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European Open Innovation market research: Gaps, opportunities and innovators' expectations

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Abstract: This paper presents the findings of a study on the market for Open Innovation (OI) services in the EU, providing meaningful insights that can be utilised to better understand, apply and support OI in SMEs. To this end, the paper starts by identifying and discussing needs, perceptions and expectations of quadruple helix stakeholders (industry, academia, government and civil society) with respect to OI based on data collected via 50 in-depth interviews across 11 countries. Then, gaps and opportunities in the current landscape of OI services are identified and discussed based on the comparative analysis of three representative OI service providers operating in the EU (i.e. NineSigma, the Enterprise Europe Network and Steinbeis). Finally, findings are used as platform to provide recommendations for the demand-driven design of OI services and support measures by academics, practitioners and policy makers.

Keywords: innovation management; open innovation; market research; quadruple helix stakeholders; market gaps; recommendations

1 Introduction

The European Union (EU) is a world-leading knowledge generator[1]. Still, it lags behind many of its global competitors when it comes to transforming this knowledge into

1 European Commission, 2014, "Innovation Union Competitiveness Report 2013", Retrieved from https://ec.europa.eu/research/innovation-union/pdf/competitiveness_report_2013.pdf

marketable innovations[2]. In an environment where the EU continues to grapple with the vast overhang of public and private debt resulting from the 2008 financial crisis, all whilst seeing many of its traditional industries being disrupted by novel technologies and business models, it is imperative that its economy seeks to improve the use of innovation as a source of sustainable competitive advantage[3]. OI, whereby organisations seek to enhance their internal innovation processes by collaborating with one or more external partners, remains a key tool in this quest for improved competitiveness. Yet many businesses and especially Small- and Medium-sized Enterprises (SMEs), which are considered the driving force of the EU's economy, are struggling to make the most out of this powerful tool to scale and grow[4]. With that in mind, it may come as no surprise that the interest for OI is increasing amongst academics, practitioners and policy makers alike in the EU[5]. In this context, the current paper gathers and analyses meaningful information from the market for OI services to offer fresh insights that can be utilised to better understand, apply and/or support OI in SMEs.

2 Theoretical and contextual background

OI has for long now been acknowledged as key for unlocking and accelerating innovation, with demand for OI services growing in the EU's economy.[6] During the years, OI gained more and more attention by researchers and practitioners who started exploring OI practices in established companies and continued with various levels of analysis which include SMEs[7], non-profit organizations[8], the public sector[9], and micro-foundation of OI[10]. In recent review studies on OI, it was demonstrated that focus on SMEs and public policy has been increasing since 2010[11]. Furthermore, it has been proved that OI is different between large and small companies concerning the practices applied, strategies followed and limitations[12]. Two innovation patterns have been derived so far based on literature, named Schumpeterian Mark I and II[13]. It is shown[14] that the

2 DG GROWTH, 2015, Innovation Union Scorecard 2015, https://ec.europa.eu/growth/content/innovation-union-scoreboard-2015-0_en, accessed April 2020
3 OECD, 2015, The Innovation Imperative: Contributing to Productivity, Growth and Well-Being, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/9789264239814-en
4 Aruzelski, Barry, and Rick Holman (2011). "Casting a wide net: building the capabilities for open innovation." Ivey Business Journal March/April
5 De Marco C., Martelli I., Di Minin A., 2019, European SMEs' engagement in open innovation When the important thing is to win and not just to participate, what should innovation policy do?, Technological Forecasting & Social Change 152 (2020) 119843
6 De Marco C., Martelli I., Di Minin A., 2019, European SMEs' engagement in open innovation When the important thing is to win and not just to participate, what should innovation policy do?, Technological Forecasting & Social Change 152 (2020) 119843
7 Laursen, K., Salter, A.J., 2006. Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. Strateg. Manage. J. 27 (2), 131–150.
8 Bogers, M., Foss, N.J., Lyngsie, J., 2018b. The "human side" of open innovation: the role of employee diversity in firm-level openness. Res. Policy 47 (1), 218–231.
9 Chesbrough, H.W., Di Minin, A., 2014. Open social innovation. New Front. Open Innovat. 16, 301–315. https://doi.org/10.1093/acprof. January 2015.
10 Bogers, M., Chesbrough, H.W., Moedas, C., 2018a. Open innovation: research, practices, and policies. Calif. Manage. Rev. 60 (2), 5–16.
11 Santos, A.B., 2015. Open innovation research: trends and influences - a bibliometric analysis. J. Innovat. Manage. 3 (2), 131–165
12 Spithoven, A., Vanhaverbeke, W., Roijakkers, N., 2013. Open innovation practices in SMEs and large enterprises. Small Busi. Econ. 41 (3), 537–562.
13 Nelson, R.R., Winter, S.G., 1982. An Evolutionary Theory of Economic Change. The Bellknap Press of Harvard University Press, Cambridge, MA.
14 Malerba, F., Orsenigo, L., 1995. Schumpeterian patterns of innovation. Cambridge J. Econ. 19, 47–65

higher share of new innovators exists in the first pattern which is composed of small-sized companies and that companies in pattern I show better technological performance than those in pattern II, enhancing the idea of supporting innovation policy for new and small firms as complementary to the R&D activities of large and established firms.

The increasing demand has led to the rise of several OI service providers and platforms, each with its own distinct blend of value propositions, target markets and business models[15]. Whilst this has been a welcome development in its own right, it has also contributed to the creation of a fragmented OI ecosystem in the EU which in turn poses a number of challenges for SMEs seeking to apply and benefit from OI in practice. Challenges are typically associated with OI in SMEs include increased search costs, information asymmetries and trust-based risks which introduce increased difficulties in successfully finding and collaborating with suitable partners[16], especially when it comes to cross-border cooperation. Moreover, such challenges are often compounded with innovation barriers typically faced by SMEs in the EU such as relatively limited available resources (be they financial or human) as well as difficulties in accessing finance[17]. It is true that these limitations usually force SMEs to practice OI in order to balance their lack of resources and access the assets they miss[18]. Along these lines, evidence stemming from contemporary literature in the field indicates that while for large enterprise OI is a strategic choice, for SMEs OI appears to be more of a one way solution that can help them overcome or sidestep challenges impeding their innovation processes and growth[19]. Including collaborative activities as part of the process of a company's functionality, it has been proved that they have positive impact in innovation capabilities and especially when it comes to new, small-sized firms[20].

In terms of how OI is managed and implemented, there is insight into the peculiarities of the practices of SMEs in comparison to OI management in large companies. There are studies[21,22] that define the difficulties of transferring the knowledge possessed about large firms to SMEs. Despite the commonalities, there are substantial differences between the large and small firms as small ones require a demanding OI framework which will help them succeed. Concerning innovative opportunities circulation, there is the need of external sources of knowledge across a variety of search channels[23]. These channels can provide the ideas and resources needed in order to help firms. Moreover, there is a significant interest in processes that combine knowledge inflows and outflows[24]. Such concepts are addressed to inter-organizational collaboration which support and point out

15 Chesbrough, H., 2017, The Future of Open Innovation. Research-Technology Management, 60(1), pp.35-38
16 Bogers, M., Chesbrough, H. & Moedas, C. (2018). Open Innovation: Research, Practices, and Policies. California Management Review, 60(2), pp.5-16.
17 Acs, Z.J., Audretsch, D.B., 1990. Innovation and Small Firms. MIT Press, Cambridge, MA
18 van de Vrande, V., de Jong, J.P.J., Vanhaverbeke, W., de Rochemont, M., 2009. Open innovation in SMEs: trends, motives and management challenges. Technovation 29, (6–7), 423–437.
19 Spithoven, A., Vanhaverbeke, W., Roijakkers, N., 2013. Open innovation practices in SMEs and large enterprises. Small Busi. Econ. 41 (3), 537–562. https://doi.org/10. 1007/s11187-012-9453-9.
20 Castellacci, F., Grodal, S., Mendoca, S., Wibe, M., 2005. Advances and challenges in in- novation studies. J. Econ. Issues 39 1, 91–121.
21 Vanhaverbeke, W. (2017). Managing open innovation in SMEs. Cambridge University Press.
22 Wim, V., Nadine, R., Muhammad, U., & Federico, F. (Eds.). (2018). Researching open innovation in SMEs. World Scientific.
23 Laursen, K., & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. Strategic management journal, 27(2), 131-150.
24 Enkel, E., Gassmann, O., & Chesbrough, H. (2009). Open R&D and open innovation: exploring the phenomenon. R&d Management, 39(4), 311-316.

the importance of knowledge transfer. Collaboration concept is also marked as an important driver for accomplishing significant innovation performance[25]. Besides, embedding firms into networks can increase the external environment and succeed in achieving innovative output[26].

In recent studies[27] the main fields explored with respect to OI are (i) how SMEs collaborate with externals[28], (ii) crowd-sourcing platforms[29], (iii) how OI adoption enhances frugal development[30], (iv) the ways SMEs are participating in crowdfunding[31] and (vi) the types of individuals in SMEs who support the OI adoption[32]. However, since OI context remains unexplored up to a great level, more studies on the issue in the whole business ecosystem are required[33]. Against this background, this paper studies the challenges of the EU's OI ecosystem from different perspectives by researching the needs, perceptions and expectations of all stakeholder groups in a quadruple helix[34] innovation model as well as by analysing key OI service providers operating in the EU along with their positioning in the market.

3 Open innovation needs, perceptions and expectations

This chapter sets out to identify different needs, perceptions and expectations of OI stakeholders in the EU with a view to providing insights and recommendations that can help better shape OI services and support measures to current demand.

Methodology

A stratified, purposeful sampling was employed in order to identify, recruit and survey research participants from a variety of OI stakeholder groups across different sectors and regions in the EU. The sample was stratified in the sense that participants varied according to stakeholder group sector and level of engagement in OI, while at the same time also purposeful as participants were recruited from key organisations and businesses, which the authors identified as impactful to the study's expected outcomes.

25 Powell, W. W., Koput, K. W., & Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. Administrative science quarterly, 116-145.
26 Shan, W., Walker, G., & Kogut, B. (1994). Interfirm cooperation and startup innovation in the biotechnology industry. Strategic management journal, 15(5), 387-394.
27 Wim, Vanhaverbeke, et al., eds. Researching open innovation in SMEs. World Scientific, 2018.
28 Dell'Era, Claudio, Stefano Magistretti, and Roberto Verganti. "Exploring collaborative practices between SMEs and designers in the Italian furniture industry." Researching open innovation in SMEs (2018): 307-345
29 Eldridge, D., Nisar, T. M., & Torchia, M. (2019). What impact does equity crowdfunding have on SME innovation and growth? An empirical study. Small Business Economics, 1-16.
30 Hossain, M. (2018). Adoption of open innovation by small firms to develop frugal innovations for inclusive development. Researching Open Innovation in SMEs.
31 Giudici, G., & Rossi-Lamastra, C. (2018). Crowdfunding of SMEs and startups: when open investing follows open innovation. Researching open innovation in SMEs.
32 Ahn, J. M., Minshall, T., & Mortara, L. (2018). How do entrepreneurial leaders promote open innovation adoption in small firms?. Vanhaverbeke. W., FF, Roijakkers. N., Muhammad. U.(ed.) Open Innovation in SMEs. World Scientific.
33 Bogers, Marcel, et al. "The open innovation research landscape: Established perspectives and emerging themes across different levels of analysis." Industry and Innovation 24.1 (2017): 8-40.
34 Carayannis, EG, & Campbell, DFJ (2009). "Mode 3" and "Quadruple Helix": toward a 21st century fractal innovation ecosystem, International Journal of Technology Management, 46(3/4), 201–234

The target groups of the study included stakeholders from the Private sector, Academic Organisations and Research Institutes, Civil Society as well as the Governmental and Public Sector, as illustrated by the following figure.

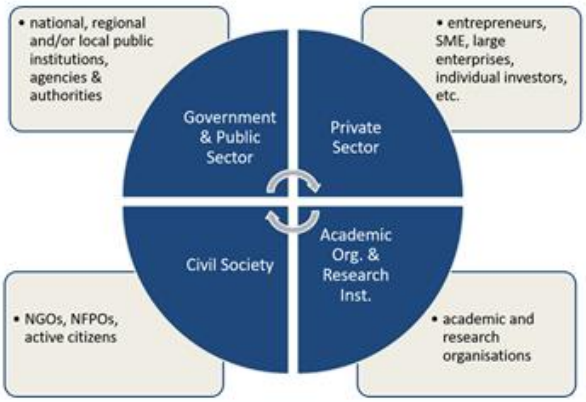

Figure 1 Open Innovation stakeholder groups

A tailored semi-structured questionnaire was developed for each target group and administered in the framework of interviews. Research participants were recruited and invited to participate in the interviews over the phone, email or a face-to-face meeting.

Data aggregation and analysis

A total of fifty (50) interviews were conducted across 11 countries, with stakeholders representing all stakeholder groups of a quadruple helix innovation model, as follows:

1. Twenty one (21) Private Sector stakeholders largely represented by SMEs but also including four investors (5/ Greece, 8/ United Kingdom, 3/ Germany, 1/ the Netherlands, 1/ France, 1/ Denmark, 1/ Belgium and 1 from outside EU).
2. Thirteen (13) stakeholders from the Academic Organisations and Research Institutes (3/ Greece, 4/ United Kingdom, 3/ Germany, 1/ Cyprus, 1/ Sweden, 1/ Austria).
3. Twelve (12) Governmental and Public Sector stakeholders ranging from regional development agencies over to municipal services (2/ Greece, 5/ United Kingdom, 2/ Germany, 1/ Sweden, 1/ Netherlands, 1/ Austria)
4. Four (4) Civil Society stakeholders (1/ Greece, 2/ United Kingdom, 1/ Germany).

The data collected were aggregated and qualitatively analysed with the aim of revealing key thematic areas arising from the interviewees' knowledge and experience of OI. A series of top-level themes emerged pertaining to: (a) Knowledge of OI; (b) Perception of Value; (c) Participation Concerns; (d) Expectations. Within these themes, several subthemes have been identified pertaining to aspects of funding, collaboration, barriers, knowledge sourcing and sharing and others.

Findings from the Private Sector

The Private Sector stakeholders comprised investors and representatives of SMEs surveyed for their views and experience on OI activities. The findings from the analysis shed light to aspects concerning their understanding of OI, criteria and concerns for participating in OI activities as well as expectations in terms of OI results.

The following list summarizes these findings:

- Understanding of OI is not uniform and overall labelling activities as OI activities is not always as straight forward as it seems.
- Participation in OI activities is typically considered a plus for SMEs irrespective of which aspect of the OI ecosystem is leveraged.
- SMEs often act as solution "providers", whereas relatively less often as "seekers" depending on their strategy, size and needs at the time of involvement.
- Measuring success is not always easy as no formal measuring mechanisms of increased relevance are in place.
- IPR protection was considered one of the main barriers to participation in OI activities, while funding not as much even though it can support the uptake of OI.
- Collaboration shortcomings were also referenced either due to misalignments with market practices or inherent incumbencies that do not fit to the innovation landscape.

Findings from Academic Organisations and Research Institutes

Representatives from Academic and Research Institutions appeared to be more focused on typical funding scheme practices and collaborations via consortiums, which although part of the OI ecosystem, do not cover the whole range of benefits they can reap.

The findings emerging from the analysis of their interviews are summarised below:

- Knowledge of the OI ecosystem and the broad range of available OI services appears to be relatively limited across this group of stakeholders.
- Publicly funded projects represent the most prevalent form of innovation-driven collaborations. EU and nationally funded projects are a key pathway to this end.
- Funding availability was considered a basic driver for research and innovation. In similar lines, funding was considered also paramount in terms of supporting OI.
- IPR management was perceived as a rather important factor influencing the further uptake of OI services.
- Despite their collaborations being more often than not research-oriented, some stakeholders from this group described how their institutions are offering services towards bridging the gap between SMEs and themselves, indicating that Academic Organisations and Research Institutes can play a catalytic role in OI collaborations.

Findings from the Governmental and Public Sector

The Governmental and Public Sector interviewees elaborated on the enabling role of their organisations under the framework of OI in the EU and how their policies and activities can help shape an environment that is conducive to OI.

The list which follows further elucidates the findings of the analysis in this respect:

- Interviewees from this group often indicated either lack of knowledge or lack of intent to participate in OI, although clearly dealing with OI activities.
- OI in coordination with the market is key in order to source solutions and stimulate societal change. This is typically achieved by outsourcing the organisation of a challenge-based scheme to OI service providers, or by launching regional open calls.

- Public sector seemed to be better organised in measuring the effectiveness of its OI activities including project-specific indicators and quality reporting.
- IPR management does not appear to be a barrier for this group. As their activities are driven by societal impact, IPR management is usually not required on their part.
- Traction constraints identified by participants include building trust with other stakeholders as well as bridging the gaps among them.

Findings from the Civil Society

Civil Society interviewees presented an almost similar case to the stakeholders interviewed from the Governmental and Public Sector, as far as knowledge gaps and IPR are concerned. However, some differences were identified in the scope of their OI activities and their dependency on external funding, as indicated below:

- Funding is a major barrier. As not-for-profit entities with often relatively limited financial capacity, civil society organisations are largely dependent on external funding sources.
- Measuring the success of their OI activities is practiced in terms of reach and engagement, which can in turn fuel future actions.
- The group expressed relatively high interest in participating in OI, with a focus on facilitating socially relevant OI activities rather than initiating OI per se.

Recommendations

Following the analysis of the data collected via the interviews and based on the insights revealed through the findings, a series of recommendations for improving OI services and support across four key themes were developed, as show in the table below.

Table 1. Recommendations.

Theme	*Recommendations*
Knowledge of Open Innovation	Knowledge gaps were identified across all target stakeholder groups, indicating a relatively limited understanding of OI and relevant services. Knowledge building and awareness raising amongst stakeholders should underpin OI services and support measures.
Perception of Value	Support collaborations in several dimensions starting from identifying the value proposition of each new service / support measure. Consider and employ suitable ways of measuring success.
Participation Concerns	Alleviate participation concerns via: • Providing supportive mechanisms for IPR management. • Offering links to public funding opportunities and support in attracting private investors. • Streamlining the OI experience via appropriate discoverability mechanisms and communication channels. • Providing on-boarding learning resources.
Expectations	Consider expectations with regards to: • Narrowing the focus to a well-defined niche. • Supporting matchmaking between collaborators to build trust. • Providing guidelines and horizontal skills widely required.

4 Gaps and opportunities in the market for open innovation services

This chapter sets out to identify complementarities, limitations and bottlenecks in the current OI service landscape of the EU by studying three (3) successful OI service providers. In doing so, market gaps and opportunities are defined and highlighted.

Methodology

The methodology employed for collecting data on the current OI service landscape of the EU, as well as on the three (3) representative OI platforms/service providers under study (namely NineSigma, the Enterprise Europe Network and Steinbeis), consisted of two (2) distinct phases, as follows:

- Phase 1: Desk research with a literature review of 27 secondary data sources. The research included: (i) review of background reports on OI and relevant services in Europe; (ii) review of information provided on the websites of the OI service providers under study; (iii) evaluation of additional marketing and research reports produced by the OI service providers under study; and (iv) review of evaluations of the OI service providers under study conducted by third-party organisations.
- Phase 2: A series of six (6) semi-structured, in-depth interviews with representatives from each of the three organisations being studied (i.e. NineSigma, EEN and Steinbeis). These interviews consisted of discussions conducted either face-to-face, by telephone or other digital means, using a discussion guide which had been sent to respondents in advance of the interview. Respondents were required to complete, sign and return an informed consent form before the interviews took place.

The data collected were evaluated in the form of a traditional SWOT analysis[35], whereby the relative strengths and weaknesses of the OI service providers were analysed, together with any potential opportunities and threats pertaining to their operation. This analysis was then used to identify potential market gaps and opportunities.

Findings from the analysis of NineSigma

NineSigma's OI platform – NineSights – connects clients to innovation solution providers across many sectors to find (new) solutions to critical technology and business challenges. NineSigma's core OI services include:

- Innovation Solutions: Delivered via a Technology Search, whereby NineSigma works with a client to articulate a specific technology requirement and to identify appropriate solution providers; or via a Managed Innovation Gallery, a fully managed innovation portal.
- Innovation Impact: Delivered either via Innovation Contests, which employ integrated marketing and PR strategies to signal to the global innovation community that the sponsoring company is committed to advancing their technology solutions and is open to collaboration or via Grand Challenges, urgent "calls to action" to identify transformative technology and development opportunities through open collaboration with the global innovation community.

[35] Lee, S., Park, G., Yoon, B., & Park, J.,2010, Open innovation in SMEs—An intermediated network model. Research policy, 39(2), 290-300.

- Innovation Insights: Delivered in the form of Technology Landscaping services, designed to help a client understand their technology in the context of a broader landscape or in the form of Expert Advisory Services, which include the development of customised solution provider search tools, the creation of a panel of vetted experts or the creation of ongoing relationships with a group of cross-industry specialists.
- Innovation Capability: Services designed to increase the expertise of a client's innovation teams, either delivered in the form of Workshops & Training or via NineSigma's annual Innovation Leadership Summit.

With the above in mind, the following table provides a concise overview of the strengths, weaknesses as well as opportunities and threats identified for NineSigma.

Table 2. Summary of SWOT analysis for NineSigma.

Strengths	***Weaknesses***
• Global reach • Solution provider network of over 2.5 million individuals/organisations • Wide range of OI services, including Technology Searches, Innovation Challenges and Grand Challenges	• Primarily corporate client base • Costly for SMEs to use • Supports mostly bi-lateral, rather than multi-lateral collaborations • Few "wrap-around" OI services offered
Opportunities	***Threats***
• Post-agreement integration support	• Relatively narrow client base • Exposed to impact on R&D investment levels of client companies during periods of economic downturn

Findings from the analysis of the Enterprise Europe Network

The Enterprise Europe Network (EEN) is amongst the world's biggest innovation support networks. It is supported by public funds and designed to help companies (especially SMEs) to innovate and grow internationally. The EEN is able to connect businesses with over 3,000 experts in 605 organisations across 65 countries worldwide through a broad range of services that support both innovation and internationalisation:

- Support for international connections: This includes tailored searches for international partners, the facilitation of sector-based, cross-border forums and the operation of business brokerage events.
- Support for innovation management: "Wrap-around" services designed to increase the innovation capacity of SMEs, e.g. through the implementation of structured innovation management processes.
- Support for access to funding and finance: Signposting SMEs towards both public and private sources of finance, as well as helping SMEs to participate in EU programmes, such as Horizon 2020.
- Support for management of IPR: The provision of basic IP support, as well as signposting to specialist providers in both the private and public sectors.
- Advisory services: Advice on international regulations and standards.
- Tender alert services: The automated notification of relevant international opportunities.

In this context, the following table provides a concise overview of the strengths, weaknesses as well as opportunities and threats identified for the EEN.

Table 3. Summary of SWOT analysis for EEN.

Strengths	***Weaknesses***
• Global reach • Broad range of both innovation and internationalisation support services • Free to use	• Not strictly an OI platform • Greater number of commercial partnerships supported than technology collaborations
Opportunities	***Threats***
• Support for capacity building in both innovation and internationalisation	• Changes to EU funding • Increased pressure to deliver services digitally rather than face-to-face

Findings from the analysis of Steinbeis

Steinbeis is a provider of know-how and technology transfer, based on entrepreneurial processes for which Steinbeis assumes legal responsibility. At the heart of the Steinbeis offering is a solution provider network – the Steinbeis Transfer Network – which consists of 1,100 Steinbeis Centres which are either wholly or partly owned by Steinbeis. The core services of Steinbeis include:

- Research and Development (R&D): The transfer of know-how and technology between over 6,000 experts within one or more of the Steinbeis Centres and industry;
- Consultancy Support: Expert advice on guidance on specific technology and commercial challenges within client companies;
- Market Studies: Research on behalf of clients to map the competitive landscape and to identify market opportunities;
- Technology Evaluation: Evaluations of both new and existing technologies;
- Training and Employee Development: A broad spectrum of training opportunities, ranging from individual training courses to degree-level programmes.

Along these lines, the following table provides a concise overview of the strengths, weaknesses as well as opportunities and threats identified for Steinbeis.

Table 4. Summary of SWOT analysis for Steinbeis.

Strengths	***Weaknesses***
• Tightly curated and managed network of 6,000+ experts across 1,100 Steinbeis Centres • High levels of trust between "solution seekers" and "solution providers" • Many OI initiatives lead to two-way information flows	• Closed network of "solution providers" • Both clients ("solution seekers") and Steinbeis Centres ("solution providers") are primarily German organisations
Opportunities	***Threats***
• Added value OI services, including support for business model innovation	• Exposed to impact on R&D investment levels of client companies during periods of economic downturn • Commoditisation of OI service provision

Gaps and opportunities in the market for open innovation services

Building upon the findings of the SWOT analysis, nine broad themes have been identified, which may represent gaps in the current state of play in the provision of OI support. These gaps could be leveraged as opportunities for new services and support measures targeting the market for OI services.

1. Incremental versus Breakthrough innovation

The majority of collaborations supported by the OI service providers under study tend to be "technology requests". Whilst such collaborations can often be highly effective in enabling organisations to access relevant expertise that exists outside their own R&D departments, they tend to result in incremental or iterative technology innovations, rather than in the discovery of new, breakthrough technologies. One potential gap in OI service provision and therefore an opportunity is addressing industry-level or major societal challenges, in addition to supporting the specific requirements of individual businesses.

2. Bi-lateral versus Multi-lateral collaborations

The majority of collaborations supported by the three OI service providers analysed tend to be "bi-lateral" in nature, as they typically involve a single "solution seeker" (who is usually the client) collaborating with a single "solution provider". Whilst the outputs of these "bi-lateral" collaborations can often be extremely fruitful, they nevertheless fall short of the concept of Open Innovation 2.0[36], whereby a broad range of quadruple helix actors collaborate in order to "co-create" solutions to a range of technology challenges[37]. An opportunity for OI service providers is to support the development of "multi-lateral" collaborations, by providing resources to facilitate the creation and management of cross-border consortia and by providing a suite of "virtual" collaboration tools.

3. Curated versus Open networks

An interesting dynamic which emerged during the in-depth interview phase is the extent to which the OI networks of the three OI service providers studied are curated, as opposed to being completely open. There is a potential trade-off between networks that are carefully curated, but which are able to engender high levels of trust between collaboration partners, and those networks which are more open, but where information asymmetries and trust-based concerns may hamper the formation of collaboration agreements. Thus, an opportunity is finding the appropriate extent to which "solution seekers" or "solution providers" should be pre-screened and actively managed.

4. Online versus Offline OI services

All three OI service providers operate some form of online platform. This generally takes the form of a database of "solution providers" (or, in the case of the EEN, profiles of organisations with both "requests" and "offers"), supported by a range of search tools. However, during the in-depth interviews, the respondents from all three OI service providers stressed that that their online platforms are regarded primarily as enabling technologies, rather than as an offering in their own right. The value they provide to clients is delivered through a range of highly personalised consultancy services. An opportunity thus, is striking the right mix of "online" and "offline" services.

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5. Building Innovation Capacity and Capability

The three OI service providers effectively act as intermediaries, putting "solution seekers" in contact with potential "solution providers". Whilst an element of "offline" support is provided in areas such as IP management and commercial agreements, this is not typically a core component of their offerings. A further opportunity therefore lays in increasing the OI capacity of clients and, in particular, SMEs.

6. Leveraging Finance

Services aimed at supporting access to finance are generally provided on an ad hoc, rather than systematic basis and tend to be disconnected from OI platforms. Thus, an important opportunity is for OI platforms to integrate with existing "crowdfunding" platforms. Furthermore, small amounts of public (or private) funding, e.g. through the provision of innovation vouchers or through incentivised innovation competitions (run by corporate entities, regional development agencies or cluster organisations), could potentially be used to provide initial "seed funding".

7. SME access to Open Innovation

A common theme throughout the in-depth interviews was the limited use of OI by SMEs, particularly in the role of "knowledge seekers" but also, to a certain extent, as "knowledge providers". This is the result of a number of factors, including low levels of awareness amongst SMEs of the benefits of OI, the fragmentation of the OI market, the high cost of using OI service providers, perceived information asymmetries between SMEs and more experienced users of OI and trust-based issues. An opportunity therefore, is facilitating SME access to OI services. This might encompass the use of intermediaries (such as regional development agencies, cluster organisations, trade associations, etc.) to aggregate the requirements of their SME clients/members and to manage OI collaborations on a collective basis.

8. Business Model Innovation

Traditionally, OI has been used to support technology innovations. Increasingly, however, businesses are looking to gain sustainable competitive advantage as much through business model innovation as through the application of new technologies. An opportunity therefore exists for the OI service providers to support both business model innovation as well as more traditional technology innovation. This could involve, for example, using an OI platform to identify collaboration partners who can help businesses to develop and implement new, disruptive business models.

9. Post-Agreement Services

Whilst the OI service providers analysed appear to be effective in helping "solution seekers" identify suitable "solution providers", their involvement tends to cease once initial introductions have been made or, in the case of the EEN, where a Partnership Agreement has been finalised. Yet, in most cases, this represents only the starting point in a successful OI project. The provision of post-agreement services therefore appears to be an opportune area of OI service provision.

5. Conclusions

The results of the research presented in this paper provide a fresh multi-stakeholder perspective into the needs, perceptions and expectations of SMEs and other quadruple helix stakeholders with respect to OI. These results, when combined with the gaps and

opportunities identified in the market for OI services, offer valuable insight into how OI services, support measures and policies can be better fine-tuned to support the successful uptake and application of OI in practice amongst SMEs in the context of the EU. In addition, the findings presented in this paper demonstrate the fragmented landscape that stakeholders face and the need to further enhance OI services in the market is highlighted.

We recognize that the referred study has its limitations, mostly pertaining to its sample which can be considered relatively limited in terms of size, geographic and sectoral coverage when compared to the vast and broad population of businesses and organisations engaged in OI. Further research could focus on the role and experiences of specific stakeholder groups, in different locations and/or sectors so as to improve the generalisability of the findings. Another interesting avenue for further research would also be the practical application of these insights to support (or refute) the findings with empirical evidence.

This avenue will be followed by the authors as well. This paper presents the first step towards the design, development and testing of a series of OI services and support measures under the frame of INVITE, a project funded by the EU under Horizon 2020 in order to better link the currently fragmented OI service landscape, empower businesses to drive value from OI and increase the participation of private investors in OI projects.

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