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Problematizing the Service Portfolio of Digital Innovation Hubs

Fredrik Asplund[1][0000-0001-5704-4504], Hugo Daniel Macedo[2][0000-0002-8882-4500] and Claudio Sassanelli[3][0000-0003-3603-9735]

[1] KTH Royal Institute of Technology, 100 44 Stockholm, Sweden
[2] Aarhus University, Finlandsgade 22, 8000 Aarhus, Denmark
[3] Politecnico di Milano, Piazza Leonardo da Vinci, 32 20133 Milan, Italy
{fasplund@kth.se; hdm@ece.au.dk; claudio.sassanelli@polimi.it}

Abstract. Digital innovation hubs (DIHs) are a strategic means to drive European Small and Medium Enterprises (SMEs) digital transition. The European Commission has envisioned four main functions characterizing DIHs' service portfolios ("Test before invest"; "Support to find investments"; "Innovation ecosystem and networking"; and "Skills and training"). However, DIHs target different functions, e.g. focusing on helping launch novel digital technologies to market, or directing investment opportunities. DIHs are also at different maturity levels, interact with different actors and exist in regions with different conditions for innovation. There might not be an equal need for all four functions, and they might not be equally well served. This study aims to explore and derive implications for the deployment of the four main functions by DIHs. It builds on the activities of DIHs involved in the DIH initiative through several innovation actions, including FED4SAE and HUBCAP.

Keywords: Digital innovation hubs, Service portfolio, Innovation ecosystems.

1 Introduction

Digital innovation hubs (DIHs) are entities that support European companies in the ongoing digital transformation of society. This support is provided in the form of services related to four "functions" [1]: (a) "Test before invest" (services related to technical expertise and experimentation); (b) "Support to find investments" (services related to brokerage between firms and funding organisations); (c) "Innovation Ecosystem and Networking" (services related to finding and supporting connections that enable or make innovation more effective); and (d) "Skills and training" (services related to ensuring that firms can access the training or adequately trained professionals they require for pursuing digitalisation). The European Commission (EC) has supported the establishing of DIHs since 2014, primarily through funding innovation actions. DIHs form the nucleus in a growing number of public-private innovation ecosystems, i.e., interconnected production and user side organisations of both public and private character that, directed by a lead organisation, focus on value creation [2, 3].

While innovation ecosystems are gaining increasing attention, the concept itself [4], their genesis [5], and the associated implications of public-private cooperation [3] are understudied. Which actions public actors should take during ecosystem genesis to ensure that an innovation ecosystem thrives is unclear. The four functions relate to activities necessary for successful ecosystem growth that typically fall under the responsibility of different roles, such as the provision of advice by experts ("Test before invest") and the forging of partnerships by ecosystem leaders ("Innovation Ecosystem and Networking"). Different DIHs will strive to fill different roles, either by choice or to ensure a fit with their current capabilities. DIHs might thus, rightfully, not strive to address all four functions, and they should possibly also address them differently.

This paper aims to problematize the DIH deployment of services according to the four functions, exploring difficulties for DIHs in providing services in one or several of the functions. More specifically, this study probes such difficulties to identify implications for public innovation ecosystem leadership.

2 Related Work

Organisations participate in innovation ecosystems for different reasons [6, 7]. Depending on whether they are public or private, they often enter into innovation ecosystems from central positions either in knowledge or business ecosystems [8, 9]. That said, many areas that used to be the responsibility of either public or private organisations have become shared [10], and the increased public-private collaboration in innovation ecosystems is a part of enabling this shift.

However, this collaboration is not without friction. Firstly, the basic culture and character of the work outputs of firms and academia usually differ, introducing problems when cooperating [11, 12]. Secondly, the reasons for participating in an innovation ecosystem can also mean that organisations choose to take on specific roles. Focusing on a leadership, direct value creation, value creation support or entrepreneurial ecosystem role [5] will both provide and remove opportunities. Thirdly, the governance of innovation ecosystems is often supported by platforms that constrain the evolution of technology and services [13]. The control of such platforms, and associated non-pricing instruments, can be critical to avoid innovation ecosystem failure [14]. Ultimately, the success of ecosystem genesis also depends on the characteristics of the people that form the collaborative network(s) within an ecosystem. Over time, this should select for relationships with little initial knowledge overlap [15], and between narrowly focused academia and firms focusing on technology recombination [16].

3 Methodology

This paper builds on the activities of several DIHs that have cooperated over several years. Each of the functions mentioned in the introduction is approached using data sets gathered by the authors during Horizon 2020 innovation actions associated with the DIH initiative. This section discusses the associated data gathering, data analysis, and associated validity concerns.

The "Test before invest" function is analysed using three data sets from the HUBCAP [17] innovation action, which started in 2020 to facilitate the use of model-based design technology for cyber-physical systems (CPS) by bringing together an innovation ecosystem around a collaboration platform[1]. The collaboration platform provides a web application that features a collaboration environment (consisting of an enterprise social software) enhanced with a sandbox (a cloud-based solution catering tools and models in a ready to use virtual environment). The first data set comes from a survey integrated on the collaboration platform to obtain initial feedback from users on its usability and limitations. Responses were gathered from a population of small and medium-sized enterprises (SMEs). The second data set comes from the 8 DIHs in HUBCAP, and consists of a summary of the most important innovation support services they provide. A central member from each DIH listed their most important services. Then the types and descriptions of the services were harmonized by a single investigator. The result was reviewed by two independent investigators to identify mistakes during the harmonization.

The "Support to find investments" function is analysed using two data sets. The second data set used for the "Test before invest" function is used again. Furthermore, the contacts providing funding opportunities to the 8 DIHs were also collected. This information was gathered through iterations with several members of each DIH and constituted: (a) the organisations that are part of their ecosystem; (b) their relationships; and (c) the associated learning, networking and funding opportunities. 7 ecosystems were mapped out with enough quality to be useful for comparative purposes.

The "Innovation ecosystem and networking" function is analysed using data from the effort of the HUBCAP project to build a more tightly connected network of DIHs. To foster the ecosystem building and networking HUBCAP set up an open call programme with multiple trickle-down funding calls. Before each call a number of open workshops and Q&A sessions brought SMEs together, creating opportunities for new partnerships. The data set for this function was collected by asking each DIH in the network which of the SMEs that were funded by first two open calls that were also new to the ecosystem.

The "Skills and training" function is analysed using data from the FED4SAE innovation action, which between 2017 and 2021 aimed to lower the technical and business barriers for innovative companies in the CPS and embedded systems markets. As part of this project 8 DIHs were asked to provide details on the organisations in their public-private innovation ecosystems, their relationships, and their ways of upskilling their employees. After networks maps for the knowledge and training relationships had been established, the firms seeking to join the DIH innovation ecosystems through FED4SAE were approached for interviews. Out of a 100 such firms, 20 were interviewed for about 20 minutes each by two interviewers. An interview script focusing on learning opportunities and the skill set of SME employees were used to ensure a coherent coverage across all interviews. As both the questions and number of inter-

[1] https://dihiware.eng.it/dihwelcome/

viewees were limited, the interviewers created summaries of the replies for each question during the interviews. These summaries were then used to discuss each question in separation when all interviews had been concluded.

4 Results

The detailed results from the survey on the initial HUBCAP industry experience[2] and the summary of innovation support services[3] are available in separate reports.

4.1 Test before Invest

Survey respondents were overall satisfied with the platform. Nonetheless, 40 percent declared that the platform limits features of the asset deployed to it, as a cloud-based/virtual machine always has limits that a physical machine does not have in terms of hardware, software, or licensing. In some cases, only part of the features of the assets provided by the initial population of SMEs were feasible to deploy.

In regard to the summary of available services, Table 1 describes the number of "Test before invest" services provided by the DIHs. These services aimed at providing (a) physical, exceptional testing and validation equipment, (b) demonstration facilities, (c) insights and training on novel technology, and (d) collaborative research.

Table 1. Testing and Funding – DIH Functions

DIH	Testing Services	Funding Services	Ecosystem Funding Opportunities
1	2	1	13
2	0	1	9
3	2	0	14
4	3	0	1
5	1	1	5
6	1	3	12
7	1	2	11
8	1	-	-

The most important "Test before invest"' services identified by the DIHs are centred on the DIHs themselves. They involve firms collaborating with DIHs through a hub-and-spoke collaboration model. i.e., a network design where the DIH as a central organisation (a hub) is connected to firms which themselves (mostly) lack direct connections. In contrast, the HUBCAP collaboration platform enables point-to-point collaboration between firms. One of the most important aspects of a central platform is that it allows innovation ecosystem leaders, by constraining technology and services, to

[2] https://www.hubcap.eu/assets/res/files/D3_2.pdf
[3] https://www.hubcap.eu/assets/res/files/D2.1_DIH-Services.pdf

avoid low quality that might turn away potential users. It is then noteworthy that survey respondents mentioned that only part of the features of some platform assets were feasible to deploy. This might lead to users becoming frustrated with the digital format. Successful quality control by ecosystem leadership rests on them being prepared for actively using non-pricing instruments, such as legal agreements, licenses, and oversight. Therefore, even if the services provided by firms are only intended to *demonstrate* the functionality of their products, *DIHs* must ensure this is framed correctly to give users the right impression.

4.2 Support to Find Investments

Table 1 also describes the number of funding services provided by the investigated DIHs, and the funding opportunities that they perceive in their ecosystem. 7 DIHs, which were possible to map with a good enough quality, are included. These DIHs provided funding services aimed at (a) helping other organisations write competitive research proposals, (b) providing direct financial support in e.g. open calls, and (c) building business and innovation skills.

Many funding services in the innovation ecosystems, and especially those focused on enabling firms to *separately* apply for funding, were not emphasised by the DIHs. The culture and character firms and academia differ, most likely making DIHs as ecosystem leaders lean towards funding opportunities that firms can explore in synergy with the research focus of academia. However, SMEs are often very focused on identifying funding to grow opportunities from early discovery to sustainable business. This suggests that DIHs should increase their emphasis on brokering funding that targets also higher technology readiness levels.

4.3 Innovation Ecosystem and Networking

Table 2 describes (a) the number of proposals that were accepted in the two calls, and (b) how many of the associated SMEs were already known to the involved DIHs.

Table 2. Networking and Open Calls

Open Call	Number of Accepted Proposals	Previously Known SMEs
#1.1	21	4
#1.2	14	3

The results suggests that the open calls enabled many new SMEs to enter the DIH innovation ecosystems. Unfortunately, this is not only positive. DIHs might be unable to collaborate smoothly with firms they are not familiar with, since they can for instance be active in application domains unknown to the DIHs[4].

[4] This was the case in this data set, as shown in https://www.hubcap.eu/assets/res/files/D2.2_Ecosystem_Building.pdf

An online collaboration platform, like that of HUBCAP, could possibly ease such collaboration difficulties: as collaboration is built upon point-to-point relationship, such platforms can allow networking firms to tie other DIHs to their original innovation ecosystem. In other words, these platforms can allow SMEs to build networks of DIHs able to jointly support their specific needs.

4.4 Skills and Training

The network maps indicated that the learning opportunities deemed most important by the FED4SAE innovation ecosystem participants could be divided into preparatory and continued education. The former preparing professionals for employment, and the latter meant to provide upskilling during their careers. Important preparatory education was carried out by the (primarily academic) partners in the innovation ecosystem nucleus. However, important continued education was almost exclusively provided by peripheral organisations or initiatives that were only open to paying members. The interviews probed the implications of the network maps, as these indicated that SMEs would struggle to access advanced continued education. However, most SMEs indicated that they had a close relationship with academic institutions, for instance through founders that were formerly, or even currently, employed within academia. Through these informal relationships they were able to access both knowledge, learning opportunities and experiment facilities related to advanced state-of-the-art research at low or no cost. In fact, even if continued education would have been accessible through more formal relationships, the SMEs would struggle to pay for it. The solution to accessing necessary skills was thus seldom upskilling, but rather recruiting someone who already possessed the right set of skills.

It is positive that the interviewed SMEs do not have difficulties in accessing the advanced training they need, but not that this access is dependent on personal contacts. DIHs should work towards also formalizing access to training, to ensure that it is provided on a fair and equal basis. However, if not supported by authorities or funding agencies, this could come with a price tag rendering the training inaccessible to most SMEs. One way of overcoming this obstacle could be for DIHs to work towards securing a training budget in other activities that involve novel technology. This could involve other services, such as those within the “Test before invest” function, or the trickle-down funding of open calls.

5 Discussion

The results obtained through this research confirm that different DIHs play different roles, addressing specific combinations of the four functions defined by the EC. These differences in emphasis are the prerogative of the individual DIH, as the EC envisions an extended pan-European ecosystem of DIHs – each DIH defined by its own nature, region, and focus regarding industries and digital technologies. As long as the pan-European ecosystem can activate innovation-driven collaboration, any single DIH

would not have to strive to concurrently address all of the four functions. However, this emphasis should impel informed choices to ensure ecosystem growth.

This should include recognizing the impact of public innovation ecosystem leadership. We explain the importance attributed to funding services focused on exploiting synergies with research with the leadership of research institutions. Although this is in line with the primary needs of public, especially academic, institutions, such DIHs should not forget to put effort into brokering funding that targets higher technology readiness levels. As funding is often the basis for enabling collaboration this focus on research might also further drive the selection for specific collaboration partners observed in public-private collaboration, i.e., firms focusing on technology recombination. Similarly, we explain the lack of formal pathways to continued education with higher education institutions found in the centre of knowledge ecosystems – actors that might easily become important stakeholders in innovation ecosystems. To avoid a skewed training provision, these DIHs should ensure that such pathways are created, and that these do not incur costs that prohibit SMEs from using them. It should also include recognizing the increased requirements of the new relationships and types of collaboration that the DIH initiative is initializing. The investigated DIHs were focused on a hub-and-spoke collaboration model and were seeing an influx of many SMEs from application domains unknown to them. As small knowledge overlaps can lead to strong relationships centred on knowledge brokering, this initial large knowledge distance could easily force a large effort upon DIHs. Collaborative platforms can help mitigate this difficulty by allowing SMEs to build networks of DIHs ably to jointly support their specific needs, as collaboration can be built on point-to-point relationships rather than the hub-and-spoke collaboration model. However, when moving away from an innovation to a business ecosystem, DIHs must still ensure a collaboration platform with high-quality services and artefacts. This might require the use of non-pricing instruments, such as licensing and oversight. These might not be well understood by DIHs run by research-focused organisations, which suggests that these DIHs should be especially careful when deploying services via digital collaboration platforms. A main limitation of this research is the study of only one particular type of DIH ecosystems, i.e., those focused on the CPS industries and with considerable engagement by public organisations. Other industries or types of innovation ecosystem leadership could have other difficulties. Nevertheless, further research should investigate these difficulties in more detail to provide further guidance to public leadership on how to ensure innovation ecosystem growth.

6 Conclusions

The innovation ecosystem literature typically focuses on private innovation ecosystem leadership. This study highlights how public innovation ecosystem leadership could fail to support (all) firms in their innovation ecosystem by providing services for the four functions primarily skewed towards exploiting synergies with their other activities. Addressing associated bias might involve considering the, especially financial, limitations of the typical SME, as well as making use of contemporary technology such

as collaboration platforms. The latter could bring further benefit through the additional flexibility brought on by moving innovation ecosystems away from the hub-and-spoke collaboration model, although it could also bring extended requirements on business skills that public organisations might find it difficult to address.

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