D3.3 Specifications and Design of DIH/CC Services 1

WP3 - Network of Competence Centers and pan-EU DIHs in CPS/IOT

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Executive Summary

Two years after the launching of the initiative "Digitising European industry"[1] and with a catalogue of almost 200 fully operational DIHs[2], the main priority today for the DIH community is the transformation of an inventorial catalogue into a truly vibrant networked ecosystem for developing/sharing/experience digital transformation services of products, processes and business models.

In particular, for the Manufacturing Industry and inside the I4MS domain of CPS/IOT (Industry 4.0), **MIDIH consortium includes a multi-stakeholder ecosystem**, made of Competence Centers, Regional Manufacturing I4MS DIHs, pan-EU DIHs and Teaching Factories, with the ambition of setting a paradigm in the creation of a coherent and *harmonized* service ecosystem across the network.

The activities reported in this document have the goal to exploit the heterogeneous set of skills and the wide geographical scope of the MIDIH multi-stakeholder ecosystem to provide European SMEs with access/usage/experience to a selected portfolio of services of the highest quality built upon smart cooperation, first across the whole MIDIH network and then through the whole catalogue of European DIHs.

Three levels of users' engagement are foreseen: an "access to" level where SMEs are able to be informed and increase their awareness; a "use of" level where targeted and limited hands-on experiments are developed; a "experience with" level where the results of the experimentations are transformed into lessons learned and recommendations for the whole community. In order to accomplish the task to build a coherent and interoperable set of digital transformation services around European DIHs, MIDIH is following a four-steps methodology

1. Identification of digital transformation services (*access to, use of*, experience with services)
2. Organization and classification of services in generic taxonomies
3. Harmonization and interoperability of services in typical interaction workflows (for Manufacturing SMEs and startups / scaleups) with constant KPIs measurement
4. Development of service-driven Innovation Strategies and Business Models to scale up to European level

In this D3.3 document we report on the activities that cover the first two steps: the identification and description of "Technology/Experiments services", "Knowledge/Competencies services" and "Market/Finance services", provided by all the entities of the MIDIH ecosystem. The services have been accurately described and structured in hierarchies. In addition, we present a first definition of workflows designed with the aim to simplify for the user the identification of the competencies, technologies and market skills needed to reach their objectives of digitalisation.

The next steps will deal with the refinement and enrichment of the workflows, definition of KPIs and development of scale-up strategies and business models. A verification and validation of implementation and deployment of a convenient subset of the identified services will take place thanks to the experimentation of the DIHIWARE platform. Results of the experimentation will allow refining the digital transformation service framework (D3.4) and the requirements for the DIHIWARE platform (D3.2).

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[1] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52016DC0180&from=EN
[2] http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool

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1 Introduction

1.1 Context and methodology

The 2018 Report - Integration of Digital Technologies by DESI[3] (Digital Economy and Society Index) outlines that only a fifth of companies in the EU-28 are highly digitised and the situation across countries is varied: while 40 % of companies in Denmark and the Netherlands are highly digitised, in Bulgaria, Romania and Latvia it is 1 in 10. Moreover, even if SMEs are closing the gap with large companies, there are a lot of opportunities still to be exploited, such as cross-border e-commerce, cloud services and automation.

The European Commission launched the DEI in April 2016[4], an initiative aimed to reinforce the EU's competitiveness in digital technologies and **ensure that every business in Europe can draw the full benefits from digital innovation**. The core of this initiative is the creation of Digital Innovation Hub, a place where companies –especially SMEs, startups and mid-caps– can get help to improve their business, production processes, products and services by means of digital innovations. According to the report "Digitising European Industry, Progress So Far, 18 Months After the Launch[5] "Digital Innovation Hubs need to focus on the main needs of the industry and build on the technological strengths available in their region. They must also collaborate to offer all necessary expertise to companies across Europe. For instance, an SME from a region has a good idea for a new product, but the facilities to produce it are only available in a DIH of another region. In that case, collaboration between the two DIHs should ensure that the company receives the support to realise its idea."

For the DIH community the main priority today is to support the transformation of the community into a truly vibrant digital innovation networked ecosystem to deliver the next level of services that should accordingly leverage new investment instruments, opportunities and mechanisms to key economic sectors in Europe and SMEs to maximize the opportunities that ICT bring to the digital transformation of their products, processes and business models.

It should also be acknowledged that the diversity of stakeholders that the initiative is targeting and interacting with has grown significantly. Hence, the complexity and richness of activities of the support action should evolve accordingly to allow DIHs fully meet their objectives.

In particular, for the Manufacturing Industry and inside the I4MS domain of CPS/IoT (Industry 4.0), **MIDIH consortium includes a multi-stakeholder ecosystem**, made of Competence Centers, Regional Manufacturing I4MS DIHs, pan-EU DIHs and Didactic Factories, with the ambition of setting a paradigm in the creation of a coherent and *harmonized* service ecosystem across the network.

The MIDIH ecosystem is composed by:

Nine ICT-driven Competence Centres, each specialized in key facets of the CPS/IoT enabling technologies:

CC1.	CPS/IoT Networks / M2M Communication in North-East Germany;
CC2.	CPS/IoT Trust Management and Cybersecurity in France;
CC3.	CPS/IoT Modelling, Simulation and Digital Twin in South Germany;

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[3] https://goo.gl/CuWuhc
[4] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52016DC0180&from=EN
[5] http://ec.europa.eu/newsroom/dae/document.cfm?doc_id=49909

CC4. CPS/IoT Real Time Stream Data Analytics in Finland;

CC5. CPS/IoT in Smart production systems and services in Slovakia;

CC6. Cloud Industrial Analytics Architectures and Tools in Italy;

CC7. CPS based distributed edge architectures in Sweden;

CC8. CPS/IoT Data Sovereignty solutions in Mid-West Germany;

CC9. CPS/IoT HPC-based Cloud Manufacturing in Poland.

Each Competence Centre is already well established in the region they operate providing a variety of services at local level to the engaged manufacturing SMEs.

Two CPS-driven Teaching Factories to implement the physical part of the technology driven innovation cycle and will provide real-world hands-on experiences for SMES to

TF1. Located in Bilbao (Spain) and focusing on the automotive value chain

TF2. located in Milan (Italy), especially focusing on machine tools and discrete manufacturing

Three pan-EU and two Regional Manufacturing Digital Innovation Hubs (DIHs).

The pan-EU DIHs provide the Pan-EU networking dimension in I4MS, the expertise and skills needed to knit together the mentioned competence centres in a "one-stop-shop" vision and the mission of disruptive ICT innovation multipliers all over Europe.

The RMDIH have been engaged to support the implementation of their business plan and in MIDIH they will provide of the effectiveness of the sustainability plan and service scale up methodology designed and implemented.

EUDIH1. EIT DIGITAL (Entrepreneurial innovation & education driving Europe's digital transformation). Supporting market uptake and the acceleration of best Digital companies in different industries and domains, EITD is already working as a most relevant pan-EU one-stop-shop for innovation, entrepreneurship and skill building in Digital Technologies.

EUDIH2. The **FIWARE Foundation**, the legal independent body completing the FIWARE mission. FF is able to provide SMEs with easy access to complex technologies, business and technological coaching, training and closer link to domain stakeholders.

EUDIH3. The **International Data Space Association** aims at exploiting the full potential of internet-based services on the basis of intelligent linked data and the Data Sovereignty principles.

RMDIH1 IMR Irish Manufacturing Research is spearheading Ireland's progress as a hub of excellence and seeks to share our passion and vision for advanced manufacturing in Ireland.

RMDIH2 AFRC Advanced Forming Research Centre (Scotland) The Advanced Forming Research Centre is a globally-recognised centre of excellence in innovative manufacturing technologies, R&D, and metal forming and forging research.

The activities being carried out under WP3 have the goal to exploit the heterogeneous set of skills and the wide geographical scope of the MIDIH multi-stakeholder ecosystem to provide European SMEs with access/usage/experience to a selected portfolio of services of the highest quality built

upon smart cooperation, first across the whole MIDIH network and then through the whole catalogue of almost 200 fully operational European DIH[6]

Three levels of users' engagement are foreseen: an "access to" level where SMEs are able to be informed and increase their awareness; a "use of" level where targeted and limited hands-on experiments are developed; a "experience with" level where the results of the experimentations are transformed into lessons learned and recommendations for the whole community. **In order to accomplish the task to build a coherent and interoperable set of digital transformation services around European DIHs, MIDIH is following a four-steps methodology:**

1. **Identification of digital transformation services** *(access to, use of, experience with services)*

   The entities belonging to the MIDIH network have already a valuable experience in providing services locally and across their reference network, I4MS for Teaching factory and RMDIH and their own reference network for the pan-EU DIH.

   In this first step we have collected through workshops, questionnaires and interviews not only the services already offered by the MIDIH ecosystem but also services that are in preparation or designed but not yet implemented. The description of these services gives the main information about the content, the target audience and the implementation.

2. **Organization and classification of services in generic taxonomies**

   The collected services have been allocated to 5 categories: "Access to Knowledge", "Access to Competencies", "Access to Technology" "Access to Experiments", "Access to Market". Moreover, for each category, a hierarchy of layers have been defined; these layers cover the different levels of engagement (assessment, use, experience) of the users with the services. The structure in layers make it easier, both for other DIHs, interested in the implementation of the services we propose, and the users to identify the needed services. In addition, reference workflows inside the category are created to steer users to identify and achieve the competencies, technologies and market skills needed to reach their objectives of digitalisation.

3. **Harmonization and interoperability of services in typical interaction workflows (for Manufacturing SMEs and startups / scaleups) with constant KPIs measurement**

   Most of the services offered by the members of the ecosystem are designed to address the main needs of the reference industry in their region. Raising the level of the service to a European scope requires the definition of a common set of rules to assess the digital maturity level of the users, especially SMEs, and identify the appropriate services, the sharing of best practices and the establishment of business partnerships to build an efficient framework for DIH service provision across the network. Moreover, a set of common KPIs to measure the level of increasing digitisation of the users (Manufacturing SMEs and startups / scaleups) will be defined. A verification and validation of implementation and deployment of a convenient subset of the identified services will take place thanks to the experimentation of the DIHIWARE platform.

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

   4. **Development of service-driven Innovation Strategies and Business Models to scale up to European level**

In this final step of our methodology, building on the strengths of the multi-stakeholder MIDIH network and on the results of the previous steps, we aim at improving and enriching the provided services and promoting a Europe-wide cooperation with the whole catalogue of DIH in Europe. In close cooperation with **WP6** "DIH Innovation Management and Sustainability Model" as well as with **WP8 "**Exploitation, Standardisation and Business Plan" Innovation Strategies and Business Models to guarantee sustainability and growth will be designed and proposed. To reach these goals the role of our pan EU Digital Innovation Hubs and collaboration with I4MS and SAE networks are key, as well as the organization of workshops and participation to conferences to share best practices and results achieved inside MIDIH.

1.2 Scope of the Deliverable

The main objectives of WP3 "Network of Competence Centers and pan-EU DIHs in CPS/IoT" are the definition and specification of the main functions of a DIH one-stop-shop marketplace, including their services to Manufacturing SMEs and ICT Innovators and the implementation of the collaboration platform, the DIHIWARE platform, which will give support to the collaboration activities and give access to a selected set of services implemented by the MIDIH ecosystem.

According to WP3 overall objective, the purpose of this deliverable is to define and specify the first iteration of the main functions of the DIH network, which will be defined as "Access to" Services. These Services will be structured in hierarchies and presented as reference workflows to steer users to identify and achieve the competencies, technologies and market skills needed to reach their objectives of digitalisation. In addition, with the support of the wide network created by MIDIH, users will have access to a larger poll of services than locally provided, that will allow them to seize new opportunities.

The deliverable reports the work done on the tasks **WP3.2** "Development of *Access to Technology/Experiments* Services", **WP3.3** "Development of *Access to Knowledge/Competencies* Services and **WP3.4** "Development of *Access to Market/Finance* Services", where all the entities of the MIDIH ecosystem have contributed by providing their experience and know-how to set the scene for the first instantiation of the "Access to" Service that will be provided through the MIDIH network. To obtain the "Access to" Services the first two steps of the methodology described in the previous section have been carried out with the identification and description of the services followed by their organization in hierarchies and workflows.

In the second iteration, a small set of services will be chosen as a proof of concept and a Pilot will be developed in order to scale up first across the MIDIH network and then across the whole catalogue of European DIH.

1.3 Contribution to other WPs and Deliverables
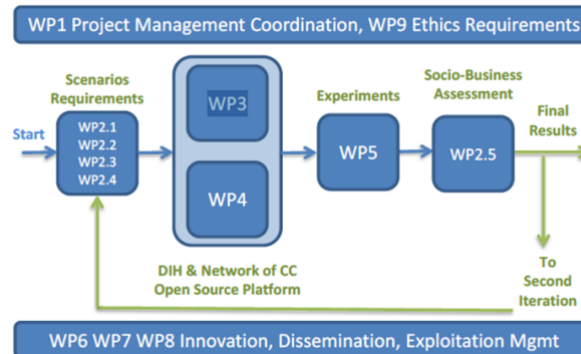
Figure 1 D3.3 contribution to other WPs and deliverables

This deliverable **D3.3 "Specifications and Design of DIH/CC Services 1"** is the second deliverable of the **WP3** "Network of Competence Centers and pan-EU DIHs in CPS/IOT". According to the iterative structure of the MIDIH project, D3.3 will guide the first release and deployment of the "Access to" Services that will be offered across the MIDIH ecosystem, with the support of the DIHIWARE Platform which will be instantiated in **D3.5** "DIH Collaboration Platform v1". The development of the services to the next level, where they will be available for the whole catalogue of European DIH, will be done in close cooperation with **WP6** "DIH Innovation Management and Sustainability Model" and in coordination with **WP7 "**Dissemination, Communication, Training and Brand Management" as well as with **WP8 "**Exploitation, Standardisation and Business Plan". D3.3 has considered the input from **WP2** "Scenarios and Requirements for DIHs and Experiments", more specifically the hints and takeaways that the **D2.3** "Scenarios, Use Case and Requirements for MIDIH 1" [Ref1] previously provided.

In the second iteration of MIDIH project, D3.3 will serve as streamline for the release of **D3.4 "Specifications and Design of DIH/CC Services 2".** The feedback loops on D3.3 will be included in D3.4, providing further inputs for an improved specification of the workflows, the definition of a pilot of services implemented through the network and the instantiation of the DIHIWARE Platform. The final specification and implementation of the DIHIWARE Platform and its instantiation for DIHs and CCs in the MIDIH ecosystem will be the core of **D3.6** "DIH Collaboration Platform v2".

1.4 Structure of the Deliverable

The deliverable is structured in 9 sections:

The present **Section 1,** as introduction to the document, presents the scope of the work carried out, the adopted methodology and the position of the deliverable in the Work Breakdown Structure of the project.

Section 2 describes the MIDIH Collaborative Platform, called DIHIWARE Platform, which will be developed in the framework of the MIDIH Project and will give support to the deployment of a subset of selected services.

Section 3 presents an introduction to the categories of services and their taxonomy.

From **Section 4** to **Section 8** the services of the five defined categories (Competencies, Technology, Experiment, Knowledge and Market) are presented in detail together with a first definition of reference workflows.

Finally, **Section 9** presents the conclusion of the work done and the next steps of the second iteration.

2 MIDIH Platform description

2.1 The DIHIWARE Platform Concept

Nowadays, in the overall industrial scenario, enterprises have to face a lot of difficulties. In fact, according to several surveys[7], close to two-thirds of managers in industry have difficulties in assessing the RoI (Return on Investment) ascribable to digital innovations, finding a trusting and maturity technology which in addition must be compatible and interoperable with legacy systems, and feeling afraid of the possibility of being locked out by one vendor. In this sense, for SMEs, this proportion is even higher. As a result, there is a clear need from industry not just for information but also to be able to assess and understand the practical implications of a digital innovation, and then to test and experiment before implementing it.

In this global scenario, the **DIHIWARE Platform** will represent 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. This Platform will act as a one-stop-shop marketplace for DIHs, serving companies **within their local region and beyond** to digitalise their business.

The DIHIWARE Platform is intended to be an IT integrated platform to support both the "Access to" and "Collaborate with" services of a network of CCs and pan-EU or Regional DIHs. The services available through the Platform will 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. Services will also **provide connections** with investors, facilitate access to financing for digital transformations, and help connect users and suppliers of digital innovations across the value chain. 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).

Furthermore, the Platform will also support communication among different DIHs: considering every DIH specialisation, through the networking of DIHs competences not available within the regional DIH may be found easily in another DIH using suitable services. This mechanism will lead to specialisation and excellence and will avoid that every region needs to invest in all competences necessary for the digital transformation.

The DIHIWARE Platform tries to reflect industry needs; this amounts to more than simply a list of solutions and services, in particular:

- Acting as **a one-stop-shop** for companies and providing **a gateway** to specialist platforms and infrastructures;

- Possessing **significant know-how** spanning, for example, across technical disciplines and between technology and non-technology areas (e.g. business, finance, law, IPR);

- Ability to market themselves and **proactively identify relevant customers** for their services;

- Ability to **'speak the language' of SME businesses** and understand their needs.

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[7] WG1 – Digital Innovation Hubs: Mainstreaming Digital Innovation Across All Sectors
https://ec.europa.eu/futurium/en/system/files/ged/dei_working_group1_report_june2017_0.pdf

- Understanding of **business models and business transformation** and being able to help companies transform;

- Ability to work with companies at **all levels of digital maturity**, including offering low-tech transfer to companies lower down the maturity curve;

- Ability to **broker** between the needs of industry and relevant technology providers in **an independent and unbiased way**;

- Ability to **assess current and future skills needs** and provide appropriate support;

- Providing **funding or facilitating access to funding** from external sources.

These aspects are reflected in the platform service offer and operating characteristics that are described in the deliverable [Ref2] D3.1 "Specification and Design of DIH one-stop-shop Marketplace 1". During the first experimentation in the MIDIH project, different configurations are needed for three typologies of entities, each one characterized by a particular attention to different aspects: pan-EU DIHs, with a specific focus on the multilingual aspect; regional DIHs, including also CCs willing to transform; regional CCs, with a distinctive attention to knowledge management aspects rather than the e-consultancy feature (synchronous in some cases, as in the download of documents or reports, but very often asynchronous, as embedding complex negotiations transaction).

3 Specifications and Design of MIDIH services

The main idea of the DIH IT integrated platform is to support both the "Access to" and services which are provided by Manufacturing Industries (specially SMEs) and Technology Innovators/Solution Providers (IT start-ups/web entrepreneurs) in the access to the locally services which are provided by the regional Competences Centers and European DIHs which will also be able to support them in the digitalization of their products/services/supply chains.

This DIHIWARE Platform will support them in the access to knowledge/competencies, expertise/technology and market/finance which could be beneficial for their digitalisation process.

The services available nowadays may be categorized under three pillars:

- The **Innovation Activities**, concerned with identifying opportunities for digitization, and developing and validating innovative solutions based on cutting-edge technology.

- The **Business Development**, concerned with helping companies to apply their solutions, assess the business implications, and manage the resultant changes.

- The **Skills Creation**, concerned with building innovation capacity through enriching human capital.

Figure 2 DIHIWARE Platform Pillars.

In particular the Platform will offer a catalogue of **B2B services** that are connected to the idea that the Platform has to behave as a one-stop-shop for Manufacturing Industries (specially SMEs) and Technology Innovators/Solution Providers (IT start-ups/web entrepreneurs) to access and show the competencies, technology, experiments, knowledge and market available services and to enable collaborative processes among them. Therefore, it is important also to model and take an inventory of organizational assets, human competencies and company capabilities.

Main services that will be offered can be divided into two main categories: the "Access to" services will enable users gather information about skills, technological and business matters which are named Competencies, Technology, Industrial Experiments, Knowledge and Market, while the "Collaborate with" services will enable dynamic interactions and collaborative creative processes among users (Open Innovation and Social Networking).

However, the scope of this deliverable will be the definition of the first version of the "Access to" services. This establishment will be complemented by cross functionalities supporting the

general mode of operation that are: Searching Functionalities, Multi-lingual support, Guide for content creation, Workflow monitoring and support.
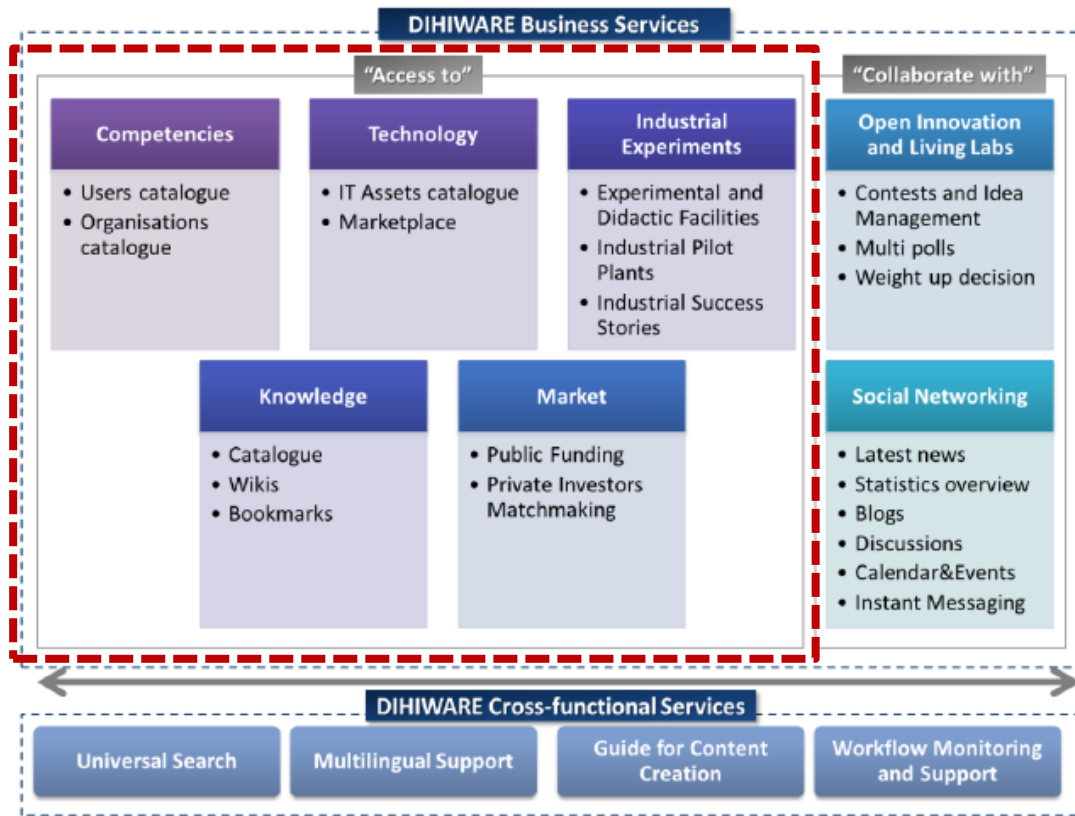
Figure 3 DIHIWARE Portfolio of Services, focused on the "Access to" Services

The main "Access to" Services that will be offered can be subdivided into five main categories and this document will gather the information about the services available nowadays categorized under the three main pillars aforementioned which are Innovation Activities, Skills Creation and Business Development.

The identified and classified "Access to" Services are: Access to Competencies, Access to Technology, Access to Industrial Experiments, Access to Knowledge and Access to Market. These Services will be presented in the following points.

3.1 Access to Competencies

In the case a new application requires specific knowledge, a collaborative development project is formed and managed by using resources available at the CC or the DIH. This is the reason why it is necessary to develop a common repository for human competencies and industrial assets in the chosen manufacturing domain, in order to profile and cluster all the human entities gravitating around the CC's specific technology and to enable partners' selection. Access to Competencies services include an inventory of Industrial capabilities and Human Skills needed to implement Industry 4.0 projects. It also includes online access to educational information and materials.

The Platform aims also to deliver effective training programs for industrialists to enable the uptake of the technologies. Particular attention will be paid both to industrial users and to any

SME that could be a potential customer. In particular, education activities could be offered, e.g. Industry 4.0 courses and workshops, seminars (i.e. on cloud infrastructures) and interactive creative sessions.

3.2 Access to Technology

The "Access to Technology" services provide an overview of technology information, useful for users and organisations looking for a solution, addressing needs and requirements specific to a specific area. This section involves structured applications to help and support SMEs and industrial companies to find the solution to a specific wicked problem they are experimenting, for which they do not know if a solution exists or if existing solutions really fit their needs and actually solve their problem, leveraging on specific technological competences: identification of IT assets and Open Source Software (OSS) catalogue; consultancy activities on the reference architectures; access to applications marketplace to support the business scenario. The company can be redirected to the DIHIT Technologies Repositories to refine their products by means of Open Source components for the most generic and commoditized functions.

3.3 Access to Experiments

SMEs get inspiration for their Industry 4.0 projects, by analysing the existing experiments. It is possible to take advantage of the best practices and exploit test open datasets provided by the Industrial Experiments. The objective is to develop structured services to support SMEs and industrial companies in understanding new experimental and technological trends in specific domain and explore and test new technologies that can be interesting for SMEs and that potentially can be applied to processes or products, with a "hands on" approach.

3.4 Access to Knowledge

"Access to Knowledge" services include consultancy services related to different thematic domains in the digitalization of the Manufacturing according to the Industry 4.0 paradigm.

These services can support the manufacturing in embracing the Industry 4.0 vision, establishing a hyper-connectivity that goes beyond the factory boundaries and where the interaction among the factory environment itself and the value chain to which customers, suppliers, logistics, etc. belong to is supported by the technological innovation.

3.5 Access to Market

SMEs have different needs when accessing the market with newly developed products and services, starting from a relevant business model, support in the market entry/development, testing of the new products and services with user before commercialisation to finally, getting access to the appropriate funding and financing.

The newly developed services the MIDIH platform is going to offer will enable different organisations, especially manufacturing SMEs, to develop an appropriate business model for their products and services and to look for possible access to public/private capital sources in order to implement their Industry 4.0 projects.

3.6 Hierarchy of the Services in the platform

The different identified "Access to" Services will be defined under a general description. However, each type of services will contain different layers which could allow a detailed description and classification of the different identified "Access to" Services.

In the following five sections, each "Access to" Service will be presented with a hierarchical description till level six in some cases. This will allow a detailed description of each one. This description will explain the target audience of this service, the objective of the service, the way it will be offered, the number of people who could access it, the analysis of the pros and cons before its implementation, its business model and finally and approx. of the duration of these services.

4 Access to Competencies Services

4.1 Hierarchy of the A2C Services

1st layer	"Access to Competencies" Services													
2nd layer	Activities		Education						Documentation		Events			
3rd layer	LAB Exploration	Workshops	Higher Education			Additional Education				Manuals/ Documents	Online Tutorials	Fairs and Exhibitions	Match making Event	Hackathon	Congress	Conferences and Seminars
4th layer	LAB Tour / LAB Short Visit		Masters	Professional School	Doctoral School	MOOCS	Training Courses	Coaching / Serious Games / VR/AR Training	Webinars					
5th Layer			Techno Specialization / Training of workers				Techno / Market / Didactic Courses		Technical / Open					

Figure 4 "Access to Competencies" services hierarchy

First hierarchical layer: "Access to Competencies" services

"Access to Competencies" services include access to skills development services such as training programs and everything related to organisational skills. Competencies are the skills, knowledge and behaviour that lead to a successful performance. Therefore, the MIDIH ecosystem will provide access to the Activities, Documentation, Training and Events that are available in de MIDIH Ecosystem.

The MIDIH Ecosystem also aims at giving access to the education activities and events in the field of the Industry 4.0 through the DIHIWARE Platform. It will be a repository of a compilation of events and education that matches the technology requirements with the workers knowledge.

Second hierarchical layer: Categorisation of the services

MIDIH platform would support the training and the development of competencies of the companies by giving access to four core type services categorised into the following four groups:

(i)   Activities

"Activities" can be defined as actions to make awareness of the new Industry 4.0. They are split into two different categories: LAB Exploration or workshops.

LAB Exploration is the practical way of showing a specific technology running and to give a physical perspective of it.

Workshops are meetings that cover different and evolving aspects of the Industry 4.0 technologies and bring participants together to present and discuss their latest findings.

(ii)   Education

The concept of "Education" is the act or process of imparting or acquiring particular knowledge or skills, as for a profession, a degree, level, or kind of schooling: a university education.

The advances in the manufacturing sector have created the need of new skills, new ways of thinking, acting and new knowledge. In support to these needs MIDIH Project will develop an education plan to fill the gap between the workers´ knowledge and the companies´ needs.

Two kinds of education will be covered: higher education and what is called "additional education" (courses and education not at a high level). For higher education (a formal learning) three kinds of programs will be deployed: Masters, Professional School and Doctoral School.

For the additional education different kinds of training activities will be developed: MOOCs, Training Courses, Coaching, Serious Games, VR7 AR Training and Webinars.

(iii)   Documentation

"Documentation" is the compilation of the knowledge and previous experiences on a set of documents. In this case, the documentation could be presented in two ways: manuals/ documents where technical people could read about a specific technology or online tutorials that everybody could follow to have a first contact and to know how to start with a technology.

(iv)   Events

"Events" is a classification of social activities such as; fairs, exhibitions, matchmaking event, hackathons, congresses, conferences and seminars that have as their main purpose to advertise new technologies and to introduce new tendencies.

Third hierarchical layer: Specification of the services

The Development Service that will be provided by the MIDIH ecosystem of CCs and DIHs can be distinguished as follows:

Table 1 Access to competencies services purpose

Explore Experiments	Purpose of the service
(i.i) LAB Exploration	It is an opportunity to have a show room of the technology. The purpose of the lab exploration is to learn and recognize the importance of the laboratory operation considering its structure and its different established areas which are specified for a certain activity, as well as the processes that are carried out in each one and the tools applied in them.
(i.ii) Workshops	During the workshops the participants develop analytical and experimental skills through observation and development of the laboratory experiments.
(ii.i) Higher Education	The larger purpose of the higher education is connecting students with real-world problems and getting them engaged in creative and collaborative problem-solving. This kind of education provides a higher level of technical knowledge and develops higher abilities.
(ii.ii) Additional Education	The additional education prepares people for employment. Additional education goes for a further development of the digital skills and for improving the performance of students or employees.
(iii.i) Manuals/Documents	Manuals and Documents are publications that include the most substantial of a subject and provide information of a specific technology. It is a guide that helps to understand the functioning of something. This type of technical publications provides the necessary instructions for a user to use a specific technology and seeks to provide assistance.
(iii.ii) Online Tutorial	The tutorial is usually configured as a steps series that progress through levels of difficulty and understanding. For this reason, it is better to follow the tutorial in its logical sequence. The purpose of a tutorial is to be an alternative learning option, by which the people who access this type of teaching tool achieve their learning objectives by learning at their own pace and accessing the contents at any time.

(iv.i) Fairs and Exhibitions	Fairs are an important marketing tool, a great commercial showcase and an important means of communication. An exhibition is a privileged presentation means, for a large number of potential clients, in a period of time and a limited space. Both of them are an acceleration phenomenon of the sales process.
(iv.ii) Matchmaking event	Matchmaking events are the main events to promote the entrepreneurial ecosystem, bringing together the best start-ups, investors and corporations. In these events the aim is to reach strategic agreements between projects and leading innovation corporations.
(iv.iii) Hackathon	A hackathon is a marathon of technological development. Hackathons promote collaborative work, as a team and are aimed at solving problems. In addition, a benefit that is obtained is that the entire work process becomes a way of learning.
(iv.iv) Congress	In the congresses, experts from different places who share the same profession or activity meet and hold lectures on technological topics to exchange information and discuss about them.
(iv.v) Conferences and Seminars	They are academic instructions develop to encourage regional and international communication and collaboration. The purpose is to upgrade the skills and techniques.

4.2 Description of the A2C Services

This section provides specifications related to the "Access to Competencies" services that will be offered by the MIDIH ecosystem of DIHs and CCs and are accessible through the MIDIH ecosystem DIHIWARE Platform.

(i)   Activities
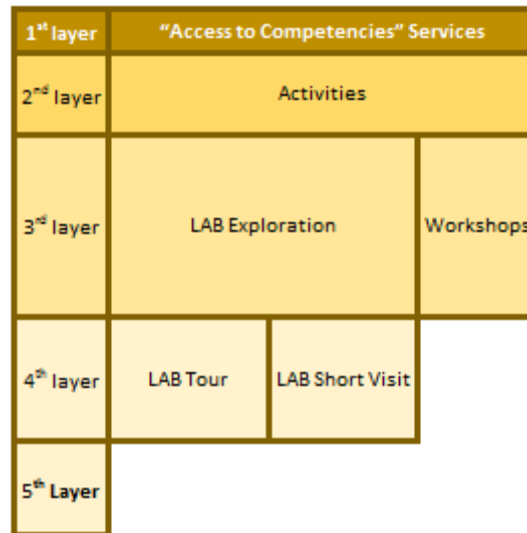
Figure 5 Activities Services

(i.i) LAB Exploration

- **LAB Tour**

Table 2 Description of LAB Tour activities.

Target people	Enterprises that would collaborate with the CC or that go to the CC as customers to access the CC's services. Delegations from the society, politics and industry; Companies from small to large.
Objective	To talk about the facility and make DEMO of the technologies in the Lab
How	Pre-planned meeting. Held by CC collaborators. Introduction slides and live demonstrations
Nº of people	Small number of people (4-5)
Pros	· Demos are always better than talks as they give physical perception of how digital can be bring to industrial reality
Cons	· Needs follow-ups or further meetings in case of intention for collaboration.
Business model	Free

Duration	1h--30'

- **LAB Short Visit**

Table 3 Description of LAB Short Visit Activities.

Target people	People who attend the I4.0 courses and training offered by the CC. Groups of students.
Objective	Give them a practical overview on what they are studying from theory. A practical overview on what is going on.
How	NO pre-planning or booking. The lab is open usually during the lunch break and people can bump in and be assisted by a CC's collaborator for any question. Little preparation.
Nº of people	Continuous flow
Pros	• Physical experience with technology. • Better understanding of the information they receive (they can touch theoretical concepts in a physical shape)
Cons	• It is a very short visit and may require some more details if requested from the visitor (in 10 minutes it is just possible to make a short overview)
Business model	Free
Duration	10'

(i.ii) Workshops

Table 4 Description of Workshops Activities.

Target people	Manufacturing companies. People with technical background from Universities; Research Organizations or companies.
Objective	Dedicated workshops for manufacturing companies interested in VR/ AR, IoT, HPC simulation. Sometimes organised together with some bigger events.
How	Trainings/ Tutorials are given usually on site of customer premises
Duration	1--2 days
Nº of people	Between 10 and 30. A group no larger than 5 , if there should be a practical session.
Pros	• Can focus on specific areas

	• Specific audience targeted
Cons	• People in companies do not know who the right person is to participate, CEO, CTO, computing person, design team director. • Considering having different workshops, would be best to have them all in the workshop, different people in the audience but one program.
Business model	Partners are co-organising, service offered from CC/ DIH side as free.

(ii)   Education
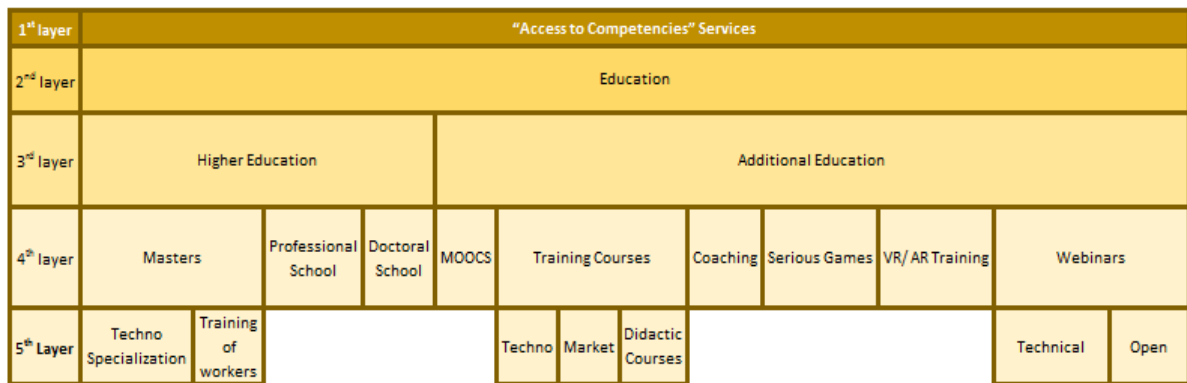
Figure 6 Education Services.

(ii.i) Higher Education

- **Masters**

Techno-Specialization

Table 5 Description of Techno-Specialization Master Education.

Target people	Graduates, post-graduates, professionals
Objective	Give them a technological specialization
How	Masters are usually organized together with universities or research institutes that are part of the CC-DIH.
Duration	3-6-12 months or up to 2 years
Nº of people	It may vary. Around 50 -- 500 students
Pros	• Front lectures and courses allow exchange of experiences and working in groups. • It is very important to show practical cases, due to the type of audience, rather than just theory. • Masters usually implies industrial projects. Wide portfolio of training courses.

Cons	• The target audience is variegated and the number of people may be an issue to be managed in order to provide a service of quality.
Business model	Premium

Training of workers

Table 6 Description of Training of workers Master Education.

Target people	Industry oriented and for company employees
Objective	To have a customised training. To train employees and discover new talents.
How	Organised and structured lessons with a specific planning to combine theory and practical demonstrations with the company' requirements.
Duration	7-10 months
Nº of people	20-100
Pros	• The graduates have the opportunity to do visits to companies and also to present a final project. • They also have an assignment to a company to develop their skills.
Cons	• The subject can be difficult so a lot of them don´t achieve the level.
Business model	Premium

- **Professional School**

Table 7 Description of Professional School Education.

Target people	Experts working in sectors highly influenced by emerging digital technologies.
Objective	To raise the digital skills and competencies' level of Europe's Professionals.
How	Blended learning courses are specially designed for professionals, executives and decision makers who want to deepen their knowledge and keep their skills up-to-date in a time-effective way. The courses have a blended format, combining university-grade content and online modules with hands-on skills building.
Duration	Online modules + 2 days workshop
Nº of people	It depends. From 5 to 10 usually

Pros	• Meet the needs of working professionals through innovative blended learning formats (combination of traditional face-to-face classroom phases and e- and mobile learning).
Cons	• Background required (professionals, executives and decision makers)
Business model	Premium

- **Doctoral School**

Table 8 Description of Doctoral School Education.

Target people	PhD Students
Objective	Doctoral candidates acquire a mindset for Innovation and Entrepreneurship (I&E)
How	The CC/ DIH partner network works closely with Doctoral Training Centres which are located in close proximity to a partner university campus in order to facilitate the implementation of the doctoral programme.
Duration	18 weeks for the Business Competence phase in the Doctoral Training Centre (DTC) plus 6 months of organisation mobility for the Business Development Experience. It can be either an internship period at a large company or SME, or with a startup in an innovation-friendly place, such as an incubator.
Nº of people	200 PhDs
Pros	• Within an Industrial Doctorate, PhD students work under academic supervision on research assignments from industry and benefit from continuous tutoring from this industry.
Cons	
Business model	For the PhD students the service is free; while for the hosting partners the service is premium.

(ii.ii) Additional Education

- **MOOCS**

Table 9 Description of MOOCs Education.

Target people	Students
Objective	The MOOC is more extensive (one out of three, will finish it).
How	The instructor is more related with the academic field and the approach is more theoretical. They do not ask for previous background. More theorical.

Duration	
Nº of people	It is open for everyone.
Pros	
Cons	• Not all the students finish it
Business model	Free

- **Training Courses**

Techno

Table 10 Description of Techno Training Courses Education.

Target people	Technical people
Objective	Training on technical aspects and I4.0 topics (cloud, mobile, security, etc)
How	Accessible from the CC-DIH website in the session "Courses".
Duration	1 full day
Nº of people	10--20
Pros	• Front lessons allow interaction.
Cons	• Background required (just for operative people).
Business model	Premium

Market [8]

Table 11 Description of Market Training Courses Education.

Target people	Executives
Objective	Give visibility on market trends, practical examples with use cases
How	Accessible from the CC-DIH website in the session "Courses".
Duration	2 half days (4 hours each)
Nº of people	Small groups

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[8] This service is a general training course for executives, it is included here and not in the "access to market services" because the A2M section has a different "hand on" approach customised to the needs of the user.

Pros	• Front lessons that allow sharing of experiences. The attendee can better achieve what he/she wants (questions, etc.).
Cons	• It must be a high-level introduction to a technical topic. This can be an issue for the one who teaches the course.
Business model	Premium

Didactic Courses

Table 12 Description of Didactic Training Courses Education.

Target people	Students (engineers)
Objective	Education on I4.0 topics
How	Accessible through the website.
Duration	Along 6 months
Nº of people	50-300 students
Pros	• Front lessons allow interaction • No background is required (apart from having a bachelor degree in engineering).
Cons	• It is just a general overview on I4.0 topics
Business model	Free

- **Coaching**

Table 13 Description of Coaching Education.

Target people	Top Managers or employees that would acquire management capabilities in order to run projects inside their enterprise
Objective	Guide employees in understanding how project management can be run effectively. First level IPMA certification
How	Accessible from the CC website in the session "Courses". Theory plus practice. They are usually structured as follows: (i) Intro to the topic in order to set a common language; (ii) technological trends; (iii) Where and how the market is going; (iv) Practical examples (industrial cases); (v) Future trends.
Duration	May vary. Usually 4-5 half days along 2-3 months

Nº of people	20--30
Pros	• Front lectures and courses allow exchange of experiences and working in groups (that is relevant for project management). • It is very important to show practical cases, due to the type of audience, rather than just theory.
Cons	• It is a very brief introductive training on project management (1st level certification)
Business model	Premium

- **Serious Games**

No information available[**]

- **VR/ AR Training**

No information available[**]

- **Webinars**

Technical

Table 14 Description of Technical Webinars Education.

Target people	Technical people/ potential stakeholders
Objective	Give to technical people an in-depth understanding and updates on specific and hype technological topics.
How	One CC's expert on the specific technological topic holds the webinar. It can also happen that webinars are done in collaboration with one CC's partner enterprise. There can be a series of webinars in a logical sequence.
Duration	Half a day
Nº of people	10--15 25--50
Pros	• It is very specific and focused on a specific technological topic. • It is preferable as webinars do not include different people inside the same enterprise (as they involve technical people), but they include people from several enterprises. • Webinars are preferable as people are usually spread up geographically.
Cons	• Due to the fact the strong niche nature, they are not that often. • People may prefer physical interaction one with the others. • If they are free this is an issue as people do not attend them.

[**] These services are being developed by the MIDIH consortium, a detailed description will be added in the next iteration.

Business model	Free/ Premium (depending on the purpose)

Open

Table 15 Description of Open Webinars Education.

Target people	People with technical background from Universities, Research Organizations or companies.
Objective	This service is used for presenting technologies or software toolkits.
How	GotoMeeting/ GotoWebinar; Events needs to be advertised and people can register to it.
Duration	60'
Nº of people	No limitations
Pros	• Easy online registration and open for everyone. • Bigger geographical outreach. • Can be recorded and reused. • It is also interactive because you know who is watching.
Cons	• For a live webinar, there needs to be an additional moderator that is supporting the expert e.g. catching up on questions.
Business model	Free

(iii)   Documentation

Figure 7 Documentation Services

(iii.i) Manuals/ Documents

Table 16 Manuals/ Documents Documentation Services.

Target people	Technical people
Objective	Give information on the technology characteristics or documents describing a technology

How	Available of the DIH-CC's website
Duration	Updates with new technologies/versions of the same technology
Nº of people	All the CC's partners and clients. No limitations.
Pros	• Available information. • The firms that are already aware of what they need, can just go on the website and explore the technological offer. • Available any time anywhere.
Cons	• It is not enough/ confusing for the firms that do not have a clear idea of what they need. • Not interactive.
Business model	Free

(iii.ii) Online Tutorials

Table 17 Online Tutorials Documentation Services.

Target people	Students, SMEs and large companies. SMEs that develop technology
Objective	To explain a technology (how to start, how to work with it and also introduction and descriptions)
How	Available on the CC's website.
Duration	60'
Nº of people	Large groups
Pros	• They have the tutorials/ services centralized so that people can learn. • Can be watched at any time from everywhere, bigger geographical outreach.
Cons	• Not interactive • You do not know who is watching
Business model	Freemium

(iv)   Events
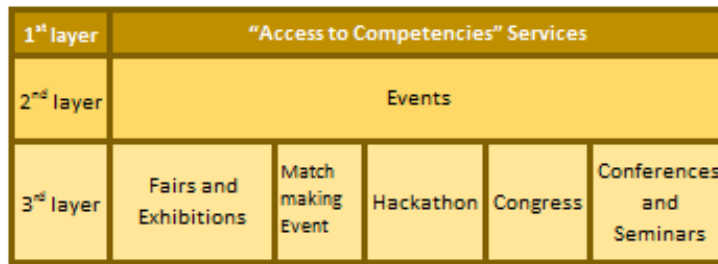
Figure 8 Events Services.

(iv.i) Fairs and Exhibitions

Table 18 Description of Fairs and Exhibitions Events Services

Target people	Clients or wide public
Objective	Exploration and positioning on specific hype topics (CC image and branding). Reach multi-enterprises rather than a big number of people within the same enterprise
How	Usually coupled with the city technological events. Usually organized with partners (universities, agencies, etc) in order to lower the effort (resources) to organize the event.
Duration	It depends
Nº of people	It varys but the more the better
Pros	• Image, branding, positioning on the market.
Cons	• It needs sponsors, location and the staff to manage and high flux of people.
Business model	Free

(iv.ii) Matchmaking Event

No available information[**]

(iv.iii) Hackathon

No available information[**]

(iv.iv) Congress

No available information[**]

(iv.v) Conferences and Seminars

[**] These services are being developed by the MIDIH consortium, a detailed description will be added in the next iteration D3.4.

Table 19 Description of Conferences and Seminars Events Services

Target people	Decision makers from SDOs; SMEs and corporates
Objective	Discuss latest developments and business opportunities of technologies. Best practices and lessons learned.
How	Running different session dedicated to one specific topic with speakers from SDOs; alliances and the industry
Duration	1 day
Nº of people	100-200 people
Pros	• You can freely define the agenda of that event. • Excellent opportunity for networking.
Cons	• High competition with other events challenging to find female speakers.
Business model	Premium

4.3 A2C Workflow Templates

	LAB Exploration	Workshops	Higher Education	Additional Education	Manuals / Documents	Online Tutorials	Fairs Exhibitions	Conferences Seminars
LAB Exploration		Potential link to give a training to a company after a visit		Training courses usually include a LAB Visit				
Workshops								
Higher Education				Some workers or students would like a higher level of technological education to be more prepared.				
Additional Education					After reading a manual a training course could be required to develop some specific skills.			
Manuals / Documents						Following the logical sequence and finishing a tutorial could end requiring a more technical knowledge.		
Online Tutorials								
Fairs Exhibitions	A deeper LAB exploration could be required.							
Conferences Seminars								

	LAB Exploration	Workshops	Higher Education	Additional Education	Manuals / Documents	Online Tutorials	Fairs Exhibitions	Conferences Seminars
LAB Exploration								
Workshops								
Higher Education								
Additional Education								
Manuals / Documents								
Online Tutorials								
Fairs Exhibitions								
Conferences Seminars								

5 Access to Technology Services

5.1 Hierarchy of the A2T Services

Figure 9 "Access to Technology" services hierarchy

1st layer	"Access to Technology" Services					
2nd layer	Development				Data Sets	
3rd layer	Software Development		Hardware Development	Integration	Historical Data	Realtime Data
4th layer	Open - Source	Closed - Source				

First hierarchical layer: "Access to Technology" services

Access to Technology covers all services that can be provided by a DIH to support the manufacturing industry, ranging from start-ups to large enterprises, to optimize their production processes and/or increase operational efficiencies. "Technology" can be defined as the application of scientific knowledge for practical purposes. In this deliverable access to technology is categorized in two main sections i.e. i) development and ii) data sets in the second layer. All services that can be mapped to these categories are listed in the third layer and will be described in more detail in section 5.2.

Technology is the overarching term in the first layer of this section whereas the generic services that are listed in the third layer are grouped in the second layer to structure the sub-categories.

Second hierarchical layer: Categorization of services

In the second layer of hierarchy the following categorization was established.

(i)   Development

One of the main activities of DIHs related to technology services can be summarized as development. This is a high-level term that covers all subsequent services no matter if they are dealing with software or hardware development. Furthermore, some developments can have started proactively or can be based on customer requests. The details of specific development services will be elaborated in the next chapter.

(ii)   Data Sets

Data is the new currency and highly relevant as data is the foundation to optimize processes in the manufacturing industry. Data is the fundamental source of information for many use cases such as predictive maintenance where data are extracted from machines and analysed to detect malicious behaviour in order to prevent interrupts of the production due to component wear out or broken parts. Models of objects also known as digital twin are a digital representation of a physical object that can be used by different operational or business applications to extract relevant information.

Third hierarchical layer: Purpose of the service

The Development Service that will be provided by the MIDIH ecosystem of CCs and DIHs can be distinguished as follows:

Table 20 Development Services Purpose

Development	Purpose of the service
(i.i) Software	*Software is an essential part of almost all of the services we are using in our daily life. In the manufacturing industry software is used to control systems or measure and monitor distributed processes. To optimize services and processes software needs to be modified, enhanced or implemented from scratch. Software development is an evolutionary process. Since new concepts and programming languages arise every year it is relevant to consider new trends as they might be capable of solving problems in a better way than existing solutions. Software can be implemented as a long-term project following technology trends or it can be an application that solves a specific issue or task of a customer. Typically, software development requires support and maintenance services which are not listed separately.*
(i.ii) Hardware	*Machineries in the manufacturing industry have a long lifetime compared to hardware of other application domains. In order to gather insights of the machines they can be equipped with sensors or other extra components which is called retrofitting. This will provide the operator with additional information that has not been available before. Furthermore, hardware can be developed as prototypes in small lots to test capabilities of e.g. new materials which is especially relevant for the automotive industry, e.g. to reduce the weight of vehicles.*
(i.iii) Integration	*Integration services are usually the combination of software and hardware from different vendors to proof that a technology is able to fulfil the expectations or to roll-out existing products into new market segments. Due to the fact that the evolution of new technologies is increasing exponentially it has become more and more unlikely that one company can provide all equipment and know-how that is required for deploying an assembly line. That is why new technologies will first be evaluated with proof of concepts before they get rolled out in production. DIH can provide infrastructure and know-how to integrate new products in existing environments or processes.*

Table 21 Data Set Service Purpose

Data Set	Purpose of the service
(ii.i) Historical Data	*Data from real scenarios are required to train algorithms for big data analysis or artificial intelligence (AI). Typically, companies that develop analytics tools or AI applications do not have access to significant amounts of data sources. Therefore, data needs to be extracted and recorded from real machines and complex processes. Historical data is highly useful to train and evaluate analytics algorithms.*
(ii.ii) Realtime Data	*Realtime data is required to monitor and control processes and trigger actions if deviation from usual behaviors / anomalies is/are detected.*

5.2 Description of the A2T Services

This section provides specifications related to the "Access to Technology" services that will be offered by the MIDIH ecosystem of CCs and DIHs and accessible through the DIHIWARE Platform.

(i)   Development
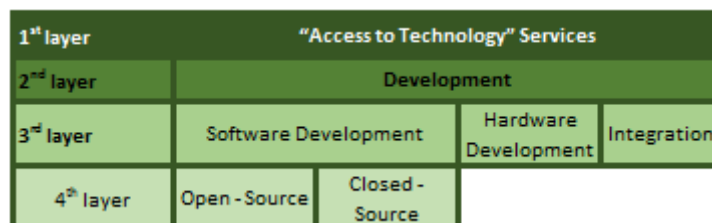
Figure 10 Development Services

(i.i) Software Development

Software development is distinguished in open-source and closed-source as they have typically different objectives and business models.

- **Open-Source Software Development**

Table 22 Description of Open-Source Software Development Services

Target people	IT Start-ups; Web Entrepreneurs; Manufacturing SMEs and Enterprises
Objective	Software is an application that is solving a specific issue in a programmatic way.
How	structured as follows: (i) Usually developed and maintained by a community, (ii) Source code is freely accessible to everyone, (iii) Licenses define the policies for the usage (iiii) Typically based on an international (de-facto) standard
Duration	An Open-Source Software project is usually maintained over multiple years, depending on the acceptance of the users.
N° of people	Usually multiple developers from different organizations developing the software depending on the size of the project.
Pros	• It can be tested and evaluated without any license costs • Usually the projects are well documented and maintained • Support is provided by a community of users without any extra frees
Cons	• Mostly the basic features are free of charge and add-ons or extensions are premium services

	• It can be challenging to add extensions or new features
Business model	Freemium for the basic features Premium services can be: customization; extensions or add-ons; support services

- **Closed-Source Software Development**

Table 23 Description of Closed-Source Software Development Services

Target people	IT Start-ups; Web Entrepreneurs; Manufacturing SMEs and Enterprises
Objective	Software is an application that is solving a specific issue in a programmable way. The implementation is based on a customer request that defines the expected outcome.
How	structured as follows: (i) Usually developed and maintained by one company, (ii) Source code is not publicly available, (iii) Licenses define the terms and conditions for the usage
Duration	A Closed-Source Software project has a life-time of weeks to years depending on the size and the features.
N° of people	Depending on the size of the project.
Pros	• Highly customized product • Professional support is usually included
Cons	• Initial investments are higher compared to open-source software • Bugs cannot be fixed by the users • Extensions of the software can be time-consuming and can be costly
Business model	Premium: Every customer has to purchase a license

(i.ii) Hardware Development

Table 24 Description of Hardware Development Services

Target people	Start-ups; Enterprises (Big or small companies and single plants).

Objective	Solve specific issues within the plant (like retrofitting of machinery) or design a new smart product able to communicate with the smart plant.
How	This need can arise after a maturity assessment, or it can be offered as a stand-alone service.
Duration	The duration depends on the type of service and activities, and to the level of a request made by the SME. It can range from a few weeks for a feasibility study to several months to design a new custom product.
N° of people	Not applicable
Pros	-
Cons	-
Business model	Premium.

(i.ii) Integration Development

Table 25 Description of Integration Services

Target people	Manufacturing SMEs and Enterprises
Objective	Integration services unify hardware and software from multiple vendors to fulfil a specific task. They can range from proof of concepts, to show that things are working as anticipated theoretically up to the deployment of operational services in the production.
How	structured as follows: (i) definition of the scope, (ii) design of the architecture or topology, (iii) Integration phase with strong collaboration with the stakeholders, (iv) presentation of the results
Duration	Depending on the size of a project. Usually from weeks to months
N° of people	Depending on the size of a project, complexity of the system and involved parties.
Pros	• Concepts and Interoperability can be evaluated prior to purchase or roll out

	• Vendor independent organizations / integrators can integrate even solutions of competing companies
Cons	• Interoperability between multi-vendor components / systems is sometimes a cumbersome task
Business model	Premium.

5.3 A2T Workflow Templates

Access to technology services are typically bundled services that have rarely links to other technology services that are described in this deliverable. However, there are strong relations to knowledge and competency services as they can be considered as initial steps in a relation to a new customer.

6 Access to Experiments Services

6.1 Hierarchy of the A2E Services

Figure 11 "Access to Experimentation" services hierarchy

1st layer	"Access to Experimentation" Services				
2nd layer	Explore Experiments (Passive)			Testing Experiments (Active)	
3rd layer	Demonstrations		Best Practices	Infrastructure	Interop / Plugfest	Testing

First hierarchical layer: "Access to Experiment" services

DIH should support the manufacturing industry on their journey towards digitization. As the subject of digital transformation is relatively new to the manufacturing industry many SMEs are lacking the knowledge or practical experiences. However, customers can leverage experiences and lessons learned from others that are already a step further. This will help in the decision-making process. As such it is important that DIHs provide the opportunity for exploring concepts of the digital transformation. Experimentation services are categorized in two sections of the second layer.

Second hierarchical layer: Categorization of the services

Experimentation is the fundamental approach to try new things whether the results in the end are positive or negative. Usually no one has to start from zero this is why you can leverage on the experiences other have made on their journey towards a digitized industry. It is common to start with several small projects to figure out what could work and what not. Companies that are more conservative can start exploring what have done by others to get to know the lessons learned. Another aspect of the knowledge transfer is to see live demonstration of new technologies at fairs or in laboratories to get a better understanding and inspiration what would be possible. For those who would like to get some hand-on experiences they can take a closer look at the testing experimentation service category.

(i) Explore Experiments

Exploration of experiments provides insights regarding capabilities, performance and feasibility of technologies and concepts in an informative way. Representatives from companies can visit the laboratories of DIHs where they can learn about best practices and success stories from other companies that could help to identify potential projects that can be addressed in their own company to optimize processes. The demonstrations are practical examples of technology and products in action. Usually the demonstrations are specific to the application domain of the DIH as it is too complex for an organization to be an expert in all domains.

(ii) Testing Experiments

In order to gain practical experiences regarding a new technology or specific practices it is useful to validate approaches through experimentation and testing. Running an experiment requires an infrastructure and typically also hardware and software from different vendors. As such infrastructures are costly it is of added value especially for SMEs to rent such infrastructures for a limited period of time without taking the risk to make the entire the

investment themselves. Testing is an essential part of the product development life cycle as you need to make sure that your product is conformant to an existing standard or interoperable with different products of other vendors. This is why interoperability events or also called plug-fests have become more and more common, where engineers from different vendors are testing their products on a neutral ground.

Third hierarchical layer: Purpose of the service

The Experiment Service that will be provided by the MIDIH ecosystem if CCs and DIHs can be distinguished as follows:

Table 26 Explore Experiment Services Purpose

Explore Experiments	Purpose of the service
(i.i) Demonstrations	*Demonstrations are a way to visualize functionalities of applications, services or processes to explain interested persons how things can be done providing a practical example.*
(i.ii) Best Practices	*Exchange of experiences and talking about lessons learned can help people to understand what are the risks and helping to develop their own strategy. This service explains best practices from projects that have been finalized with the subject of digitization in the manufacturing industry.*

Table 27 Testing Experiment Services Purpose

Explore Experiments	Purpose of the service
(ii.i) Infrastructure	*Running experiments requires an infrastructure that consists of physical systems. Usually experiments run only for a limited period of time. Therefore, it is not necessary to purchase such infrastructure which is expensive and can be a high risk especially for an SME. That is why service centres are renting their infrastructure temporarily to customers.*
(ii.ii) Interop / Plugfest	*Interoperability test or also called Plugfests are technical meetings where engineers and developers from different organizations come together. The main objective is to do some functional test of products from different vendors to assure interoperability. This will create confidence by the end user in a standard that various devices are able to communicate with each other.*
(ii.iii) Testing	*Testing needs to be done to validate the functionalities of a product and improve its quality. Testing is usually a periodic task during the development phase of a product. Testing centres provide services such as scalability; performance; conformance tests to customers without the necessity to invest in own*

equipment or experts, which is especially relevant for small and medium enterprises.

6.2 Description of the A2E Services

This section provides specifications related to the "Access to Experiment" services that will be offered by the MIDIH ecosystem of CCs and DIHs and accessible through the MIDIH ecosystem.

(i)   Explore Experiments (Passive)

1st layer	"Access to Experimentation" Services	
2nd layer	Explore Experiments (Passive)	
3rd layer	Demonstrations	Best Practices

Figure 12 Explore Experiments Services

(i.i) Demonstration

Table 28 Description of Demonstration Services

Target people	IT Start-ups; Web Entrepreneurs; Manufacturing SMEs and Enterprises
Objective	Demonstrations create confidence in a technology or in a process and proof the feasibility of a new approach.
How	structured as follows: (i) Demonstrations can be developed for one or several specific events or as part of a showroom, (ii) They can be presented in a laboratory or at fairs, (iii) Demonstrations show the benefits of specific technologies and should inspire how those technologies could be adopted and applications applied in the own facilities / environments
Duration	Usually they last from 10 – 30 minutes.
N° of people	At least it requires one presenter, if they are not self-descriptive. Number of people in the audience should typically not be more than ten.
Pros	• Can be shown multiple times to different people • Promotion of a concept or a technology
Cons	• There is always the risk that demonstrators are not working properly as they typically showcase technologies in an early stage

	• Not all people from the audience have the same background knowledge
Business model	Free of charge.

(i.ii) Best Practices

Table 29 Description of Best Practices

Target people	IT Start-ups; Web Entrepreneurs; Manufacturing SMEs and Enterprises
Objective	Show how challenges have been approached and solved in other projects / solutions
How	structured as follows: (i) face-to-face meeting with the possibility to access some documentation, (ii) presentations can be shown at conferences without providing confidential information
Duration	It is usually something that is done quickly through a face-to-face meeting or a presentation
N° of people	Depends on the setup. One to one or one to many
Pros	• Companies can get an inspiration on how similar problems can be solved
Cons	• There is not a *single* best practice that can be adopted to solve individual challenges
Business model	Free of charge.

(ii) Testing Experiments (Active)

1st layer	"Access to Experimentation" Services		
2nd layer	**Testing Experiments (Active)**		
3rd layer	Infrastructure	Interop / Plugfest	Testing
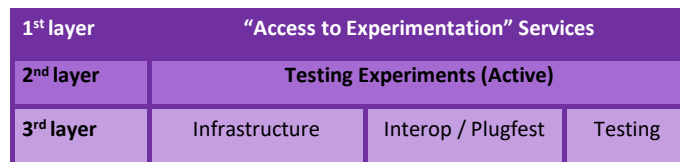
Figure 13 Testing Experiments Services

(ii.i) Infrastructure

Table 30 Description of Infrastructure Services

Target people	IT Start-ups; Web Entrepreneurs; Manufacturing SMEs and Enterprises
Objective	Infrastructure services provide access to costly and or highly specialized equipment without the necessity for customers to invest in the infrastructure themselves. This is frequently highly useful, since the infrastructure is usually a means for a specific strategic purpose, but not essential for the core business of the customer.
How	structured as follows: (i) Customers get access to the infrastructure for a limited period of time, (ii) The customer needs to be able to allocate resources or a time slot for the usage of the infrastructure.
Duration	It is depending on the infrastructure service. The duration can range from hours to multiple months or even years.
N° of people	Not applicable
Pros	• Access to latest technologies without high upfront investments, • Resources can be scaled up or down based on demands • Focus can be on the core business
Cons	• Dependency to a third party
Business model	Typically, it is a premium service. Limited access can be also a freemium business model.

(ii.ii) Interop/Plug-fests

Table 31 Description of Interop / Plug-fests Services

Target people	Manufacturing SMEs and Enterprises
Objective	Interoperability is one of the major challenges in the manufacturing industry. In order to provide confidence in a technology, vendors need to assure interoperability between the solutions of each other.
How	structured as follows: (i) Meeting of engineers from different companies, (ii) Plug devices from multiple vendors together,

	(iii) Invited by a vendor-neutral organization.
Duration	Two to three days.
N° of people	15 – 30 people
Pros	• Modifications can be made before roll-out • Exchange know-how with other experts • Feedback can be provided to the standardization organization
Cons	• Standards can be interpreted and implemented differently
Business model	Free for members of the organizing association.

(ii.iii) Testing

Table 32 Description of Testing Services

Target people	IT Start-ups; Web Entrepreneurs; Manufacturing SMEs and Enterprises
Objective	Testing services follow a formal procedure to assure that the system under test is behaving as specified in a given standard. It can be part of the development phase or part of a certification process.
How	structured as follows: (i) Company needs to contact a testing center, (ii) Reserve a time slot and ship the system, (iii) Receive the test results from the testing center, (iv) Implement changes if required according to the feedback.
Duration	Depending on the test it can range from hours to several days.
N° of people	1-3 people
Pros	• Customer does not have to invest in expensive testing equipment • No testing specialist required in house • Improves quality of the product
Cons	• Dependency on third party • Tests can be typically run with one system at a time

Business model	Premium.

6.3 A2E Workflow Templates

Access to experimental services are typically bundled services that have rarely links to other experiment services that are described in this deliverable. However, there are strong relations to knowledge, competencies and technology services as can be considered as initial steps within a relation to a customer.

7 Access to Knowledge Services

7.1 Hierarchy of the Services

1st layer	"Access to Knowledge" Services					
2nd layer	Digital Maturity consultancy services		Digital skills consultancy services		Technology-specific consultancy services		
3rd layer	Digital capabilities assessment	Technological digitalization strategy development	Digital skills assessment	Skills digitalization strategy development	Smart industry architecture	Systems optimization	Smart technology selection

Figure 14 "Access to Knowledge" services hierarchy

First hierarchical layer: "Access to Knowledge" services

"Access to Knowledge" services include access to consultancy services related to different thematic fields in the digitalization of the Manufacturing according to the Industry 4.0 paradigm.

Consultancy services are intended to drive the change in organizations (especially SMEs) that are approaching the wave of innovation, to work on projects with a high digitalization degree as well as digital knowledge (human skills) related to the Industry4.0 portfolio of technologies. To this purpose, the aim of the MIDIH Collaboration Platform (DIHIWARE) is to providing access to knowledge through models, methodologies and the support of experts in the field for improving performance such as effectiveness and efficiency in production through the use of the digital technologies. Thereafter, Industry 4.0 (or Smart Manufacturing) define the lines of a vision where the technology totally disrupts the perception of manufacturing plants and factories, and the need for a renovated knowledge arise and became a central issue for the entire manufacturing ecosystem.

In fact, while technology is "pushing" the offer of new services thanks to the innovative functionalities enabled by digital technologies and capabilities, manufacturers face new challenges. On the market side, continuous innovative developments are required in order to give a concrete answer to cheaper, greener and more customized and higher quality products. On the company side, the need for improved performances has to be satisfied in order to manage complex internal disturbances (e.g. minimization of the production costs and the consumption of energy, equipment breakdowns, suppliers' delays, etc.). In other words, the manufacturing is "pulling" new technology and capabilities for supporting the execution of processes and the delivery of products and services that are competitive.

In that light, "Access to knowledge" services can support the manufacturing in embracing the Industry 4.0 vision, establishing a hyper-connectivity that goes beyond the factory boundaries and where the interaction among the factory environment itself and the value chain to which customers, suppliers, logistics, etc. belong to is supported by the technological innovation. To this purpose, the MIDIH ecosystem of CCs and DIHs will provide access to consultancy services to achieve horizontal integration of data flow between partners, suppliers and customers, as well as vertical integration within the organizations frames (from the development phase to the achievement of the desired scenario), considering the wide scope of applications enabled by combining digital technologies in manufacturing industry including supply chains, business models, and designs of products and services.

The MIDIH ecosystem aims at giving access to consultancy and capability improvement services in the field of the digital transformation of the manufacturing through the DIHIWARE platform, which is intended to act as a matchmaker between the manufacturers' requirements (process pull) and the opportunities offered by the (digital) technology functionalities (technology push). In practical terms, this means find a way to support manufacturing companies in undergoing the digital transformation process towards the Industry 4.0 vision.

Second hierarchical layer: Categorization of the services

"Access to knowledge" services include the provision of solutions primarily to support manufacturing SMEs in leading the market and gaining competitive advantage through the implementation of optimal solutions in the field of the advanced technology towards the digitalization of the manufacturing. These services might allow users to identify relevant areas for improvements in terms of technology adoption at different level of the manufacturing system: products design, processes reconfiguration and optimization, systems integration and digital capability advancement, etc.

In fact, if on the one hand manufacturing companies seek for the knowledge that can allow them to "ride" this wave of transformation in order to remain competitive, on the other hand, before investing in digital technologies and human skills enhancement, they need to gain awareness on their current technological capabilities in order to define their needs. This is a complex exercise that requires combining different competences (i.e. knowledge of digital technology and existing technology functionalities, manufacturers' needs, market requirements, value-added areas for improvement, prioritization of the interventions, etc.) in order to be correctly and effectively undergone.

To this purpose, MIDIH Platform will support the digitalization path of the manufacturing SMEs by giving access to three core type of services categorized as: (i) Digital Maturity Consultancy Services; (ii) Digital Skills Consultancy Services; (iii) Technology-specific Consultancy Services.

(i)   Digital Maturity Consultancy Services

"Maturity" can be defined as the state of being complete, perfect or ready and implies an evolutionary progress from an initial (AS IS) stage to a desired (TO BE) stage (Mettler & Rohner 2009), which underlines the characterization of the path towards the achievement of the maturity through different stages of growth (or maturity levels). Therefore, maturity models are tools that allows the evaluator to understand what is necessary to achieve a higher level of maturity going through a series of steps towards progressively more complex or perfect version of the current status of a process, organization, and supply chain (Van Steenbergen et al. 2010).

The DIHIWARE platform will provide manufacturing companies (especially SMEs) the opportunity to evaluate their digital maturity and plan the development path towards improvement of the activities that generate value through the management of the product - process – plant cycles.

By accessing the Digital Maturity Consultancy Services provided by the MIDIH network of CCs and DIHs, the manufacturing SMEs would find support in Product Development and Product Lifecycle Management, Software and Hardware Development and Maintenance as well as Requirements Engineering, IT Architectures and Data Security, Project Management, Business Process Management, Information and Knowledge Management, Collaboration processes within the organization and with the actors upstream and downstream the supply chain, Performance and Risk Management. Manufacturing companies will be supported in defining current gaps and in planning further improvements in the most relevant process

area impacted by the Industry 4.0 paradigm: Design and Engineering, Production Management, Quality Management, Maintenance Management, Logistics Management.

(ii)   Digital Skills Consultancy Services

The concept of "human skill" refers to the ability in make use of knowledge, attitudes and abilities, as well as put in place behavioural schemas intended to achieve the expected results within the organization or as individual workers. Skills are also related to a concept of control and verifiability of the achieved results. The advances in the manufacturing technology has pushed increasing attention to changes in jobs and skills generated by the Industry 4.0 paradigm, and more specifically on the need for the evolution of technical skills including a variety of manufacturing stakeholders. In fact, the introduction of the advances in technology automation and digital technologies within the manufacturing - such as Cyber-Physical Systems, the Internet of Things, cloud computing and Big Data – has been significantly affecting work activities and work environment at large (Chryssolouris & Dimitris 2013). Jobs are expected to change and adapt to this changing environment and new requirements both terms of content and creation of new types of job. As a consequence, novel skill requirements are foreseen (J. Smit, S. Kreutzer 2016).

In support to the increasing attention paid to the renovation of human skills according to the requirements brought by the manufacturing digitalization process, MIDIH Project will support manufacturing enterprises and single workers in understanding the significant gaps pertaining the evolution of the job profiles and what types of skills will be relevant and in demand in Industry, contributing the re-skilling and up-skilling of the human capital and the development of the future workers. The MIDIH ecosystem of CCs and DIHs will offer support to the manufacturing SMEs that would overtake the gap in the human digital capabilities in order to be able to support internal processes management and deliver products and services that are competitive on the market. More specifically, the MIDIH Project will support manufacturing SMEs and professionals in sets the need for renovation of human capabilities and will support companies and single workers in overtake the identified gaps in the most critical managerial areas of the Industry 4.0: Operations Management, Supply Chain Management, Product-Service Innovation Management, Data Science Management, IT-OT Integration Management.

Third hierarchical layer: Purpose of the services

(i)   Digital Maturity Consultancy Services

The purpose of digital maturity assessment models and methodologies lies either on the representation of the current maturity situation of the organization/process or on giving indications on how a higher maturity level can be achieved. More in general, the application-specific purposes can be identified as *Descriptive purpose* and *Prescriptive purpose*. According to this specification, the *Digital Maturity Consultancy Services* that will be provided by the MIDIH ecosystem of CCs and DIHs can be distinguished as follows:

Table 33 Digital Maturity Consultancy Services Purpose

Digital Maturity Consultancy Services	Purpose of the service
(i.i) Digital Capabilities Assessment	*Descriptive.* Descriptive digital maturity assessment models and methodologies aim at evaluating the current digital status of a process, organization, etc. Are static in nature because the

	output they provide does not offer guidelines and opportunities to improve the current level of digital maturity and does not explain the current level of maturity in relation to the operational and strategic aspects of the analysed system. In other words, descriptive models depict the current (AS IS) maturity of processes, organizations, etc. in terms of digital capabilities without giving any further indication or support on how to more towards the next digital maturity levels,
(i.ii) Technological Digitalization Strategy Development	*Perscriptive.* Prescriptive digital maturity assessment models and methodologies provide information on how to deal with the improvement of the digital maturity in order to positively influence the generation of value deriving from business activities, allowing the development of a roadmap aimed at improving the current level of maturity. These models focus on the relationship between the performance (defined as a function of the digital readiness) and the analytical and strategic factors of the analysed system. In other words, prescriptive digital maturity models go a step further compared to the descriptive digital maturity models since they do not just provide the current level of digital maturity but allows to define a roadmap defining a digitalization strategy to achieve progressive improvements.

(ii)   Digital Skills Consultancy Services

The purpose of digital skills assessments lies either on the representation of the current human skills in the field of digital manufacturing or on giving indications on how to improve the level of digital human skills. More in general, the application-specific purposes can be identified as *Descriptive purpose* and *Prescriptive purpose*. According to this specification, the *Digital Skills Consultancy Services* that will be provided by the MIDIH ecosystem of CCs and DIHs can be distinguished as follows:

Table 34 Digital Skills Consultancy Services Purpose

Digital Skills Consultancy Services	Purpose of the service
(ii.i) Digital Skills Assessment	*Descriptive.* Descriptive digital skills assessment models and methodologies aim at evaluating the current status of the human digital skills within a firm or of single professionals. These models are static in nature because the output they provide does not offer guidelines and opportunities to improve the current level of digital skills.
(ii.ii) Skills Digitalization Strategy Development	*Perscriptive.* Prescriptive digital skills assessment models and methodologies provide information on how to deal with the improvement of the digital skills of a firm or of single professionals identifying areas for improvements and

	supporting tools aimed at improving the current level of digital skills. In other words, prescriptive digital skills assessment models go a step further compared to the descriptive digital skills assessment models since they do not just provide the current level of the digital skills but allows to define a set of actions intended to define a strategy to achieve the digitalization of human skills.

7.2 Description of the A2K Services

This section provides specifications related to the "Access to Knowledge" services that will be offered by the MIDIH ecosystem of CCs and DIHs and accessible through the MIDIH ecosystem.

(i) **Digital Maturity Consultancy Services**

Figure 15 Digital Maturity Consultancy Services

(i.i) Digital Capabilities assessment

- **Self-assessment**

Table 35 Description of Digital Capabilities Self- Assessment Services

Target people	Enterprises (Big or small companies and single plants).
Objective	Analyse the maturity level of the firm/plant in order to identify areas for improvement in terms of digital capabilities. It is provided in the shape of a self-assessment where the CC/DIH has the role of informant.
How	The firm contacts the CC/DIH and the project starts. The project is structured as follows: (i) on-site visit(s) to see the technological implants, (ii) interviews to people, (iii) screening of the current situation.
Duration	Maximum one day.
N° of people	It depends on the client dimension and on the main functions that are to be assessed within the company in terms of digital capabilities.
Pros	- Quick and free of charge. - It is intended to create the awareness of what is going inside the firm. - It is a very introductory picture of the current digital capabilities of the firm. - Can be in the national language.
Cons	- It is a low-level analysis (low detail). - It requires further investigation to identify the potential areas for improvement and to plan actions to achieve digitalization. - Due to the fact that it is a self- assessment, the questionnaire should be well structured to avoid misunderstanding and difficulty in data construction. - Can be in the national language.
Business model	Freemium.

- **Assisted**

Table 36 Description of Digital Capabilities Assessment Assisted Services

Target people	Enterprises (Big or small companies and single plants).
Objective	Analyse the maturity level of the firm/plant in order to identify areas for improvement in terms of digital capabilities. The assessment is conducted by the CC/DIH that does not have the simple role of informant, but guide and support the customer in the analysis, facilitating the construction of the data useful for the analysis.
How	It can be provided in the shape of dedicated workshops organized at the CC/DIH or on customer premises. It may require on site visits.
Duration	n.a
N° of people	It depends on the client dimension and on the main functions that are to be assessed within the company in terms of digital capabilities.
Pros	- Vendor independent organization. - There is support in the data construction. - Quick and free of charge. - It is intended to create the awareness of what is going inside the firm. - It is a very introductory picture of the current digital capabilities of the firm. - Can be in the national language.
Cons	- It is a low-level analysis (low detail). - It requires further investigation to identify the potential areas for improvement and to plan actions to achieve digitalization. - Can be in the national language.
Business model	Freemium.

(i.ii) Technological Digitalization Strategy Development

Table 37 Description of Technological Digitalization Strategy Development Services

Target people	Enterprises (Big or small companies and single plants).

Objective	Analyse the maturity level of the firm in order to identify areas for improvement on terms of digital capabilities and define a roadmap for improvement.
How	The firm contacts the CC and the project starts. The project is structured as follows: (i) on-site visit(s) to see the technological implants, (ii) interviews to people, (iii) screening of the current situation, (iv) gap analysis (between the AS IS status of the firm and the desired status), (v) digitalization roadmap, (vi) implementation of the actions defined in the roadmap.
Duration	1 month for the analysis (screening of the current situation).
N° of people	It depends on the client dimension and on the main functions that are to be assessed within the company in terms of digital capabilities.
Pros	• Vendor independent organization. • There is support in the data construction. • It is a quite quick way to assess the digital maturity and to understand which potential actions can be put in place to perform a change. • It allows the definition of a roadmap starting from the characteristics of the single enterprise or part of it. • It is an ad-hoc digital roadmap. • It is valid for different manufacturing applications (no industry-specific).
Cons	• There is the need for competent analysts. • It requires the engagement of the enterprise in terms of time and it also requires effort to the analyst. • This type of tools requires to be kept updated in order to avoid obsolescence. • Relatively high cost because of overhead. Therefore, projects with smaller companies need to be third party funding.
Business model	Premium.

(ii)   Digital Skills Consultancy Services

1st layer	"Access to Knowledge" Services															
2nd layer	Digital skills consultancy services															
3rd layer	Digital skills assessment											Skills digitalization strategy development				
4th layer	Self-assessment						Assited					Corporate level	Organizational areas			Individuals
5th Layer	Corporate level	Organizational areas				Individuals	Corporate level	Organizational areas					Product-service design management	Supply chain management	Operations management	Data science management	IT-OT integration management
6th Layer		Product-service design management	Supply chain management	Operations management	Data science management	IT-OT integration management		Product-service design management	Supply chain management	Operations management	Data science management	IT-OT integration management					

Figure 16 Digital Skills Consultancy Services

(ii.i)

(ii.i) Digital Skills Assessment

- **Self-assessment**

Table 38 Description of Digital Skills Self-assessment Services

Target people	Companies (SMEs e big companies) or single professionals.
Objective	Evaluate the level of preparation on Industry4.0 skill categories.
How	Self-assessment questionnaire.
Duration	Half day / one day.
N° of people	It depends on the client dimension and on the main functions that are to be assessed within the company in terms of digital skills capability.
Pros	- Quick and free of charge. - It is intended to create the awareness of the digital readiness of the human skills. - It is a very introductory picture of the current human digital capabilities. - Can be in the national language.
Cons	- It is a low-level analysis (low detail). - It requires further investigation to identify the further needs in terms of improved digital skills and to plan actions to achieve the desired level of digitalization of the human capabilities. - Due to the fact that it is a self- assessment, the questionnaire should be well structured to avoid misunderstanding and difficulty in data construction. - Can be in the national language.
Business model	Freemium[9].

- **Assisted**

Table 39 Description of Digital Skills Assisted Services

Target people	Companies (SMEs e big companies) or single professionals.
Objective	Evaluate the level of preparation on Industry4.0 skill categories.

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[9] Freemium services can be free, when the scope of the services is limited to certain aspects, and premium when the scope is wider

How	It can be provided in the shape of dedicated workshops organized at the CC/DIH or on customer premises. It may require on site visits.
Duration	Half a day / one day.
N° of people	It depends on the client dimension and on the main functions that are to be assessed within the company in terms of digital skills capability.
Pros	• Vendor independent organization. • There is support in the data construction. • Quick and free of charge. • It is intended to create the awareness of the digital readiness of the human skills. • It is a very introductory picture of the current human digital capabilities. • Can be in the national language.
Cons	• It is a low-level analysis (low detail). • It requires further investigation to identify the further needs in terms of improved digital skills and to plan actions to achieve the desired level of digitalization of the human capabilities. • Can be in the national language.
Business model	Freemium

(ii.ii) Skills Digitalization Strategy Development

Table 40 Description of Skills Digitalization Strategy Development Services

Target people	Companies (SMEs e big companies or single professionals).
Objective	Evaluate the level of preparation on skill categories for I4.0 people and understand the digital skills profile to support further improvements through the definition of an action plan.
How	(i) Contact with the people interested in the analysis (it can be conducted in the shape of workshops or interviews to people), (ii) screening of the current digital skills level, (iii) gap analysis (between the AS IS status of the firm and the desired status), (iv) definition of an action plan,

	(v) support in the implementation of the action plan.
Duration	From one to four weeks.
N° of people	It depends on the client dimension and on the main functions that are to be assessed within the company in terms of human digital skills.
Pros	• Vendor independent organization. • There is support in the data construction. • It is a quite quick way to assess the digital skills level and to understand which potential actions can be put in place to improve them. • It allows the definition of an action (e.g. training courses, etc.). • It is an ad-hoc roadmap. • It is valid for different manufacturing digital skills (no industry-specific).
Cons	• There is the need for competent analysts. • It requires the human engagement of in terms of time and it also requires effort to the analyst. • This type of tools requires to be kept updated in order to avoid obsolescence. • Relatively high cost because of overhead. Therefore, projects with smaller companies need to be third party funding.
Business model	Premium.

7.3 A2K Workflow Templates

	Digital Capabilities Assessment	Technology Digitalization Strategy Development	Digital Skills Assessment	Skills Digitization Strategy Development	Technology-specific consultancy
Digital Capabilities Assessment	Assess the current technological capabilities of a plant or organization				
Technology Digitalization Strategy Development		Strategic planning towards the achievement of higher digital capabilities			
Digital Skills Assessment			Create awareness on the current human digital skills		
Skills Digitization Strategy Development				Definition of the needs and an action plan to improve human and digital capabilities	
Technology-specific consultancy					Definition of the requirements and identification of the technological solution to support the digitalization and process
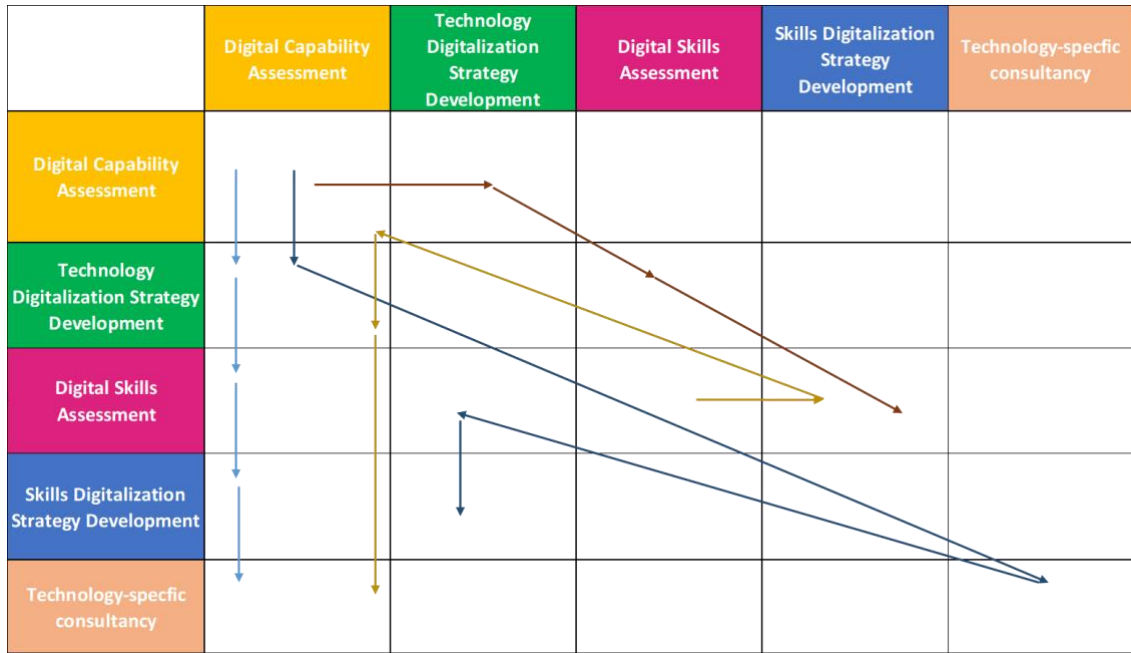
8 Access to Market Services

8.1 Hierarchy of the A2M Services

1st layer	"Access to Market" Services									
2nd layer	Access to Finance				Market Entry / Expansion services					Living Lab Service
3rd layer	Public funding		Private funding		Business Development				Market Cooperation / Expansion	
4th layer	General Information	Supporting getting funding	General Information	Supporting getting funding	General Information	Business Development	Business Consul ting	Aceleration/ Incubation Services	Access to Market Package	Collaboration Partner Search / Selection

Figure 17 "Access to Market" Services Hierarchy

First hierarchical layer: "Access to Market" services

It is well known since year that SMEs and startups/scaleups need support when entering the market or trying to expand their market outreach[10] [11] [12].Normally it is difficult for these small players to get the appropriate support, in particular not in one place where all their needs can be addressed. This is in particular valid for the players in the Manufacturing Industry that are very much affected by the Digital Transformation and the pressure to adapt their technological status quickly[13].

In that light, "Access to Market" services are needed – in addition to the ones described in the previous chapters – to support the manufacturing industry in embracing the Industry 4.0 vision. To this purpose, the MIDIH ecosystem of CCs and DIHs will provide access to different types of consultancy services, to acceleration programs as well as to public and private funding to support Manufacturing SMEs and IT Entrepreneurs in successfully commercialise their newly developed products and services.

The MIDIH ecosystem aims at giving access to these services through the DIHIWARE platform, which is intended to act as a matchmaker between the manufacturers' requirements (process pull) and the opportunities offered by the (digital) technology functionalities (technology push) including the complete business support.

Second hierarchical layer: Categorization of the services

As already outlined previously, "Access to Market" services are essential for SMEs to get into the market or expand their business on national or international level. These services have to provide in most of the cases tailormade support in the different categories to the single SMEs, but can provide also generic information about future trends, etc.

The range of these services, which mostly will be provided as consultancy services and related tools, includes business modelling, business development, market entry, market expansion, market collaboration, information and access to public funding (national and international) as well as to private investors at different levels (like Business Angels, VCs, corporate investors, etc.)

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[10] https://www.oecd.org/cfe/smes/2090740.pdf
[11] http://www.oecd.org/cfe/smes/31919223.pdf
[12] http://www.oecd.org/cfe/smes/glossaryforbarrierstosmeaccesstointernationalmarkets.htm
[13] https://www.oecd.org/mcm/documents/C-MIN-2017-8-EN.pdf

All above mentioned a subset of selected services will be categorized and offered in the MIDIH Platform, which will support the "Access to Market" of the manufacturing SMEs by giving access to three core type of services categorized as: (i) Access to Finance Services; (ii) Market Entry/Expansion Services; (iii) Living Lab Services.

(i)   Access to Finance Services

Many companies, in particular SMEs, in Europe are struggling to get their innovative ideas financed – especially when dealing with digitization, to be able to enter new markets and expand their business. This includes also startups or scale-ups (young companies that have already customers and sales – they have already "traction"). As an assumption could be said that private financing (Business Angels, Venture Capitalists, etc.) is extremely important for the startups/scale-ups, while public financial support in terms of funding for innovation is normally more attractive for SMEs, like e.g. the cooperation in publicly funded projects (the SMEs get financial support for creating an innovative product/service, while working together with other companies that could be either potential cooperation partners or potential for future business.

The DIHIWARE platform will provide to manufacturing companies (especially SMEs) access to the different types of financial support; it will provide a comprehensive general information about all services and options for giving the interested persons accessing the platform the possibility to get an overview and then choose the right service.

(ii)   Market Entry/Expansion services

As already previously explained, SMEs, and in particular the ones facing the challenge to adopt digitization and develop related products and services, need support in getting new products/services into the market or expanding their business in other markets (national or international).

The MIDIH network of CCs and DIHs will offer to the DIHIWARE platform all kinds of services to the SMEs for supporting them with their "Access to Market": business modelling, business development, business advice, market entry, - collaboration, - expansion.

(iii)   Living Lab Services

For many companies, it is important to have a user testing before launching the product to understand if adaptions have to be done or if the service/product fits already customer's needs. Inspired by the Lead User Method from Eric von Hippel14, many institutions are offering Living Lab services; these include the provision of user groups in the targeted areas that are doing a precommercial testing. The Method of Lead User Innovation per se is quite expensive and are mostly used by big corporates when innovating products for the mass market.

The Living Lab Services provided by the MIDIH network and offered in the DIHIWARE platform can be seen as a complementary category to complete the whole "Access to Market" services.

Third hierarchical layer: Purpose of the services

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[14] http://www.lead-innovation.com/en/lead-user-method

The Market Service that will be provided by the MIDIH ecosystem of CCs and DIHs can be distinguished as follows:

    (i)   Access to Finance Services

Access to Finance Services that will be provided by the MIDIH ecosystem of CCs and DIHs have been divided into two categories as the service is serving different purposes:

Table 41 Access to Finance Services Purpose

Access to Finance Service	Purpose of the service
(i.i) Public funding	Public funding is important for SMEs when developing new innovative products and services. Normally this development cannot be financed through the Cash Flow and it is also difficult to get bank financing, especially after Basel III[15], a regulatory framework which was established after the financial crisis (2007-2009) imposing to bank severe restrictions when lending money. So, SMEs try to get public funding, either through collaboration in national or international projects or applying, e.g. to an Innovation Voucher or the EC SME instrument. A DIH should provide to its "customers" these services by giving information and support in getting involved.
(i.ii) Private funding	SMEs, but also statups/scale-ups, who need financial support quite quickly for being able to proceed with the development of their innovations, will most likely approach private investors. Depending on the type of solution and type of company different types of investors will be interesting for them. Startups might need seed funding (mostly provided through Business Angels), scale-ups Round A or Round B financing through investors, mostly VCs and SMEs would most probably prefer private investors for not having to give away a stake of their companies. MIDIH with its network of DIHs and CCs will offer all indicated services in its DIHIWARE platform.

    (ii)   Market Entry/Expansion Services

All Market Entry/Expansion Services that will be offered by the DIHIWARE platform have been divided into two different categories, which are following different purposes:

Table 42 Market Entry/Expansion Services Purpose

Market Entry/Expansion Services	Purpose of the service

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[15] https://www.bis.org/bcbs/basel3.htm

(ii.i) Business Development	In a very competitive world it is especially for SMEs, startups and scale-ups of extreme importance to get the business model right for newly developed products and services. This is even more important in a digitised economy where different types of business models might be necessary in a multi-sided platform economy and only well-developed business models lead to a competitive advantage, which is important for the small players.
	MIDIH with its network of DIHs and CCs will offer via its DIHIWARE platform business development services on different levels, mainly tailormade consultancy services like business modelling, business advice and business development as well as different types of acceleration and incubation services.
(ii.ii) Market Collaboration/Expansion	SMEs and scale-ups need support in growing their business or expanding to other markets; especially for these small players it is important to have support in getting access to the right partners or customers in an adequate timeframe fitting to their market cycle. Manufacturing SMEs, e.g., need particular support in getting collaboration partners in the supply chain or production partners for a new product.
	The MIDIH Network will offer a subset of selected services via its DIHIWARE platform, to ensure that Manufacturing SMEs and IT Entrepreneurs can get the support needed in the different countries.

(iii) Living Lab Services

Table 43 Living Lab Services Purpose

Living Lab Services	**Purpose of the service**
(iii.i) Living Lab Service	Living Lab Services are an additional and complementary part to business development and financial services. Companies that would like to do a pre-commercial testing of their innovative products/services can make the testing with targeted user groups that could provide valuable feedback. This can be applied to new products but also to modified products. This service can avoid a potential market entry failure when customers are not interested in the new product.

8.2 Description of the A2M Services

This section provides specifications related to the "Access to Market" services that will be offered by the MIDIH ecosystem of CCs and DIHs and accessible through the MIDIH ecosystem.

(i)   Access to Finance Services

1st layer	"Access to Market" Services									
2nd layer	Access to Finance									
3rd layer	Public funding					Private funding				
4th layer	General Information			Supporting getting funding		General Information		Supporting getting funding		
5th Layer	National projects	International Projects	Innovation on Voucher	Application process	Matchmking for new projects	Investor network	Investor services	Selection of Investor type	Investor meetings	Pitch training

Figure 18 Access to Finance Services

(i.i) Public Funding Services

- **Information Services (free)**

Table 44 Description of Public Funding Information Services

Target people	Enterprises (all sizes)
Objective	Provide companies of all sizes interested in public funding about possibilities: • Open Calls for national and international projects, • funding possibilities on national and international programmes, • Innovation Voucher, etc.
How	(i) online documentation (ii) links to the related websites (iii) contact information for related persons
Duration	Always available
N° of people	No limitation
Pros	• Easily accessible • Comprehensive in terms of variety • always available
Cons	• generic information • difficult to assess which would be the right option • public text which is often not easily understandable
Business model	Free

- **Support Services (premium)**

Table 45 Description of Public Funding Support Services

Target people	SMEs; Startups/Scaleups (mainly for public funding for acceleration)
Objective	Provide a tailormade support in: • addressing the right funding option for the individual firm • supporting/conducting the application process • supporting matchmaking with potential partners for new projects
How	(i) Offer a contact point on the portal and approach potential customers (ii) Analysis of the needs of the customer for funding: national, international, project or standalone (Innovation Voucher) (iii) support in the preparation of the application, keeping track of deadlines (iv) if desired and possible, match customers with potential partners for projects
Duration	Depends on customer's requirements
N° of people	Depends on available supporters
Pros	• tailormade services, more efficient support can be provided • individual clients
Cons	• Difficult to find the right match between an SME and a project • Premium service (not all SMEs can pay for that)
Business model	Premium.

(i.ii) Private Funding Services

- **Information Services (free)**

Table 46 Description of Private Funding Information Services

Target people	SMEs, Startups/Scaleups
Objective	Provide SMEs and Startups/Scaleups with information about the Investor Services that are available (types of investors, offered support, etc.)
How	(i) online documentation

	(ii) contact information to related persons
Duration	Information is always available
N° of people	No limitation
Pros	• Easily accessible • As comprehensive as possible • Always available
Cons	• Generic information • Not possible to assess which is the right option (e.g., in terms of investor type or training needed)
Business model	Free

• **Support Services (premium)**

Table 47 Description of Private Funding Support Services

Target people	SMEs, Startups/Scaleups
Objective	Provide SMEs, Startups and Scaleups with tailormade support in: • Finding the right investor (Business Angel, Series A or B) • Arrange targeted Investor meetings • Offering Pitch Trainings
How	(i) active promotion on the website, but normally SMEs are actively approaching the DIH/CC when in need of private funding (ii) checking the business model of the SME/Startup and making a valuation of the company (iii) identify the investors meeting the company's requirements (Business Angels, VCs; seed funding, round A or round B) (iv) prepare a meeting plan (v) arrange a pitch training before the meeting with investors
Duration	Depends on customer's requirements
N° of people	Depends on available supporters
Pros	• Tailormade support in checking the business model and the type of investor needed • Addressing exactly the category of investors the company needs (Business Angels, VCs, corporate investors, etc.)

	• Tailormade preparation for the meetings (pitch training, etc.) • Arrangement of specific meetings with a clear matchmaking between the company and the best investors
Cons	• High costs, especially for a small company • No fixed guarantee to get funded • Getting private funding can take up to 8 months of negotiation, so service is not appropriate for companies that need money in a very short period
Business model	Premium.

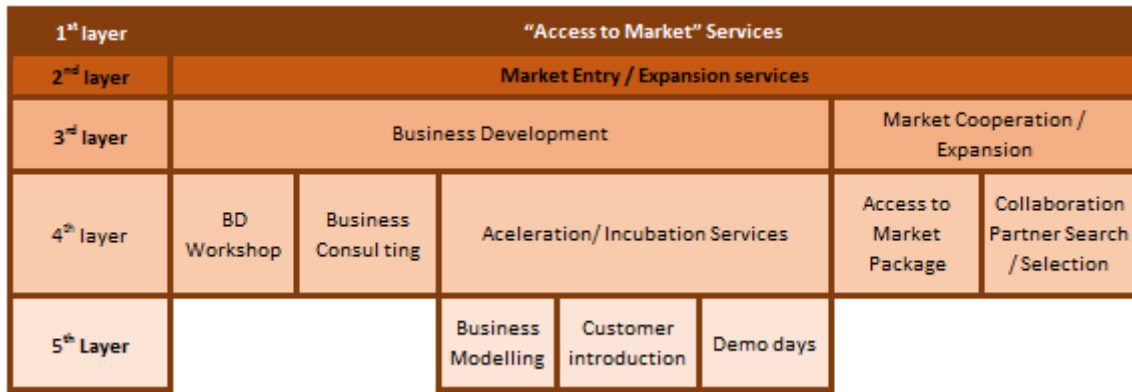### (ii)   Market Entry/Expansion Services

Figure 19 Market Entry/Expansion Services

General information about all Market Entry/Expansion Services can be found on the portal and can be assessed for free, among others Acceleration and Incubation programs, Business advice/consulting, Business Development workshops, market Cooperation, etc. The information is generic and for all areas. Contact persons for next steps for each of the different services are indicated.

(ii.i) Business Development Services

Table 48 Description of Business Development Services

Target people	SMEs, Startups/Scaleups, professionals interested in starting their own business, entrepreneurs
Objective	Provide companies with a various set of services to support the start of their business, the development/improvement of their business model as well as the acceleration of their business: • Business Advice (validation of business idea) • Business Consulting • Business Development Workshop

	• Accelerator/Incubator programs
How	(i) Services actively promoted on the portal, People/companies are approaching the DIH/CC
	For <u>Business Advice</u>:
	(ii) evaluation with self-assessment tool
	(iii) based on result consultancy on specific product, idea or company
	For <u>Business Consultancy</u>:
	(ii) analysis of situation based on request from customer
	(iii) definition of an action plan,
	(iv) support in the implementation of the action plan.
	For <u>Business Development Workshop</u>:
	(ii) group activities, e.g., serious games
	(iii) brainstorming sessions
	For <u>Accelerator/Incubator programs</u>:
	(ii) interested companies have to apply
	(iii) after selection done dedicated program starts
	(iv) company will be supported with mentoring and business modelling, etc.
	(v) company will be introduced to customers and will take part in Demo Days/events
Duration	Depends on the services:
	• Business advice (depends on customer's requirements)
	• Business consulting (depends on customer's requirements)
	• Business Development Workshop (2 days – weekend)
	• Accelerator/Incubator programs (3-12 months depending on the program)
N° of people	Depends on the services:
	• Business advice (depends on number of consultants)
	• Business consulting (depends on number of consultants)
	• Business Development Workshop (max 100 persons)
	• Accelerator/Incubator programs [depends on the program; can be between 10 and 100 (for big accelerators/incubators)]

Pros	• Tailormade service for each individual customer (Business Advice/Consulting)
	• Comprehensive introduction into entrepreneurship and what has to be considered when starting a Business (Business Development Workshop)
	• Specific program for getting a product market-ready within a couple of months providing help on all levels – business, legal, market (Accelerator/Incubator program)
Cons	• High costs, especially for small companies/startups that want to scale up their business (Business Advice/Consulting)
	• Generic, for all areas (Business Development Workshop)
	• Duration of the program – it might take more time than originally planned (Accelerator/Incubator programs)
	• Access to Finance normally also needed (Accelerator/Incubator programs)
Business model	Premium.

(ii.ii) Market Cooperation/Expansion Services

Table 49 Description of Market Collaboration/Expansion Services

Target people	Startups that want to scale up their business and expand (Access to Market Package)
	Mainly SMEs that want to expand their business to broader market or internationally (Collaboration Partner Search/Selection)
Objective	Provide services to SMEs and startups that want to expand their business on different levels:
	• Access to Market Package (for scaling up the business, getting more customers)
	• Support in search for collaboration partners, e.g. technology providers or corporates, to expand the business (to a broader market or internationally)
How	(i) active promotion on the website, companies (SMEs, startups) are approaching the DIH/CC for this service
	For Access to Market Package:
	(ii) working on business plan
	(iii) introduction to customers
	(iv) presentation of the scale-up on Demo Days/events

	(v) normally related to Access to Finance Service
	For <u>Collaboration Partner Search/Selection</u>:
	(ii) identify customer's needs
	(iii) select potential interesting companies for the customer
	(iv) arrange the meetings with these companies
	(v) continue supporting collaboration if needed
Duration	Depends on the type of service: • Access to Market Package (12 months) • Collaboration Partner Search/Selection (depends on customer's requirements)
N° of people	depends on number of consultants
Pros	• Tailormade for each individual customer with respect to customers addressed, partners needed, etc.
Cons	• High costs, especially for small companies
Business model	Premium.

(iii) Living Lab Services

General Information about Living Lab Services is provided for free on the portal indicating the possibilities of the Living Lab Services, which areas, which formats of user groups, indicative timeline, etc. Contact information is indicated for further steps, e.g., asking for an explicit offer.

Table 50 Description of Living Lab Services

Target people	All types of companies
Objective	Provide companies with a user testing service (verify, test and provide feedback) both for new products and services and the improvement of existing products and services through: • Focus groups • User panels • Lead users which consist of actual users of this product/service or a similar one in case of a new product
How	(i) Companies are approaching the Living Lab because they want to test a new product/service or want to improve an existing one (ii) screening of the new product/service to check which user group and which format would be appropriate

	(iii) monitor the work of the user groups
	(iv) provide customer with results from user groups for him to proceed with final development and market launch
Duration	Depends on how many tests the customer wants to have
N° of people	Depends on customer on how many test users he wants to involve
Pros	• Valuable testing before market launch
	• Possibilities of corrections for product/service
	• Tailormade addressing the right user group
Cons	• High costs, especially for small companies
	• Quality depends on user groups that fit
Business model	Premium.

8.3 A2M Workflow Templates

The following figures show the workflows between the different categories of the A2M Services.

	Public Funding	Private Funding	Business Development	Market Collaboration / Expansion	Living Lab Services
Public Funding	investigate all potential offers	check private funding possibilities and also its complementarity with public funding	investigate all potential offerings for business development	Investigate all potential offerings for Market collaboration/entry / expansion	Evaluate the possibility of user testing for the related product
Private Funding		investigate all potential offers	investigate all potential offerings for business development	Investigate all potential offerings for Market collaboration/entry / expansion	evaluate the possibility of user testing for the related product
Business Development	Interest in getting public funding, e.g., working either on national or international level in public funded projects	interest in finding private investors or venture capital to scale up and expand their business	investigate all potential offerings for business development	cross check next steps in entering a new market or expanding to other countries	evaluate the possibility of user testing for the related product
Market Collaboration / Expansion	Interest in public funding, collaboration in public funded projects	interest in finding private investors to expand business in new markets or internationally	Interest in fine-tuning of a business model	investigate all potential offerings for Market collaboration/entry / expansion	evaluate the possibility of user testing for the related product
Living Lab Services		check all possibilities of private funding as support for the product to be launched	Interest in fine-tuning of a business model	investigate all potential offerings for Market collaboration/entry / expansion	check all potential areas where these services are offered
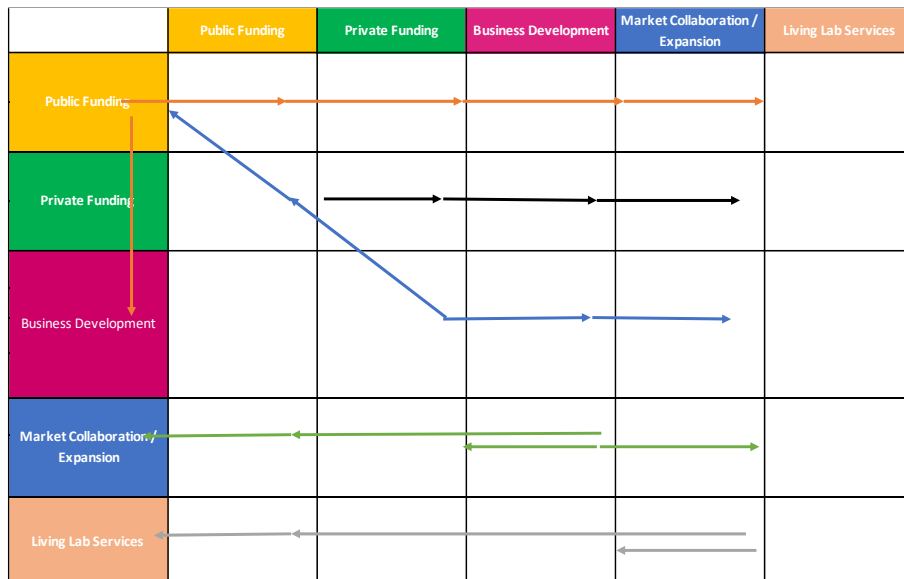
9 Conclusions

The D3.3 deliverable reports on the work done in the first iteration of the tasks **WP3.2** "Development of *Access to Technology/Experiments* Services", **WP3.3** "Development of *Access to Knowledge/Competencies* Services and **WP3.4** "Development of *Access to Market/Finance* Services". This deliverable gathers all the work performed by the whole MIDIH ecosystem in relation to the definition of digital transformation services that should be provided by any DIH.

The services have been accurately described, organized in 5 categories (Competencies, available Technology, Experiments, Knowledge and Market) and hierarchies. Workflows of services are also described where three levels of users' engagement are foreseen: an "access to" level where SMEs are able to be informed and increase their awareness; a "use of" level where targeted and limited hands-on experiments are developed; a "experience with" level where the results of the experimentations are transformed into lessons learned and recommendations for the whole community.

In the next iteration the description of workflow will be refined and enriched, a set of common KPIs to measure the level of increasing digitisation of the users (Manufacturing SMEs and startups / scaleups) will be defined and service-driven Innovation Strategies and Business Models will be designed with the aim to scale up these services, that are now mainly available only locally in the reference regions of the provider, to European level. Moreover, a subset of the identified services will be deployed as a proof of concept through the DIHIWARE platform in order to verify and validate their implementation.

The results of the second iteration will be reported in D3.4 "Specifications and Design of DIH/CC Services 2" at month 27.

10 References

[Ref1] MIDIH **D2.3** "Scenarios, Use Case and Requirements for MIDIH 1

[Ref2] MIDIH **D3.1** "Specification and Design of DIH one-stop-shop Marketplace 1".

List of Acronyms and Abbreviations

Acronym	Meaning
CCs	Competence Centers
CPS	Cyber-Physical System
DIHs	Digital Innovation Hubs
DIHIWARE	MIDIH Innovation and Collaborative Platform
IoT	Internet of Things
MOOC	Massive Open Online Course
SME	Small and Medium Enterprises
VC	Venture Capitalist