellence and customer service, and a proactive, innovative, agile approach.

Adding to, rather than disrupting, existing service provision. The attitude toward and relationship with existing service providers will be key. This applies both to the public sector, where DIHs potentially overlap with existing business support centres run by universities, RTOs and training centres, and the private sector, where there are many digital SMEs offering ICT and other services to non-tech SMEs. Hubs must find their own place in this market. This will require them to build relationships with both public and private providers, and **pioneer a new and distinctive approach** so as not to replicate existing forms of support and advice. Clear frontiers should be established so that, rather than competing against existing service providers, Hubs create networks that facilitate non-tech SMEs to access their expertise. They could have a particular role in **reaching out to companies that have yet to engage with the digital transformation agenda** and which existing centres have found hard to reach.

5.2 The Digital Innovation Hub Offer

The Service Portfolio

Digital Innovation Hubs have to translate this value proposition into a unique offer that addresses the specific needs of the companies they serve and does not replicate existing service provision.

In broad terms, the services available through Digital Innovation Hubs may be categorised under three pillars, with the services split as shown:[26]

- **Innovation activities**, concerned with identifying opportunities for digitisation, and developing and validating innovative solutions based on cutting-edge technology;
- **Business development**, concerned with helping companies to apply their solutions, assess the business implications, and manage the resultant changes; and
- **Skills creation**, concerned with building innovation capacity through enriching human capital.

Innovation Activities	Business Development	Skills Creation
• Awareness creation • Digital needs/maturity assessment • Innovation scouting • Access to specialist expertise • Access to platforms & infrastructure	• Envisioning & strategy development • Matchmaking & brokering • Business coaching & mentoring • Start-up support • Access to finance	• Technical training & skills development • Business & finance training & skills development • Management training & skills development

[26] Model developed by EIT-KIC Trento

- Collaborative research

More specifically, the principal services may be defined as follows:

1) **Awareness Creation around Digital Technologies**: Engage objectively and at large within the business community to create awareness of the opportunities and benefits of digitisation. This should go beyond simply disseminating information. **Hubs must be evangelists**, challenging companies to evaluate whether their current efforts really address global trends and threats. Only by focusing on the gap between where companies think are and where they actually are can they start to formulate their true needs in a way that enables them to remain competitive.

2) **Innovation Scouting**: Actively searching for SMEs and midcaps that could benefit from digitisation, understanding their needs and showing them through success stories how they can digitise their processes, products or business models. Channels for this outreach should include innovation scouts who are trained in innovation management; trade fairs and exhibitions; and online channels, including social media.

3) **Digital Maturity Assessment**: Diagnosing a company's needs and readiness in relation to digital technologies, providing feedback on its level of maturity in relation to digital technologies, and identifying potential solutions.

4) **Visioning and Strategy Development for Businesses**: Having identified a company's needs, work with the client to envision its digital future and develop a strategy for delivering this vision. DIHs would help to evolve companies' business models, ensuring they targeted the right combination of digital technologies, digital services, and other advanced technologies in their products. This may involve working with the client directly or directing them to further tailored help and advice within the Hub's ecosystem. In some cases it may be necessary to bring producers and end-users together to develop a common understanding.

5) **Brokering/matchmaking**: Having stimulated interest in digitisation, work with companies to understand their challenges, develop a solution and propose technology and service providers that could help to implement a solution. This could be achieved through direct contact and through physical events that bring stakeholders (e.g. digital IT SMEs, user SMEs, supply chains, investors, other regions) together to network, access information, share experiences, and/or tackle innovation-related problems. Large enterprises could play a key role here, especially by helping small companies within their own supply chains. Formats include roadshows, workshops, innovation camps, and hackathons.

6) **Access to Specialist Expertise and Infrastructure**: Support the technology providers and users to carry out experiments and to test whether the proposed approach would indeed be beneficial for the user. At the same time these experiments can be useful for the provider that has an early customer and can adapt the technology to the needs of a certain class of user. Learning from this experience and creating a best practice which will be disseminated further will be important. The support can be:
    - providing expertise;
    - providing technology building blocks on the basis of which the solution may be built;
    - providing manufacturing pilot lines to produce prototypes or first series production;
    - providing facilities that are needed for testing;
    - providing access to living labs that can validate new products/business models.

7) **Mentoring**: Once a successful experiment has been carried out, provide support on how to roll it out to the next level (start-up/scale-up expertise, business expertise, access to finance,

incubator support services, internationalisation, marketing, market assessments, trend analysis, co-creation, value-chain creation, etc.).

8) **Training**: both technical and management, for the workforce to be able to deal efficiently with the newly digitised products, processes or business models (see below).

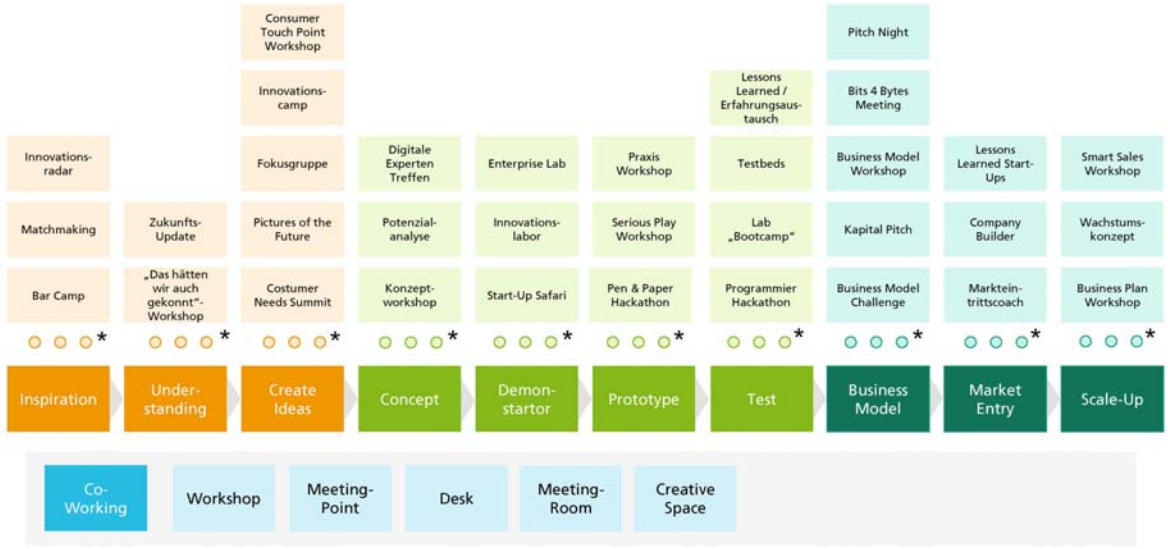
9) **Access to Funding and Investor Readiness Services:** Help for SMEs and start-ups to access regional, national and/or European funding to make use of new technologies (see below).

10) **Collaborative Research on Issues of Common Interest**. Although in general DIHs are not research organisations, in certain cases applied research and development may be justified in areas of common interest for the client companies. Depending on the local circumstances, the DIH could either undertake this research directly or act as the gateway to relevant expertise within universities or RTOs.

Characteristics of the DIH Offer

Staged services offering companies a clear path towards digitisation. Every hub will have its own approach and categorisation of services. What matters is that they are delineated in such a way as to offer companies a clear progression as their needs change and evolve. Digital Hub Dortmund, for example, a digital hub supporting transformation in logistics, offers a portfolio of over thirty services and activities designed to address the full spectrum of needs encountered within its client base. These are arranged in ten groups, spanning from 'inspiration' through to 'scale-up' (see diagram). This illustrates how hubs will need to cater for a very broad range of service provision.

Figure 9: Service Portfolio at Digital Dortmund Hub 'Start-In Factory'



Courtesy of Digital Hub Logistics Agency, Dortmund

Digital Maturity Assessment as a core service. Assessing what stage a business has reached on its digitisation journey is likely to be one of the most important services offered by Digital Innovation Hubs. Such an assessment helps both the business and the DIH to understand the company's current position and to identify future options and needs.

Typically, this would involve either a survey undertaken by Hub experts or a self-help tool that the company could apply itself. The assessment would diagnose the company's needs and readiness in relation to digital technologies, provide feedback on the level of maturity, and direct the client to further tailored help and advice within the Hub's ecosystem. This could include referrals to recognised private sector suppliers (digital IT SMEs, consultancies, etc.). However, even such

assessment services might be seen as competing with private companies offering professional services (consultancies, lawyers) and so conflict with the Hub's role as 'honest broker'.

For example, Mittelstand 4.0-Kompetenzzentrum Dortmund utilises such an assessment to place companies at one of five stages within a maturity ladder, allowing it to match the business to available services accordingly.

Figure 10: Mapping of Digital Maturity Level to DIH Services at Dortmund DIH

Courtesy of Mittelstand 4.0-Kompetenzzentrum Dortmund

Targeting SMEs with High Potential through Innovation Scouting

ACTPHAST, a H2020 support network for photonics innovation, uses innovation scouting as a key part of its business outreach.

Scouts either seek out companies with the potential to benefit from photonics technologies or respond to requests received. A company visit is quickly organised (typically within two weeks of an initial approach) to discuss the innovation request. These discussions take in factors such as: TRL level of the innovation support; company commitment; intellectual property arrangements; maturity of the business plan; and potential impact on growth and jobs.

This personalised interaction between scouts and SMEs enables ACTPHAST to target support towards those SMEs with the highest potential, while also improving the knowledge of many others along the way.

See: www.actphast.eu

Easy and cost-effective access to specialist testing, pilot and experimentation facilities is a unique part of the Hubs' offer. Such facilities are often complex and expensive and no one hub will be able to afford to equip itself with all relevant testbeds. Hence, this is a key area for hub-to-hub collaboration, with hubs sharing and opening up their facilities to others within the network of digital and other innovation hubs. It might even extend to co-investment between hubs/regions in new facilities.

Training and skills will be essential in building capacity within businesses. Activities should cover the whole employment spectrum. Students should be introduced to the fundamentals of digitisation and its potential. Industry should communicate its vision about future needs and requirements to academia and collaborate in developing curricula, such as pan-European Masters courses. Junior employees should have opportunities to take digitally-based apprenticeships and employees at all levels should have access to courses to upgrade their competences. Managers, too, will need to hone their skills around economics, business models and change management. Means should be found to ensure continuous feedback from industry on training and skills needs.

Nurturing a digital culture. Digital innovations and business models will involve a profound shift for many companies. They need to be encouraged not just to write a business case but to think more deeply about the implications of digitisation for the business, addressing issues such as sustainability and monetarisation. They have to establish and embed a digital culture. Entrepreneurial thinking will need to be nurtured and employees empowered.

Access to funding will be another key service. Digital Innovation Hubs should help SMEs and start-ups to access regional, national and/or European funding to make use of new technologies, possibly in line with regional Smart Specialisation Strategies. They could also help and support SMEs to explain their strategies to banks and private investors who often do not understand the need for (apparently) low-tech companies to 'go digital'.

5.3 DIHS in Practice

Beyond defining the services to be delivered, many issues arise as to how the DIH model can be made to work in practice. Contributions in this area have been a key focus for the WG's work to date and are on-going. The discussion below summarises the debate so far.

Business Models for Digital Innovation Hubs

Business models based on mixed funding and that evolve over time: DIHs are fulfilling services of different kinds that have a mixed public and private nature. They require a hybrid 'business model' that combines public and private financing sources. Depending on the situation, money will be needed to build and maintain the infrastructure, buy machines and equipment, and employ qualified personnel. On the income side, membership fees, training, contract R&I, testing, and service brokerage are all potential revenue streams.

Public goods and services are information and knowledge that can be shared and that expose (positive) externalities: therefore they may be subsidised. Private goods and services are appropriated by clients who should pay the market price. Parts of the financing of infrastructures could therefore be provided by private service contracts (that also cover usage of the infrastructure) and by subsidies for research. The same is true for training that is performed on this infrastructure. The combination of different services and functions to fully use the capacity of the infrastructure can be translated into a business model and financial plan that would make it possible to attract banks or other financial agents with a longer-term perspective to invest in the set-up of new infrastructures or the extension of existing ones.

Public funds as a means of de-risking private investments: The business model can only take account of direct financial returns, but the indirect return on investment provides a guarantee for the financial risks. The leverage effect on private follow-up investments will be bigger when more innovation hub services succeed in de-risking private investments in the modernisation of industry which at present are still hesitant. The use of shared infrastructures reduces costs and increases returns for experimentation. The more successful the facilities, the more the capacity will be used and the more services will be paid fully with private funds.

European funding for cross-border collaboration and services: The Commission Communication foresees that funding of cross-border services (such as a company wanting to make use of the specialised services of a DIH located outside its region or country) could be funded at European level through H2020. Local public goods and services could be funded by local public funds.

Governance of Digital Innovation Hubs

What does it take to be part of 'the club'? It is clear that a Digital Innovation Hub can have multiple facets. How many of the services discussed in the previous section must an organisation

cover to be classified as a 'Digital Innovation Hub'? Should there be a list of core services that all DIHs have to provide? What does a DIH mean in organisational terms – is it merely a brand or label that any organisation operating in the field may sign up to? Or does it imply certain minimum competences, in which case who/which organisation would/should certify that relevant standards have been met? Is there a need for accreditation?

The touchstone here is flexibility. We should not be prescriptive in defining what does and does not constitute a DIH. The services offered within a given region should be those **most relevant to the client companies**. Variable geometries are allowed and all Hubs will have access to the extensive expertise and facilities of the wider DIH Network. So while it may be necessary to set out some basic criteria for the services to be offered to industry, these are likely to be sufficiently broad for all reasonably qualified organisations to comply.

Should DIHs be legal entities? The term 'organisation' here prompts a further question: should a Digital Innovation Hub be a legal entity? While in some cases Hub services will be delivered by individual organisations, in others the DIH will effectively be a network of collaborating organisations which may or may not be a legal entity. Again, we should be guided by what works and not lay down rules and regulations that may restrict the scope to act. In certain regions and Member States having a recognised legal entity will be a prerequisite for being able to deliver DIH services in any form to SMEs, especially where public money is involved. In others the rules may allow collective efforts between collaborating organisations. In general, **Hubs should operate according to local conditions** with, perhaps, the legal entity route being considered as a 'best practice' model.

Operationalising the DIH Model

DIHs should have a strong physical presence. It is tempting to think that organisations concerned with promoting digital technologies and services should operate only in the online space: this would be a mistake. As noted above, a key part of the value proposition of Digital Innovation Hubs is that they work with companies at all levels of digital maturity and speak the language of the businesses they deal with. Many of these companies are still 'analogue' and it will be essential not only that Hubs have a physical presence within the communities where these companies are situated, but also that they proactively 'scout' for businesses within those localities. There should be a named contact point for firms to speak to. DIHs should certainly have a strong online identity, but they must also be identifiable physical entities.

Another reason for Hubs being physical is that they will provide access to specialist (and expensive) technology assets – demonstrators, testbeds, pilot lines, etc. These must be readily accessible either within a dedicated DIH facility or at a partner organisation within the DIH network.

Collaboration and networking as a defining characteristic. Central to the Hubs' approach is the notion of collaboration and networking. To deliver its services effectively a Digital Innovation Hub requires a well-coordinated initiative that leverages the skills and capacities of entities across the region and beyond. It must build collaborative relationships in order to:

- be able to identify and respond to the needs of local client companies;
- bring together technology providers and user industries;
- involve the whole value chain;
- animate their networks – both local and further afield – as a coherent ecosystem;
- provide links to other hubs and to digital industry platforms (as being promoted under WG2).

DIHs should work closely with regional authorities and with national agencies to identify industry needs and develop the necessary tools to address them. This would include a gap analysis based on mapping the regional and national landscape in terms of need and existing coverage. In addition to

scouting and brokerage services, service delivery should be supported by networking and match-making activities that directly link needs with the technology and business offering. For instance, the DIH could put SMEs and start-ups in contact with supply chain partners and financial services to support product and service innovations, which would establish a channel for growth. Detailed analysis and specification of companies' training needs will also be an important aspect. This should go beyond the usual academic target-setting and embrace also upskilling of the existing workforce. Stakeholders should be involved in governance so as to help Hubs to define their long-term goals.

Measuring Performance and Impact

Indicators will be required by which to measure the impact of DIHs: Such measures should span from individual hub-client relationships, to a hub's overall performance and the impact of the DIH ecosystem as a whole. Particular emphasis should be placed on measuring the quality and impact of collaborative links, since (as noted above) it is primarily the strength of these links, rather than unconnected activities, which will define DIHs. Key performance indicators at Hub level could include:

- Number of DIH users;
- Number of referrals to ICT companies and other service providers;
- Percentage of users with successful digitisation activities;
- Percentage of users returning and/or referred on for other services;
- Number of events and participation in events;
- Number of collaborations and cross-border linkages;
- Amount of training provided and increases in digital skills;
- Amount of external funding secured for client companies.

Selective measurement indicators could be used to establish benchmarks and standards of services, as well as in sharing best practices.

Econometric measures: Further impact could be measured in terms of increased awareness, enhanced competitiveness and assessment of digital maturity. Examples include: increase in a company's market share; creating value via new markets and business models; establishing new value chains; increasing the turnover ratio between services and products; quantifying cost reductions of services and resource optimisation due to digitisation; number of patents and other IP protections (e.g. registered designs); number of innovation projects (e.g. hackathons); number of people trained in digital skills.

User-rated approaches and social media: Systematic monitoring can be complicated and expensive. While certain performance metrics will certainly be needed, user-rated approaches could also be used. Users should be able to share their experiences of hub providers through a 'TripAdvisor-type' engine so as to create a user-rated ecosystem for digitisation services. Social media should also be used as a means of evaluating hubs' performance.

Communication and Outreach

Ensuring the message is highly targeted and relevant: Communication activities should be targeted, in terms of sector, type of company, etc., and be delivered through both online and offline channels. At its core should be an online portal with readily accessible information on success stories, use cases, best practices, and business models, as well as a catalogue of competences and specialist services.

Instilling entrepreneurial thinking: Equipping businesses of all sizes and sectors to make the most of the new digital age requires profound change at many levels that will only be achieved through entrepreneurial thinking. The communication and outreach activities undertaken by Hubs need to do more than just raise awareness. They have to instil a spirit of entrepreneurship in

companies, stimulating them to raise their game to match the opportunities ahead. Business aspects – such as business models, training, and establishing a digital culture – will be as important a part of the message as the technology.

Addressing public awareness and the social dimension: Communication activities must also address public awareness of digitisation, including the social dimension. Consideration should be given to issues related to the impact on employment (e.g. job losses/displacement due to digitisation; creation of new jobs from increased competitiveness, new markets and business models; benefits and challenges in upskilling of the workforce, etc.); the impact on services (e.g. decrease cost at point of care, safer products, better quality of life, etc.); and issues related to privacy and security.

6. Towards a European Network

Digital Innovation Hubs hold significant potential to support and assist SMEs and start-ups and could become key actors in bringing digitisation within the reach of all industry sectors. The question now is how can policy-makers, research and technology organisations, industry and investors work together to establish and strengthen a European network of Digital Innovation Hubs able to deliver these goals?

The Working Group 1 foresees four key challenges in establishing such a network 'on the ground': mapping service provision and sharing information; building capacity and skills through upgrading existing hubs and setting up new ones; building collaboration between digital and other high tech innovation hubs; and establishing coordination and governance of Digital Innovation Hubs as a European network. These aspects are discussed below and the related issue of investment is discussed in Section 7. The discussion is mapped to the Action Lines recommended in Section 8.

6.1 Mapping Service Provision

While Europe has a wealth of knowledge and experience in hub-type initiatives, the available provision is not sufficiently visible either to industry or to other hubs. Greater transparency on the range of initiatives available would make it easier for companies to know where to turn for help. It would also help individual hubs and the network as a whole to understand the gaps and needs, and the opportunities for collaboration. Such information should be made readily accessible through a **central information portal**, an open catalogue or web-based tool documenting the types of hub, their competences, services, facilities, etc. It should be widely disseminated to industry and multiplier organisations (industrial associations, Hubs themselves, other networks), and regularly updated and maintained. The portal should be used to share experiences and disseminate use cases, for example, to stimulate reuse of solutions between industry verticals and between regions. [➲ Referred in **Action Lines 1, 2 & 3**]

The Commission has recently issued a contract to compile an initial Catalogue of Digital Innovation Hubs, which was awarded to a consortium led by TNO. The project aims to map the provision of DIHs in Europe and compile a database with over 100 DIHs in the EU28, including comprehensive information on each hub. The Catalogue will enable SMEs and industry to find infrastructure and expertise they need and to contact potential partners, as well as provide a platform for Competence Centres and DIHs to advertise their expertise to potential customers. It will also identify networks in the field of digitisation in industry, so as to enable connections between them, and provide policymakers with information about the state-of-play of DIHs in Europe.

Recommendations on how to maintain and further extend the database will also be proposed, including strategy for updating.[27]

Other activities that are contributing to close the information gap are:

- The KET Catalogue mapping competence centres offering expertise in key enabling technologies (see Section 4.3). The DIH and KETs catalogues will be closely coordinated to create maximum synergies, clarity and impact for stakeholders.
- The Digital Transformation Monitoring national policy reports prepared by DG GROW (see Section 4.3).
- National and regional mappings being undertaken by Member States and regional authorities, in some cases as a direct result of involvement in WG1.

Involvement in the WG is also helping actors responsible (or potentially responsible) for DIHs to establish common understanding of needs and requirements and how to deliver them.

6.2 Developing Capacity

Digital Innovation Hubs need expertise in both breadth and depth. On the one hand, they must have the 'soft skills' necessary to communicate with companies, assess their business needs, and promote their own offer. On the other hand, they need specialist technical and management skills to provide tailored solutions, or to access these from elsewhere in the network. Hubs must also be proactive in building networks of stakeholders that help them to engage with companies and others.

Measures will need to be taken to ensure that all Digital Innovation Hubs have the necessary capacity to deliver services across all of these areas. Such actions should address in particular three distinct situations:

- **Upgrading of Competence Centres to Digital Innovation Hubs**: As noted above, some competence centres offer technical services only, whereas others also offer the business and training services associated with a DIH. For those competence centres that are not yet embedded in a DIH, it is important they form alliances with other entities in order to be able to offer an integrated set of services as a 'one-stop-shop', covering technology, skills, finance, and business growth. In such cases, specific measures will be needed to upgrade or transform existing centres into Digital Innovation Hubs. [Referred in **Action Lines 4 & 6**]

- **Federating existing activities into larger initiatives**: To work as ecosystems that span from the local to the European level, DIHs must effectively join up many existing activities. The better networking and upgrading of infrastructures, promotion of cross-border exchanges and experimentation, and integration of regional and industrial hubs and facilities will be essential in creating EU added value. Specific actions will be needed to support stakeholders in coalescing around these larger initiatives. [Referred in **Action Lines 4 & 6**]

- **Setting up new Digital Innovation Hubs**: Competence centres and innovation hubs are not equally spread in Europe and some regions lack the necessary capacity to support their local companies in digitisation. In these cases it will be necessary to set up new Digital Innovation Hubs in places where they do not exist yet. The Smart Specialisation Strategy can be a guide to understand the competencies necessary for such a DIH. [Referred in **Action Lines 5 & 6**]

Preliminary estimates of the associated investment requirements have been made and are being scoped further through the WG (see Section 7 below).

[27] For further information contact the Project Manager, Maurits Butter, maurits.butter@tno.nl

6.3 Building Networks and Collaboration

As already described, collaboration will be at the heart of the Hub philosophy and approach. The actors concerned will be at different points along the CC-DIH continuum and have expertise and facilities in many different technologies and industry sectors. Activities that can help build networks between existing initiatives include:

- The DIH Catalogue, as well as the KETs Catalogue of centres with competences in other advanced technologies and combinations of digital/physical technologies;
- Networking through WG1;
- The annual DEI Stakeholder Forum;
- Dedicated events intended to publicise and promote the DIH concept, including in regions with current gaps.

Existing EU programmes, such as Horizon 2020 and S3, will have an important role in supporting such networking. [Referred in **Action Lines 4, 5, & 6**]

Hubs could collaborate in a number of ways: developing a common approach to service provision (e.g. covering contracts, IPR); developing common services and solutions (e.g. training, tools, events); putting in place exchange programmes between Hubs and/or between client companies;[28] and identifying best practices and areas of competence excellence around which to develop links. The information portal mentioned above could evolve into a more general digital collaboration platform. [Referred in **Action Lines 1 & 8**]

Incentives should be put in place to encourage SMEs to engage with the Hubs and their activities, and also to encourage Hubs to engage with each other. In general, such activities should be financed by local (national/regional) agencies. EU funds could be utilised to incentivise collaboration and exchange (e.g. travel, events), build skills, and undertake research to directly support Hubs in their mission. To ensure activities stay close to the market, cross-border supply chains should also be leveraged for the collaborative development of Digital Innovation Hubs across regions. Such interactions would have a real and visible benefit for all supply chain actors. [Referred in **Action Line 7**]

As well as innovation within the Hubs themselves, there should be dynamic thinking at national level so as to facilitate them in doing their job. This means, for example, showcasing how Digital Innovation Hubs can be organised, engaging with local/regional clusters and competences centres, and creating space for bottom-up initiatives to emerge. National agencies could also show how ESF could be used to create DIHs. [Referred in **Action Lines 2 & 7**]

6.4 Coordination and Governance of the DIH Network

The issues highlighted previously regarding the governance of individual hubs reflect also in the governance of the DIH network.

The notion of a 'European network' of digital innovation hubs raises the question of what form of coordination and governance such a network would require. While certain principles have been established, key aspects of the *modus operandi* of the network remain to be addressed. For instance, given that a 'light touch' is foreseen with minimal central coordination, what form of coordination should actually be put in place?

Issues the Working Group is exploring here include:

[28] For example, exchanges based on the Erasmus model. The scheme could be open both to members of the DIH network and professionals from industry, and could offer both short-term and long-term assignments.

- What would be the criteria for admission/recognition to/within the DIH Network? For example, should a minimum set of services be offered; or should a hub have to meet set conditions in a specific area of service/specialisation.
- Would some form of certification mechanism be necessary and if so by whom?
- What profile should the term 'Digital Innovation Hubs' have within the marketplace? Should it be a brand in its own right or remain in the background as a policy instrument/tool?
- How would issues of competition between Hubs be addressed?
- What governance structures, if any, would the network require?

Based on the discussion within the Working Group 1 to date, it is clear there is little support for a formal certification process. Such an approach would require an accreditation structure, an awarding body, etc.; it would be too rigid and too cumbersome for a network that needs to be defined by its agility and responsiveness to market demands. In order to create a dynamic network, the barriers to entry for DIHs must be kept as low as possible while, of course, maintaining service quality to client businesses.

Instead WG members favour an approach whereby:

- Funding through national/regional authorities is taken as a proxy for quality and **deemed to provide recognition for network membership**. This reflects the fact that local support is very important in configuring hubs within the national/regional context.
- Digital Innovation Hubs are issued with **a lean set of network guidelines** developed collectively and/or by the European Commission, covering aspects such as minimum service levels, working arrangements, etc. The guidance would be flexible to give space for variations based on actual needs.

7. Investing in Digital Innovation Hubs

7.1 Financing Digital Innovation Hubs

The full development of a network of Digital Innovation Hubs calls for a surge in investment in adequate competence centres and in capacity to deliver the services to implement digital transformations.

The volume of investment necessary is difficult to assess at present. Under Commission proposals, it is foreseen that over the next five years an additional 100 new hubs and an upgrade of 200 existing hubs will be required. This means:

- Around 20 new hubs to be established every year with investments primarily targeting the establishment or reinforcement of digital competence centres, focusing on development and experimentation facilities and on relevant expertise (technical, business and financing) to support industry in its digital transformation.
- A regular re-assessment of existing Digital Innovation Hubs across regions in Europe leading to updating and upgrading the existing facilities and resources (40 hubs upgraded per year). All hubs need to have sustainable business models.

The proposed investment plan will take into account the diversity of starting conditions and future needs in the regions and countries. National and regional public-private partnerships are shaping co-investments through their national initiatives on digital transformation.

Possible funding sources are ESIF, EFSI,[29] and other national and regional funds. For example, the European Structural and Investment Funds (ESIF) have programmed around €14 billion specifically for the enhancement of access to and use and quality of ICT (one of the 11 thematic objectives). Another €7 billion under ESIF investments is programmed for digital growth in all other thematic objectives, e.g. related to low-carbon economy, SME competitiveness, research and innovation, transport, environmental and climate solutions, educational infrastructure, e-inclusion, entrepreneurship, health and other themes. Together these represent a significant increase in funding for digital growth. Potential contributions from specific programmes and projects are highlighted further in Section 8.

In total, at least €5bn needs to be mobilised from various financial sources. The following table gives an initial overview of the necessary investments. Further study is required to assess this more fully.

2016-2020	No. of hubs	EU (planned)	Member States (digital focus)	Industry
EU networks (continuation/refocus/stream-lining of existing initiatives)[30]	250 hubs (10-20 digitisation experiments per hub)	€500m (from H2020) (additional cost on top of basic national or regional infrastructures)	Basic innovation/ competence centre infrastructure	€150m
New hubs	100		€2000m	Incl. in MSs
Reinvestment, upgrading of national or regional hubs	200		€3000m	Incl. in MSs
TOTAL		€500m	€5000m	

7.2 Mobilising Investment

It is clear that a great many investment tools and funding programmes exist and need to be mobilised. These include at European level Horizon 2020, Cohesion funds (ESF), EFSI, EIB, and Erasmus+, as well as national and regional funds. Hubs should be designed to match regional needs (e.g. tourism, agriculture) and their strategies aligned with regional/domain specialisation. The new Smart Specialisation Platform for Industrial Modernisation, which aims to mobilise co-investment in new industrial value chains within European regions, is seen as an especially important vehicle (see Section 4.3). Indeed, applications are already being received relating to Industry 4.0 and the assimilation of digital services by SMEs. The aim should be to create an 'investment triangle' between region-technology-funding, with the three elements being co-located. Structures should be transparent so as to prevent double investments.

[29] The European Fund for Strategic Investments (EFSI) administered jointly by the EIB and the European Commission as part of the 'Juncker Plan'.

[30] I4MS, SAE, iHubs, ODINE, ECHORD, ACTPHAST, …

Scalable Funding for Innovation: The EARTO Experience

The 350 research and technology organisations represented by EARTO[31] are at the forefront of innovation funding in Europe. RTOs work with a wide range of organisations – large enterprises, SMEs and RTO spin-offs – and across all sectors and technologies to bring innovative solutions to the market. In doing so, they address the whole value chain and span many technology levels (expressed as TRLs).

This requires the marshalling of funding streams from various sources, often with very different objectives. There are research and innovation grants, through H2020, that support technology development; ESIF grants that support innovation in a regional context; and EIB financial tools (loans, advice) that finance near-to-market activities as well as the creation and maintenance of infrastructures. Added to this are the various national and regional funding systems.

RTOs frequently encounter different funding tools operating at different TRL levels and with different criteria, rules and timing. There are synergies between them but securing these is not straightforward. Funding streams tend to be sequential rather than parallel, which represents a risk to project continuity. In some cases State Aid Rules are also a factor. For example, State Aid considerations apply to ESIF funding but not to H2020 funding and innovation can often get caught in the middle. A coherent approach requires careful consideration so as to establish appropriate risk-sharing between the various stakeholders.

The experience of Europe's RTO could be extremely valuable both in establishing and financing individual hubs and in operating the DIH network. For example, they have experience in launching and operating innovation infrastructures as well as strong links to InnoFin, the innovation financing arm of the European Investment Bank (EIB). At policy level, too, RTOs – through EARTO – could help create the right climate for hubs to grow and prosper.

Three distinct but closely related issues have been identified here:

1) **Accessing launch funding for DIH initiatives**: In most cases some form of launch or seed funding will be required. Where relevant initiatives already exist this might be achieved by aligning existing funds towards the Digital Innovation Hub mission; in other cases separate/dedicated funding may be necessary to facilitate such a realignment. Public bodies can provide valuable pump-priming funds to help create Digital Innovation Hubs.
2) **Ensuring funding is relevant and scalable**: Digital Innovation Hubs will be organic entities whose funding needs (and those of their clients) will evolve over time. Ensuring that the available funding streams are relevant and able to scale as the Hub grows is a key concern. For example, many existing EU schemes aim towards early adopters. It may be necessary to adapt these for mainstreaming investment or to introduce new schemes better suited to those further down the adoption ladder. It will be essential that stakeholders learn from the experiences in this area available through actors such as the RTOs, which show that investments need to be able to scale as the initiative progresses (see box above).
3) **Effectively combining funding from different funding sources**: The strategic alignment of financing from different schemes (EU, national, regional, private) will be a key issue. DIHs are not unique in this respect: similar issues are encountered in many large-scale research, development and innovation initiatives (LSIs) and common solutions need to be sought. The recently-completed EU-GREAT! project has studied experience in this area and developed guidelines and policy recommendations (see box).

In general, in finding the appropriate balance for DIH funding the approach should be to **stay local where possible and go European where necessary**.

Experience in establishing new DIHs in countries such as Poland emphasizes the importance of the crucial early stages. The seed funding phase needs to be accelerated by intensifying the funding and support available to the founding team so as to enable them to **develop the 'minimum value**

[31] European Association of Research & Technology Organisations, www.earto.eu

proposition' necessary to make the initiative viable. In this context, local coaching 'on the ground', as opposed to mentoring from afar, is to be preferred. Once operational the DIH needs to be consolidated through putting in place an extended team, proper structure and governance. These should be financed out of the service income stream as well as the seed funding. Once local SMEs start to perceive the DIH's value, the services can be ramped up to the point where the hub becomes financially self-sustaining. [Referred in **Action Line 5**]

Post-2020 inter-regional collaboration is likely to become much more of an issue. New thinking is needed on how to mainstream the experiences of Vanguard pilots and other innovative initiatives: networks of (digital) innovation hubs are likely to be key to this.

Combined Funding for Large-Scale Research Development and Innovation Initiatives (LSIs): Meeting the Challenge

Large-scale research, development and innovation (RDI) initiatives (LSIs) are playing an increasingly important role across Europe for the development and commercialisation of new novel products and services. Research under the EU-GREAT! Project found that:

- LSIs generate high economic impact via product innovation and job creation.
- Their funding tends to combine finance from different public and private sources including national, regional, Horizon 2020, European Structural and Investments Funds and commercial subcontracts.
- LSIs create and spinout a significant number of new collaborative R&D projects.

But there can be lack of:

- Stakeholder commitment, mainly from financers, for setting up new LSIs.
- Adequate fiscal grants for industry-driven LSIs.
- Investment requested for setting up and operation of LSIs and as a consequence, they have a high dependency on public sector funding.

The project recommends that EU policy-makers:

- Establish long-term EU policies and strategies to directly support co-financing needs of LSIs in all regions across Europe.
- Design and implement new EU and national level funding instruments that will enable consortia to form, launch and operate LSIs.
- Improve synergies between the finance rules of different national, regional and European RDI funding programmes so as to reduce administration costs.
- Encourage combined funding through Horizon 2020 and European Regional Development Fund (ERDF).
- Increase coherence between policy, legislation, and R&D+I strategy.
- Better and proficient communication of funding opportunities across Europe.

Source: "Combined Funding for Large Scale Research Development and Innovation Initiatives (LSIs)", http://eu-great.com

8. An Agenda for Action

A Europe-wide network of Digital Innovation Hubs able to support any business at 'working distance' is an ambitious but thoroughly achievable goal. The WG1 recommends the following as areas for priority action in realising this objective. The areas are referred to as Action Lines, reflecting the fact that they each represent a cluster of activity (in some cases over an extended period) rather than discrete one-off actions. Activity under certain Action Lines is already underway or is planned: most require further elaboration. This agenda will be developed further in future reports.

8.1 Building Consensus for a European Network of DIHs

A first group of actions concern the building of consensus between stakeholders over the nature and direction of a European network of Digital Innovation Hubs, including improving the available information base. These are:

- **Action Line 1: Develop the information base**: While the Catalogue of Digital Innovation Hubs currently being compiled will provide much-needed clarity on DIH initiatives in Europe, it should be seen as only a first step towards building the information base on DIH activities and services. The database will need to be maintained and extended, and over time grown into a central information portal for the whole European DIH network. Plans for the portal beyond the current catalogue phase have yet to be developed but are part of the TNO contract.

- **Action Line 2: Share experiences across Member States and regions**: As awareness of the DIH concept grows actors from Member States and regions will need to come together to plan and develop the network. Such meetings would enable hub actors to get to know each other and share best practices, success stories, training methods and materials, and learn from each other. WG1 meetings provide a forum for such networking to a certain extent, as does the annual DEI Stakeholder Forum. Further dedicated events intended to publicise and promote the DIH concept should also be organised, including in regions with current gaps. An Annual Conference of DIH Practitioners could be held, perhaps alongside or within the DEI Stakeholder Forum.

- **Action Line 3: Ensure high-level political support**: Investments in DIH will not materialise by themselves and therefore it will be essential to ensure high-level political support for these investments. Channels here include:
  - The Roundtables on Digitising European Industry convened by Commissioner Oettinger and held twice per year and to which all Member States and other key stakeholders are invited.
  - Conferences and workshops on the Digitising European Industry agenda.
  - Strategic Policy Forum on Digital Entrepreneurship and in particular its Digital Compass initiative to train policy makers on digital transformation by allowing participants to experience and experiment with the showcased technologies.
  - The Programme Committees of H2020, consisting of national policy makers in the field of research and innovation.
  - Regional authorities, which could be addressed through the Smart Specialisation Platform, cluster activities and other activities of DG REGIO.

8.2 Developing Synergies and Building Larger Initiatives

- **Action Line 4: Launch pilot actions aimed at developing synergies and building large initiatives.** These pilot actions should be varied in their scope and intent, aiming to demonstrate mechanisms for:
  - upgrading existing competence centres to Digital Innovation Hubs;
  - facilitating knowledge transfer within the DIH network;

- combining different funding sources within scalable projects;
- creating synergies with hubs active in other advanced technologies; and
- federating existing projects funded by different agencies into larger initiatives.

Potential mechanisms include the following:

- The EIT-KICs (see Section 4.3) are a model for European networking of competence centres and excellent education and training programmes. They have their own budget, but combine this with other funding sources on the basis of projects and services. The EIT Digital with its accelerator capacities is expected to become a key part of the digital innovation hubs network.
- SESAME-NET, a CSA in the area of High Performance Computing, is creating a network of HPC Competence Centres which will address coordination, outreach, training and the exchange of best practice and software components between the participating national and regional competence centres.
- EU-GREAT![32], another CSA, has explored the best practices and barriers faced by stakeholders of large-scale research, development and innovation initiatives (LSIs) in combining funds from different public and private sources. It has provided an inventory of such initiatives (including digital innovation hubs) and developed guidelines and policy recommendations for creating successful LSIs in the future (see box above). A co-operation between I4MS and EU-GREAT! has been created in order to maximize the results of both actions.
- MANUNET III is an ERANET Co-fund that brings together relevant stakeholders to define and schedule research cooperation between Member States and regions in the thematic area of manufacturing technologies through annual transnational calls.[33] Since its inception, MANUNET has funded more than 180 projects and 500 SMEs, with a total investment of more than €190m. The ERANET Co-fund could be used to share good practices between Member States and to connect the digital innovation hubs.

As well as combining funding from different sources, there needs to be knowledge transfer from the highly innovative competence centres to DIHs focusing on companies further down the technology adoption curve. As a best practice in this field, the I4MS projects have started a mentoring and sponsorship programme, whereby regional hubs are associated to the H2020 projects. Their particular role is to learn about supporting SMEs with their digital transformation from the I4MS competence centres and undertake a feasibility study into whether these experiments could be replicated successfully in their own region. Following a call, 25 new regional hubs have been selected with total funding of €1.2m available for the mentoring and sponsorship programme.

One of the main challenges is to design business models for multi-stakeholder co-investment and co-financing of digital innovation hubs, in order to put services on a sustainable basis after the initial programmes have ended. The EIB-EFSI might be part of the co-financing solution through the establishment of specific investment platforms that operate a financial engineering of different sources. The financial instrument logic applies to services that will have an economic return.

[32] http://eu-great.com
[33] www.manunet.net

8.3 Intensified Outreach to Regions with Few DIHs

- **Action Line 5: Intensify outreach to regions with few DIHs.** As mentioned above, regions with little or no existing infrastructure to support DIHs present a particular challenge. Partnering/sponsorship programmes will need to be established, where regions work with others with successful Hubs to understand what they are and the benefits they can bring. New Hubs would draw on guidance and support from these other regions and might even set up formal relationships (i.e. become satellite hubs). Regions could use ESIF, EFSI or other sources of funding to seed and develop DIHs during the critical early stages and to generally foster collaboration between Hubs.

Specific measures already underway or planned are:

- Smart Factories in New EU Member States, a €2m project to establish DIHs in the EU-13 Member States. The call for tender is currently being evaluated.
- The action "Transforming regions and cities into launch-pads for digital transformation and industrial modernisation" (COSME 2016) will provide professional advice and support to regions to shape their local digital ecosystems. This will intensify experimentation and networking within and among local ecosystems, help companies and organisations to innovate, and boost investments in industrial modernisation.
- A technical and financial assistance facility for industrial modernisation and investment being set up under the COSME Work Programme 2017 to support the work of the Smart Specialisation Platform on Industrial Modernisation (SSP-IM).

8.4 Enhancing European Added-Value

- **Action Line 6: Utilise H2020 investments to enhance EU added value.** Horizon 2020 (together with COSME) will be a powerful catalyst in seeding and growing the DIH ecosystem. European funding should be focused in such a way as to enhance the EU-added value of the European DIH network. This should be achieved by:
  - Using EU funds to better network EU, national and regional infrastructures;
  - Encouraging convergence of EU-schemes under the DEI and broad innovation umbrella;
  - Focusing EU schemes on highly innovative cross-border experiments;
  - Rooting EU-supported hubs in national and regional infrastructures;
  - Bringing industry hubs/labs into the structure;
  - Making EU models more sustainable.

Plans in this area are already well advanced. The European Commission is programming €500m in the H2020 and COSME work programmes 2016-17 and 2018-2020 towards DIHs. The 2016-2017 Work Programme, of which some calls have already happened and some are still open, dedicated €200m to hubs.[34] Under Work Programme 2018-2020 the remaining €300m will be dedicated to DIHs. Many of the existing initiatives will be continued as well as new hubs being created.

EU funds will be used to pool resources across programmes. H2020 ICT initiatives will become the linking pin, with contributions also from ESIF, EFSI, national, regional and private funding.

[34] SAE: €25M; FIWARE: €15M; FIRE: €25M; Big Data: €27M ; Creative Industry: €14M; Robotics: €18M +~11; Photonics: €43M; Innovation Radar: €12M; FoF 12 (I4MS): €33M

Specific action may be required to ensure the various instruments are compatible and are able to fit together seamlessly (for example, in relation to State Aid Rules). In certain cases it may be necessary to consider making EU funding conditional on other investments.

Key initiatives already foreseen under H2020/COSME are:

- ICT Innovation for Manufacturing SMEs (I4MS) will be continued in 2018-2020.
- Smart Anything Everywhere, now including EuroPractice, will be continued in 2018-2020.
- ACT-PHAST will be continued in 2018-2020.
- An EU network of technology centres in advanced manufacturing for clean production providing services to SMEs will start in 2017 (€4.9m under INNOSUP-3-2017).
- Advanced Manufacturing Support Centre helping SMEs to make informed investment decisions (€2.4 M under COSME, 2017-2020). The Centre will: provide at cross-sectoral level SMEs with practical information, advice and support on how to transform their company towards a smart factory with more competitive and sustainable production; and support learning networks of next-generation ('factories of the future') companies which will become inspiring examples for other European manufacturing companies.

In addition, sector-based digital innovation hubs will be launched in the agriculture sector to support the uptake of digital technologies at farm level, and in the health sector to innovate and scale up health and care services and businesses (both foreseen for 2018-2020).

There is a high potential for the pan-European e-Infrastructures to support the digitalization of European SMEs and other industrial actors through networking with Digital Innovation Hubs. Pan-European e-Infrastructures (EGI, PRACE, GÉANT, OpenAIRE, etc.) would enable SME users to access a wide portfolio of remote services, including access to data, data processing and cloud storage. This would also stimulate collaboration between SMEs and other stakeholders like universities or research centres. In practical terms, this could be fostered by making funding available through the H2020 e-Infrastructures Work Programme 2018-20 for the e-Infrastructures to be able to contribute to the networking with DIHs and to adapt their services to the specific needs of SMEs.

8.5 Mobilising Investment by Member States

- **Action Line 7: Mobilise investment by the Member States.** Continuing investment at national and regional level will be essential to realising a truly pan-European DIH network. As well as developing digitisation policies and providing investment for Digital Innovation Hubs, national and regional authorities must stimulate and animate their own local ecosystems. National and/or regional authorities should take the lead in:
  - Showcasing how DIHs can be set up and operationalised within the specific national/regional context;
  - Engaging local/regional hubs and competence centres in the DIH concept and fostering synergies with other enabling technologies;
  - Showing how European funding could be used to create DIHs;
  - Removing obstacles and barriers to cross-border activities; and
  - Generally creating space for bottom-up initiatives to emerge.

There are many initiatives at regional and national level, either ongoing or planned, some of which have already been described. It is expected that the existing initiatives will be further reinforced in the next years as well as new initiatives will be launched.

The DIH Catalogue, KET Catalogue, DTM national reports, and Blueprint for Cities and Regions all provide valuable inputs for policy-makers on national approaches and experiences to digital

transformation programmes as well, of course, as the activities of Working Group 1 and wider activities under the Digitising European Industry initiative.

Cross-border activities may require some form of **innovation voucher** which companies could utilise to access services from a hub outside their own country. The project InnoVoucher, funded under Horizon 2020 (managed by EASME), is developing a new model of innovation voucher supporting the transnational exchange of innovation services in Europe which may provide useful lessons.[35]

Public procurement can also be a way to stimulate innovation and digital innovation hubs can help in connecting public authorities with innovators and in helping public authorities to write tender specifications that stimulate innovation.

8.6 Activating the European DIH Network

- **Action Line 8: Activate the European network of Digital Innovation Hubs:** Building on the solid foundations established through Working Group 1, European stakeholders should take immediate action to operationalise individual Digital Innovation Hubs and start down the path towards a European network. This should include concerted effort in relation to: hub business models; common systems, methods and tools; collaboration structures; and governance structures.

After more than six months of intense discussion within the Roundtable and elsewhere, the concept of a European network of Digital Innovation Hubs, readily accessible to firms in all sectors and regions, and able to support, assist and mentor companies in embracing digitisation is well advanced. The objectives, characteristics, modalities, and services have all been intensively explored, most notably through the discussion and collaboration established under Working Group 1 itself. While certain issues require further elaboration, it is clear that stakeholders must move quickly – and collectively – to start putting the network in place. The message from industry is that **speed is of the essence**: the benefits for the European economy and society from digitisation are huge and our international competitors are already setting their own course. Meanwhile, Horizon 2020 – which will play such a vital role in underpinning the network – is heading towards its final stages and the funding window is limited. **Europe must act now to make Digital Innovation Hubs a reality**.

Building the network will require two separate but closely related streams of work:

1) Activities and services **for the marketplace**, i.e. that form part of the Hubs' offer to client business. Examples include:
   - development of the **Central Information Portal** as a repository for all information on Hubs' services and activities, and for sharing experiences and best practices (see Action Line 1 above).
   - development of **common systems, methods and tools** (e.g. a Digital Maturity Assessment tool, business mentoring methodology, joint/shared events, training courses, innovation vouchers, etc.).
2) Activities and services **to help hubs themselves to grow and improve**. These are not part of the offer to client businesses but facilitate collaboration between hubs and their efficient operation as a European network. Examples include:

[35] www.innovoucher.eu

- development of **hub business models**, learning from each other regarding set-up and operation and how to make hubs sustainable. This could include standardised procedures to speed up the launch and development of (new) hubs;
- development of **collaboration structures**, for example: a communications platform between hubs; training of hub personnel; inter-hub exchange schemes, sharing of best practices, tracking of interactions between hubs;
- development of **governance structures**, in line with the 'light touch' approach outlined above. This should include guidelines regarding minimum service portfolios, competition between hubs, sharing of IPRs, and measuring performance.

As noted, DIHs will need to access funding schemes according to their different evolutionary stages: initial set-up & launch; basic operations; 'Europeanisation'; new or improved infrastructure, etc.

9. Conclusions

The DEI Working Group 1 has brought together stakeholders with interests in running and operating Digital Innovation Hubs as well as potential beneficiaries in industry. As such it marks a milestone in terms of practitioners 'on the ground' taking ownership of this aspect of the DEI initiative, which up to now has focused at political and strategic level.

Digital Innovation Hubs hold significant potential to support and assist SMEs and start-ups and could become key actors in bringing digitisation within the reach of all industry sectors. The WG1 strongly supports the proposed European network of Digital Innovation Hubs as a means of supporting business, and especially SMEs and non-technology intensive industry, in seizing the opportunities of digital transformation.

Key messages from the WG's discussions so far in terms of achieving this goal are:

- **Europe has a wealth of knowledge and experience in hub-type initiatives** on which to draw in implementing such a network. Solid examples are evident at European, national and regional levels and further instances are set to emerge as a result of policies designed to accelerate and give direction to digital transformation. At present, however, the available and emerging provision is not sufficiently visible either to industry or to other hubs and initiatives. Much greater transparency is required, so as to facilitate both access for companies and mutual learning between service providers.

- Digital Innovation Hubs must **cater for a wide spectrum of needs and as such will have multiple facets**. They must be agile and demand-led, and build sustainable innovation ecosystems, not just gateways to services. While there can be no one-fit-all approach, Hubs should be united by common values based on independence, a commitment to excellence and customer service, and a proactive, innovative approach.

- Digital Innovation Hubs should offer **a broad range of services accessible through multiple entry points**. Core services should include: awareness creation around the business potential of digital technologies; innovation scouting; visioning and strategy development; working with companies to assess their digital maturity and develop appropriate plans; brokering relationships with service providers; mentoring and training; and cost-effective access to specialist experimentation, testbeds and production facilities. The available services should complement rather than compete against existing public and private service offerings.

- **Digital Innovation Hubs have to pioneer a new and distinctive approach**. They must be evangelists for digitisation within their constituencies. They must be highly client focused while having collaboration and networking as a defining characteristic. They must instil

entrepreneurial thinking and embed a digital culture in companies while being firmly rooted in practical business solutions. They must have a strong physical presence while also operating effectively in the digital space. And they must have flexible business models that are able to adapt and evolve over time as circumstances and funding regimes change.

- **Establishing and strengthening a European network of Digital Innovation Hubs** will require, among other measures: mapping service provision and sharing information; building capacity and skills in both breadth and depth; building collaboration between digital and other high tech innovation hubs; and creating incentives for SMEs and others to engage with the network. A 'light touch' governance is foreseen with minimal central coordination. Recognition of hubs on the basis of national/regional funding and adherence to a lean and flexible set of network guidelines are envisioned as the key elements of the quality assurance regime.
- **Mobilising the many investment tools and funding programmes available represents a major challenge.** The aim should be to create an 'investment triangle' between region-technology-funding, with the three elements being co-located. Further consideration is required on the roles of national/regional versus European funding, mechanisms for combining and scaling different funding sources, and investment approaches for regions with little or no existing infrastructure. In general, the approach should be **stay local where possible and go European where necessary**.

Eight Action Lines designed to address these issues have been identified and are being further elaborated by the Working Group.