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The role of open innovation intermediaries in initiating and coaching new types of firm- innovation lab collaborations: Findings from an exploratory study of a mediated knowledge creation process for collaborative innovation projects in Austria and Italy.

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Abstract:

This paper deals with the newly emerging phenomenon of open collaboration between firms and digital innovation labs[1] pursuing joint innovation projects. It describes the different roles and especially the mediating role of open innovation intermediaries in initiating and coaching such new types of firm-innovation lab collaborations. On the background of the interactive coupled open collaboration approach (ICOC) between firms and innovation labs by Piller & West (2014) we examine the relevance of the traditional four dimensions of an ICOC (external actors, coupling topology, impetus for collaboration and locus) when cooperating with digital fabrication labs and open accessible makerspaces. The contribution highlights specific findings from an applied research study carried through in Austria and Italy during 2017-2019, in which 20 small and medium-sized companies (SME) and innovation labs jointly worked on innovation projects in the physical space of a digital fabrication labs or makerspace. Results show that all of these collaborations were initiated by innovation challenges as impetus and 50% of the work in the innovation projects took place physically in the locus of a makerspace. In all collaborations, new relations to external actors in the regional innovation system and global maker-world were established. The role of the intermediaries varied between initiating the cooperation and coaching the innovation process.

Keywords: interactive coupled open innovation process; innovation intermediaries; digital fabrication labs, makerspaces, innovation eco-system, interorganisational knowledge management, innovation collaboration.

1. Introduction

In German-speaking countries, collaboration with digital innovation labs was identified as the most important mode of interorganizational knowledge management: In 2018, 19% of German companies

[1] Throughout the paper the term digital innovation lab is used as umbrella term for the different types of digital fabrication labs, rapid prototyping centres and open accessible makerspaces.

employ at least one digital innovation lab, 17% employ accelerators or another form of knowledge management in companies (Boston Consulting Group 2018). Nevertheless, systematic ways of initiating and establishing such interactively coupled open collaborations (ICOC) among a company and an innovation lab, which achieve high innovation effects, have not yet been sufficiently researched (Chesbrough 2020; Piller & West 2014). Such impacts might be having established the the "right match" with the cooperating innovation lab, launching trust-building, knowledge reflection or leveraging activities.

In this contribution, we will introduce digital innovation labs and their facilitators as new mode of a modern innovation mediary relevant for a thriving innovation eco-system. In order to understand the role of digital fabrication labs and makerspaces for innovation firstly, a literature review has been conducted by the authors and its research group. A combination of network, cluster and bibliometric analysis yields relevant existing publications on innovation and makerspaces (update 2019) as depicted below.

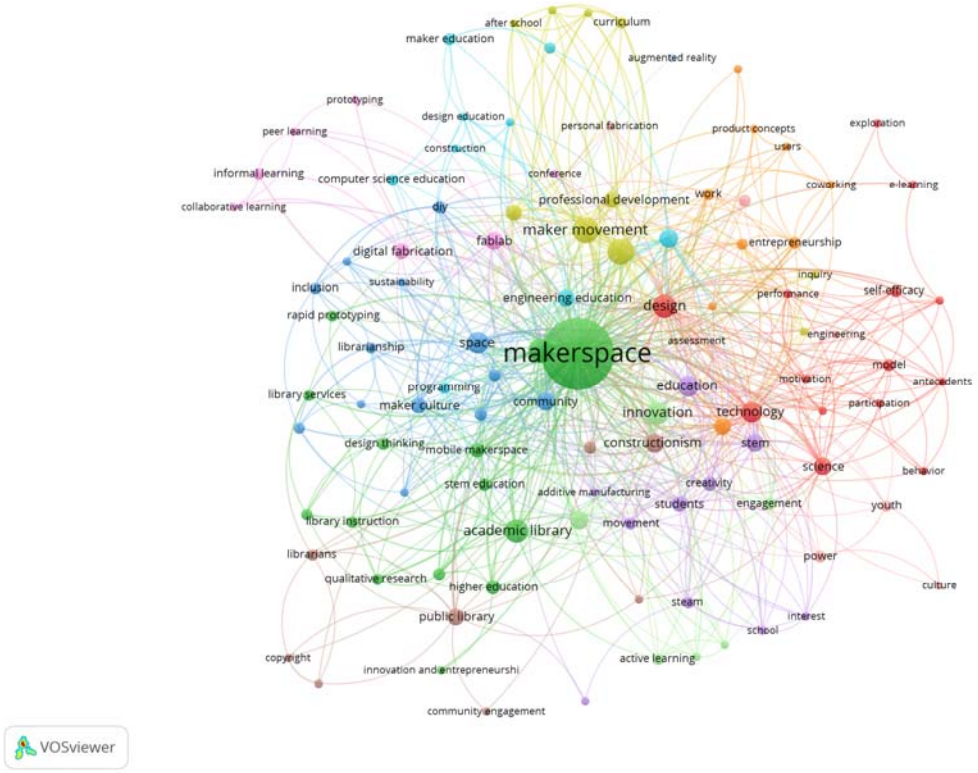

Figure 1: Visualisation of the 219 results of bibliometric search: co-occurrence network for makerspace(s) and innovation for the search period 2014-2019 in the Web of Science Core Collection: 219 publications; (update search 2019).

However, it has not been easy to start a bibliometric analyses in this field, since the terms "innovation", "innovation and fabrication lab" and "makerspace" are not coined in a unified understanding. We thus follow a broad definition by Saunders & Kingsley (2016, p.6) and understand makerspaces as "open accessible spaces that are equipped with technological facilities and creativity practises where anyone, private or company-based innovation teams can work on steps necessary in an innovation process, especially functional or design prototyping of a new idea or product solution". This encompasses also open accessible digital fabrication labs (FabLabs), but

no company-internal innovation workshops or creativity spaces. With the bibliographic software-tool VOW Viewer, 219 publications in Web of Science between 2013 and 2020 could be found according to the most relevant keywords (e.g. keywords: makerspace(s) 118; innovation 10; , Making 17; Maker Movement 14 and others see visualisation figure.) and published by research groups in more than 15 countries, with the US, China and Germany among the leaders. The figure below depicts the steady increase in scientific literature examining the yet unknown role of makerspace(s) in techno-socio-innovation processes.

Secondly, having reviewed the latest literature in the field of open innovation and knowledge management, the following theoretical works could be identified that deal with influencing factors on ICOC: Technology convergence or complementary competences are regarded as fostering factor (Orlando 2019; Mortara & Parisots 2016). Other authors point to internal firm factors such as absorptive capacity, control of knowledge input, relational capability and coordination capability. Further, also external firm factors are assessed as critical: distribution of knowledge input, appropriation of knowledge output, network position and diversity (Fisher & Quals 2018). Despite the popularity of theoretical open innovation approaches, more empirical data on the firm-size specific knowledge-based factors impacting innovation firm-lab collaboration, especially in open accessible makerspaces, are needed (Chesbrough, 2020; Balle 2019; Böhm 2019). Besides early empirical work on interactive coupled open innovation (Schössler&Fabol (2015; ICOI- case study in biotechnology), only a few works e.g. from Vanhaverbeke (2017) and Torchia (2019) deal with specific factors for small and medium-sized companies (SMEs) in innovation methods, however, not with open firm-innovation lab collaboration.

Back in 2009 Lopez & Vanhaverbeke identified various types of innovation intermediaries helpful in open innovation processes, and stressed their importance in connecting, collaborating and providing technological services to firms (e.g. innovation trader, innovation consultant, innovation incubators and innovation mediaries) (2009, p.26). With this contribution, we aim at closing the research gap in this field a bit and specifically investigate the contribution of OI intermediaries and facilitators in successfully implementing all phases of an interactive coupled OI process. We will examine and discuss the two main research issues:
RQ.1 How can firms engage in open collaboration with digital innovation and fabrication labs and the world-wide makerspace communities? At which stage of the IOCI process can third actors (i.e. innovation intermediaries) facilitate the collaboration in order to enhance the innovation impact?

RQ.2 What are the characteristics, success factors and impediments of such mediated knowledge creation process especially for SMEs?

The paper is structured as follows: In *section 2* the theoretical approach of the core processes of open innovation and especially the interactive coupled process is introduced and enhanced by the new mode of fabrication labs as locus of innovation. This serves as theoretical framework for examining the collaboration, success factors and role of intermediaries in firm-lab innovation projects. *Section 3* presents the used method and data collection within the European project "Labs4SMEs" (2017-2019),www.labs4smes.eu. *Section 4* summarises the results, its limitations and suggests further research avenues

2 The process of the interactive coupled open innovation process

In innovation research literature, Gassmann & Enkel are regarded as important representatives of three essential building blocks of open innovation processes and they describe them as follows (2004, p.6):

a) *"the outside-in process:* Enriching the company's own knowledge base through the integration of suppliers, customers and external knowledge sourcing can increase a company's innovativeness";
b) *the "inside-out process:* earning profits by bringing ideas to market, selling IP and multiplying technology by transferring ideas to the outside environment"; and,
c) *the "coupled process:* coupling the outside-in and inside-out processes by working in alliances with complementary partners in which give and take is crucial for success".

Based on their work, another prominent innovation research team worked especially on the third type of open innovation process and identified it as an "interactive approach towards coupled process" (Piller & West 2014) . The authors stress especially the collaboration between organisations and individuals to innovate, which is based on the above mentioned open innovation study of Gassmann & Enkel (2004), on user innovation studies of von Hippel (1988, 2005, 2010) and other co-creation studies of Normann & Ramirez (1992) and Wikström (1996) (all cited in Piller & West 2014, p.39). The authors highlight very specific dimensions of the interactive coupled open innovation process, which are of utmost relevance also for examining the newly emerging mode of firm-makerspace cooperation. The dimensions characterised are:

a) Nature of external actors:
b) Topology of the relationship with the external actor
c) The impetus for collaboration, and
d) the locus of the innovation process.

These dimensions are described in the table below (Piller & West 2014, p.38).

Table 1 Multiple dimensions of coupled open innovation processes (Piller & West, 2014, p.38)

Dimension	**Alternatives**
External Actor	• Firms: customers, supplier, complementor, rival • Other organisations: university, Research lab, government, other non profit • Individual: customer, user, inventor, citizens
Coupling topology	• Dyadic. Single partner • Network: multiple partners • Community: a new interorganisational entity
Impetus for Collaboration	• Top-Down: initiated by upper management • Bottom up: developed thorugh employee or customer collaborations
Locus of Innovation	• Bidirectional: innovation created within each organisation • Interactive: innovation jointly created outside the organisations

Since we attempt to incorporate the newly emerging phenomenon of firm-digital innovation lab and makerspace cooperation in the existing theoretical framework, we suggest to regard and assess

- makerspaces as new locus of innovation,
- the numerous open idea and innovation challenges as impetus for collaboration, and,

- the emerging relation to makers or start-up coordinators as new characteristics in this interactive coupled innovation process.

This refined approach can visualised by integrating the new features in the conventional core open innovation processes (see Gassmann & Enkel, 2004). The usefulness of such an understanding and further enhancement will then be explored in the cross-border study.

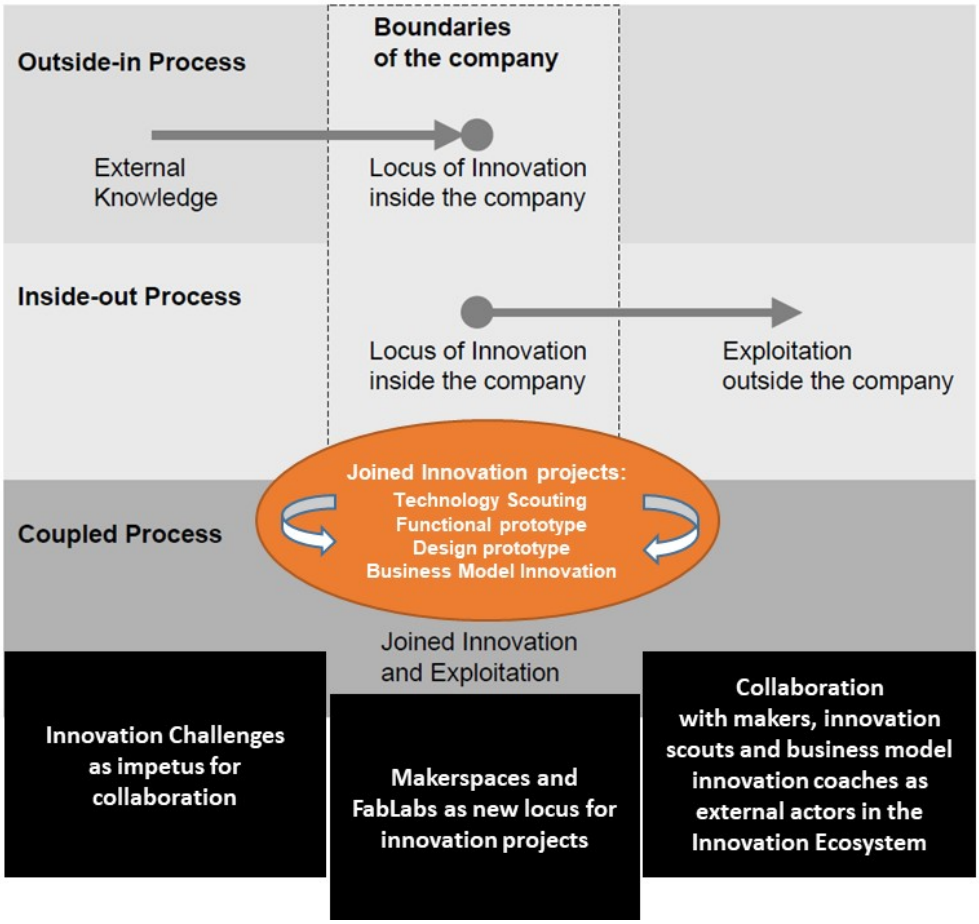

Figure 2: Integration of new firm-digital innovation, fablab or maker space collaboration in the model of interactive coupled OI process; Graphic by authors based on Gassman& Enkel (2004) and Piller & West (2014).

3 Methods

The study carries out an exploratory qualitative analysis, adopting a multi-case study method. It evaluates success factors, impediments and results of 20 innovation project collaborations between Italian and Austrian SMEs and Fablabs, initiated by local OI intermediaries and innovation facilitators (2017-19). Based on the theoretical understanding of the dimensions and the process model of interactive coupled open collaboration (ICOC) between firms and innovation labs by Piller & West (2014), we follow the four stage innovation process: *defining a problem, finding partners and OI participants, collaborating and leveraging*. Firstly, the firm needs to define the problem that it aims to address via engaging external partners in the co-creation effort. Secondly, it has to search

for suitable external lab partners with relevant competences. Thirdly, the company has to select the best ideas and engage in collaborative project work and, finally internalise both knowledge types: tacit (technological and business learnings) and explicit knowledge (prototypes as artifacts) (Nonaka and Krogh, 2009).

First of all, the status quo of innovation labs, their services and competences in two regions of Austria (Salzburg, Tyrol) and three regions in Northern Italy (Emilia-Romagna, Veneto, Friuli-Venezia Giulia and Trentino-Alto Adige) were assessed (Map of Innovation Labs). Then innovation intermediaries initiated the matching process between firms (looking for new solutions) and labs (offering technological expertise, material and design knowledge) by means of a cross-border Innovation Challenge. Various challenge briefings for joint innovation projects were worked out. These project briefings were then assessed by external experts according to (a) the level of digital innovation, b) the level of mutual benefits of the labs, c) the probability of success and d) the level of embeddedness in the local innovation eco-system. 20 project briefings out of 40 were selected and 20 innovation project collaborations finally set up. The joint project work did not involve a direct financial reimbursement, only a subsidized membership to the makerspace were offered to the participating companies.

The research adopts a qualitative approach, with a set of qualitative comparative analysis to analyse data from the mini-case studies that are gathered from 20 documentations about firm-lab collaborations (Italy & Austria). Besides documenting the project processes, analysing the artefacts (prototypes) according to their knowledge types, 30 in-depth interviews were conducted with all involved stakeholders (CEOs, project team members from firm, lab and the coaching OI intermediaries). The evaluation was done formativ, with three interview rounds (before, mid-term and after the project). The full evaluation report can be accessed at the project portal. In this contribution we will only focus on reporting the results relation to the role of OI intermediaries and the influence of third parties on the innovation project success.

5 Results

RQ1.Results on research question 1: the role of intermediaries in ICOC

Results show that for SMEs a pilot innovation project-approach is a well-received entrance mechanism to foster collaboration between firms and innovation labs. 92% of the interview partners appreciated this form of loose ties as it facilitates the process of building up trust. The role of intermediaries was found important in all ICOC-steps: In 50% of the projects the moderators even coached both partners in the solution finding process, in all cases the intermediaries mediated the right lab competences and their network capacity. Additionally, the OI moderators steered continuous communication between the partners (for full study details see final report Aceto et al, 2019).

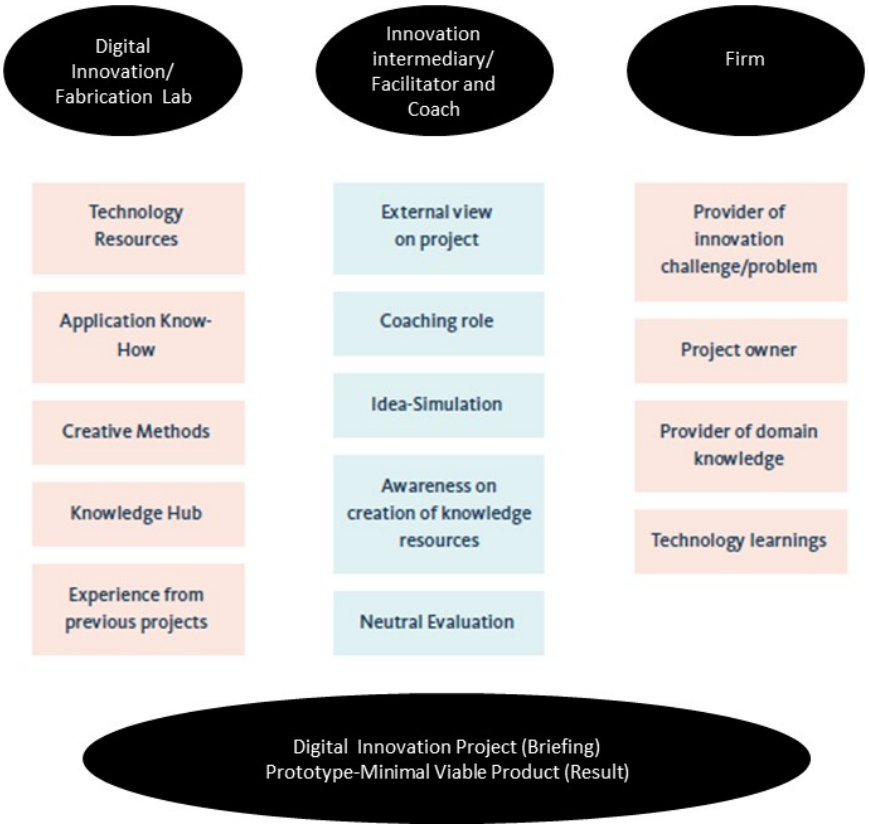

Figure 3: Roles in the Cooperation Model; adapted graphics by authors based on the CoMod-model described by Böhm & Paul (2019) and visualised in Aceto et al. 2019, p.39)

The figure above summarizes the identified roles of each actor in the mediated open innovation process and the influences of OI intermediaries (cf. Aceto et al, 2019, p.38):

a) From the point of view of the digital innovation lab, its understanding is the position and attitude of being a provider of relevant new technology and the application know-how for these relatively new technologies (e.g. 3D-Printing or specific industrial material items). Other relevant knowledge aspects are the labs open mindset within the space, the knowhow of applying creative methods and the inclusion of experiences from previous maker projects. Finally, the role as being a knowledge hub for additional competences from other organizations is an important activity, too.

b) The external innovation intermediary or coach (facilitator) is the only role that is not directly and actively involved into the innovation project and can thus provide an external view on the project. This could be helpful for a coaching support on the project and for the stimulation of new ideas for the project. Another aspect is the possibility to create awareness on the creation of intangible results of the project. Finally, the role is able to provide a more neutral and objective evaluation of the result.

c) The role of the firm is to be the primary provider of the innovation challenge or problem. The company acts as the owner of the innovation project and provides the relevant domain knowledge for the project. In this respect the role is the initiator of the activities in the project and the same beneficiary of the results – therefore, it is the driving force behind the project. At the same time the role also has the primary role of adopting the learnings of the technology for

the application in other activities of the organisation. Within the different projects this less obvious aspect has been present in different intensity.

Generally, an OI innovation coach or third partner, which aids in the cooperation can be considered beneficial. However, there are certain aspects, which are inhibiting a smooth innovation process.

RQ: Results on research question 2: Knowledge Management characteristics

The knowledge created can be categorized in explicit and implicit knowledge. In all 20 innovation projects explicit knowledge in the form of digital artefacts (prototypes) were created. Knowledge resources encompass individuals (firm team-members) as well as knowledge from related maker communities. Implicitly, the collaboration process generated extensive networks by becoming member of the regional and world-wide maker community. Regarding the type of knowledge created in the collaboration projects, interview partners from both enterprises and labs reported mutual learning benefits from working together in their individual project. Nonetheless, the interview partners highlighted the need for sustainable communication formats and activities during these six months (interim-workshops steered by the facilitator or on a more regular basis where the individual partner visited the lab/makerspaces). The knowledge creation process was observed as a constant and ongoing activity with many iterations before ultimate prototyping.

6 Limitation of results and further steps

Due to the qualitative nature of the study, no generalization is possible. Additionally, the study's limitation is that it involves organizations from diverse industries, so no industry-specific factors can be delineated. However, the multiple mini-case studies and the in-depth-interviews with CEOs, innovation managers and makers provide a rich, contextualized understanding of the phenomena, while allowing only some theoretical generalizations.

The project results made evident that factors such as technological convergence (as proposed by Orlando, 2019) is indeed an influencing factor in entering a collaboration also as SME. For example, the fact that a FabLab has the newest 3D printing technology and the material-knowhow for applying it, may form an important advantage to enhance a firms internal innovation capability. In all cases, the mutual trust relationship was enhanced by joint presentations of the projects (lab and the firm together took the credit together) and in half of the collaborations, the relations became more stable and intensified.

The findings argue also for enriching the theoretical ICOC-process model (Piller & West, 2014) by structurally including the role of OI intermediaries as third actor influencing the impact of this mode of innovation collaboration not only for SMEs, but also for corporates (e.g. as investigated by the Austrian initiatives: www.industrymeetsmakers.com.)

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