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Digital Innovation HUBs and CollAborative Platform for cyber-physical systems



# HUBCAP

## **DIH Collaboration**

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## Abstract

The eight HUBCAP Digital Innovation Hubs offer a wide range of services to support SMEs to innovate with digital technologies. It is the ambition of the HUBCAP project to integrate these individual services into a joint portfolio and to enable collaboration across the HUBCAP DIHs on that basis.

During the first project year the HUBCAP DIH partners have collected and documented the innovation support services available at the hubs. Based on this initial service inventory the hubs have now worked on collecting more information necessary to actually gain valuable insights about their service provisioning, with the particular aim of enabling the identification of opportunities for potential collaboration among the HUBCAP DIHs. This comprises both structural information about the kinds of services and their specific areas of use and operational information about the way the various services are actually used by different kinds of SMEs at various stages of maturity.

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# 1 Introduction

One of the central objectives of HUBCAP is to create a network of Digital Innovation Hubs (DIHs) that will offer a comprehensive set of digital innovation services. These services will include supporting businesses to experiment with model-based design (MBD) for Cyber-Physical Systems (CPSs), finding investments and business opportunities, accessing the innovation ecosystem around the hubs, around other DIHs and across borders, and accessing skills and training. As a starting point, HUBCAP can build on eight such DIHs located in seven European countries, each embedded in its regional innovation ecosystem, offering complementary technical expertise, experimental capabilities, and specialist knowledge in CPS application domains.

The HUBCAP work programme comprises a set of activities to gradually build the network of HUBCAP DIHs and the desired portfolio of collaborative innovation support services. During the first year of the project, the HUBCAP DIH partners have developed a comprehensive inventory of the innovation support services available at their hubs. Each hub collected its already existing services and described its portfolio according to the established Business-Ecosystems-Skills-Technology categorisation. Based on this initial service inventory, the second project year was now dedicated to work towards enabling collaboration opportunities among hubs. This concerns both collaboration among the HUBCAP DIHs, which is at the core of the projects work plan in this respect, but also the collaboration with hubs that are outside the project consortium.

Addressing the first aspect, HUBCAP-internal DIH collaboration, the project partners have further analysed their service portfolios in terms of structural attributes of the services, such as focus on certain technologies or application domains, but also in terms of operational aspects, i. e., how the services are actually intended to be used by different kinds of SMEs looking for support in coping with challenges in their digital technology adoption strategies. To this end the HUBCAP DIHs have developed so-called customer journeys, prototypical ways of how SMEs would make use of the various services. These customer journeys have then been analysed and the service portfolios and journeys at different DIHs have been compared to each other in order to reveal similarities or complementarities. This initial analysis is used to identify potential collaboration opportunities, e. g., for hubs with similar customer journeys to work together on the development of a new service that would currently be missing in their portfolios, or hubs with experience in a given area to provide support to another hub to share or replicate a service to fill gaps.

Concerning the second aspect of enabling collaboration with external DIHs, the HUBCAP DIH partners have integrated the descriptions of their existing services into the HUBCAP collaboration platform, such that these become accessible to a wider audience. Furthermore, an understanding of the specific value proposition that HUBCAP offers towards such external DIHs has been developed, as a vehicle to prepare the outreach to further hubs across Europe.

**Scope** This document reports on the work performed within Task 2.3 of Work Package 2 and presents interim results towards enabling cross-DIH collaboration, both project-internally

and with other European DIHs. It has to be noted that this task will continue throughout the final year of the project, where concrete collaborative services will be developed and possibly deployed with a few selected early adopter SMEs, and external DIHs will be invited to join the HUBCAP DIH network to allow for collaboration on a European scale.

## 2 Collaboration with other DIHs

Although the main focus of the work plan of Work Package 2 is on enabling collaboration opportunities among the HUBCAP DIHs, it became apparent that establishing ways to interact and collaborate with other European DIHs outside the HUBCAP project consortium is also key when it comes to achieving sustainability of the HUBCAP DIH network and services. We therefore initiated work towards creating offerings for such external DIHs. As first steps, descriptions of the existing services offered by the HUBCAP DIHs (see also HUBCAP deliverable D2.1 [HUB20]) have been added to the collaboration platform, and we have developed a Value Proposition for the HUBCAP offering towards external DIHs.

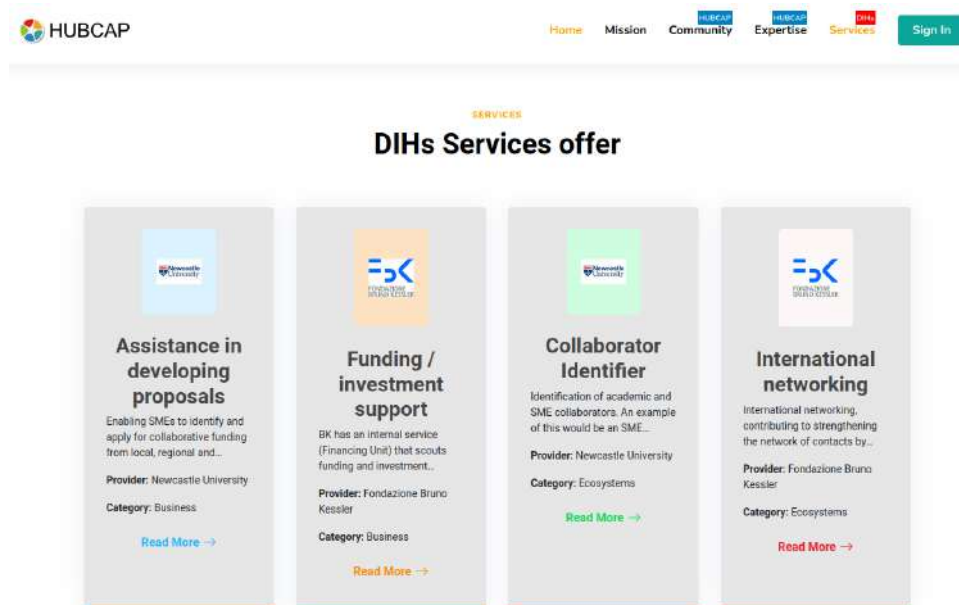


Figure 1: Public part of HUBCAP DIH services on the Collaboration Platform

### 2.1 Presentation of HUBCAP services on the collaboration platform

During the first year of the project, the HUBCAP DIHs have collected and documented their existing innovation services [HUB20]. Using this portfolio as a baseline, the service descriptions have now been integrated in the HUBCAP Collaboration Platform. A selection of these service descriptions are available publicly, (see Fig. 1).

The full collection of offerings is restricted to registered users of the platform and is presented when the user is signed in, split into the categories of *business*, *ecosystem*, *skills*, and *technology* services.

Fig 2 shows a snapshot of the overview of the technology services.

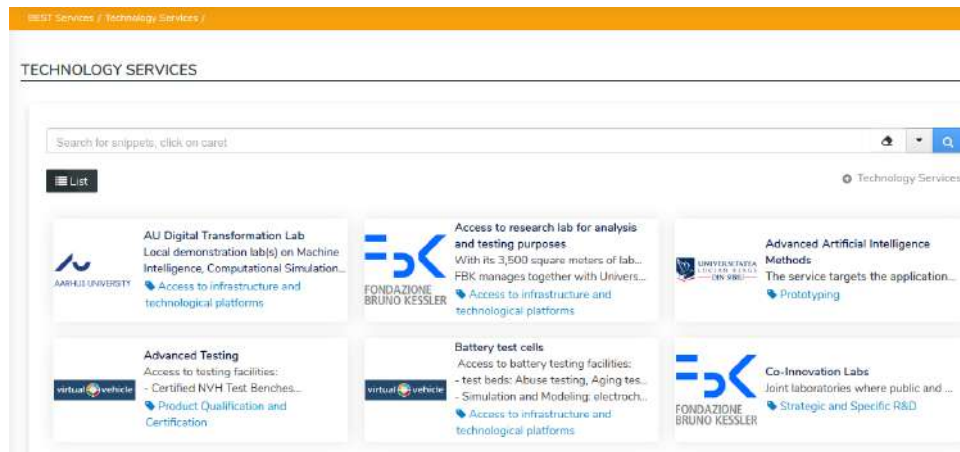


Figure 2: Presentation of HUBCAP DIH *Technology* services on the Collaboration Platform

The catalogue of DIH services is gradually being extended with additional services as they become available at the hubs. Furthermore, it is intended to invite external DIHs to present a selection of their services most relevant to the HUBCAP domain on the platform.

## 2.2 HUBCAP value proposition towards other DIHs

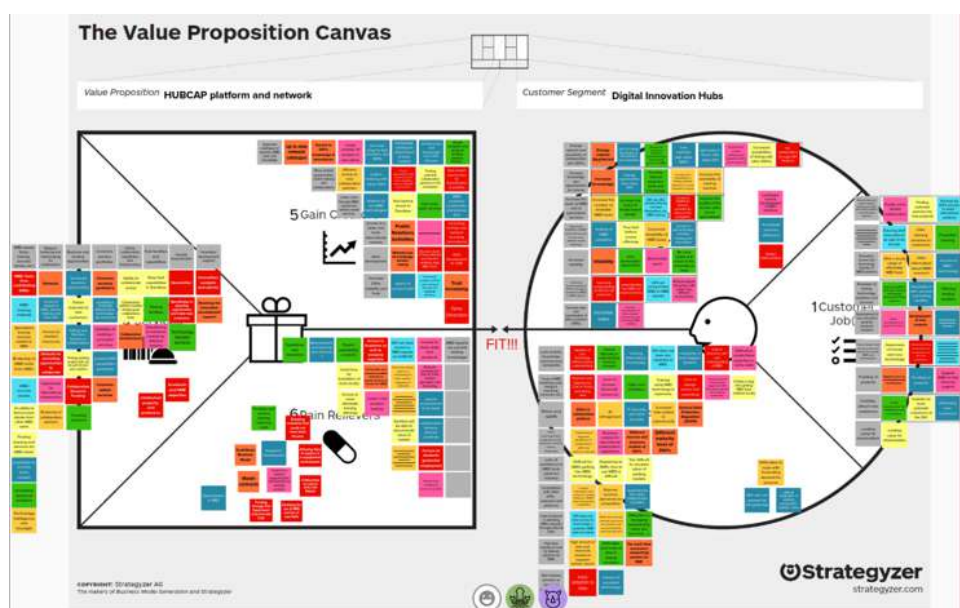


Figure 3: Value Proposition Canvas



As a preparation for reaching out to other European DIHs outside the HUBCAP consortium, the project partners have worked on developing a *value proposition* for the HUBCAP offerings, in order to understand better what the HUBCAP project can deliver to such external hubs and to ensure that the offering provided actually fits their needs.

For this exercise we have made use of the *Value Proposition Canvas* [OPB<sup>+</sup>14], which is a tool that facilitates structuring the various elements that are needed in the development. The canvas basically provides a template that divides the considerations into a view on the *customer*, which would be the external DIHs in our case, and one on the *product*, which is the HUBCAP offering towards those DIHs. For the customer part of the canvas (the right-hand side of Fig. 3) one has to explore three aspects: first, the *jobs* or activities a customer intends to do, the problems they are trying to solve, second, the *pains* of the customer, e. g., the challenges for the customer to perform their jobs, or the risks or costs, and, third, the *gains* of the customer, i. e. the benefits they expect. Similarly, for the product part (the left-hand side of Fig. 3) one looks at the *products and services* that can be provided (by HUBCAP, in our case), the *gain creators*, which are the factors of the product that offer added value, and the *pain relievers*, i. e. elements of the product that help the customer solve their challenges, reduce cost, lower risks, etc.

The HUBCAP partners have worked jointly to provide input to the Value Proposition Canvas, using the *MURAL* online collaboration tool (<https://www.mural.co/>). The interim result is briefly summarised in the transcript of the canvas as shown in Fig. 4.

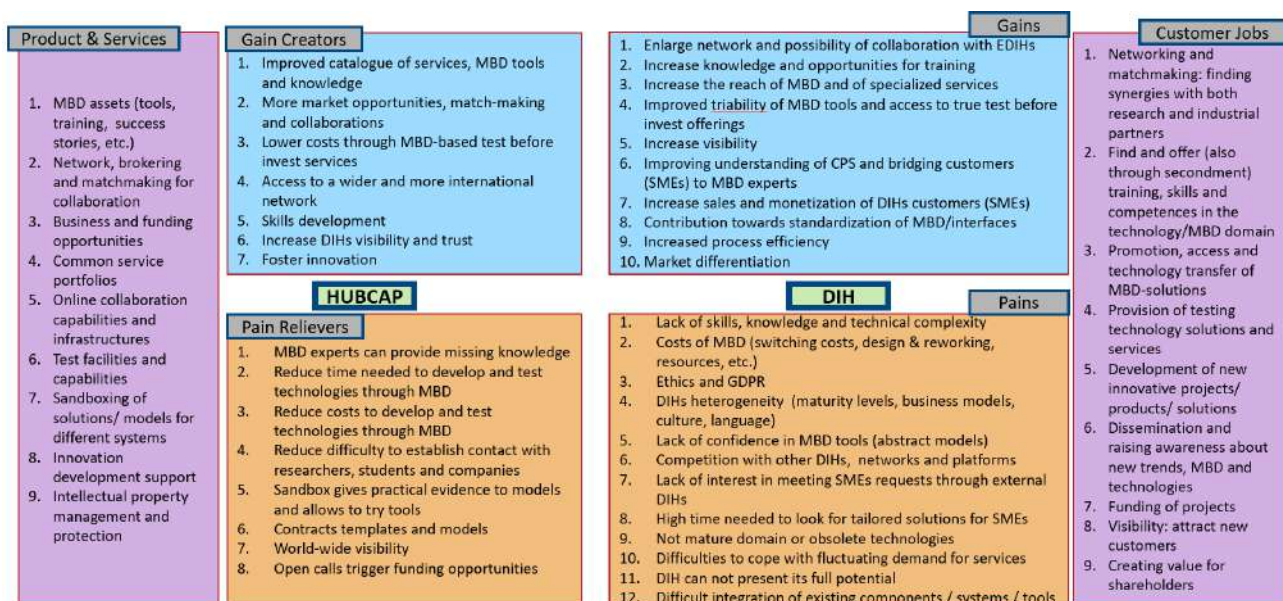


Figure 4: Transcript of HUBCAP DIH Value Proposition Canvas

The challenge is then to map the two sides of the canvas to each other, i. e., to analyse if and how well the product addresses the customer's jobs, and helps them achieve the desired gains while reducing the perceived pains. This mapping is a multi-staged process and it is beyond the scope of this report to present all the details. As a result, Fig. 5 shows a summary of the development. The overall benefit of the HUBCAP offer, its value proposition towards DIHs, is to "*Leverage Model-Based Design assets to trigger a trustful platform-driven*

collaboration among DIHs on CPS innovation.” This is achieved by

- Providing MBD assets (tools, training, success stories, etc.) in a common service portfolio to easily test facilities and capabilities in the CPS innovation development through online collaboration infrastructures.
- Supporting networking, brokering and matchmaking of DIHs providing business and funding opportunities and managing and protecting intellectual property.

Title / Slogan	<b>Leverage MBD assets to trigger a trustful platform-driven collaboration among DIHs on CPS innovation</b>	<i>Express in one sentence the ultimate benefit of HUBCAP offer</i>
Summary	Provide MBD assets (tools, training, success stories, etc.) in a common service portfolio to easily test facilities and capabilities in the CPS innovation development through online collaboration infrastructures. Support networking, brokering and matchmaking of DIHs providing business and funding opportunities and managing and protecting intellectual property	<i>HUBCAP offer content (for who? Why is it useful?)</i>
Details	<ol style="list-style-type: none"> <li>1. Improved catalogue of services, MBD tools and knowledge</li> <li>2. More market opportunities, match-making and collaborations</li> <li>3. Lower costs through MBD-based test before invest services</li> <li>4. Access to a wider and more international network</li> <li>5. Skills development</li> <li>6. Increase DIHs visibility and trust</li> <li>7. Foster innovation</li> <li>8. MBD experts can provide missing knowledge</li> <li>9. Reduce time needed to develop and test technologies through MBD</li> <li>10. Reduce costs to develop and test technologies through MBD</li> <li>11. Reduce difficulty to establish contact with researchers, students and companies</li> <li>12. Sandbox gives practical evidence to models and allows to try tools</li> <li>13. Contracts templates and models</li> <li>14. World-wide visibility</li> <li>15. Open calls trigger funding opportunities</li> </ol>	<i>Detail :</i> <i>Benefits of HUBCAP outcomes.</i> <i>Problems solved by HUBCAP outcomes.</i> <i>Arguments that prove HUBCAP is doing better than competitors.</i>

Figure 5: HUBCAP DIH Value Proposition Summary

It is worth noting that the HUBCAP value proposition specifically emphasises HUBCAP’s focus on model-based design for supporting innovation in cyber-physical system. Regarding the outreach to other DIHs for potential collaboration this means that it is not the intention of HUBCAP to invite those external DIHs to just a (yet another) network of more or less strongly linked entities, but indeed to address those DIHs that have an interest in the MBD/CPS domain and may be able to contribute to the online collaboration platform.

### 3 Collaboration among HUBCAP DIHs

With the goal of identifying opportunities for collaboration among the HUBCAP DIHs, the project has carried out two tasks looking more deeply at the services that currently exist at the hubs: a (light-weight) structural analysis of the services and an analysis of the way services are actually used by SMEs at the hubs.

#### 3.1 Preliminary DIH Service Analysis

In this analysis we were looking at a number of structural aspects of the existing services of the HUBCAP DIHs. In particular, the hubs were asked to provide information about their services (based on the collection provided in the previous deliverable D2.1 [HUB20]) for the following questions:

- Technology focus: is the service focusing on a particular technology domain, e. g., model-based design, one of the key specialisation areas relevant for (E-)DIHs, i.e. Artificial Intelligence, High-Performance Computing, Cyber-security, or is it generally applicable? Up to 3 answers could be given.
- CPS application domain: is the service dedicated to a particular application domain for CPS? Up to 3 answers could be given.
- Digital skills: does the service address the provision of digital skills? Binary answer “yes” or “no”.
- Public administration: does the service concern the public services domain? Answers are “yes” or “no”.
- Shareable / replicatable: Would the service be shareable to other DIHs, or could they easily replicate the service (“yes” or “no”).
- Extensible: Is there a potential to extend the service, e. g., to broaden the scope, address other domains? Could the extension be done by other DIHs, e. g., by integrating some of their offers? Answers restricted to three options: “not extensible”, “extensible only by DIH itself”, “extensible by other DIHs possible”.

The responses from the DIHs considered 43 services in total. In the following, some key numerical insights are given.

- Technology focus: about one third of the services concern AI (15) or model-based design (16), while more than half of them are more or less technology-independent (28). Only very few of the services are specific to HPC (1) or cyber-security (3).
- Digital Skills, Public Administration: about half of the services are providing digital skills and/or are relevant for the public services domain.
- Sharability, extensibility: for more than half of the services the DIHs indicate that those services may be shareable and could be replicated by other DIHs (31), or could be extended by other DIHs (29).

On a more qualitative level, it can be observed that commonalities concerning types of services across the DIHs mainly concern the service categories “Support to find investments” and “Skills and Training”, where the respective DIHs offer information services related to Open Calls, provide assistance to find consortia for research proposals or help in writing such proposals, and provide webinars or similar for certain specific technologies. Furthermore, while there seem to exist some significant overlaps of the services in terms of their focus domains, it is hard to identify concrete opportunities for collaboration based on the current descriptions of the services, which are somewhat generic and at a high level. Nevertheless, possibilities for collaboration among the DIHs seem to exist across all four service categories, e. g., through

- organising joint brokerage events for SMEs
- providing courses with joint webinars, or for “train-the-trainer” type of events
- exchanging experts from DIHs through a “rent-a-researcher” programme

- lessons-learnt webinars on problems with open calls / collaboration with SMEs

The survey also showed that the distribution of the focus areas across the DIHs varies, in that some DIHs have no services in certain technology domains,<sup>1</sup> while others (who could be called “experts”) have several service for a given domain. This could be exploited for instance by DIHs who are weaker in some technology domain to look into best practices for a given kind of service from one of the “expert” DIHs, with the latter providing support to implement similar services at the other DIH.

## 3.2 Customer Journey

In addition to collecting structural information about existing DIH services, the project partners also aimed at gaining and sharing a better understanding of their services on an operational level, i.e., how the services are intended to be actually used by SMEs. To this end, the HUBCAP DIHs have developed a series of prototypical *customer journeys* that describe the pathways for SMEs through the service portfolio of a DIH as they go forward in their digitisation process. Customer journeys have been developed for two types of customer SMEs, viz. SMEs that are looking to adopt certain digital technologies, so-called *technology users*, and those that are offering such technology, the *technology providers*.

The approach used to develop the journeys uses a methodology developed by POLIMI developed in previous H2020 projects and relies on the notion of typical digital transformation processes for such SMEs. This process describes the various stages an SMEs goes through and reflects their different levels of digitisation maturity. The journey of a technology-user SME would comprise stages such as

- Observation: the initial step where the SME is searching information in a more or less targeted manner
- Awareness: the next step where the SME becomes more actively engaged, evaluates opportunities and starts to understand benefits and challenges
- Experiment: on this level SMEs get introduced to new technologies and skills and try them out up to a level of building a proof-of-concept
- Experience: in this level prototypes are already tested inside the company’s facilities
- Adoption: the final stage comprises the decision to invest in the new technology and adopt it

Similarly, a technology provider SME would go through the following stages:

- Ideation: the initial stage where the SME would consolidate and validate their new business idea
- Design and Engineering: this phase involves the design of the idea and the specifications for its technical development

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<sup>1</sup>It has to be noted that this is based on the selection of services made by the DIHs for this survey. Several DIHs have more services in place that were not part of this exercise.



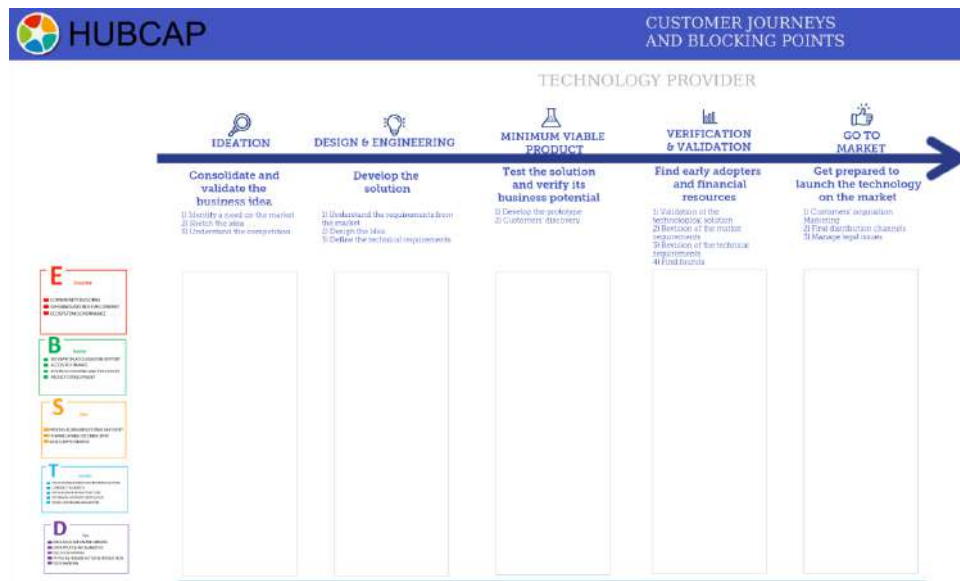


Figure 6: MURAL template used to develop the customer journeys for technology providers

- **Minimum Viable Product:** this is the phase where the solution is tested and its business potential is verified
- **Verification and Validation:** this phase is used to determine the quality of a product, and to find early adopters and financial resources
- **Go-to-Market:** this phase prepares for the launch of the technology on the market and includes customer acquisition and marketing

The task of the DIHs was to structure the actual deployment of their services for each customer type along two dimensions: the first axis is given by the stages of the digitisation journey as just described, whereas the second axis is related to the service categories of the “D-BEST” reference model developed by POLIMI, referring to business, ecosystem, skills, and technology services, extended with an additional category for data-related services.<sup>2</sup> Each of the service categories comprises several services types, which can be further decomposed into service classes and instances. To facilitate the development of the various journeys we again made use of the online collaboration tool *MURAL* and used dedicated templates (provided by POLIMI) as shown in Fig. 6 for the technology provider case.

As a preparation step, each DIH had to map their existing services to the D-BEST service categories. To this end a table was provided that contained a hierarchy of different kinds of services along the D-BEST structure, an snapshot of which is depicted in Fig. 7 for some ecosystems services.

For each type of service that has an instance in the DIH's service portfolio a (square-shaped) sticky note was provided on the MURAL board, with colours reflecting the corresponding D-BEST category, and the DIHs organised these sticky notes into an illustration of the respective customer journey. During this process the DIHs were able to include new services, that are not yet in place and used by the DIH at this point, but are planned to be developed in the

<sup>2</sup>In the POLIMI methodology the categories are called “macro-class definitions”.

TYPE	Class of SERVICE	SERVICE INSTANCES	Yes/no	DIH SERVICE INSTANCE
ECOSYSTEM				
Community building	SME and People Engagement and brokerage	DIH Annual Conference		
		Industrial event		
		Academic conferences and workshops		
		Sectorial fairs		
		Online events		
		DIH products and services portfolio		
	Innovation incitation, Awards	Challenges for collaborative innovation		

Figure 7: Snapshot of the table to map DIHs services to the D-BEST categories

future. Such services are depicted in the journey with sticky notes of a different (hexagon) shape. Finally, a verbal explanation of the journeys was developed by each DIH. The results of this task are presented in the following section.

## 4 Customer Journeys at HUBCAP DIHs

In this section we present the summaries of the various customer journeys at the eight HUBCAP DIHs at Aarhus University (AU), Newcastle University (UNEW), fortiss (FOR), Virtual Vehicle (VV), Fondazione Bruno Kessler (FBK), Politecnico di Milano (POLIMI), KTH Royal Institute of Technology (KTH), and University “Lucian Blaga” of Sibiu (ULBS), each from the perspectives of an SME intending to *use* certain digital technologies and model-based design and from that of an SME acting as *providers* of such technology.<sup>3</sup>

### 4.1 DIH AU

#### Technology User

At AU, a typical customer journey for Technology Users starts (at the observation stage) with a contact to AU’s collaboration offices, a match on events, for instance the “Live from Behind the Walls” (<https://orbitlab.au.dk/events/ece-webinars/>), or direct reference via AU’s established local network (ecosystem services). Typically SMEs contact AU in the need for digital competencies or partners with expertise in key digitalisation areas.

<sup>3</sup>The figures shown in this section are also reproduced in a larger format in the appendix for improved readability.

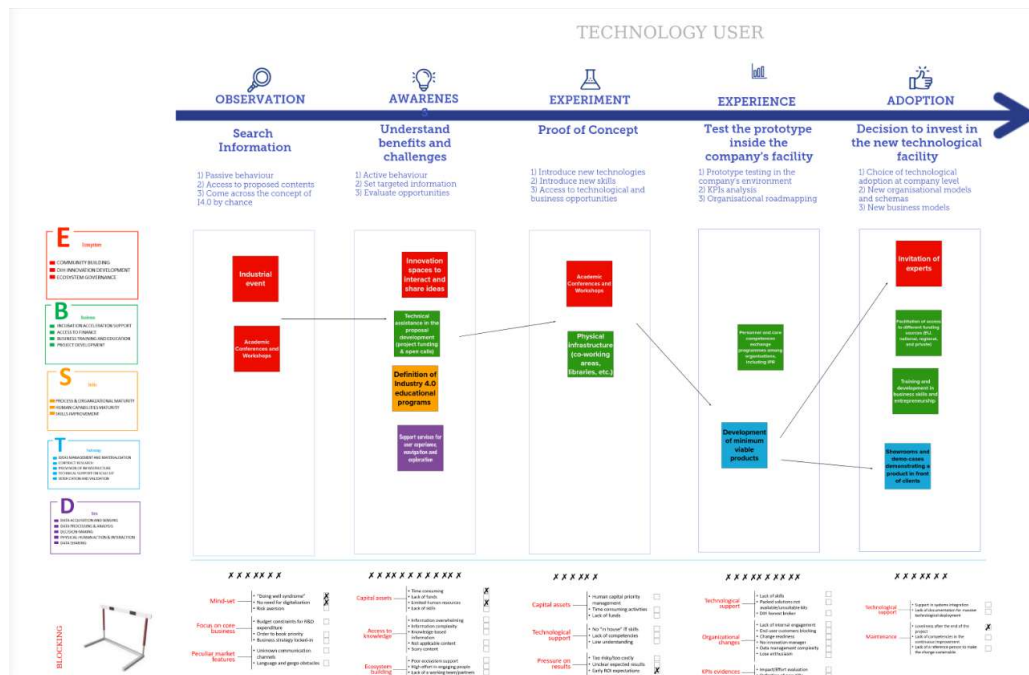


Figure 8: Customer Journey for a Technology User SME at DIH AU

Once this initial contact is established, a variety of different engagements is possible in the the awareness stage, the two main options are:

- Clarification of ideas and partnership opportunities, for example the invitation to other events hosted by the AU DIH where we open innovation spaces to interact and share ideas (ecosystem services). In this case there is a rather loose connection between the SME and the DIH expertise.
- Inclusion in grant proposal writing for adopting technologies and provide support to apply to funding (business services), for SMEs with a mature idea, but lacking complementary partners/funding. In addition, the partners may be invited to participate in education programs (skills) or given access to data services or technology (data).

The next level for technology adopting SMEs is the experiment stage, where partners are given access to physical infrastructure (business services) and are able to develop their ideas further and validate them by participating in workshops or conferences (ecosystem services). In the next stage, the experience stage, the idea is matured/put in practice and minimal viable products and demonstrators (technology) are put in place. At this point AU also provides “Personnel and core competences exchange programmes among organisations” (business services), enabling researchers to intern at companies for further development, e.g. the “rent a researcher scheme” <https://digit.au.dk/collaboration>.

The last stage is adoption, a stage at the boundary between AU’s core expertise and the business expertise provided by partners. At this stage successful experiences are showcased and demonstrated in front of the potential clients (technology), experts in the business area are invited (ecosystem services), and both access to business development skills and further funding (business services) is provided.

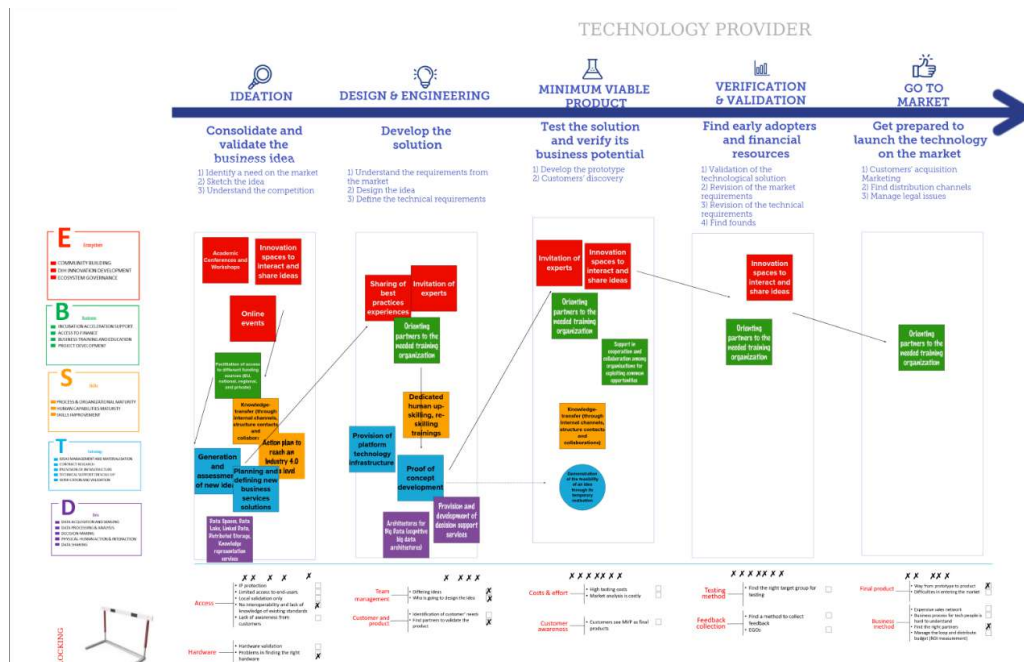


Figure 9: Customer Journey for a Technology Provider SME at DIH AU

## Technology Provider

At AU, a typical customer journey for Technology Provider starts (at the consolidate and validate the business idea) through the participation on AU's online events, such as Live from Behind the Walls, participation in AU's innovation spaces (<https://orbitlab.au.dk/>), or direct reference via our established local network (ecosystem services). Typically SMEs contact AU in the need for enhance their services and looking for further usage of their tech. At this stage AU provides support to apply to funding (business services), knowledge transfer, contacts, business idea development, ... (skills). In addition, it is possible for providers to access Data Spaces, Data Lake, Linked Data, Distributed Storage, Knowledge representation services (data) and further develop their solutions via planning and defining new business solutions or generate new ideas (technology).

The next step is the Design and Engineering phase, where the AU DIH provides the sharing of best practices and invites expert to assist in the process (ecosystem services). In case there is a lack in skills, partners may be oriented to another training organisation (business services) or in case the lack matches AU's in-house expertise dedicated human up-skilling, re-skilling trainings interventions are made (skills). When the core expertise and knowledge is in place, the provision of platform technology infrastructure and the development of a proof-of-concept is the usual service provided (technology). Additionally, provision and development of decision support services or access to data and architectures for big data (data) may be required.

After that, at the Minimum Viable Product phase, there are usually two alternative routes in the journey:

- Demonstration of the feasibility of an idea through its temporary realisation, in the



case there is a full match between the business needs and the research/core activities/competencies of the AU DIH (technology).

- Forwarding to the appropriate partners, by invitation of experts to provide input or forwarding to adequate innovation spaces where the product can be developed (e.g.: Aarhus University Startup Hub, <https://thekitchen.io/>) (ecosystem services)

Typically, the AU DIH is not involved/delivers services at the remaining two phases, namely the Verification/Validation and Go To Market, except in case the idea only requires access to innovation spaces and funding (ecosystem services). The reason for this lack of service provision is the nature of the local ecosystem. AU is an academical institution focusing mainly on research and education with well established bridges with business developers and partners with better competencies and position to find adopters/customers and launch technologies on the market.

## 4.2 DIH UNEW

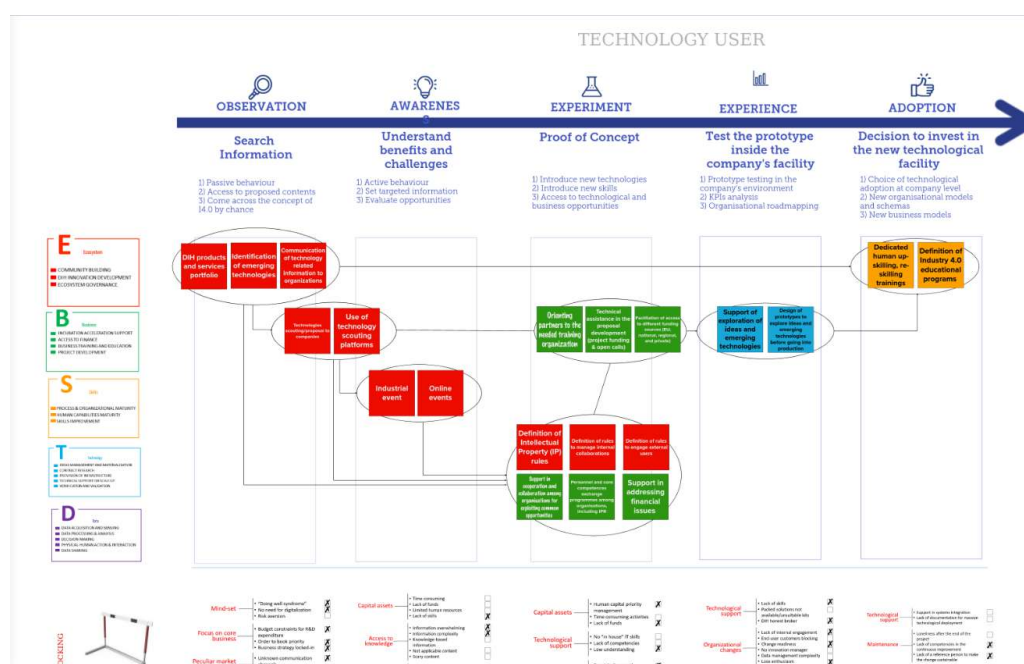


Figure 10: Customer Journey for a Technology User SME at DIH UNEW

## Technology User

UNEW's expertise and services for providers cover the five areas identified, "Search Information", "Understand Benefits and Challenges", "Proof of Concept", "Test the Prototype in Companies' Facilities", and "Decision to Invest in New Technological Facilities." These are however focused and limited services based on UNEW's primary drivers as a University.

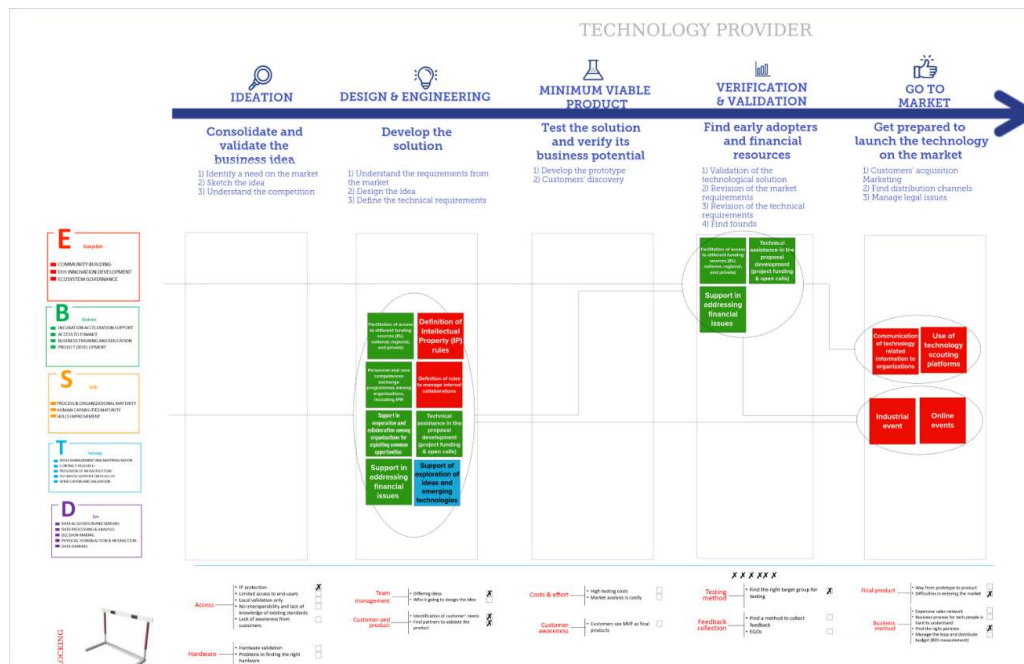


Figure 11: Customer Journey for a Technology Provider SME at DIH UNEW

**Search Information / Understand Benefits and Challenges** UNEW's outward-facing communication channels act as a way draw in potential users. UNEW also reaches out actively to complement these passive channels using scouting platforms/ events.

**Proof of Concept** Some UNEW services here focus on helping users who need more support on IP / collaboration rules, competency exchange and support for financial issues. After this, companies can be helped with proposal writing and access to funding. Users may immediately use these services if IP / collaboration rules etc. are in place already.

**Test the Prototype in Companies' Facilities** UNEW's services here focus on helping to support experimentation and acting as an "honest broker".

**Decision to Invest in New Technological Facilities** UNEW runs a range of Continuing Professional Development (CPD) programmes, and more recently Degree Apprenticeships (DA) in which employees from companies spend two days per week developing technical and professional skills, reaching a master's degree with additional professional qualification. These programmes support up-skilling, re-skilling and training, and cover include Data Science, Cyber Security and Software Engineering.

**Paths:** The communication channels and scouting aim to deliver companies to other services. Some may immediately identify the need for training, others may only need help for financial support, and some will be earlier in their journey and need more support on defining rules and how to cooperate.

## Technology Provider

UNEW's expertise and services for providers are centred around "Developing the Solutions", "Finding Early Adopters" and "Get Prepared to Launch the Technology on the Market".

**Developing the Solutions** UNEW has significant experience in collaborative research and development, and therefore has expertise and dedicated teams for defining and resolving IP rules, managing consortia and teams, and applying for funding from a range of sources.

**Finding Early Adopters** UNEW's experience in funding helps particularly in this phase in help with access to funding sources, proposal development writing and resolution of financial issues.

**Get Prepared to Launch the Technology on the Market** UNEW's help in this area focuses on industrial / online events as way to access new potential customers, and to use its communication channels and access to scouting platforms to reach out beyond current markets.

**Paths:** Technology Providers can engage with UNEW at any of these three points and will be lead to the next phase as appropriate. For example, companies may not need further financial support after resolving IP rules and can go straight to UNEW's communication services.

## 4.3 DIH FOR

FOR offers through its transfer initiative "fortiss Mittelstand" and the Munich Innovation Hub for applied AI (DIH) a variety of services to SMEs in Bavaria and Europe. Following the D-BEST taxonomy, FOR is offering services to Technology User SMEs in each category.

### Technology User

A typical customer journey for Technology Users starts with ecosystem services such as conferences, fairs or online events in an early observation phase. Through these services, SMEs get in contact with FOR and learn about the research and transfer portfolio offered.

Once this initial contact is accomplished, a variety of different cooperations is possible in the next stage, the awareness stage.

- The first option is a rather loose connection, for example the provision of trend reports, white papers or best practices to SMEs (ecosystem services).

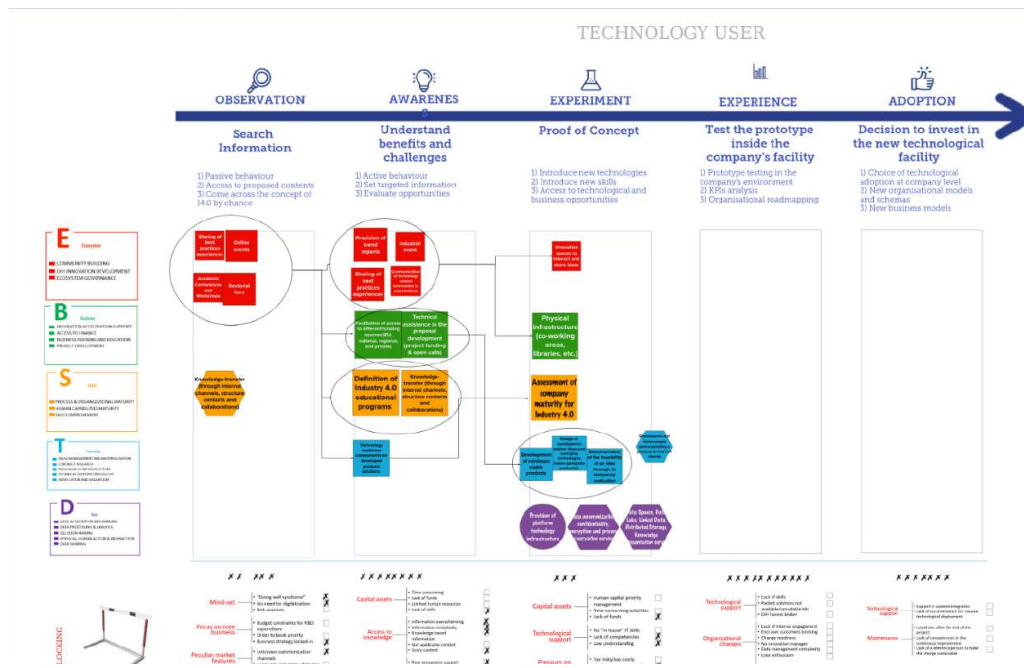


Figure 12: Customer Journey for a Technology User SME at DIH FOR

- A second possibility is the provision of educational and further development programs in several fields through researchers of FOR (skills services).
- Also, the execution of technology readiness assessments through FOR and its partners for interested SMEs is a potential next step in the customer journey (technology services).
- Last but not least, the facilitation and development of (joint) projects between FOR, Technology User SMEs and other partners are the fourth potential form of collaboration. This maybe the case through funded projects, contract research or the assistance in access to funding through e. g., open calls (business services).

FOR is offering services only as far as the experiment phase, but does not cover later stages; this is mainly due to internal and national regulations such as public aid. In the experiment phase, FOR's portfolio includes innovation spaces (ecosystem) and physical infrastructure (business) as well as demonstrators (technology) which can be made available for SMEs collaborating with FOR in different scenarios. Also detailed workshops and maturity assessments (skills) belong to that stage.

For further going activities and support of SMEs, FOR is in contact with different other organisations, such as multipliers, incubators and business service providers in the local ecosystem.

## Technology Provider

A typical customer journey of a Technology Provider at FOR usually starts with the participation in information events, such as webinars, fairs and conferences or via publications of

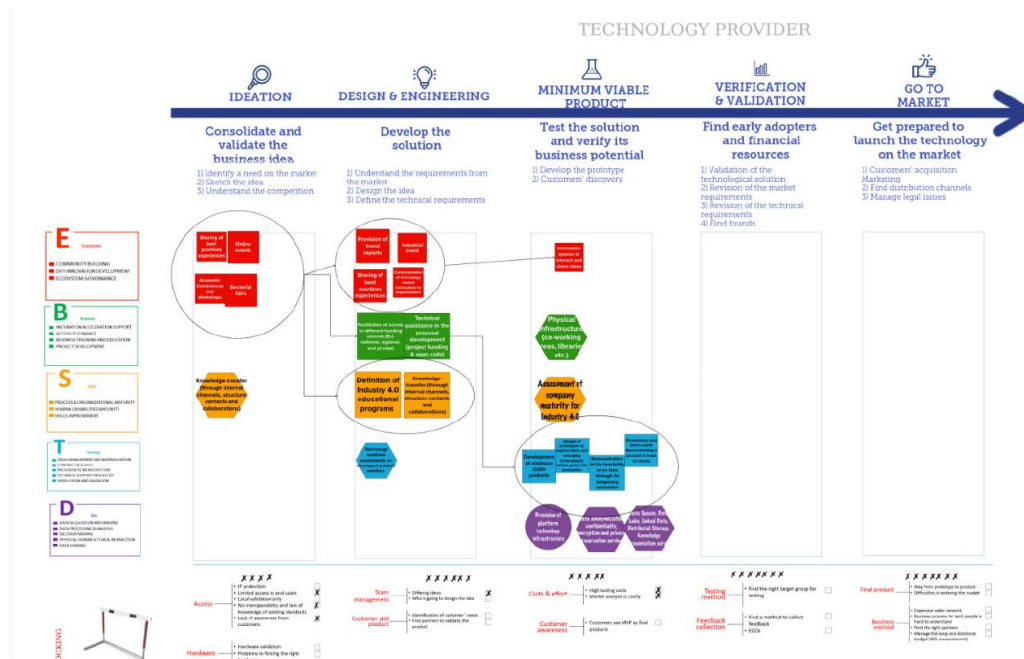


Figure 13: Customer Journey for a Technology Provider SME at DIH FOR

scientific articles or press releases. In a first meeting, an interested company and FOR will get to know each other, talk about fields of interest and expertise and come up with a first idea about potential collaborations.

Depending on the company's needs FOR is offering several services. One possibility is to provide further information and deeper insights in one of FOR's research areas through trend reports, scientific papers or webinar series. If the company is already aware of the need of a specific topic in depth, FOR is offering so-called customised solution workshops, specifically dedicated to a certain company. In addition, potential analysis are of interest for some companies, which FOR provides via FOR's engagement within the Mittelstand 4.0 Kompetenzzentrum Augsburg.

Additionally, FOR offers a Living Lab with software and hardware demonstrators originating from several different projects, which are available for interested SMEs.

If the company has the need for a dedicated research project there are three different options that FOR is offering:

- Contract research, company is contracting FOR to do research and development on a certain topic.
- Joint projects, here FOR is offering the possibility to engage in (mostly nationally) funded research projects via one available funding schemes in Germany.
- Open Calls assistance, here FOR is informing about Open Calls in general and about the currently up and running calls within the FOR's projects. For general information, FOR is providing a dedicated white paper on open calls, which aims at explaining the function of the funding mechanism and states some success stories from previous projects.



FOR provides assistance and development of products and services up to demonstrator or prototype level. FOR does not engage in further work towards product development mainly for legal reasons.

#### 4.4 DIH VV

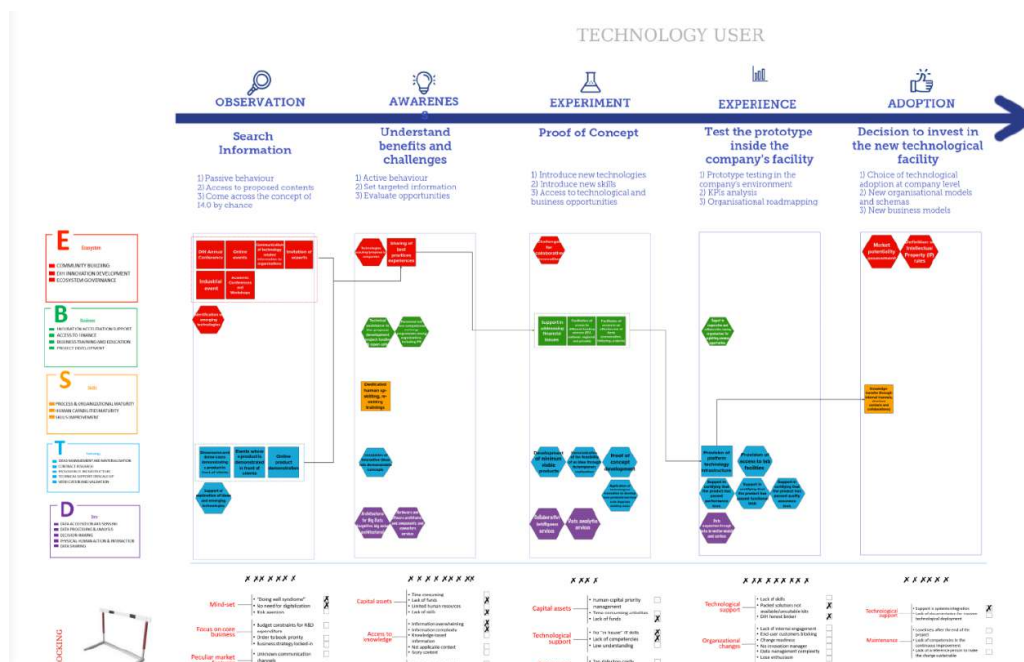


Figure 14: Customer Journey for a Technology User SME at DIH VV

## Technology User

To search information the DIH offers for Technology Users events, conferences and workshops, or product demonstrations (online, showrooms). In sharing of best practices experiences via Articles, Reports, Scientific papers, lectures and contribution to standards, the Tech User gets awareness and understands benefits and challenges. A support in finding different funding opportunities on EU, national and regional level as a One-Stop-Shop (R&D project development) or Living Innovation Lab, enables SMEs to get access to new technologies and experiment with them. Different platforms and demonstrators (Driving Simulator, AD/ADAS Demonstration Vehicles, a mobile HiL-Platform "SPIDER", ModelConnect/ICOS) allows the user to gain own experience or test prototypes. Through research projects and the Living Innovation Lab, the Tech User benefits from a knowledge transfer to facilitate the adoption of a new technology at a company level or new business models.

Solved blocking points that could arise for Tech Users are in Mind-Set (Doing well syndrome; No need for digitalisation) and especially the Lack of Skills, Knowledge, Information, Partners and Funds. In Addition, the DIH offers a lot of technological support with IT skills, Competencies, individual solutions, brokerage, as well as support in system integration.

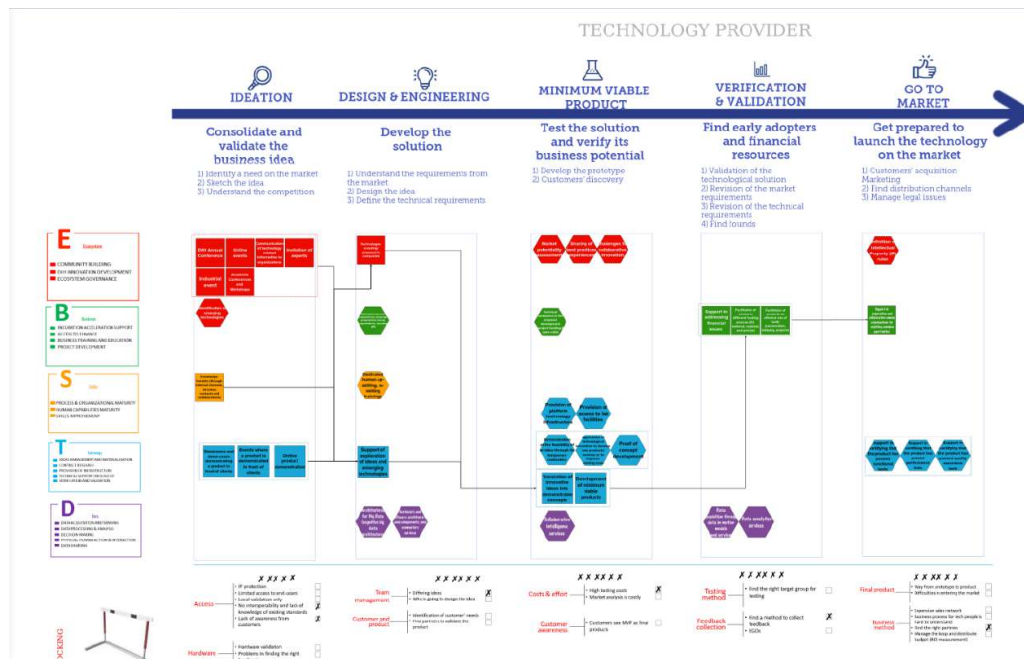


Figure 15: Customer Journey for a Technology Provider SME at DIH VV

## Technology Provider

For Technology Providers there are different starting points: The first idea is either based on events, conferences or workshops attended, collaborations / personal contacts or via product demonstrations of the DIH (online, showrooms). To encourage the SME to develop its own solution, either open calls are launched or the DIH generally supports the SME with the project idea and the development of project proposals as part of a one-stop shop or joint research projects. In the next step, with the development of a prototype, the DIH provides assistance via the Living Innovation Lab or dedicated research projects. To find funding sources and facilitate an effective mix of funds on EU, national and regional level, the DIH supports within the scope of a One Stop shop (R&D project development) and the internal Living Innovation Lab. With these the DIH offers also support in cooperation and collaboration for exploiting common opportunities in the following market entry phase.

In addition to the services mentioned, other services are also offered that solve some blocking points that could arise in the SMEs. The DIH gives access to knowledge, facilitates interoperability, and furthers awareness from customers. Differing ideas in the team are resolved by a support in exploration of ideas and emerging technologies. Via different test benches, platforms, and simulations, testing costs are lowered and collecting feedback is simplified. Also, the DIH helps to find the right partners by networking.

## 4.5 DIH FBK

The following descriptions narrate the ideal journey where Technology Providers and Technology Users follow all the step foreseen. In some cases, FBK are asked to offer single

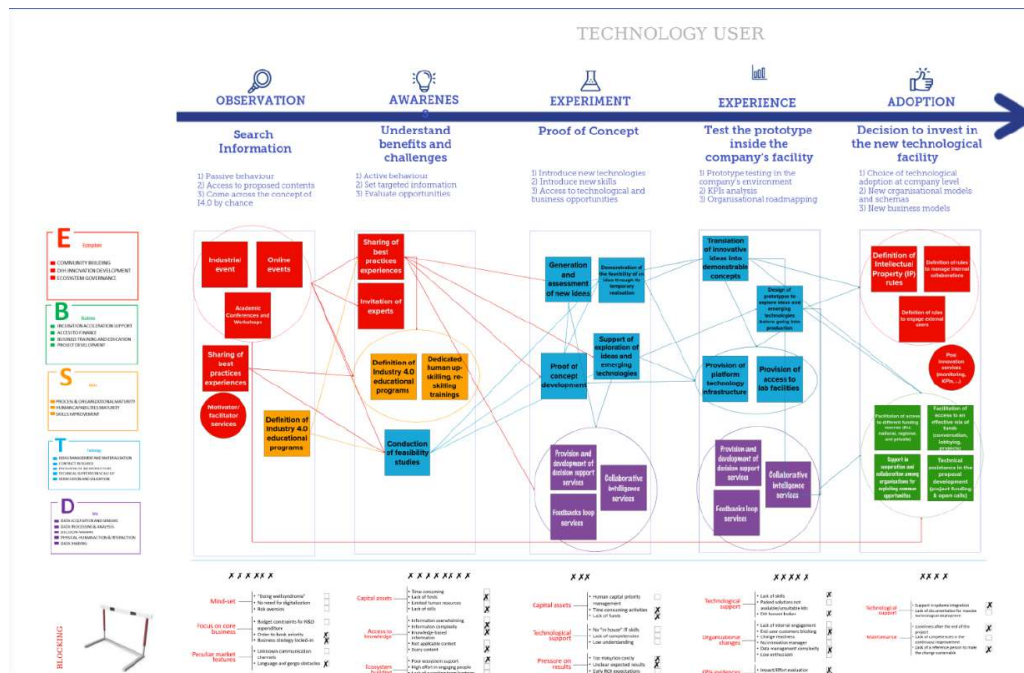


Figure 16: Customer Journey for a Technology User SME at DIH FBK

services or the journeys do not follow all the steps.

## Technology User

The initial approach of the Technology User to increase their knowledge on technical issues starts with the participation in events organised by and/or attended by FBK (Industrial events, Academic conferences and workshops, Online events), and in the general events FBK organises to present and share best practices and experience with a wider audience. Other important occasions are the trainings offered and dedicated in general to Industry 4.0 that intrigue potential users. [Step 1]

Also in this case, the pandemic changed these first interactions and many of the meetings are now only on-line, reducing in part the interactions and their success, but increasing the opportunity to participate and to online share information.

If the participation in events has stimulated some interest in the topics proposed, Technology Users ask for more focused information, knowledge and skill on more specific topics. So, FBK organises other occasions/events sharing best practices and experiences and invite experts for more specific presentations on the requested topics. We organise and plan also new and tailored training and education opportunities. If the Technology User has more clear ideas, FBK works with them on possible feasibility studies on the possible adoption/development of new technological solutions that solve their problem and/or introduce innovation in their work. [Step 2]

If the in-depth analysis and presentation of technologies, solutions and approaches answer to the needs and requirements of the Technology User, FBK's collaboration with them contin-



ues with specific services aimed at the introduction of new technologies, skills and business opportunities working on the generation and assessment of new ideas, demos, technology exploration and PoCs. The most suitable service is chosen according to the specific request of the Technology User. The first ideas and prototypes developed in this phase are in parallel object of other services such as Decision support services, Collaborative intelligence services and Feedbacks loop services are offered related to the use of MBD for control. [Step 3]

The prototypes developed in the previous phase are then tested by the Technology User. Technical services are here necessary, so FBK supports with its technical skills the translation of innovative ideas into demonstrable concepts and the design of prototypes to explore ideas and emerging technologies before going into production. FBK offers also technical facilities, providing platform technology infrastructure and the access to lab facilities. The test also offers the possibility to develop a possible organisational roadmap and FBK helps the Technology User its planning to their adoption. Support to this are the services of Decision support services, Collaborative intelligence services and Feedbacks loop services are offered related to the use of MBD for control. [Step 4]

After the process of prototype test, the Technology User is usually ready to decide whether to adopt or not the innovation proposed. If they choose to adopt it, services to better define the use of the technology and the relationship with other stakeholders (definition of IP, rules to manage internal and external collaborations) are necessary and requested. In parallel, the request for funding scouting is common. So, FBK works with/for the Technology User on the access to possible funding opportunities choosing the most suitable, the support in the creation of the necessary consortia and networks and the proposal development, participating (or not) as partner. A service that at this phase would be useful is a post-innovation one that help both the Technology User to monitor and assess according shared KPIs the success or not the taken action. [Step 5]

## **Technology Provider**

Usually, Technology Providers approach FBK thanks to the participation in events organised by and/or attended by FBK (Industrial events, Academic conferences and workshops, Online events, Invitation of experts) where FBK have a first discussion about possible ideas and collaborations. Services like Generation and assessment of ideas, Conduction of feasibility studies, and Support in the exploitation of ideas and emerging technologies are requested and start after the first discussions with dedicated meetings and calls to better define the idea and its possibility on the market. [Step 1]

The pandemic changed these first interactions and many of the meetings are now only on-line, reducing in part the interactions and their success, but increasing the opportunity to participate.

If the ideation step has a positive result, the interactions continue to better define market and technical requirements, and the idea. At this stage, working on MBD, the services asked are Dedicated human up-skilling, re-skilling and trainings. Technical services like Data analytics services, Architecture for Big Data, and Hardware and Software architecture

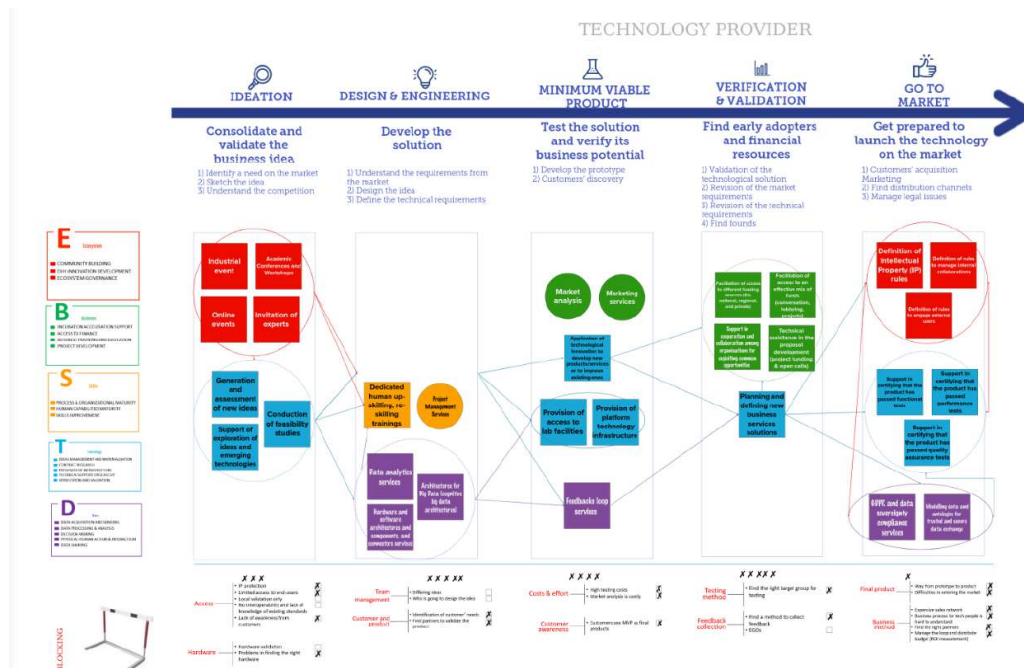


Figure 17: Customer Journey for a Technology Provider SME at DIH FBK

and components, and connected services are required to better develop the idea, define its technical requirements, and start a first possible development. Often, to define a possible development of the idea requires Project Management skills/service that at the moment is not present. [Step 2]

With a defined idea, next step is its technical development in a prototype to test it both technically and from a business perspective. As a research institution (and not only DIH) FBK has all the skills to the development in collaboration with the technology provider of the prototype offering services such as Application of technological innovation to develop new products/services or to improve existing ones, Provision of access to lab facilities, and of platform technology infrastructures. Furthermore, Feedback loop services are offered related to the use of MBD for control. From a business perspective FBK lacks Market Analysis and Marketing services that would complete the prototype and its validation on the market. [Step 3]

So, the prototype is ready for its validation and verification both from a technical and a business perspective, but often the main issue emerging is the lack of money for the real development and testing of the prototype. FBK has a long and good experience in fund scouting and funded projects, so FBK offers various services (Facilitation of access to different funding sources, Facilitation of access to an effective mix of funds, Support in cooperation and collaboration among organisations for exploiting common opportunities, and Technical assistance in the proposal development) supporting Technology providers in finding, planning and managing project funded by other entities. In parallel (but also answering to the requests for funding), FBK works with them also on the planning and defining of new business solutions that support the commercialisation and success of the developed idea. [Step 4]

At the end of the process, FBK works with the Technology Provider on the preparation of

the launch of the production on the market and the solution of legal issues. Working on this means for FBK to define IP rules, internal and external collaborations. An important step is usually here the product qualification and certification, where FBK uses MBD that allows to certify functional, performance and quality assurance tests. In parallel, services concerning GDPR and data sovereignty, modelling data and ontologies for trusted and secure data exchange are offered. [Step 5]

Sometimes, this journey is difficult for FBK because technology providers are very similar to FBK for activities, products and objectives and there could be concurrence. So, FBK tries to better structure the collaboration and possible complementarity.

## 4.6 DIH POLIMI

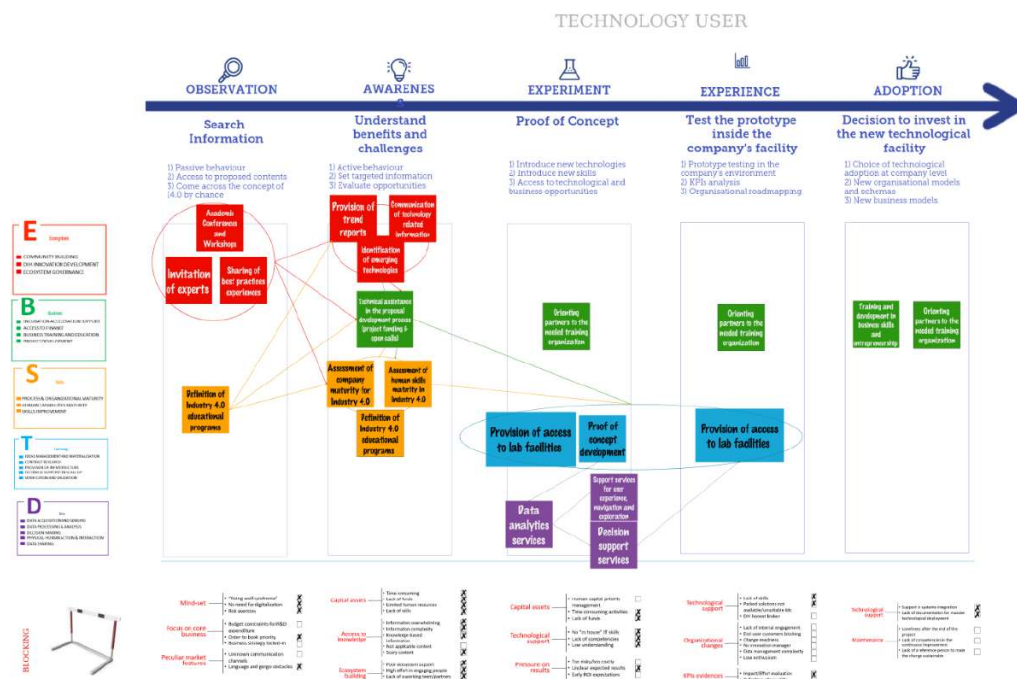


Figure 18: Customer Journey for a Technology User SME at DIH POLIMI

### Technology User

**Observation** The generic customer journey of a Technology User starts with the observation step. During this first phase, POLIMI organises (and also participates in) many public events like conferences, webinars, open days and workshops (e. g., those of the Observatory Transition I4.0) that Technology Users can access to understand and realise which are the possible application of digital technologies in the manufacturing context. Such events can be focused on specific topics, to provide the extant state of theory and practice to both academics (professors, researchers, students, etc.) and practitioners (manufacturing companies and professionals). A reference example of these events is the World Manufacturing

Forum (WMF), a yearly event of general interests in the manufacturing digital domain organised by the World Manufacturing Foundation together with POLIMI. The WMF indeed aims to enhance and spread industrial culture worldwide, as a means to ensure economic equity and sustainable development. It promotes innovation and development in the manufacturing sector, with the fundamental goal of improving competitiveness in all nations through dialogue and cooperation among the manufacturing sector's key players. The WMF supports national and international industrial agendas, provides a framework through which its stakeholders can meet and exchange opinions to find innovative solutions, disseminates knowledge through international and regional meetings and publications. This kind of events is also the best opportunity to share best practices experiences coming from research projects and to invite business and entrepreneurship experts/industry actors to give talks and interact with (potential) customers and partners. Always to support the observation phase, POLIMI defines educational programs allowing to attract and form next generation talent (forming I4.0 employees and workers). The main examples are the Master's Program in Industrial Engineering and the MBA and Master's programs about Industry 4.0 topics.

**Awareness** For those Technology Users interested in further collaborating with POLIMI, a maturity model, called DREAMY (Digital REadiness Assessment MaturitY model) is provided. Indeed, in the awareness phase manufacturers need to realise which is their digital status quo. DREAMY model assesses a manufacturing company's readiness level to trigger its digital transitioning process and to identify manufacturing company's strengths, weaknesses, and opportunities, creating a roadmap for investments in digitisation and transitioning to smart manufacturing. Moreover, manufacturers need to understand and evaluate how these new digital technologies are used to support their product development process along the entire company. Indeed, to deliver successful solutions in the market, companies can choose among various best practices to apply in their development process. The "Chaos-low-intermediate-mature-best practice (CLIMB)" model measures maturity in product development activities. Together with DREAMY, CLIMB provides an evaluation also of the digital skills needed in the organisation to better address the digital transformation of a Technology User. In addition, these services are the starting point for more structured collaborations aimed at increasing Technology User's digital maturity level through tailored paid projects. In the awareness phase, also Business-related services are provided. Technical assistance in the proposal development process to comply with specific proposal requirements (e. g., for project funding) can be the key to involve Technology Users in new European projects collaborations. In this phase, also open calls, launched throughout research projects, can be exploited to support the ideation of new technologies (several calls have been launched by POLIMI in the last years thanks to its belonging to different consortia). Finally, ecosystem services (as provision of trend reports, communication of technology related information to organisation, and identification of emerging technologies) are provided. They can be provided also during Open Days including demonstrative applications of the Industry 4.0 Lab functionalities. Afterward, the generic Technology User can have access to specific didactic services, namely Corporate Education & Training courses encompassing realistic demonstrations of I4.0 applications representing the state-of-the-art of manufacturing.

**Experiment** In addition to the didactic services offered, companies would be provided with specific services aimed at experimenting applications in their specific fields. In particular, POLIMI makes available the facilities and instruments present in the Industry 4.0 Lab to support manufacturing Technology User in this sense. Doing this, POLIMI supports the development of proofs of concepts. In addition, strictly related to the technologies experimented, are provided data analysis services, followed by decision support services and user experience/navigation (dashboard and KPIs setting) service. Finally, contacts of POLIMI's ecosystem (secondment) can be provided in this phase.

**Experience** To prepare the Technology User to best cope with the adoption phase's issues, POLIMI provides training on business skills and entrepreneurship (for instance, formal courses, workshops, seminars). In addition, secondment services are provided.

**Adoption** Finally, once the Technology User has been specifically trained and has both experimented and experienced the technologies needed, POLIMI can provide secondment services to support Technology User in the very last phase of adoption.

## Technology Provider

**Ideation** The Technology Provider customer journey starts with the Ideation step. During this first phase, POLIMI organises (and also participates to) many public events like conferences, webinars, open days and workshops (e.g. of the Observatory Transition I4.0) that Technology Providers can access to improve and update their knowledge on digital technologies and to get in contact with Technology Users. Indeed, such events can be focused on specific topics, to provide the extant state of theory and practice to both academics (professors, researchers, students, etc.) and practitioners (manufacturing companies and professionals). As stated in the Technology User's journey, one of the main events is the WMF. POLIMI also supports the IPR definition throughout the entire Technology Provider journey. Also Business-related services are provided: technical assistance in the proposal development process to comply with specific proposal requirements (e.g. for project funding) can be the key to involve Technology Users in new project collaborations. From this phase up to the last ones, open calls, launched throughout research projects, can be also exploited to support the ideation of new technologies (several calls have been launched by POLIMI in the last years).

**Design and Engineering** In this phase, as in the case of Technology Users, ecosystem services (as provision of trend reports, communication of technology related information to organisation, and identification of emerging technologies) are provided, also during dedicated events and Open Days, including demonstrative applications of the Industry 4.0 Lab functionalities. Afterward, the Technology Provider can have access to specific didactic services, namely Corporate Education & Training courses that encompass also realistic demonstrations of I4.0 applications (representing the State-of-the-Art of manufacturing). These courses can support Technology Providers in either defining the PoC of the technology to



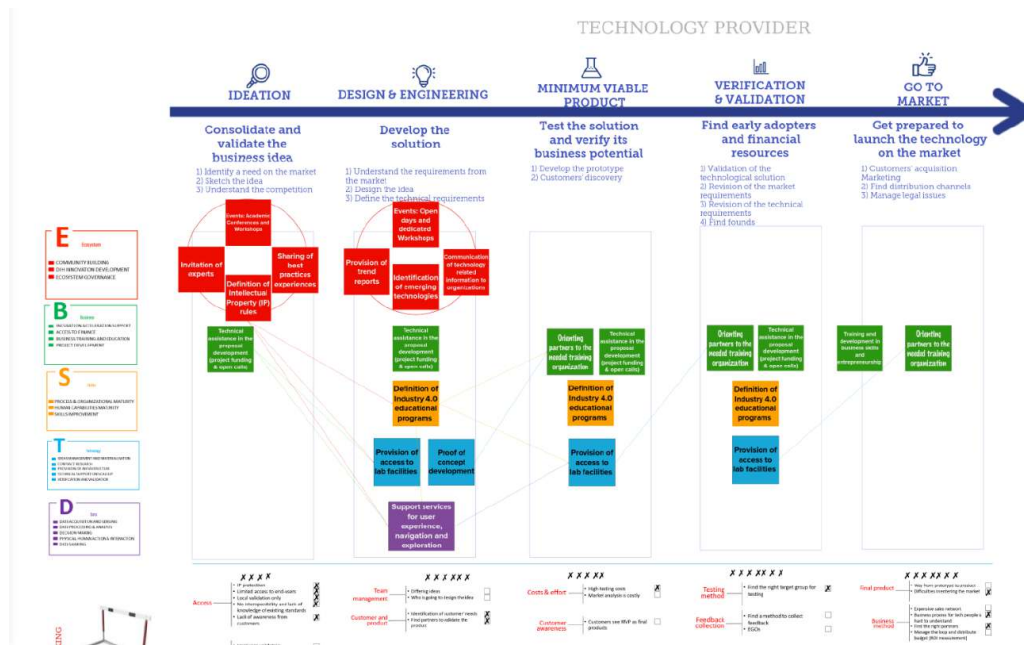


Figure 19: Customer Journey for a Technology Provider SME at DIH POLIMI

be provided or improving and refining the design and engineering of their solutions. This combined Technology/Training service can be provided by POLIMI from this phase up to the Verification & Validation. In addition, POLIMI provides services for user experience, navigation and exploration (through the configuration of dashboards and sets of KPI related to the developed technology).

**MVP** The development of an MVP is supported through the provision of secondment services to meet Technology Providers needs. Otherwise, the access to the Industry 4.0 lab is provided to support them. Finally, educational programs in the I4.0 domain and the involvement in consortia and open calls can be catered in this phase.

**Verification & Validation** The same happens for the Verification & Validation step. In case the Technology/Training services are not suitable to the Technology Provider case, POLIMI provides secondment services. Also the participation to new project consortia or open calls can be fostered. Finally, before the launch to the market, the generic Technology Provider may rely on POLIMI for training on business skills and entrepreneurship.

**Go to Market** Also in this last step, POLIMI can provide secondment services.

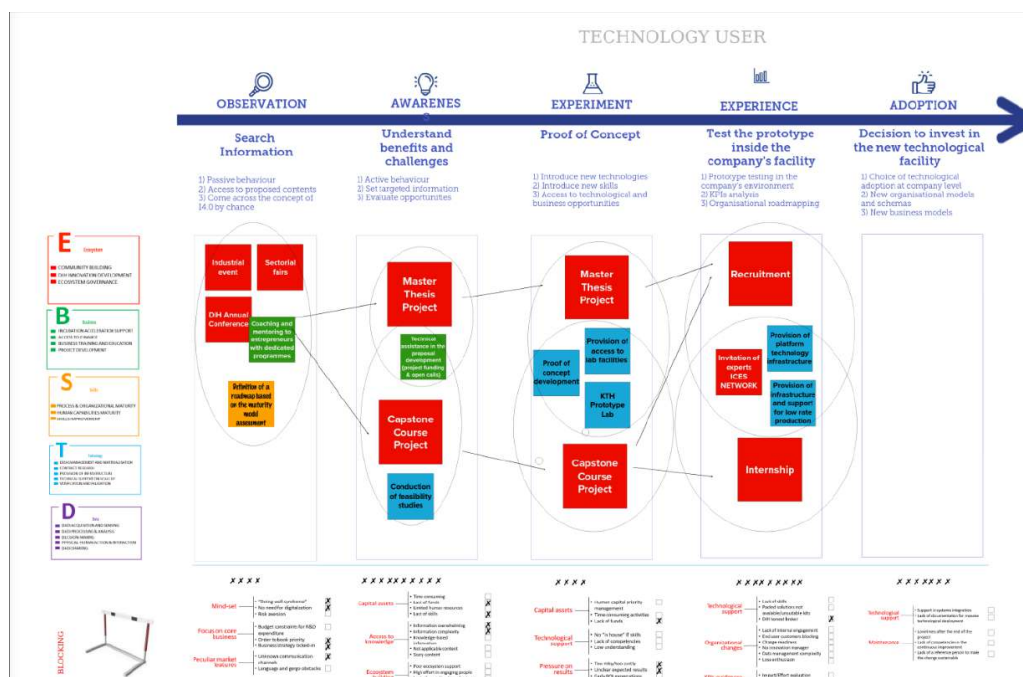


Figure 20: Customer Journey for a Technology User SME at DIH KTH

## 4.7 DIH KTH

### Technology User

Technology Users have a simpler journey, but it is also individual – these steps are not a sequence of services as much as a sequence of collaborative contexts in which services are provided based on a need.

Typically a Technology User comes in contact with the DIH through industrial events, online events, etc. Through these they are made aware of the technological knowledge/skills of KTH's staff and the master students KTH has access to. By providing a research-related task to put together / configure some technology for use in their business, they are provided with support through a master thesis or capstone course project. This progresses from feasibility to proof of concept development of the targeted technology, and at times to recruitment of KTH students into the Technology User organisation. At this point the journey can start iterating with more support from the hub at each step (for instance more and more master thesis projects using technology KTH suggests).

### Technology Provider

Technology Providers typically start collaborating with the KTH DIH in one of two ways: either they join the ICES network to take part in industrial events, online events, etc., or they come in contact with an individual researcher through, e. g., a conference and are made aware of the available DIH services. In both cases they become part of an ecosystem, in which they can engage with the services based on their need. So, there is no “ideal”, planned sequence

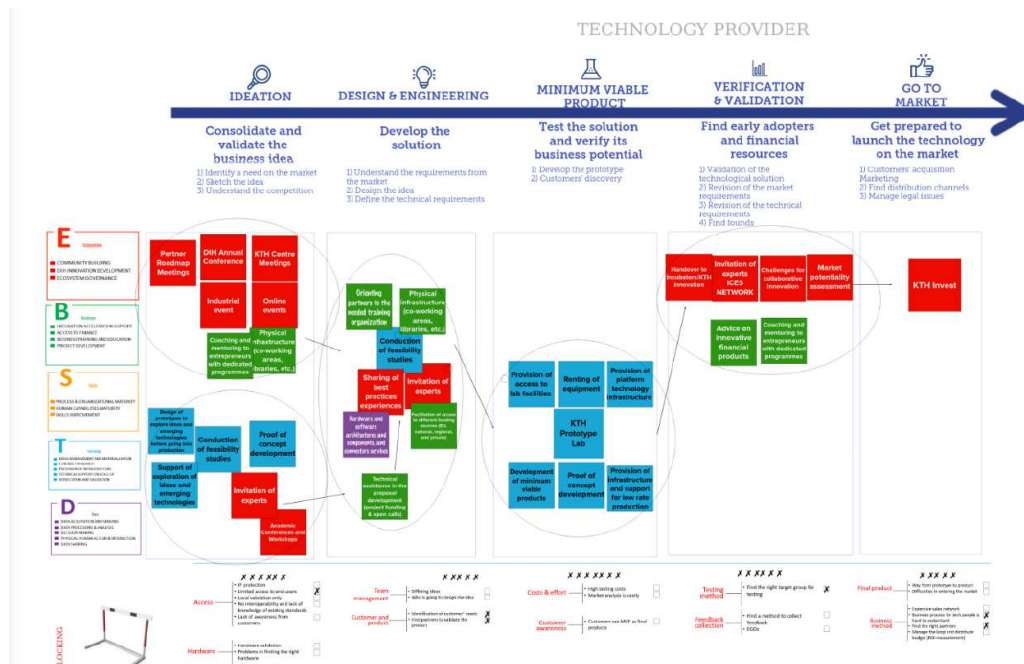


Figure 21: Customer Journey for a Technology Provider SME at DIH KTH

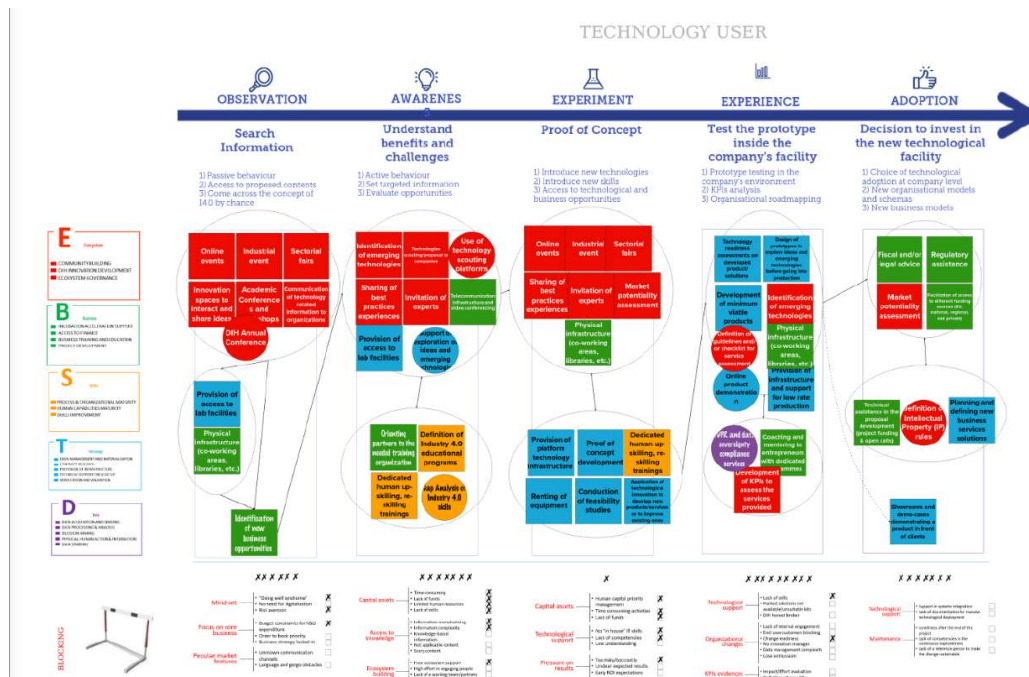
of services in which KTH take them by the hand and lead them from low to high proficiency in some business/technical skill, but rather an individual journey in which KTH collaborates based on their needs (a need which might be a weakness to address, but just as well a strength to leverage on).

However, typically a closer cooperation does not develop until the Technology Provider ties one of their projects to KTH (i. e. the researchers running the hub). This is mainly done by getting a research or innovation project funded, in which resources are shared for e.g. best practice transfer or proof of concept research (i.e. very applied research). If an innovation is identified (either at the Technology Provider (i.e. digitalization of their process/organisation) or related to their products), then KTH provides early prototyping/networking/funding support to capture benefit. After that the project is typically carried forward by the technology provider itself, but in rare cases it can also be transferred to pre-incubator/incubator services centrally at KTH.

## 4.8 DIH ULBS

The following descriptions depict the ideal and complete journey (i.e., capacities/experts to execute the services exist but financing is not currently available for all) where Technology Providers and Users follow all the step foreseen. In most cases ULBS are asked to offer single services from the journeys. Moreover, the specific services or journeys are usually within the first three phases (Ideation - Minimum Viable Product).





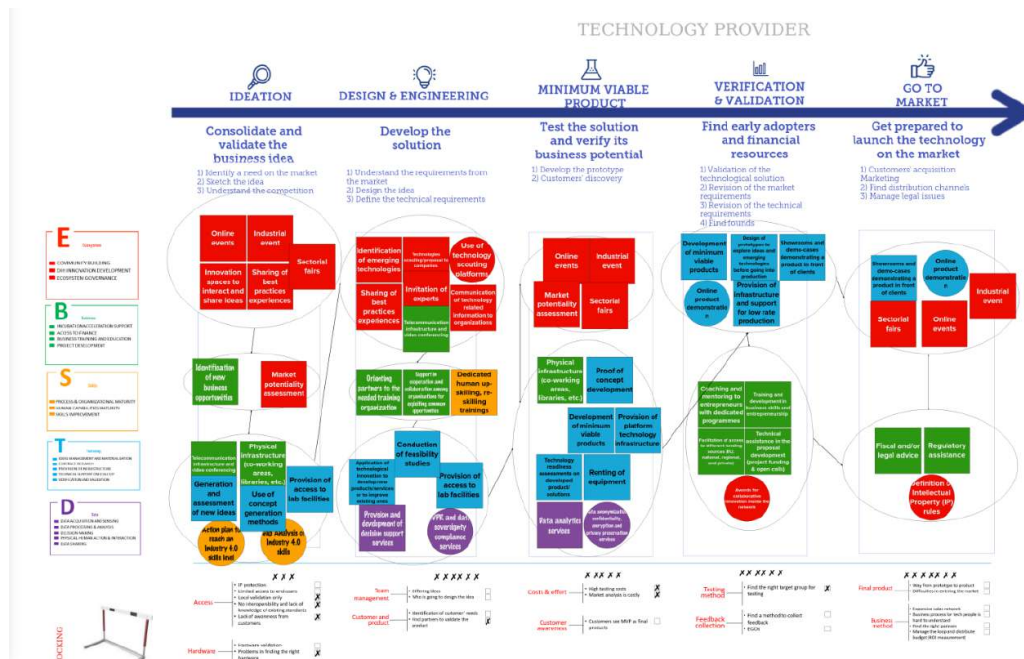


Figure 23: Customer Journey for a Technology Provider SME at DIH ULBS

## Technology Provider

**Ideation Phase:** [Step 1] Technology Providers generally approach during the participation in events organised by and/or attended by ULBS (e.g., fairs, online events etc.). Here ULBS is approached by organisation and/or find out about collaboration (market, business) opportunities and proceed with detailing them [Step 2]. Depending on the collaboration interest, work on initial idea takes place [Step 3]. Interactions between Step 2 and Step 3 services take place in case the topic is challenging in both market and technological sense. At the end of Step 3 an idea should be formalised.

**Design and Engineering phase:** If the ideation [Step 3] has a positive result, work on making the idea into a solution follows [Step 4] by finding the best technology/approach for that idea. If for that solution staff from the organisation are required and know-how doesn't exist, then training is proposed within the ecosystem or executed by the DIH (if suitable experts/capacities exist) [Step 5]. The phase ends with the definition of a potential solution [Step 6] (iterations between Step 5 and Step 6 might take place).

**Minimum Viable Product:** In [Step 7] a proof-of concept/prototype is conceived and evaluated. This is later exhibited in outreach events [Step 8], e.g., fairs, events to be discovered by customers and evaluate the market potential.

**Verification and validation:** If [Step 8] is successful, then a more mature prototype is developed within services part of [Step 9]. Support for funding and collaboration within the network is provided, if necessary, in [Step 10].

**Go to Market:** To present the product, participation at events or showcasing it is foreseen in [Step 11]. Moreover, financial, regulatory and IP aspects are covered in [Step 12]. Interactions between Step 11 and Step 12 might take place.

## 5 Analysis and Discussion of DIH Customer Journeys

DIH	Service Portfolio TU				
	E	B	S	T	D
Sibiu	19	11	3	13	0
UNEW	10	6	2	2	0
FBK	9	4	3	9	6
FORTISS	9	3	3	4	0
KTH	10	2	1	6	0
VVRC	7	3	2	4	0
Aarhus	5	5	1	2	1
Polimi	6	5	4	3	3
	<b>75</b>	<b>39</b>	<b>19</b>	<b>43</b>	<b>10</b>
	40%	21%	10%	23%	5%

Figure 24: Portfolio of DIH services used in Technology User customer journeys

This section presents an initial analysis of the customer journeys presented in the previous section with the aim to better understand the nature of the DIHs composing the HUBCAP network and unveil common features as well as the degree of complementarity among them. This analysis can point out potential future collaboration opportunities. These collaborations may then facilitate the day-to-day operations of the individual DIHs in supporting the SMEs towards digital technologies adoption. Joint provision, development or matchmaking of a needed service among different DIHs, characterised by different inclinations towards specific macro-classes of services of the D-BEST model, can enhance the effectiveness of DIHs in the digitalisation customers journeys.

DIH	Service Portfolio TP				
	E	B	S	T	D
Sibiu	18	13	6	11	2
UNEW	6	8	0	1	0
FBK	7	4	1	10	6
FORTISS	9	2	2	4	0
KTH	14	8	0	12	1
VVRC	7	4	1	6	0
Aarhus	8	6	4	4	3
Polimi	8	8	3	4	1
	<b>77</b>	<b>53</b>	<b>17</b>	<b>52</b>	<b>13</b>
	36%	25%	8%	25%	6%

Figure 25: Portfolio of DIH services used in Technology Provider customer journeys

First of all, looking at the service portfolio overviews, see Fig. 24 and Fig. 25 for the customer journeys of Technology Users and Technology Providers, respectively, it can be seen that the classical Ecosystems, Technology, and Business services represent the largest share of what is provided by the DIHs. This can be observed in the two tables below, where around the 40% of the services belong to Ecosystem, 25% to Business and 25% to Technology.

However, Skills and Data services are not to be neglected and play a strategic role in the typical paths of the customers.

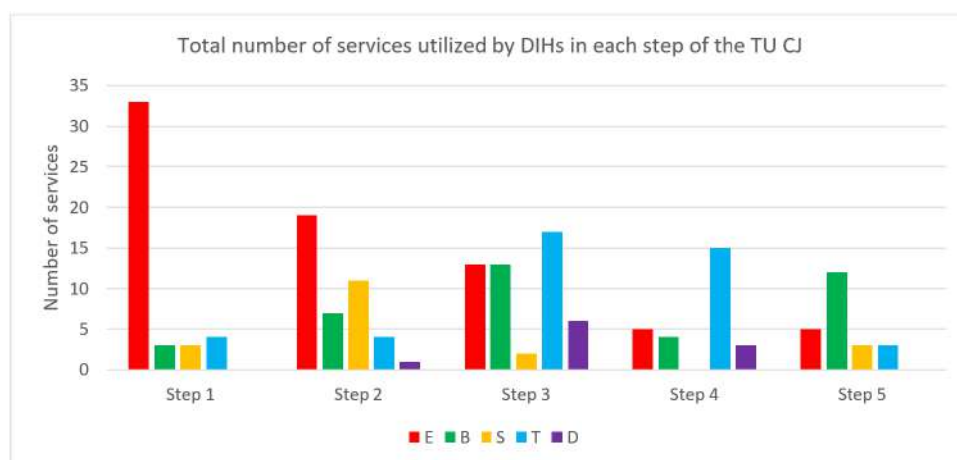


Figure 26: Total number of services utilised by DIHs in Technology User customer journeys

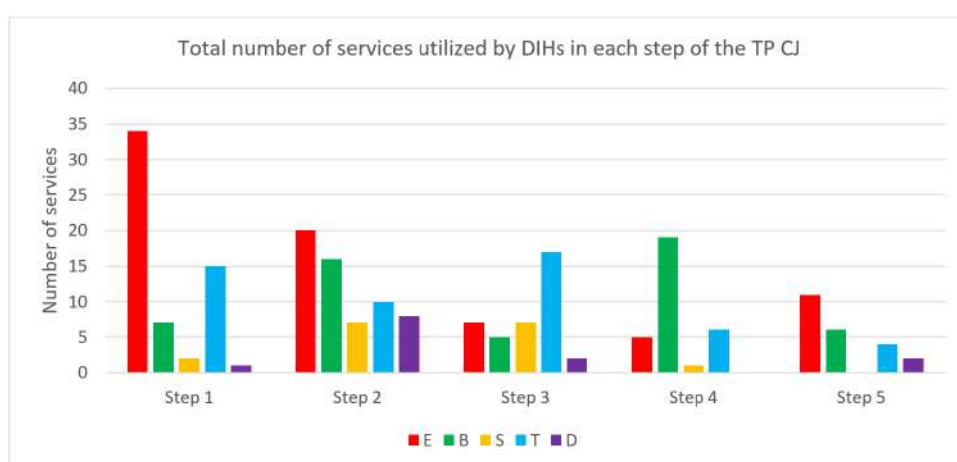


Figure 27: Total number of services utilised by DIHs in Technology Provider customer journeys

It is interesting to look at how these services are distributed (or delivered) along the different steps that conform the digitalisation journeys of Technology Users and Technology Providers. As shown in the Fig. 26 and Fig. 27 (for Technology User and Technology Provider, respectively), the number and types of services employed in the customer journeys are different per each step and reflect how the DIHs support their customers along the digital transition. For instance, in the Technology User customer journey, it is worth mentioning the relevance that Ecosystem services have for the first, second, and third step (though there is less influence for the latter). In the third and fourth step, the most predominant services are Technology services, but is important also to highlight that Data services are mostly offered also in these steps, while Business services have relevance in the second, third and fifth steps. Lastly, the skills services are mainly offered in the second step and not at all in the fourth.

With regard to the Technology Provider customer journey, the Ecosystem services show a similar usage as in Technology User, but with some relevance also in the fifth step. In this case, Technology services are mostly utilised in the first three steps while Data services are utilised mainly in the second step. Business services are mostly relevant in the second and fourth steps, while skills are offered in a low amount in the second and third steps.

It is also notable that DIHs support Technology User and Technology Provider in different ways, since they employ different sets of services to support the digital transition of these two kinds of customers.

In the following, each of the customer journeys is analysed in detail. First, the Technology User customer journeys of the 8 DIHs are analysed, considering the services offered and blocking points solved. Later, the same analysis is presented for the Technology Provider customer journeys. Then, an overall perspective of the HUBCAP network is taken. Here, the customer journeys are analysed to understand which are the different ways in which DIHs offer their services and to group the DIHs into relevant clusters that act in a similar way with a specific type of customer. The clustering can help to detect possible overlaps, synergies and complementarity conditions between the DIHs composing the HUBCAP network.

## 5.1 Customer Journeys for Technology Users

TU	Step 1 - Observation					Step 2 - Awareness					Step 3 - Experiment					Step 4 - Experience					Step 5 - Adoption				
	E	B	S	T	D	E	B	S	T	D	E	B	S	T	D	E	B	S	T	D	E	B	S	T	D
Sibiu	6	2	-	1	-	4	2	2	1	-	6	1	1	5	-	2	2	-	4	-	1	4	-	2	-
UNEW	5	-	-	-	-	2	-	-	-	-	3	6	-	-	-	-	-	-	2	-	-	-	2	-	-
FBK	4	-	1	-	-	2	-	2	1	-	-	-	-	4	3	-	-	-	4	3	3	4	-	-	-
FORTISS	4	-	-	-	-	4	2	2	1	-	1	1	1	3	-	-	-	-	-	-	-	-	-	-	-
KTH	3	1	1	-	-	2	1	-	1	-	2	-	-	3	-	3	-	-	2	-	-	-	-	-	-
VVRC	6	-	-	3	-	1	-	1	-	-	-	3	-	-	-	-	-	-	1	-	-	-	1	-	-
Aarhus	2	-	-	-	-	1	1	1	-	1	1	1	-	-	-	-	1	-	1	-	1	2	-	1	-
POLIMI	3	-	1	-	-	3	1	3	-	-	-	1	-	2	3	-	1	-	1	-	-	2	-	-	-
	33	3	3	4	0	19	7	11	4	1	13	13	2	17	6	5	4	0	15	3	5	12	3	3	0

Figure 28: Types of services occurring in the Technology User customer journeys of the DIHs

DIH	Step 1 - Observation							
	Mind-set		Focus on core business				Peculiar market features	
	"DWS"	No need Digitalization	Risk aversion	Budget Constrains for R&D expenditure	Order to book priority	Business strategy locked-in	Unknown communication channels	Language and gergo obstacles
Sibiu	1	0	1	1	0	0	0	0
UNEW	1	1	0	1	1	1	1	1
FBK	0	0	0	0	1	1	0	1
FORTISS	1	1	0	0	0	1	1	0
KTH	1	1	0	0	1	1	1	0
VVRC	1	1	0	0	0	0	0	0
Aarhus	1	1	0	0	0	0	0	0
POLIMI	1	1	1	0	1	0	0	1
Total	7	6	2	2	4	4	3	3
% of DIHs solving issue	88%	75%	25%	25%	50%	50%	38%	38%

Figure 29: Blocking points addressed during "Observation" stage (Technology User)

Starting from Technology Users journeys (Fig. 28), it is evident that Ecosystem services have a relevant role in Step 1 (Observation). In addition, sometimes also some Skills, Technology and Business services are provided to trigger the provision of new services in the

following steps, the first in a lower degree of incidence. Finally, it is important to note that Data services are usually not requested at this initial stage (although Ecosystem services might include data-related activities: e.g. data sharing awareness events, data exploitation webinars, etc).

This initial phase is also usually the longest one: it takes some time to convince the customer to start the digitalisation journey. Indeed, a high percentage of DIHs centre their efforts on the blocking points that cope with Mind-set type and Focus on core business, in particular prioritisation and strategy (see percentages of DIHs addressing these blocking points in Fig. 29).

DIH	Step 2 - Awareness												
	Capital assets				Access to Knowledge					Ecosystem building			
	Time consuming	Lack of funds	Limited human resources	Lack of skills	Information overwhelming	Information complexity	Knowledge-based information	Not applicable content	Scary content	Poor ecosystem support	High effort in engaging people	Lack of a working team/partners	Challenges not specific enough
Sibiu	1	1	1	1	1	1	0	0	0	1	0	0	0
UNEW	0	0	0	1	1	1	0	0	0	1	0	1	1
FBK	0	1	0	1	0	1	1	0	1	1	0	0	0
FORTISS	0	0	0	1	1	1	1	0	1	1	0	0	0
KTH	0	1	0	1	1	1	0	0	0	0	0	0	0
VVRC	0	1	0	1	1	1	0	0	0	0	0	1	0
Aarhus	1	0	1	0	0	0	0	0	0	0	0	0	0
POLIMI	1	1	1	1	1	1	1	0	1	1	1	1	1
Total	3	5	3	7	6	7	3	0	3	5	1	3	2
% of DIHs solving issue	38%	63%	38%	88%	75%	88%	38%	0%	38%	63%	13%	38%	25%

Figure 30: Blocking points addressed during “Awareness” stage (Technology User)

DIH	Step 3 - Experiment								
	Capital assets			Technological support			Pressure on results		
	Human capital priority management	Time consuming activities	Lack of funds	No "in house" IT skills	Lack of competences	Low understanding	Too risky/Too costly	Unclear expected results	Early ROI expectations
Sibiu	1	1	1	1	1	0	1	0	0
UNEW	1	0	1	0	0	1	1	0	0
FBK	0	1	1	0	0	0	1	1	0
FORTISS	0	0	1	0	1	1	0	1	0
KTH	0	0	1	0	0	0	1	1	0
VVRC	0	0	1	1	1	0	0	0	0
Aarhus	0	0	0	0	0	0	0	0	1
POLIMI	0	1	1	1	1	1	0	1	0
Total	2	3	7	3	4	3	4	4	1
% of DIHs solving issue	25%	38%	88%	38%	50%	38%	50%	50%	13%

Figure 31: Blocking points addressed during “Experiment” stage (Technology User)

In Step 2 (Awareness), Ecosystem services leave some space to the provision of more Business and Skills services. In this specific phase, Skills services are very important. The blocking points unlocked are mainly of the types of Capital assets and Access to knowledge (Fig. 30).

In Step 3 (Experiment), Technology services are the most dominant. And Data takes its mayor participation on these types of customer journeys. The blocking points unlocked are mainly of the Technological support type and pressure on results. But also Capital assets are important (Fig. 31).



DIH	Step 4 - Experience										
	Technological support			Organizational changes						KPIs evidences	
	Lack of skills	Packed solutions not available/unsuitable kits	DIH honest broker	Lack of internal engagement	End-user customers blocking	Change readiness	No innovation manager	Data management complexity	Lose enthusiasm	Impact/Effort evaluation	Definition of new KPIs
Sibiu	1	0	0	0	0	1	0	0	0	0	0
UNEW	1	0	1	1	0	1	0	0	1	0	1
FBK	1	0	1	0	1	0	0	1	0	1	1
FORTISS	0	0	0	0	0	0	0	0	0	0	0
KTH	0	0	1	0	0	0	0	0	0	0	1
VVRC	0	1	1	0	0	0	0	0	0	0	0
Aarhus	0	0	0	0	0	0	0	0	0	0	0
Polimi	1	1	0	0	0	0	0	0	0	1	0
Total	4	2	4	1	1	2	0	1	1	2	3
% of DIHs solving issue	50%	25%	50%	13%	13%	25%	0%	13%	13%	25%	38%

Figure 32: Blocking points addressed during “experience” stage (Technology User)

In Step 4 (Experience), still Technology services are the most delivered but also business (consortia development) and ecosystem services are supporting this phase. The blocking points unlocked are mainly of the Technological support and KPI evidences types (Fig. 32).

DIH	Step 5 - Adoption				
	Technological support		Maintenance		
	Support in systems integration	Lack of documentation for massive technological deployment	Loneliness after the end of the project	Lack of competencies in the continuous improvement	Lack of a reference person to make the change sustainable
Sibiu	0	0	0	0	0
UNEW	0	0	0	1	1
FBK	1	0	1	0	1
FORTISS	0	0	0	0	0
KTH	0	0	0	0	0
VVRC	1	0	0	0	0
Aarhus	0	0	1	0	0
POLIMI	1	1	0	0	0
Total	3	1	2	1	2
% of DIHs solving issue	38%	13%	25%	13%	25%

Figure 33: Blocking points addressed during “Adoption” stage (Technology User)

In the last step, Step 5 (Adoption), Business services are very important to support the adoption of the technology. All the other services, except for Data services, are also delivered in this phase but with a lower impact. The blocking points unlocked in this phase are of the Maintenance type (lack of reference person to make the change sustainable and Loneliness after the end of the project), than technological support (Fig. 33) without quitting importance to the technological support in systems integration.

TP	Step 1 - Ideation					Step 2 - Design & Engineering					Step 3 - MVP					Step 4 - Verification & Validation					Step 5 - Go to Market				
	E	B	S	T	D	E	B	S	T	D	E	B	S	T	D	E	B	S	T	D	E	B	S	T	D
Sibiu	6	3	-	3	-	5	3	1	3	1	4	1	5	-	1	-	4	-	4	-	3	2	-	1	-
UNEW	-	-	-	-	-	2	5	-	1	-	-	-	-	-	-	-	3	-	-	-	4	-	-	-	-
FBK	4	-	-	3	-	-	-	1	-	3	-	-	-	3	1	-	4	-	1	-	3	-	-	3	2
FORTISS	4	-	-	-	-	4	2	2	-	-	1	-	-	4	-	-	-	-	-	-	-	-	-	-	-
KTH	7	2	-	4	-	2	4	-	1	1	-	-	-	7	-	4	2	-	-	-	1	-	-	-	-
VVRC	6	-	-	3	-	1	-	1	1	-	-	-	-	2	-	-	3	-	-	-	-	1	-	-	-
Aarhus	3	1	2	2	1	2	1	1	2	2	2	2	1	-	-	1	1	-	-	-	-	1	-	-	-
POLIMI	4	1	-	-	-	4	1	1	2	1	-	2	1	1	-	-	2	1	1	-	-	2	-	-	-
	34	7	2	15	1	20	16	7	10	8	7	5	7	17	2	5	19	1	6	0	11	6	0	4	2

Figure 34: Types of services occurring in the Technology Provider customer journeys of the DIHs

DIH	Step 1 - Ideation						
	IP Protection	Access				Hardware	
		Limited access to end-users	Local validation only	No interoperability and lack of knowledge of existing standards	Lack of awareness from customers	Hardware validation	Problems in finding the right hardware
Sibiu	0	0	1	1	1	0	1
UNEW	1	0	0	0	0	0	0
FBK	1	1	0	0	1	0	1
FORTISS	0	1	0	1	1	0	0
KTH	0	1	0	0	0	0	0
VVRC	0	0	0	1	1	0	0
Aarhus	0	0	0	1	0	0	1
POLIMI	1	1	1	1	1	0	0
Total	3	4	2	5	5	0	3
Total %	38%	50%	25%	63%	63%	0%	38%

Figure 35: Blocking points addressed during “Ideation” stage (Technology Provider)

## 5.2 Customer Journeys for Technology Providers

For Technology Providers, the most relevant services for the first step of the customer journey (Ideation) are the Ecosystem and Technology services, which are the two bases of the technology adoption process for Technology Provider. Indeed, they represent most of the actions done by DIHs to support Technology Providers (Fig. 34). Sometimes also Business (strategic support) services are provided in this phase. this phase is functional to unlock mainly Limited access to end-users, Interoperability and lack of knowledge of standards and Lack of awareness from customers (Fig. 35).

In Step 2 (Design & Engineering), there is a good balance between Ecosystem, Business and Technology services. Also, data and skills services begin to be provided, paired with Technology services which maintain relevance from the previous phase. The most unlocked blocking points are the Customer and products domain (Identification of customer needs and Find partners to validate the product), but still, Team Management is also relevant (Fig. 36).

Concerning Step 3 (MVP), Technology services are the most relevant as in this step the first usable product should be proposed. Nevertheless, Skills and Ecosystem services are also dominant. The main blocking points unlocked are related to high testing costs (Fig. 37).

In Step 4 (Verification & Validation) Business services, flanked also by Technology and Ecosystem ones, are the most delivered. From this phase onward, Skills services are less important since the technological solution is already proposed. The main blocking points unlocked is to find the right target group for testing (Fig. 38).



	Step 2 - Design & Engineering			
	Team Management		Customer and product	
DIH	Differing ideas	Who is going to design the idea	Identification of customer' needs	Find partners to validate the product
Sibiu	0	0	0	1
UNEW	1	0	1	1
FBK	0	0	1	1
FORTISS	1	0	0	0
KTH	0	0	1	1
VVRC	1	0	0	0
Aarhus	1	1	0	1
POLIMI	0	0	1	1
<b>Total</b>	<b>4</b>	<b>1</b>	<b>4</b>	<b>6</b>
<b>Total %</b>	50%	13%	50%	75%

Figure 36: Blocking points addressed during “Design & Engineering” stage (Technology Provider)

	Step 3 - MVP		
	Cost & Effort		Customer Awareness
DIH	High testing costs	Market analysis is costly	Customers see MVP as final products
Sibiu	1	1	0
UNEW	0	0	0
FBK	1	1	1
FORTISS	1	1	0
KTH	0	0	0
VVRC	1	0	0
Aarhus	0	0	0
POLIMI	1	0	0
<b>Total</b>	<b>5</b>	<b>3</b>	<b>1</b>
<b>Total %</b>	63%	38%	13%

Figure 37: Blocking points addressed during “MVP” stage (Technology Provider)

In the last step, Step 5 (Go to Market), Ecosystem and Business services are very important to support the awareness and adoption of the technology. All the other services, except for skills, are also delivered in this phase but with a lower impact. The blocking points mostly unlocked in this phase are the Business method type (business process for tech people is hard to understand and find the right partners). Final product blocking points (difficulties in entering the market) are also addressed (Fig. 39).

### 5.3 DIH groups

With the intention to better understand the customer journey dynamics for both Technology Provider and Technology User cases, the total number of services offered by each DIH clustered with the D-BEST model were plotted. This, in combination with the customer journey from each DIH, was utilised to identify similarities between the paths of the DIHs customers. To cluster the DIHs, several sources of information were utilised. First the charts as shown in Fig. 40 and Fig. 42 were utilised to analyse trends in number of services

	Step 4 - Verification & Validation		
	Testing method	Feedback collection	
DIH	Find the right target group for testing	Find a method to collect feedback	Ego
Sibiu	1	0	0
UNEW	1	0	0
FBK	1	1	0
FORTISS	0	0	0
KTH	1	0	0
VVRC	0	1	0
Aarhus	0	0	0
POLIMI	1	0	0
Total	5	2	0
Total %	63%	25%	0%

Figure 38: Blocking points addressed during “Verification & Validation” stage (Technology Provider)

	Step 5 - Go to Market					
	Final product		Business method			
DIH	Way from prototype to product	Difficulties in entering the market	Expensive sales network	Business process for tech people is hard to understand	Find the right partners	Manage the loop and distribute budget (ROI)
Sibiu	0	0	0	0	0	0
UNEW	0	1	0	0	1	0
FBK	1	1	1	1	1	1
FORTISS	0	0	0	0	0	0
KTH	0	0	0	1	1	0
VVRC	0	0	0	0	1	0
Aarhus	1	0	0	0	1	0
POLIMI	0	1	0	1	1	0
Total	2	3	1	3	6	1
Total %	25%	38%	13%	38%	75%	13%

Figure 39: Blocking points addressed during “Go-to Market” stage (Technology Provider)

offered by each DIH, and in addition the individual graphs of services offered by each DIH in the customer journey (see App. B) were analysed, together with the graphical customer journey build in the Murals and presented previously.

Through the analysis of the Technology User customer journey, it was possible to identify three clusters of DIHs with similar structures of their service offerings, see Fig. 41. The DIHs with the highest level of support to their customers are FBK, Aarhus and POLIMI. All these DIHs offer a complete set of services considering all the categories of the D-BEST model for the complete customer journey. Nevertheless, each one of these DIHs is centred in some specific areas; POLIMI is more focused on Business perspective, while FBK centres its services on Technology and Data services and Aarhus is centred on Business and Ecosystems perspectives with very limited services in the other categories. It is important to highlight that even when POLIMI has a complete support of their customers for the whole customer journey, it has also less coverage of the last two steps of their customer journey as there are low level of services offered in these last steps. Similarly, Aarhus has an evenly distributed set of services through the customer journey, but is limited by the low number of services offered, while FBK offers a complete and consistent support to their customers in every step. ULBS could be considered as the most complete DIH to offer complete and seamless connection of services through all the customer journey, nevertheless, it lacks of Data services.

It was also possible to identify another group of DIHs with similar customer journey offerings,

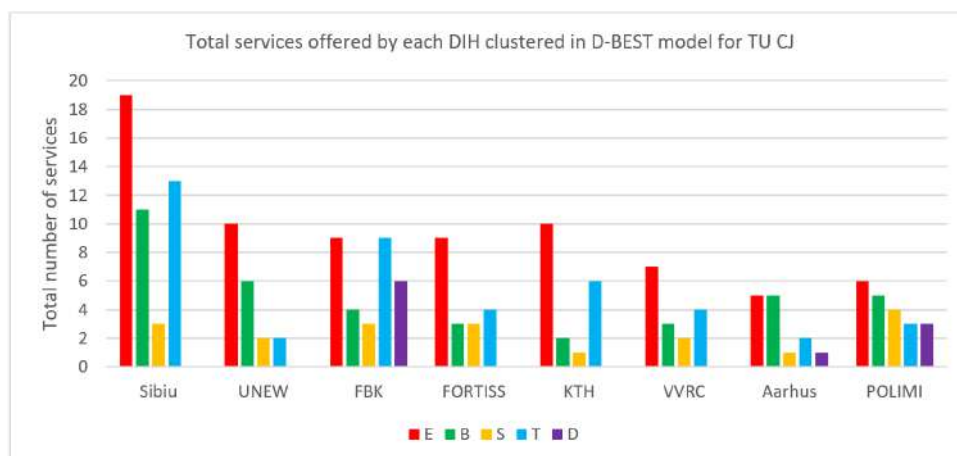


Figure 40: Number and categories of DIH services offered for Technology Users

composed by FOR and KTH. Both DIHs offer a good customer journey guidance in the first three steps but require further support in the last two. Additionally, both DIHs do not provide any services related to the Data category. Nevertheless, both DIHs have a strong offer of Technology services.

UNEW and VV show also similar set of offered services as they are limited by the lack of Data services and limited set of Technology services. Both DIHs offer a strong set of services focused mostly on Business and Ecosystem perspective with strong support in the first three steps of the customer journey.

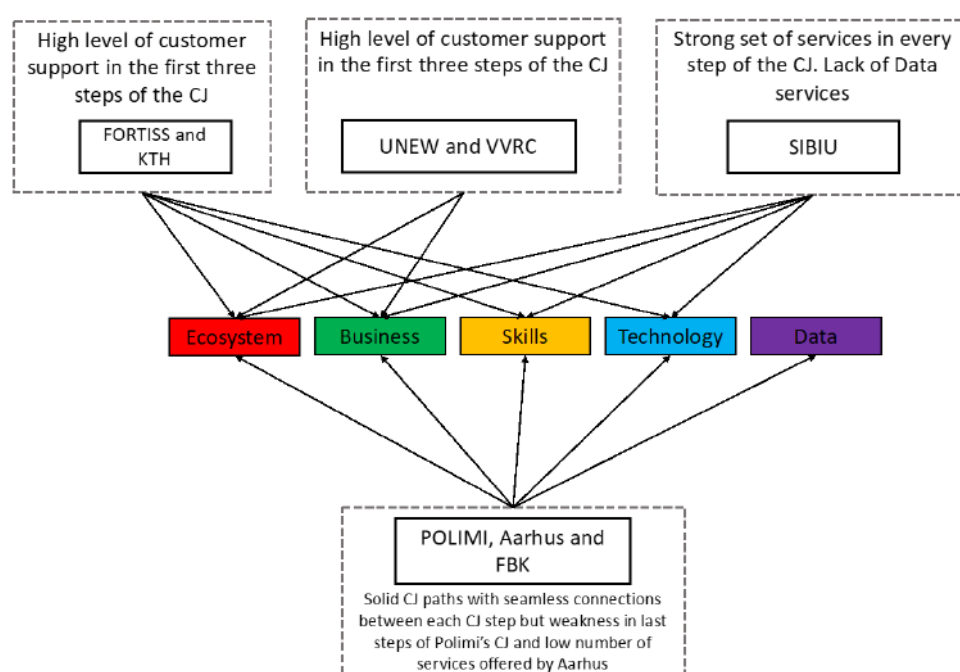


Figure 41: Similarities among DIHs for Technology User customer journeys

It is relevant to highlight that all the DIHs can improve their set of services offered in the Skills category as they offer none or only a limited number of them.

The same analysis was performed for the Technology Provider customer journeys, see Fig. 43. Initially, a plot of the services offered by each DIHs classified in the D-BEST categories was made, see Fig. 42.

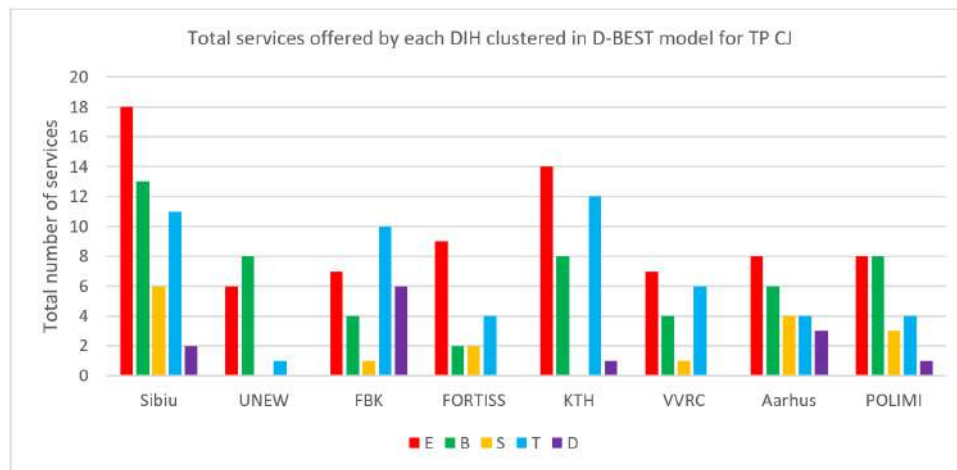


Figure 42: Number and categories of DIH services offered for Technology Users

In this case, Aarhus, FBK and POLIMI show a similar trend as for the Technology User case. Both have a structured service offer through the customer journey. Nevertheless, both DIHs have a lack of broad offering of services in the last two steps of the customer journey. Inside this cluster, there are some specific characteristics for each DIH, i.e., FBK has a strong pool of services focused on Technology and Data, while Aarhus and POLIMI have a lower number of services in these categories. It was also identified that ULBS has the strongest customer journey path as it offers a complete and complementary set of services through every step of the journey. In this case, it also provides data services that are implemented in the second and third step of the customer journey.

The DIHs analysed have heterogeneous service offers and distribution of them through the customer journey, which makes it difficult to cluster them in groups. KTH has a strong offer of services in the first four steps of the customer journey. Nevertheless, it lacks Data and Skills services, which limits their capacity to support the customer in these two areas of development. UNEW is an exceptional case as this DIH offers only some specific categories of services i.e., Ecosystem and Business categories, which does not allow the DIH to offer a complete support through the whole customer journey path. This gives only a complete support to the second step of the customer journey. FOR and VV are also an exceptional case as they provide a complete offer of services in the first three steps of the customer journey, but lack of services to offer in the last two steps. Additionally, they do not provide any Data services which limits the capacity of support to their customers.

As a global remark, in the Technology Provider customer journey case, it is also obvious that all DIHs show less focus on two categories of the D-BEST model: Skills and Data services.

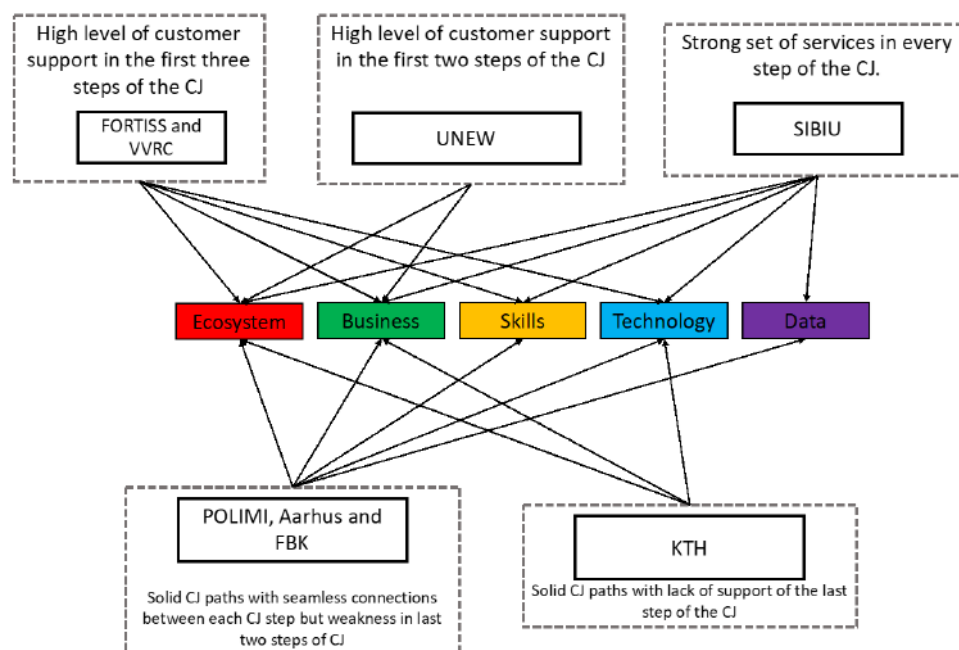


Figure 43: Similarities among DIHs for Technology Provider customer journeys

## 6 Summary and Outlook

In this report we have presented the work performed within Work Package 2 during the second project year. The main focus has been on enabling opportunities for the HUBCAP DIHs to collaborate on providing innovation support services to SMEs. In addition to this, the partners have also prepared for reaching out to other DIHs, not part of the project consortium, by starting to include descriptions of the existing services on the HUBCAP collaboration platform, and by analysing the concrete value proposition of the project's offerings towards such external DIHS.

Towards the goal of creating cross-hub collaboration within HUBCAP, the DIHs have gathered information about their services already existing at the respective hubs, both on a structural level, looking at certain attributes of those services, and on an operational level, where information about how the services are actually being used, or intended to be used, by SMEs. These "customer journeys" have been analysed and compared to each other to understand where the HUBCAP DIHs provide similar portfolios in similar ways to their SMEs, and where there are complementarities, where one hub provides offers in a given area in which others do not.

The analysis of the customer journeys provides valuable insights, e. g., that the offers of the various HUBCAP DIHs show a certain degree of variety in terms of the types of services provided, the stages of the customer journeys addressed, and the complexity of the journeys themselves. For instance, some DIHs offer a substantial number of ecosystem or technology-related services, while others have services in place in the business or, to a lesser extent, the skills categories. Also some of the journey stages, especially the later ones towards technology adoption or go-to-market are less covered by service offerings by



some of the hubs.

These findings provide valuable input to the work planned within this Work Package for the final year of the project to develop new services for the blank spots that could be filled collaboratively, and to identify opportunities where two or more DIHs could work together to extend their sets of services to provide either a more comprehensive portfolio or more in-depth offers for given service categories, technologies, or journey stages.

## References

[HUB20] HUBCAP. Project Deliverable D2.1: DIH Services, 2020.

[OPB<sup>+</sup>14] Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, and Trish Papadakos. *Value Proposition Design: How to Create Products and Services Customers Want (The Strategyzer Series)*. John Wiley & Sons, 2014.

## A DIH Customer Journey Illustrations

The illustrations of the customer journeys developed by the HUBCAP DIHs are reproduced in this appendix in a larger format for better readability.

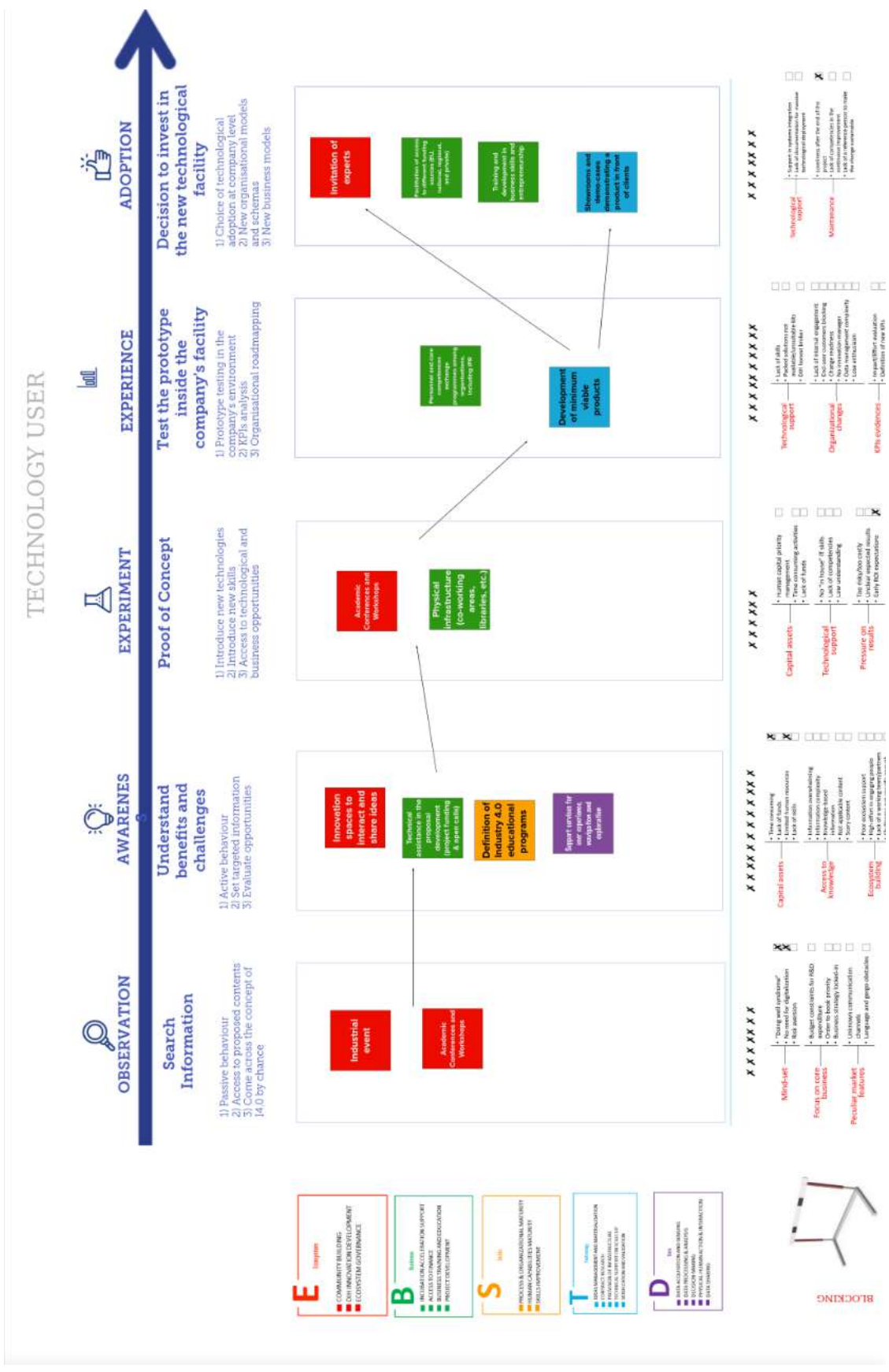


Figure 44: Customer Journey for a Technology User SME at DIH AU

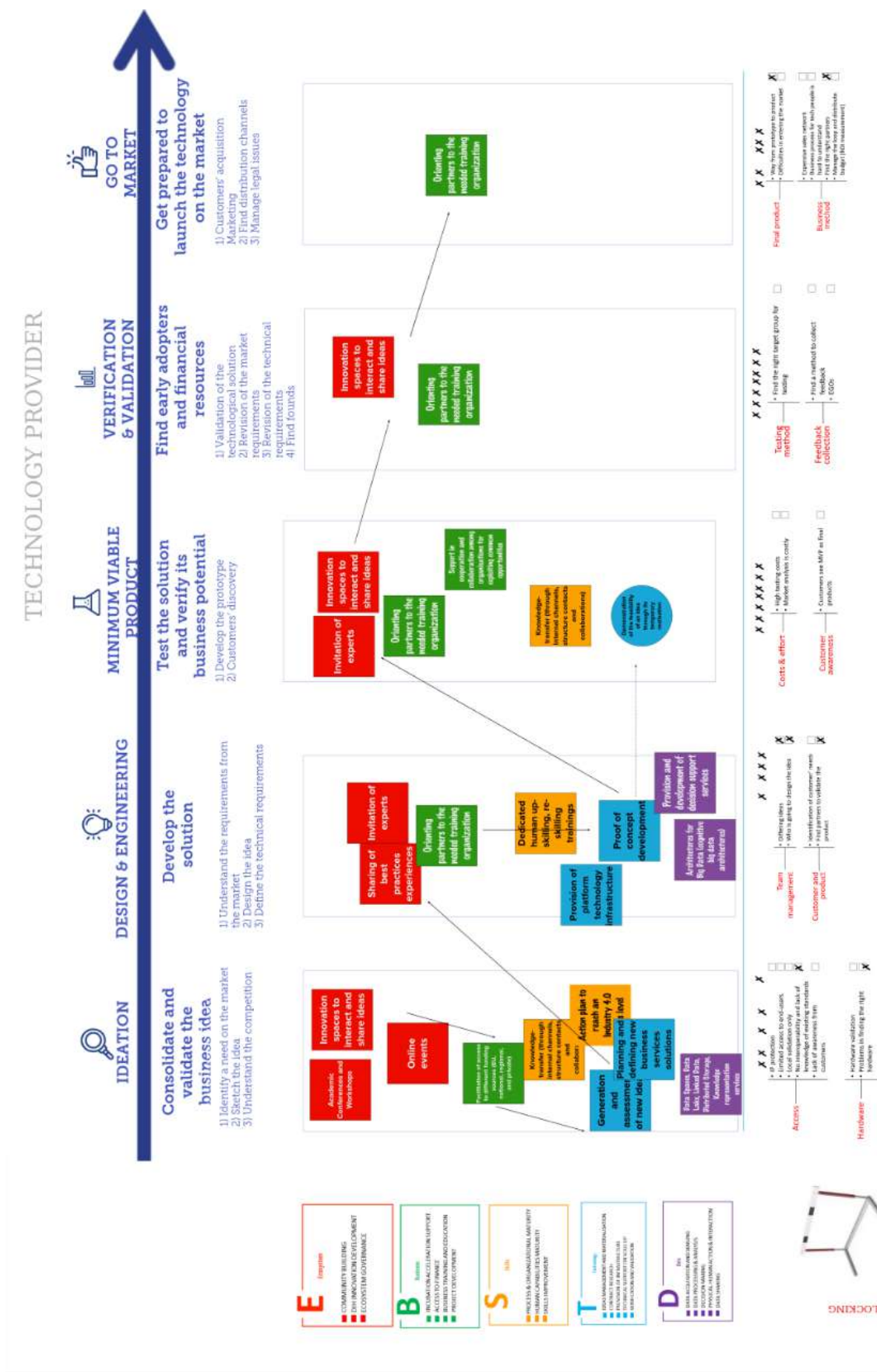


Figure 45: Customer Journey for a Technology Provider SME at DIH AU

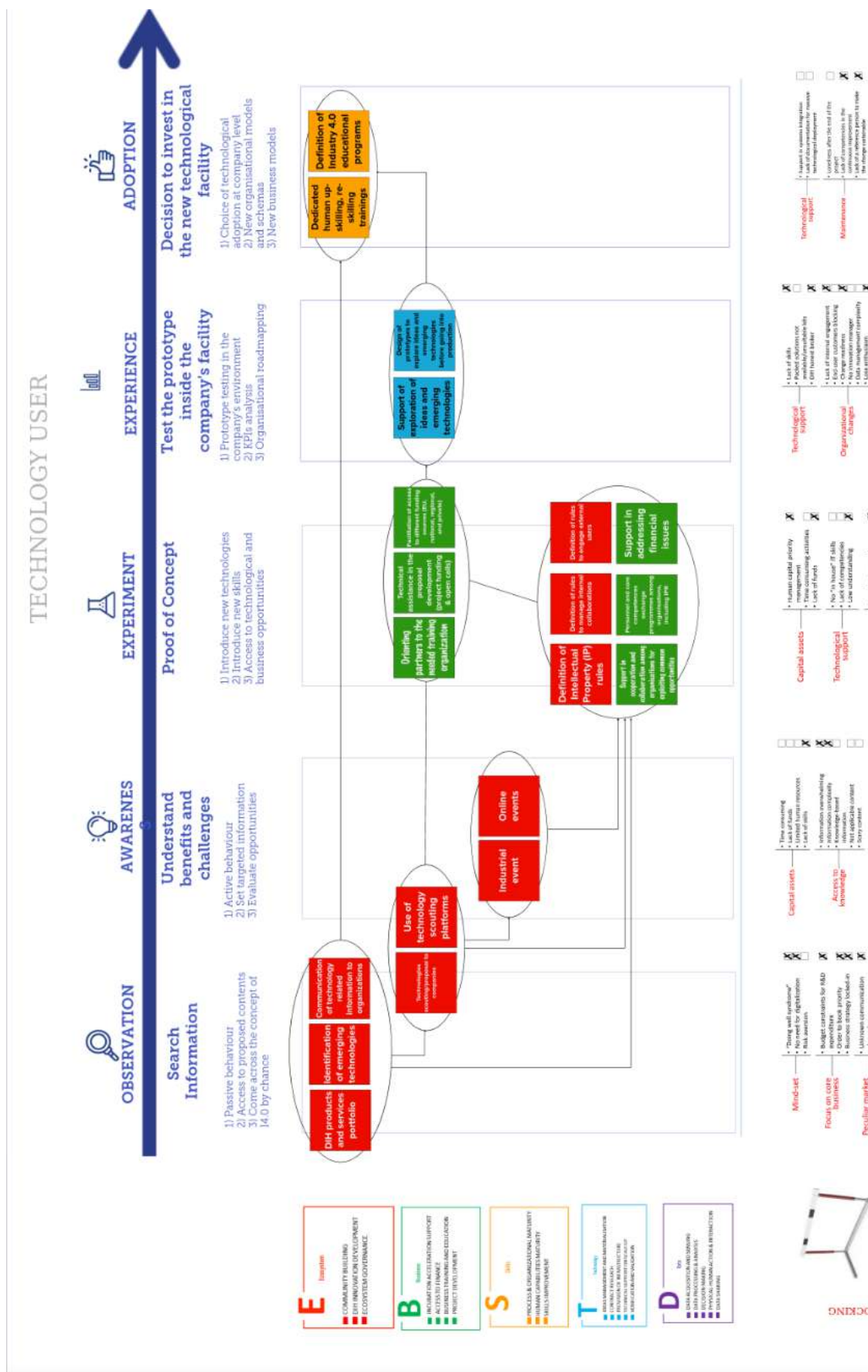


Figure 46: Customer Journey for a Technology User SME at DIH UNEW

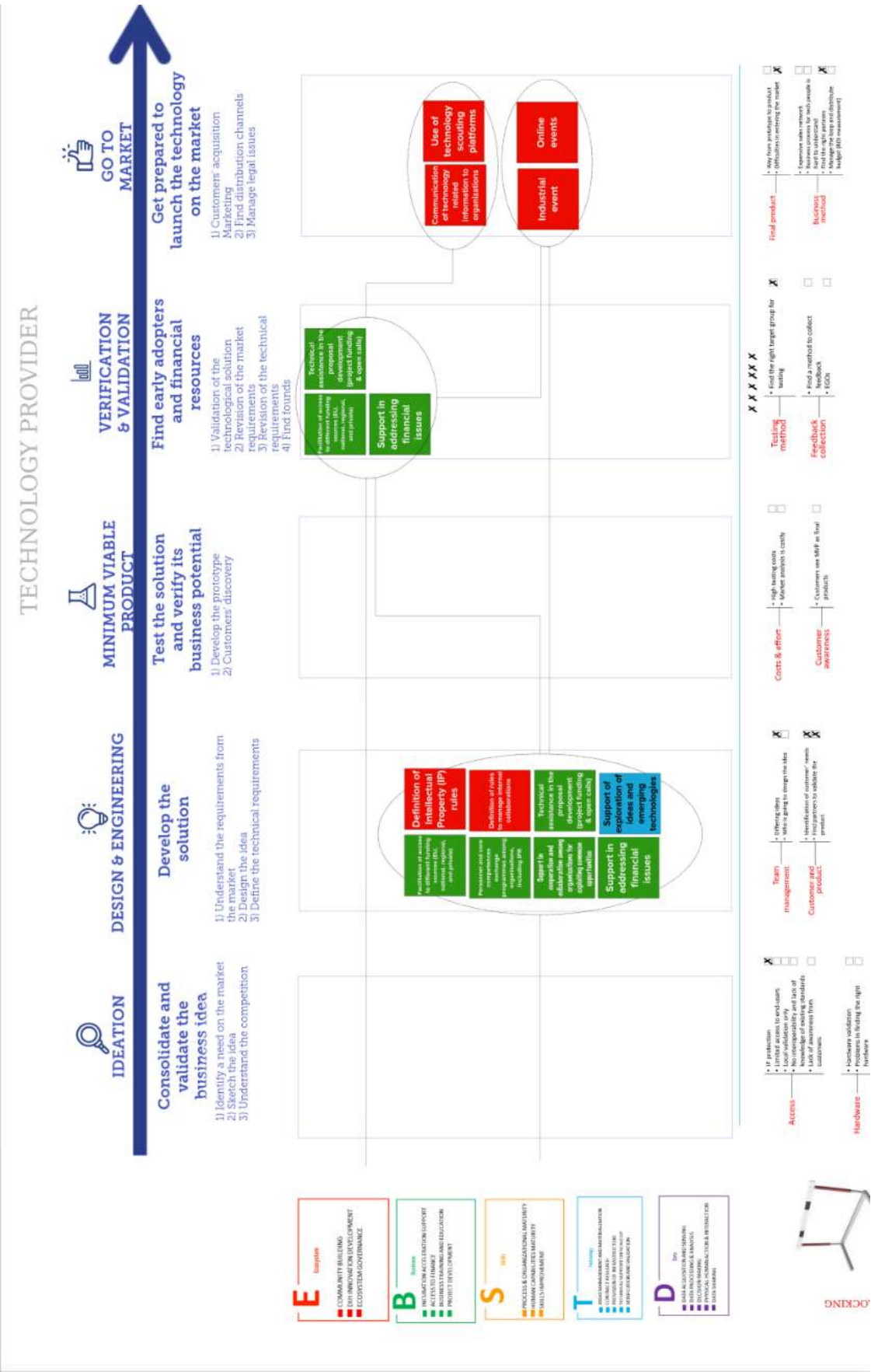


Figure 47: Customer Journey for a Technology Provider SME at DIH UNEW





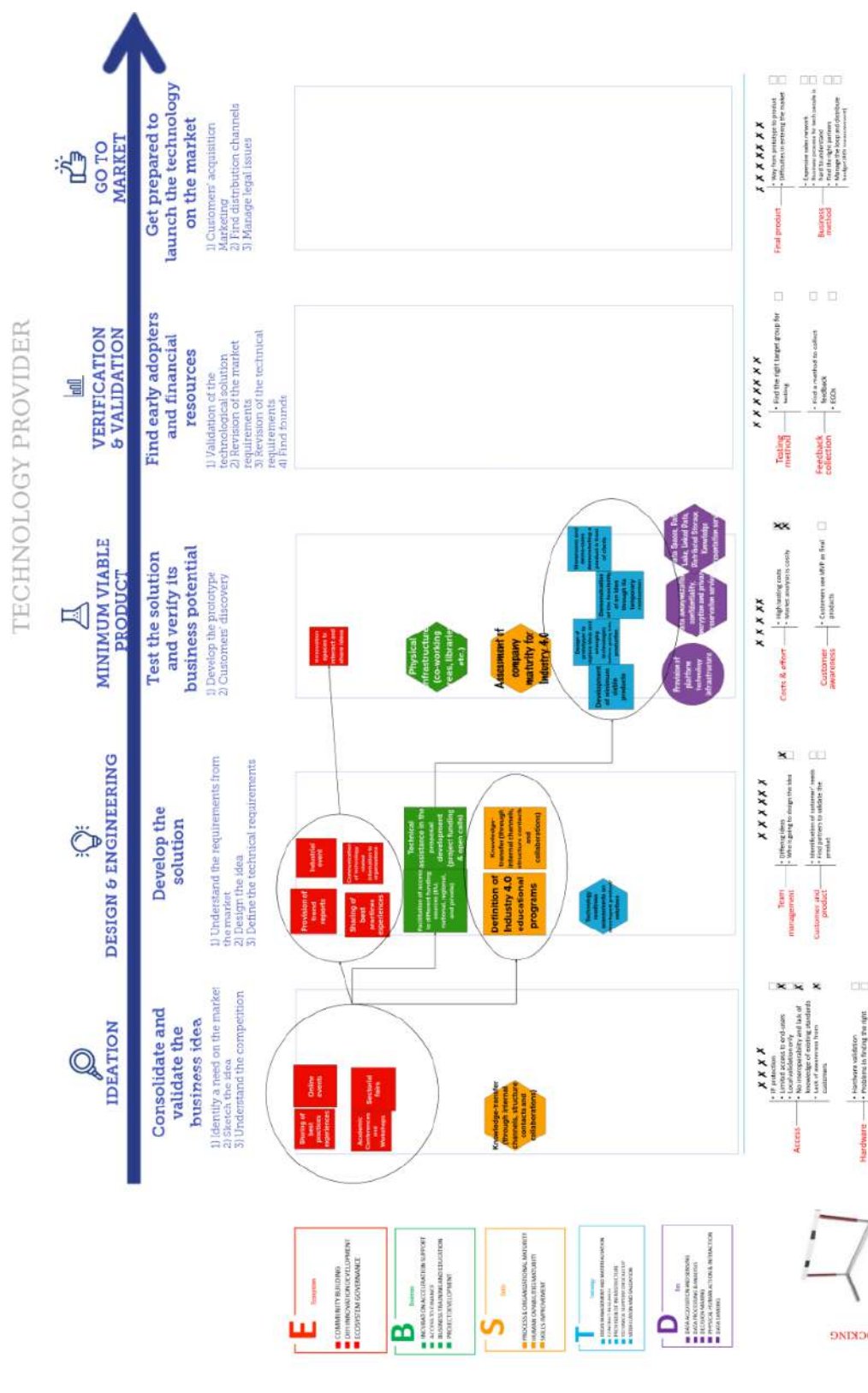


Figure 49: Customer Journey for a Technology Provider SME at DIH FOR

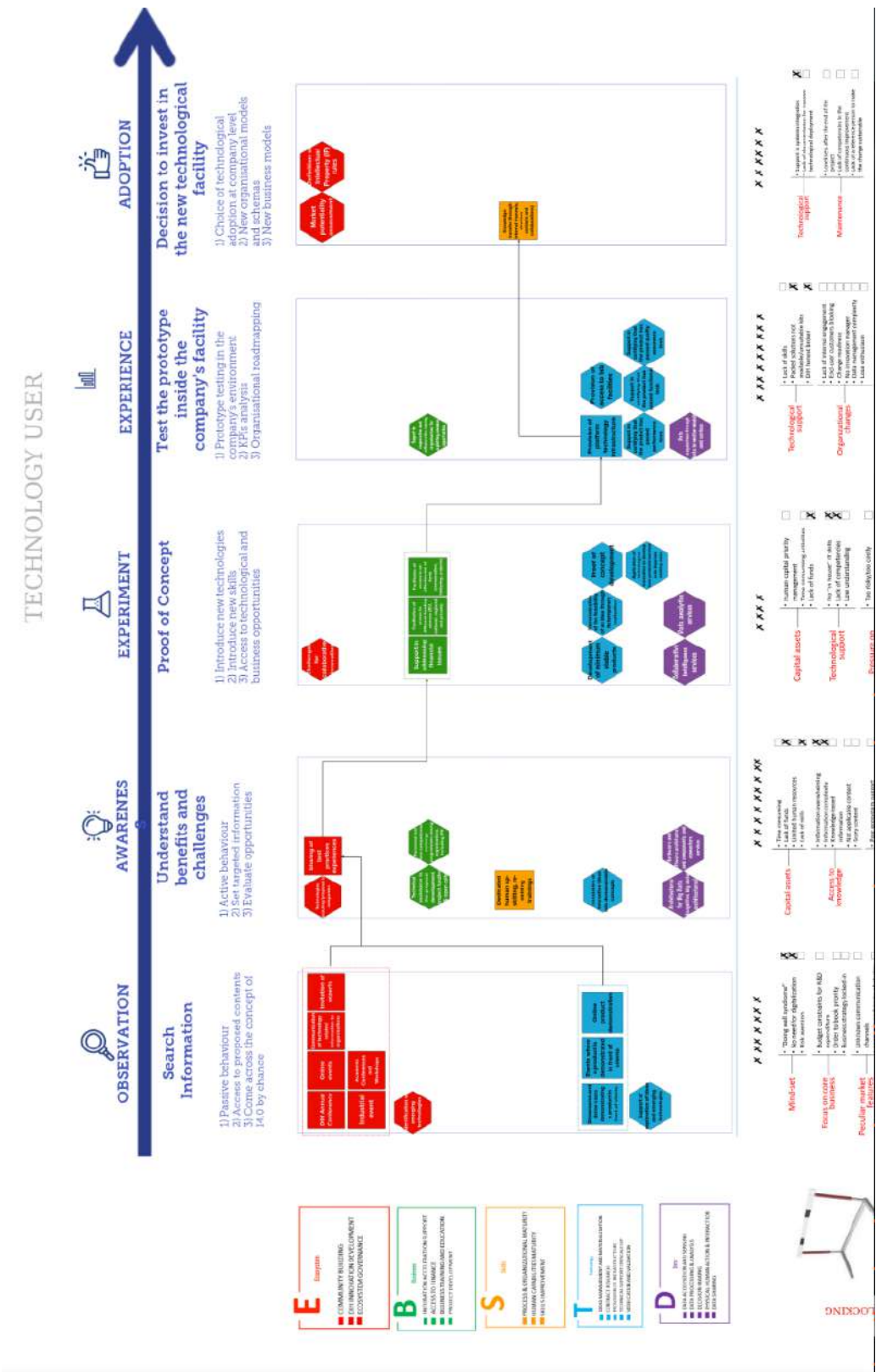


Figure 50: Customer Journey for a Technology User SME at DIH VV

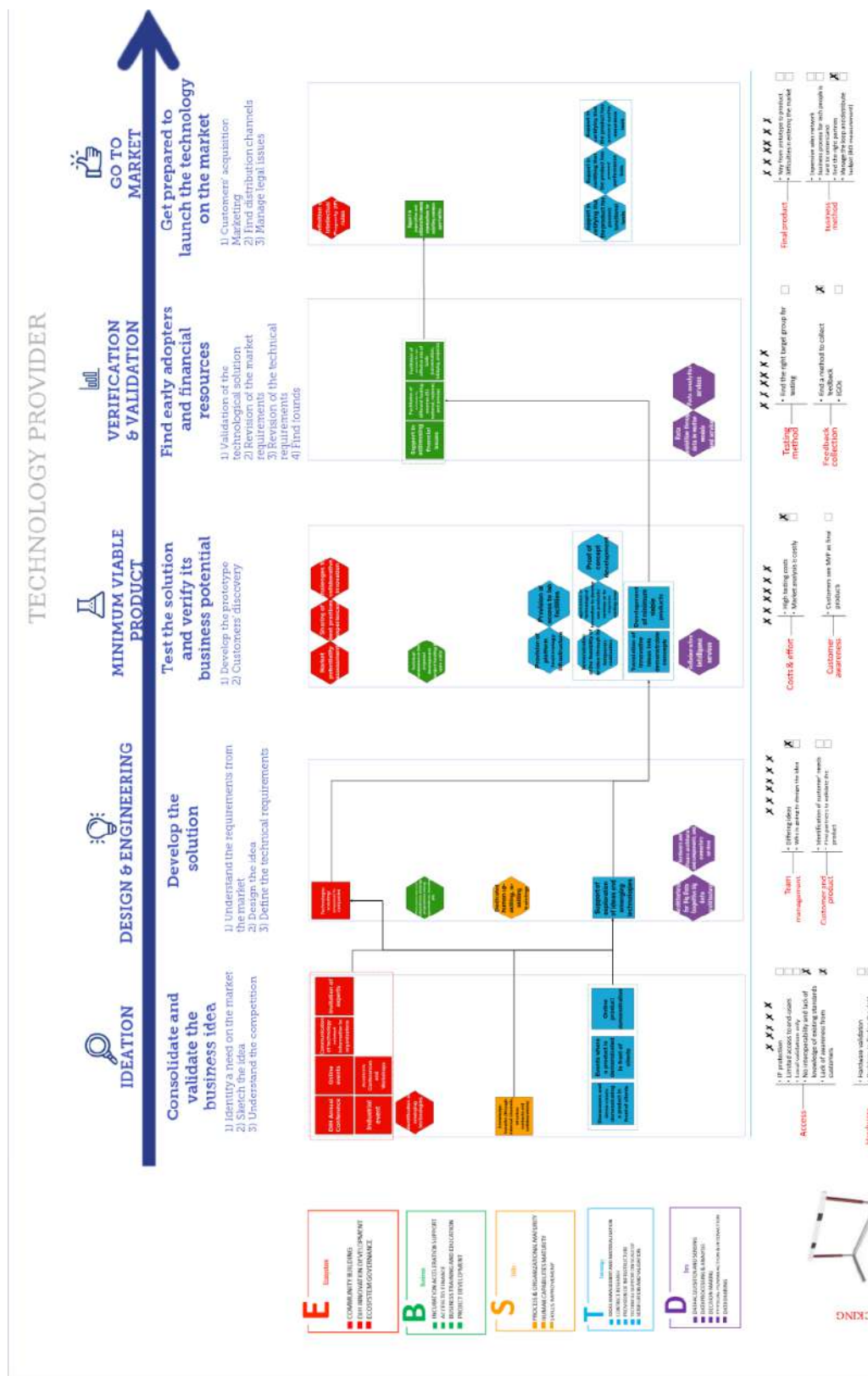
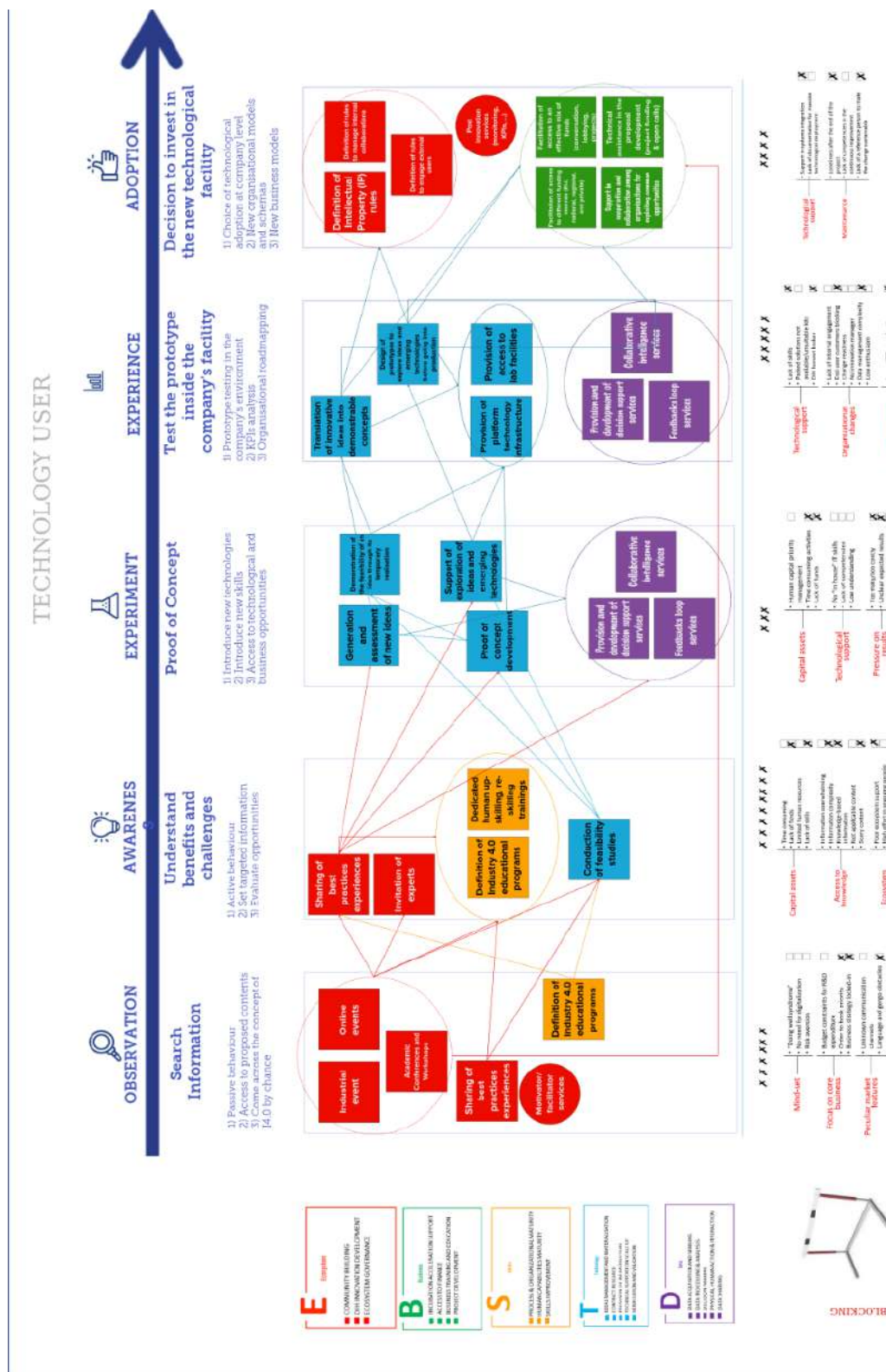


Figure 51: Customer Journey for a Technology Provider SME at DIH VV







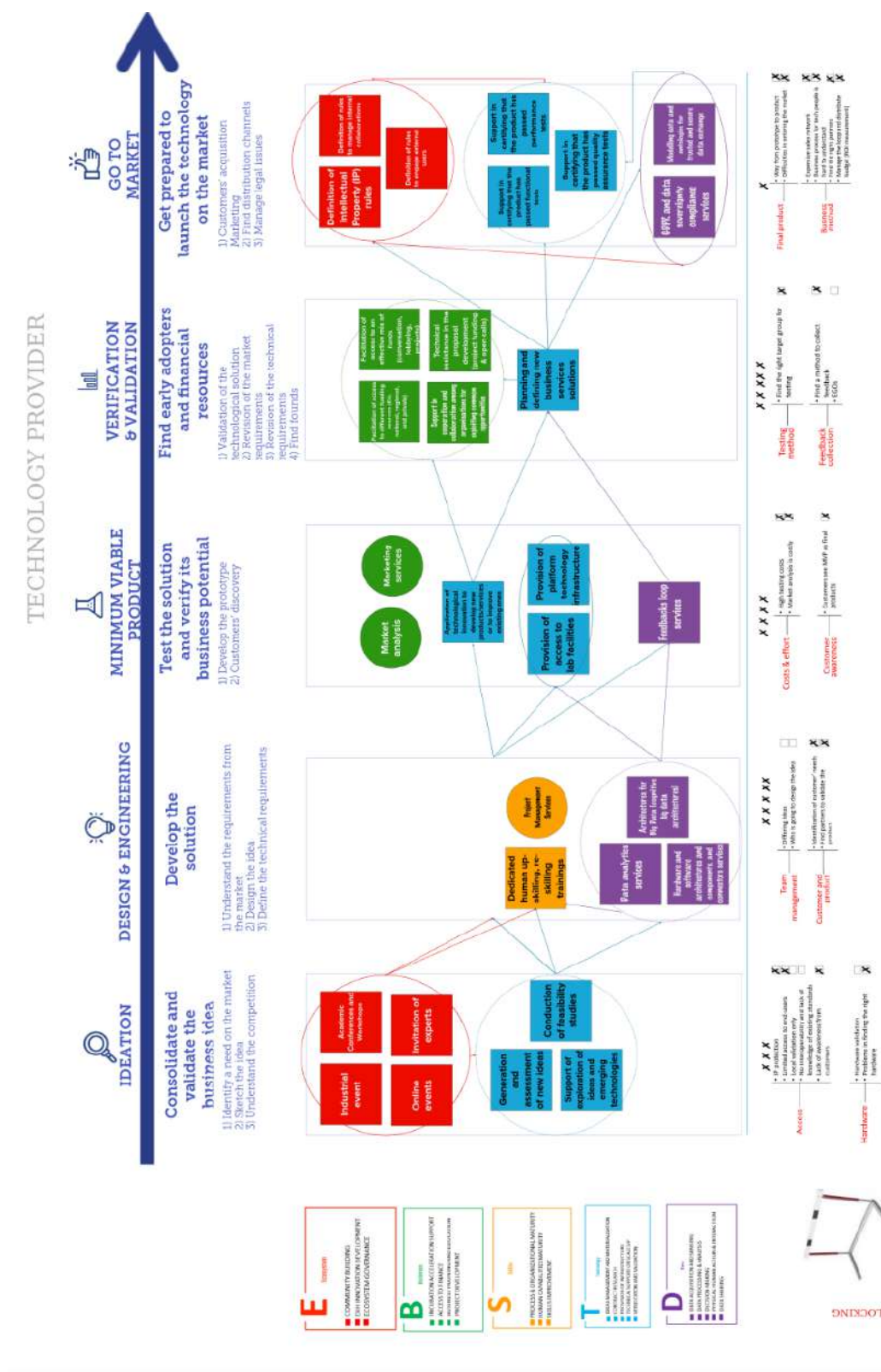


Figure 53: Customer Journey for a Technology Provider SME at DIH FBK

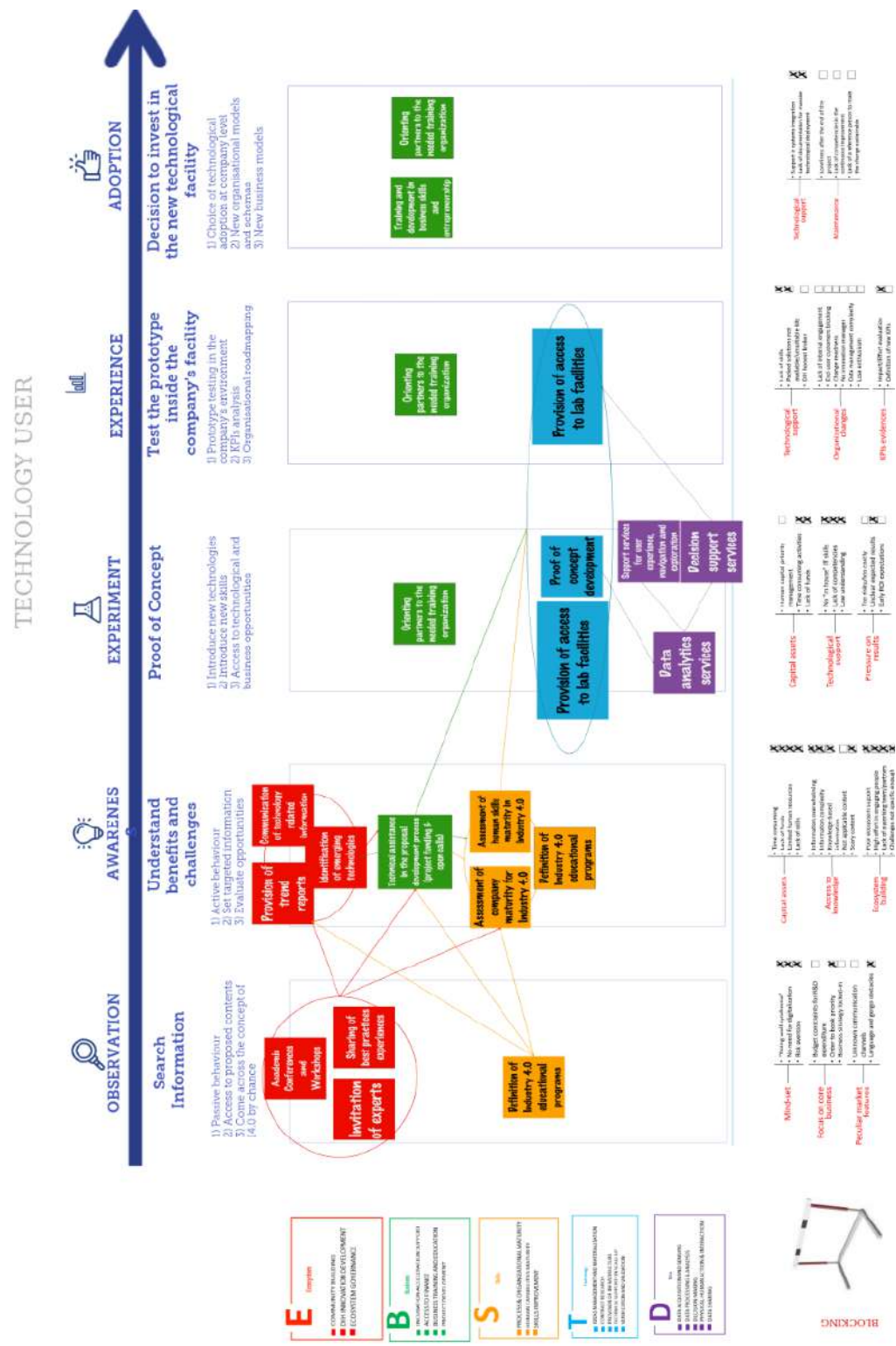


Figure 54: Customer Journey for a Technology User SME at DIH POLIMI

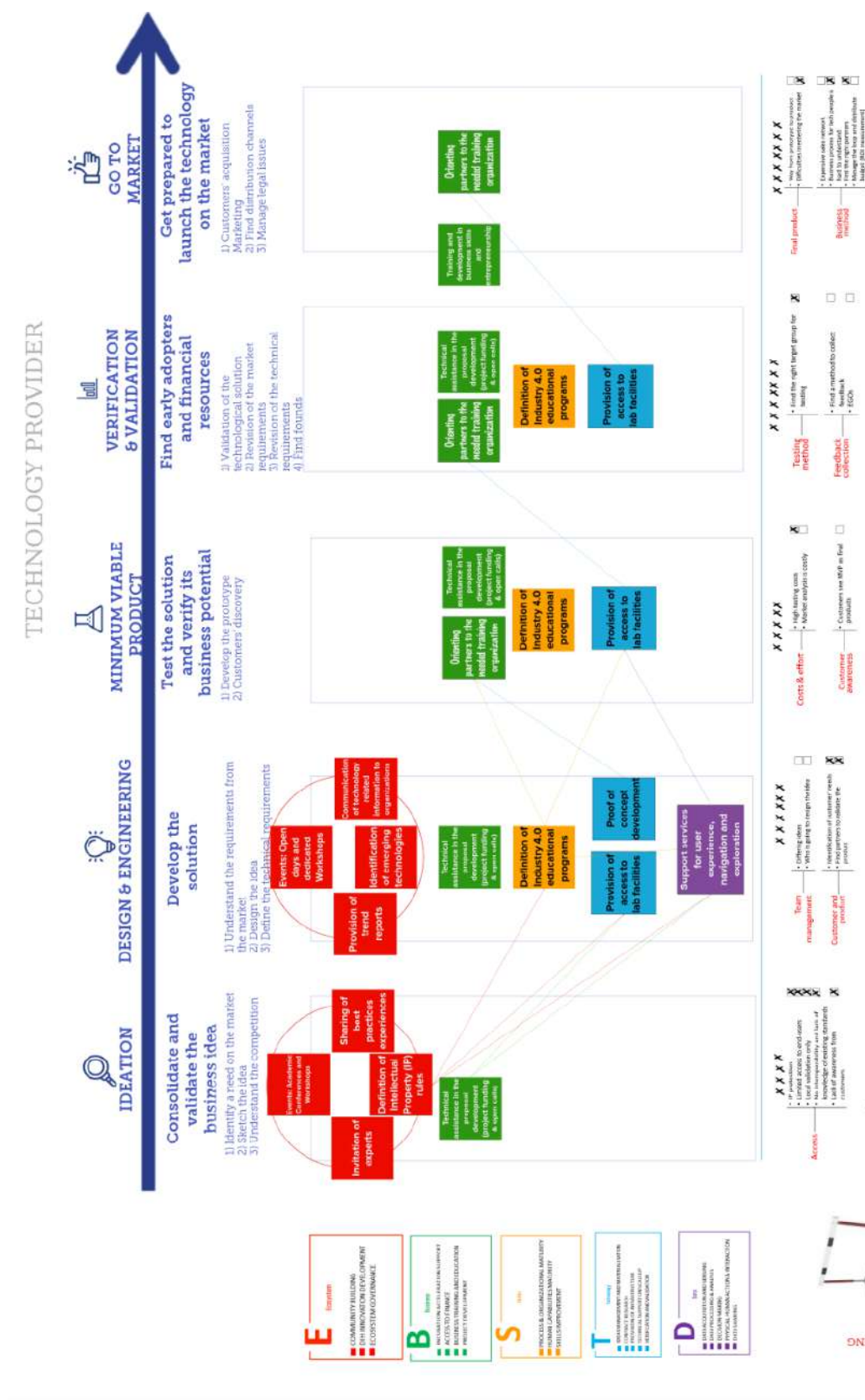


Figure 55: Customer Journey for a Technology Provider SME at DIH POLIMI

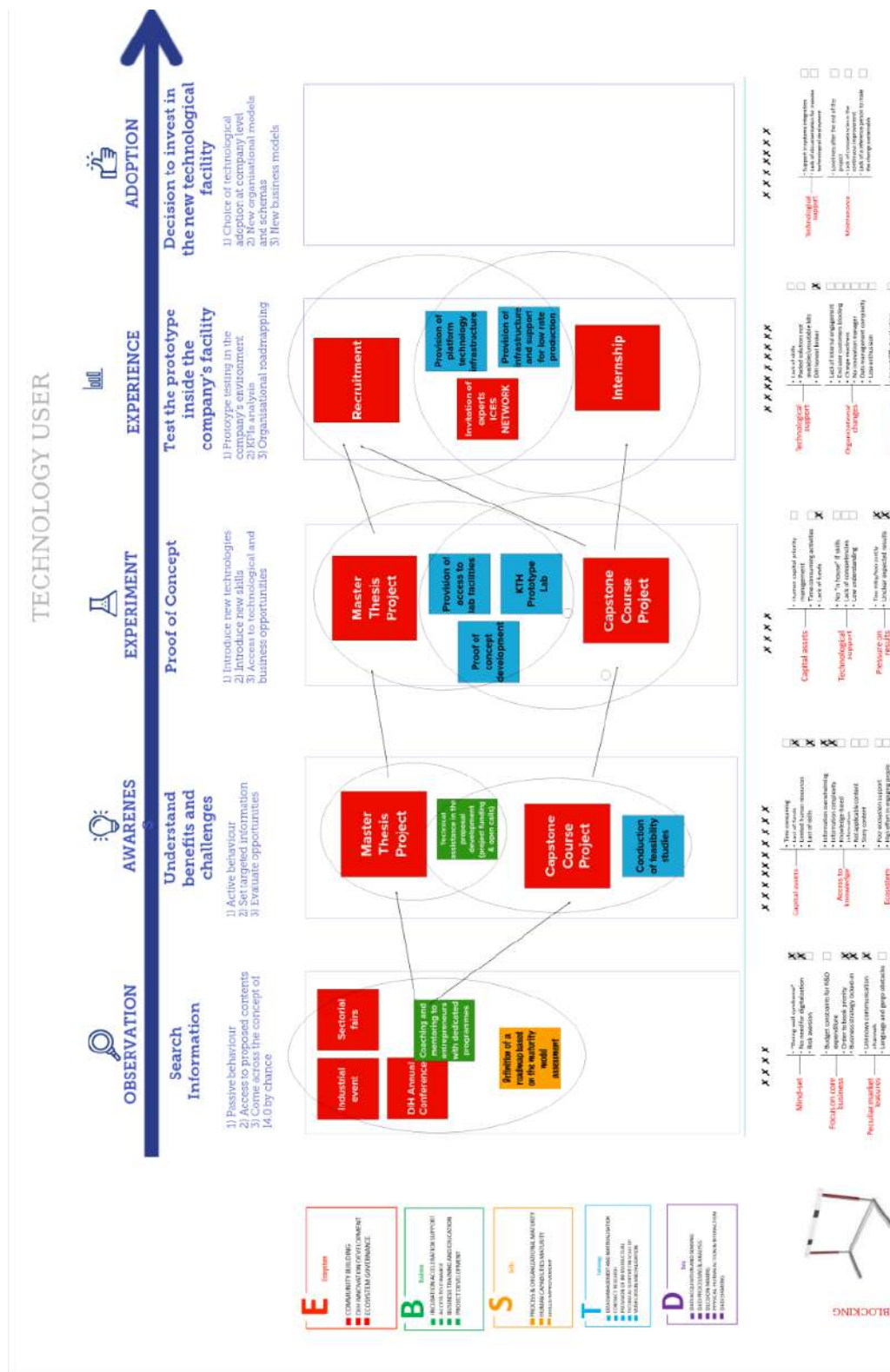
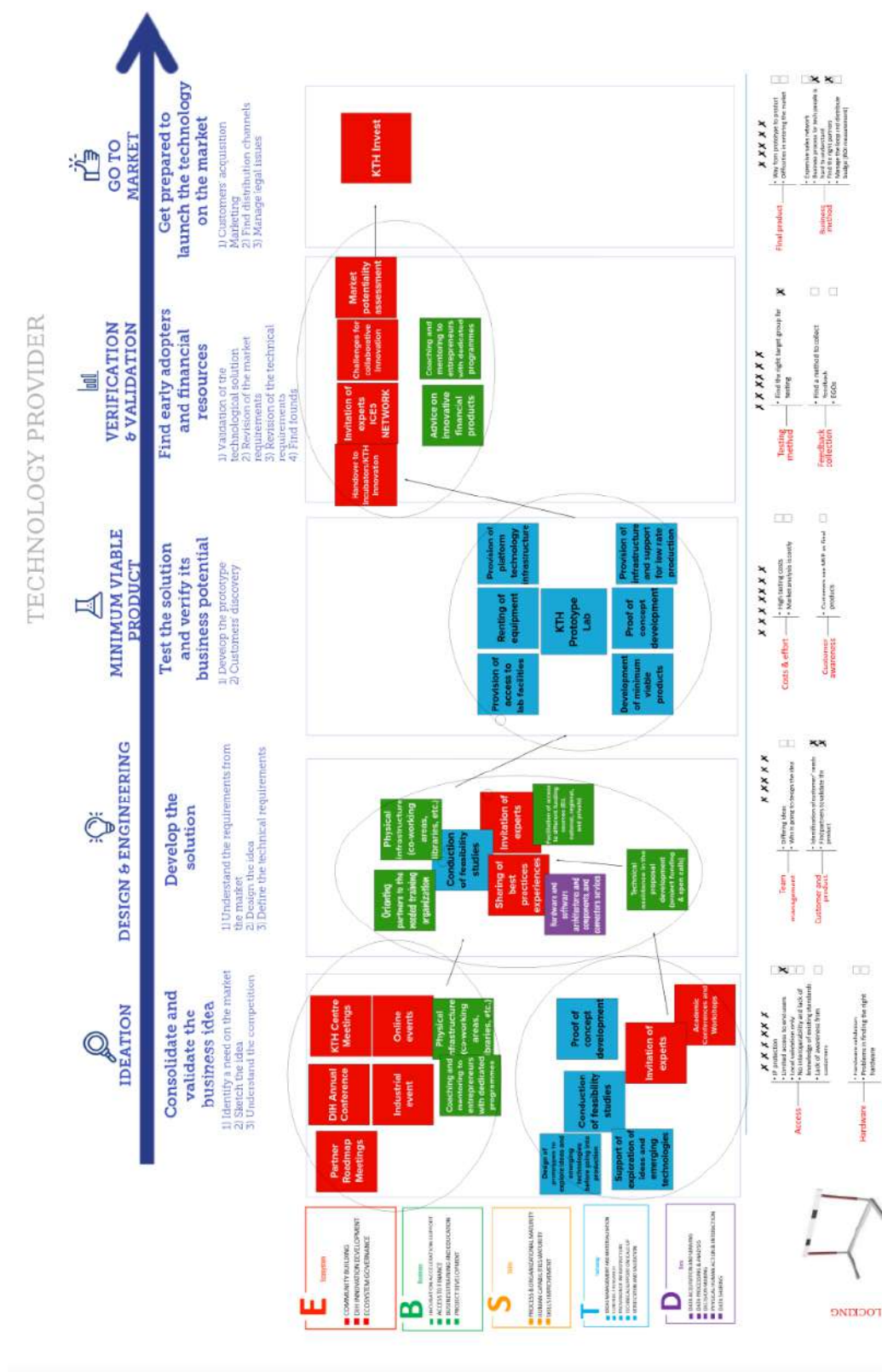


Figure 56: Customer Journey for a Technology User SME at DIH KTH







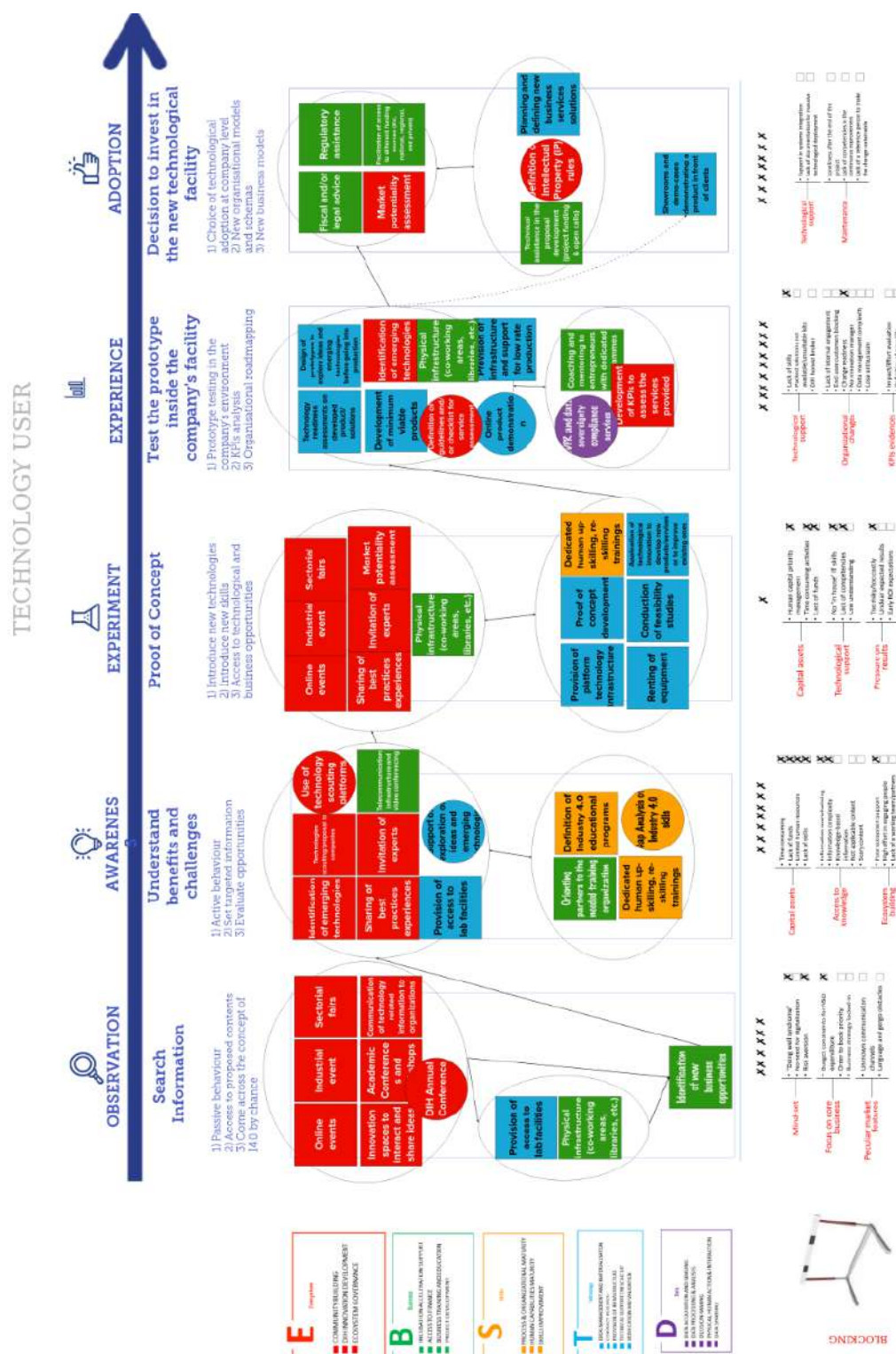


Figure 58: Customer Journey for a Technology User SME at DIH ULBS



## B Number of D-BEST services offered per DIH in Customer Journeys

This section presents charts showing the number of services per D-BEST service category provided by the HUBCAP DIHs along the different stages of the customer journeys for both Technology Users and Technology Provider SMEs.

### Technology User journeys

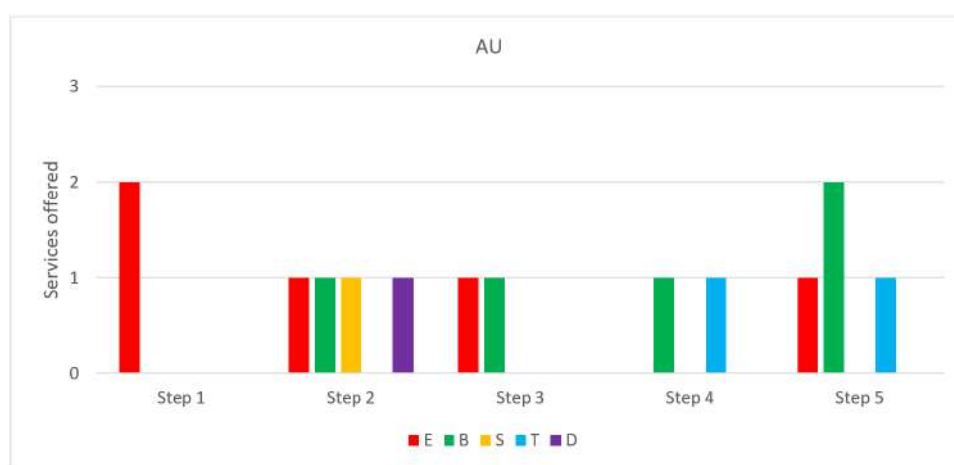


Figure 60: Number and categories of DIH services offered for Technology Users by DIH AU



Figure 61: Number and categories of DIH services offered for Technology Users by DIH UNEW

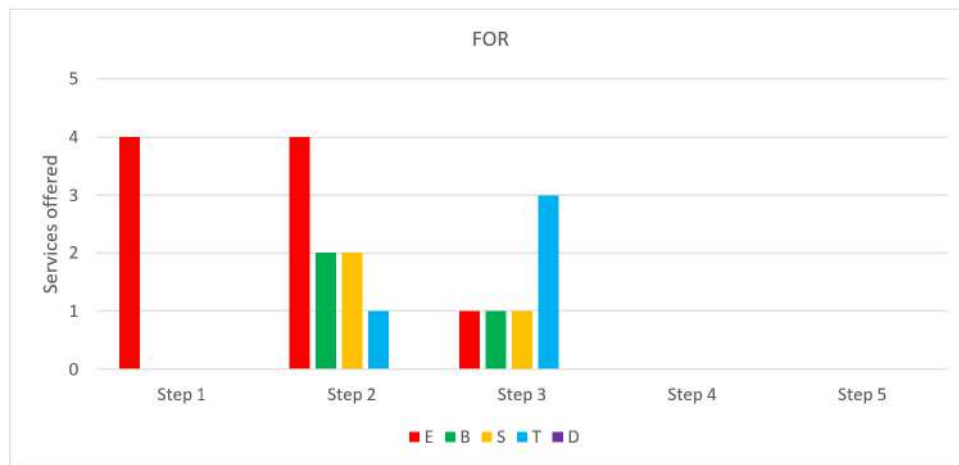


Figure 62: Number and categories of DIH services offered for Technology Users by DIH FOR

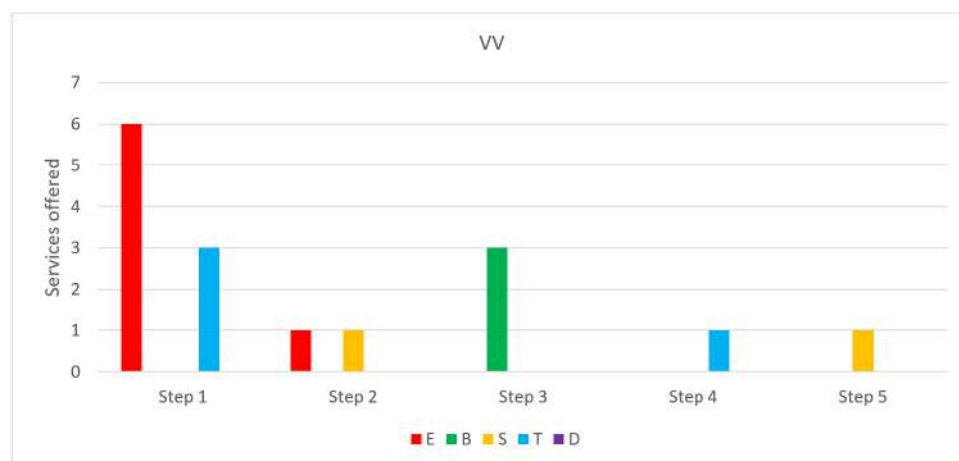


Figure 63: Number and categories of DIH services offered for Technology Users by DIH VV

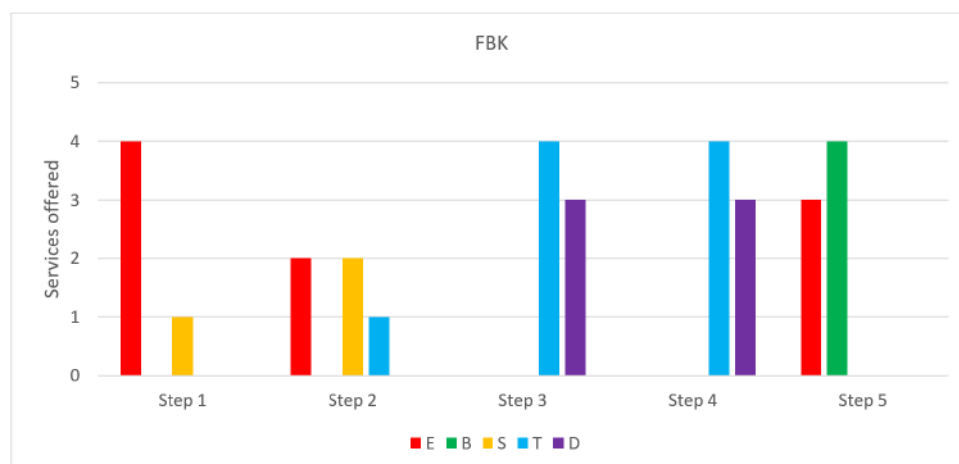


Figure 64: Number and categories of DIH services offered for Technology Users by DIH FBK



Figure 65: Number and categories of DIH services offered for Technology Users by DIH POLIMI

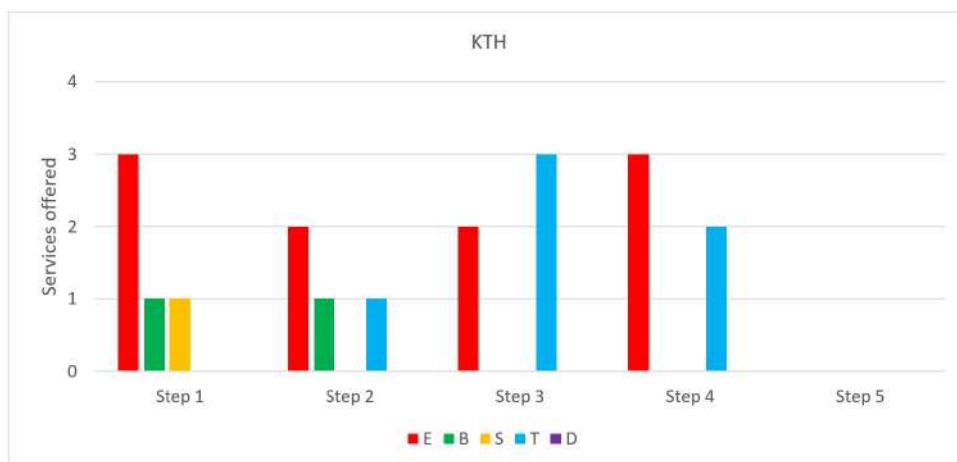


Figure 66: Number and categories of DIH services offered for Technology Users by DIH KTH

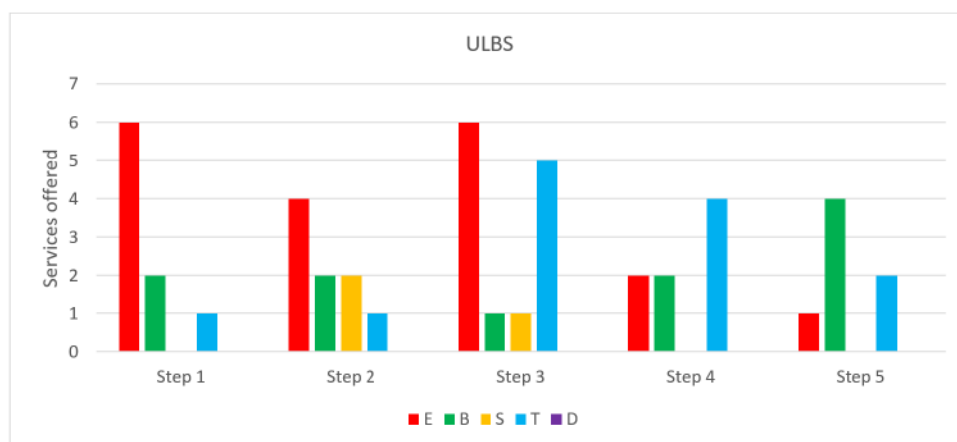


Figure 67: Number and categories of DIH services offered for Technology Users by DIH ULBS

# Technology Provider journeys

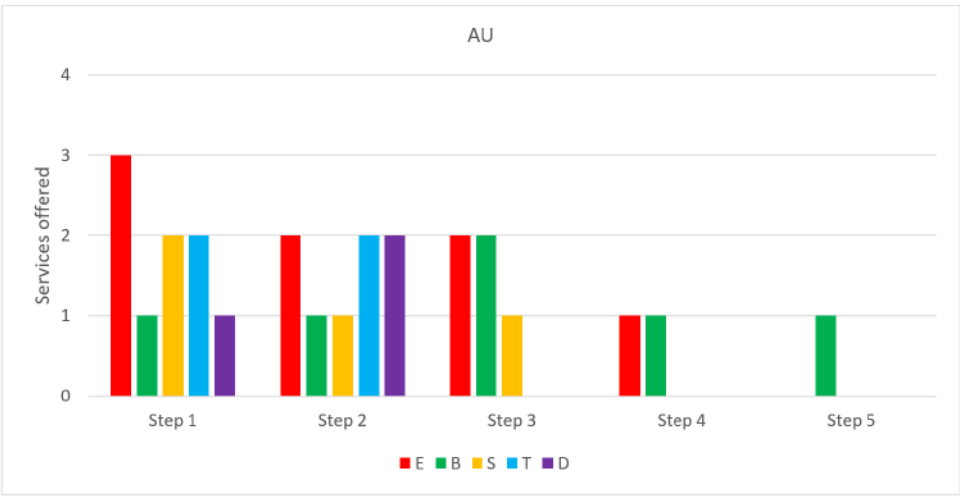


Figure 68: Number and categories of DIH services offered for Technology Users by DIH AU



Figure 69: Number and categories of DIH services offered for Technology Users by DIH UNEW



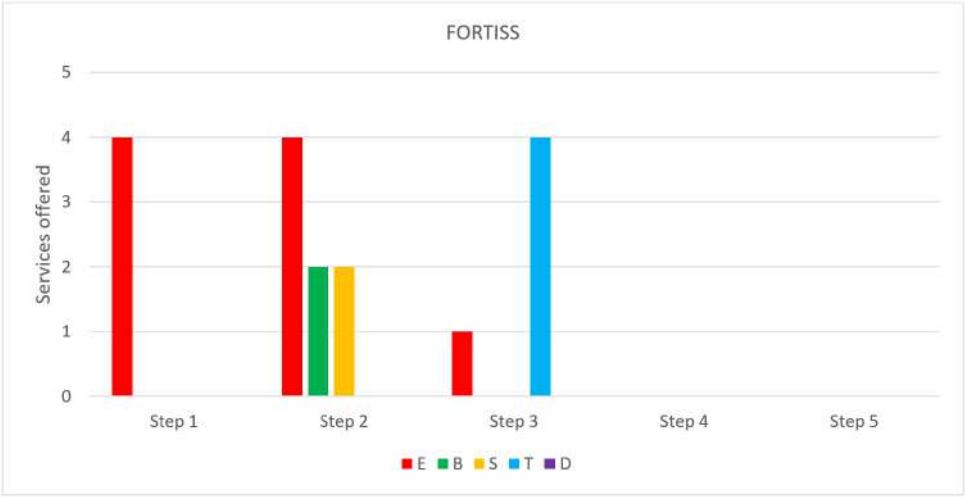


Figure 70: Number and categories of DIH services offered for Technology Users by DIH FOR

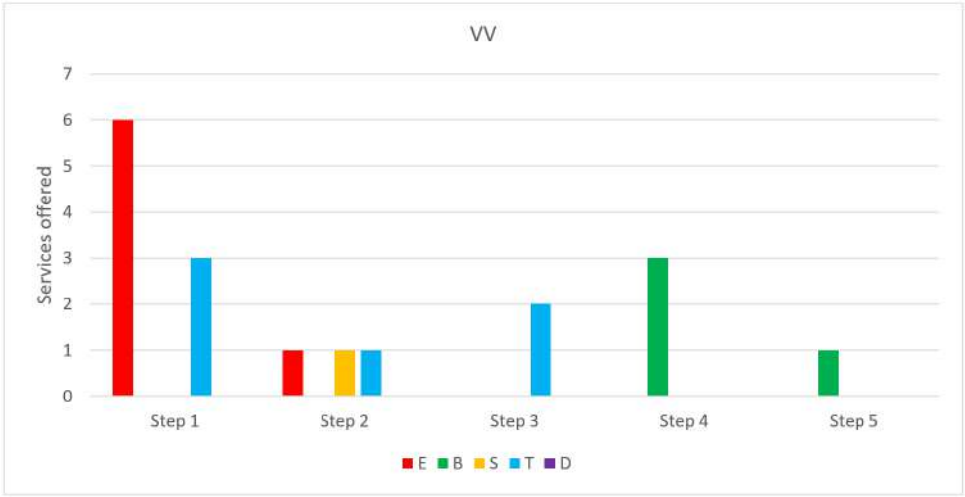


Figure 71: Number and categories of DIH services offered for Technology Users by DIH VV

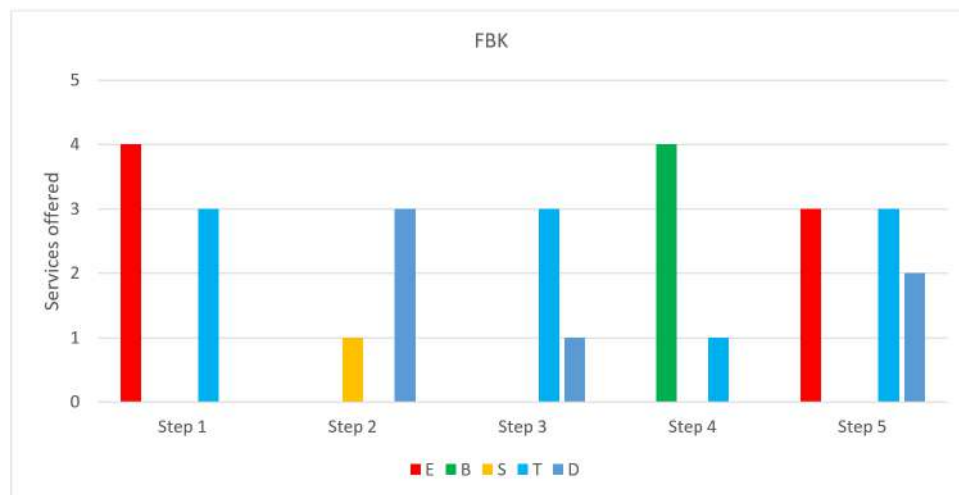


Figure 72: Number and categories of DIH services offered for Technology Users by DIH FBK

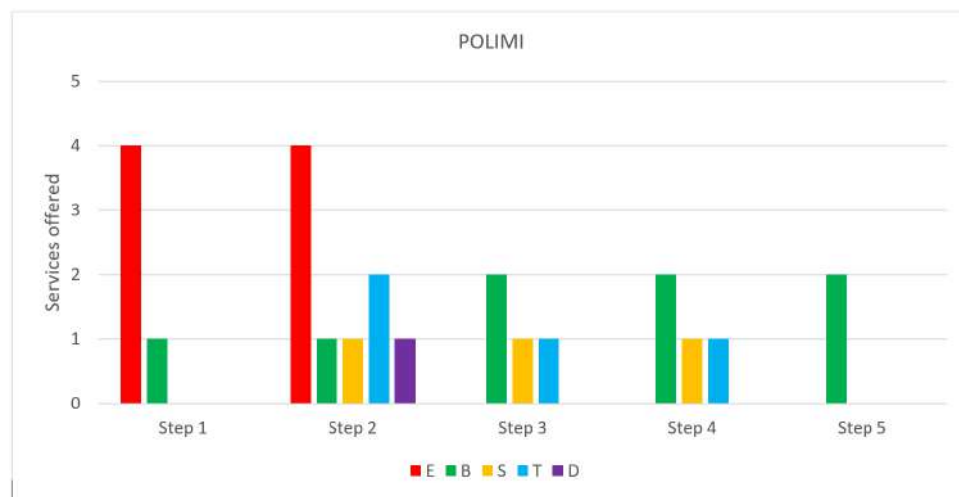


Figure 73: Number and categories of DIH services offered for Technology Users by DIH POLIMI

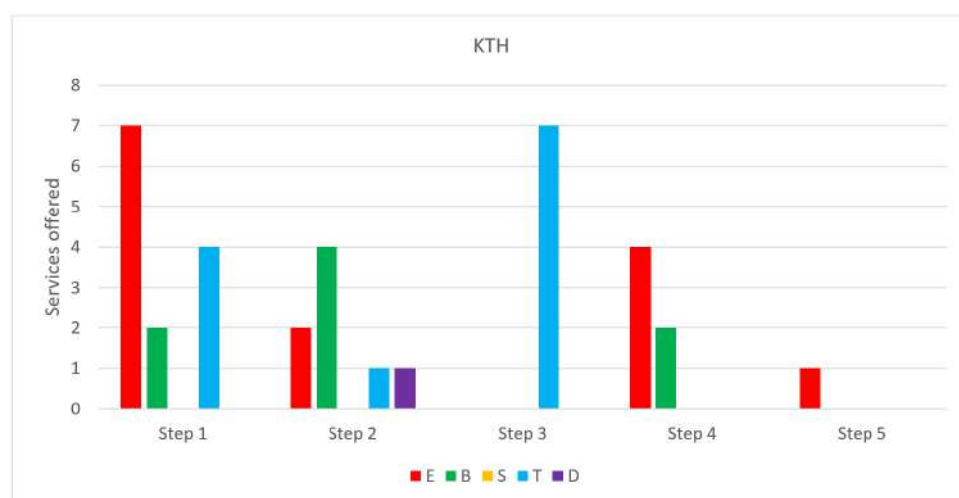


Figure 74: Number and categories of DIH services offered for Technology Users by DIH KTH

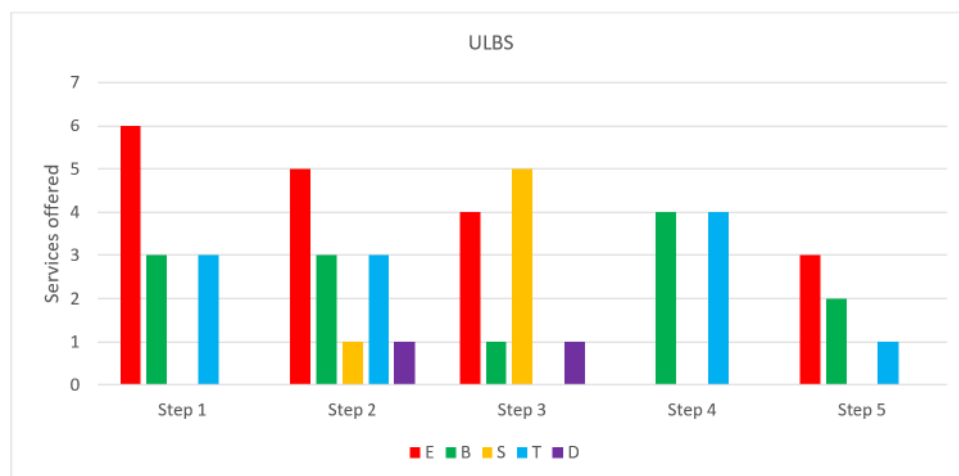


Figure 75: Number and categories of DIH services offered for Technology Users by DIH ULBS