THE CURRENT EXTENT AND MODE OF INTERCONNECTION AMONG INNOVATION LABORATORIES: AN EMPIRICAL STUDY

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Abstract. *This paper relates to the assessment of inter-InnoLab collaboration. A qualitative approach in the form of semi-structured expert interviews with a sample of 21 Innovation Laboratory facilitators selected through a purposive sampling technique is used to investigate the current extent and mode of interconnection among existing Innovation Laboratories. The findings reveal that the current state of inter-InnoLab collaboration is sparse whereby only a few existing InnoLabs exercise exchanging information with others in sporadic physical meetings. The main barriers hindering the inter-InnoLab collaboration are identified as business competition, inadequate information about others' existence and competencies, and fractional understanding of other types of innovation support. It has been further found that the InnoLabs leverage physical meetings and usual web-based communication tools as primary means for connecting and there is no particular tool for supporting the inter-InnoLab collaboration process in a dedicated and domain-specific manner.*

Keywords: Innovation laboratories; inter-organizational collaboration; Inter-InnoLab collaboration; open innovation; innovation platforms; inter-connection

Introduction

With the increased degrees of global competition and innovation needs, inter-organizational collaboration has been widely recognized as playing an important role in the success and long-term survival of participating organizations (e.g. Goes & Park, 1997; Powell *et al.*, 1996; Willoughby & Galvin, 2005). It enhances the innovation competencies of participating organizations by enabling the sharing of diverse and complementary competencies and resources (Hagedoorn, 1993), network formation and knowledge creation (Hamel, 1991; Powell *et al.*, 1996), cost reduction (Hagedoorn, 2002), and risk-sharing (Faems *et al.*, 2005). The benefits and

the need for inter-organizational collaboration becomes, even more, when the actors of an ecosystem aim at achieving a similar and mutual goal but possess diversified and insufficient competencies to fulfill that desired goal (Memon *et al.*, 2018).

This paper deals with inter-organizational collaboration among Innovation Laboratories (InnoLabs) referred to as inter-InnoLab collaboration. InnoLabs are understood as a kind of innovation intermediaries that assist business organizations in developing new or enhancing their existing products and services by facilitating a dedicated and creativity stimulating space (Magadley & Birdi, 2009) together with a group of facilitators (Gey *et al.*, 2013) and innovation mediating services (Memon *et al.*, 2014) and technical resources (Thieme & Meyer, 2011). They stood different from traditional innovation intermediaries (varyingly regarded as agents/brokers of information exchange, technology transfer, and network formation) in that they offer one-to-one innovation support to the business organization without the necessary involvement of any third party. Recent scholarship on the topic of InnoLabs (e.g. Schmidt, 2009; Meyer *et al.*, 2015; Memon & Meyer, 2017; Memon *et al.*, 2018) advocate that the phrase 'Innovation Laboratory' is adopted as a fancy term whereby different types of innovation mediating structures who offer varying kinds of innovation support call themselves as InnoLabs. As innovation process is a multifaceted activity (requiring intertwined processes of new idea generation, selection, implementation, testing, commercialization, and evaluation) and thus the organizations based on their individual lacking(e.g. scarcity of informational, operational, human, and financial resources) and innovation challenges (e.g. difficulty in acquiring raw material, finding business partners, understanding customer needs and wants) seek different kinds of innovation assistance, the existing InnoLabs are also focusing on addressing varying kinds of innovation challenges (Memon & Meyer, 2017). Therefore, As a result, an organization looking for assistance in innovation projects needs to come in contact with multiple InnoLabs during a single innovation project. For example, they might need to consult one InnoLab (say InnoLab A) for generating new ideas, other InnoLab (say InnoLab B) for the testing and validation of the selected idea, another one (say InnoLab C) for the implementation, and fourth one (say InnoLab D) for the commercialization of designed innovative product/service. As a consequence, organizations need to put a lot of effort into finding and consulting multiple InnoLabs and then coordinating and integrating the services received from each of them. Accordingly, inter-InnoLab collaboration is considered beneficial for the participating InnoLabs in enhancing their innovation mediating capacities as well as their customers (business organizations) in allowing them to get

extended innovation support in one place with a better quality of service (Memon *et al.*, 2018).

1.1. Problem statement and research questions

Whilst inter-InnoLab collaboration is hypothetically shown as beneficial for participating InnoLabs and their customers (e.g. Memon *et al.*, 2018), there is no practical information on if and how the existing InnoLabs are connected? To address this research gap, the current study undertakes an empirical investigation of different kinds of InnoLabs through in-depth expert interviews conducted with facilitators running InnoLabs to determine:

RQ1. How are the existing InnoLabs collaborating within and across categories? In this regard, we identify different mutual activities of our participants (types and statistical distribution) and use an already existing inter-InnoLab collaboration maturity model as a reference point to map the identified activities to different categories of interconnection.

RQ2. What are the motivating and inhibiting factors for the extant inter-InnoLab collaboration? In this regard, we identify five factors that form the basis for existing interconnection among InnoLabs and three factors that hinder the InnoLabs from collaborating. The factors are elucidated from the conceptual analysis of our open-ended discussion with interview participants.

RQ3. What type of offline and online tools are InnoLabs using for connecting? In this esteem, we elaborate on different means of interconnection among InnoLabs along with their occurrence rate across the interview sample.

The organization of the rest of the paper is as follows. In section 2, we explain the concept of inter-InnoLab collaboration, its types and respective benefits, and different stages of the inter-InnoLab collaboration process. Section 3 defines the research design and research instrument. Section 4 discusses the research results. The paper concludes in section 5 with an outlook to the future research agenda.

2. Theoretical Framework of the Study

2.1 Diversity of Innovation Laboratories

Given that the existing InnoLabs focus on addressing different innovation challenges, they are found offering eight different functional contributions to the innovation process including the provision of a dedicated and creativity stimulating space along with various play tools, dissemination of knowledge through expert advice and moderated workshops, incubation of new business

ideas and financial assistance to the startups, network formation, provision of different technological and non-technological hardware and software resources, mediating innovation process, researching and developing innovation strategies, guidelines, and tools, and undertaking customer and market research (cf. Memon & Meyer, 2017 for more details). About different functionalities that different InnoLabs focus they offer varying kinds of innovation services. Accordingly, a particular InnoLab can be identified as a service laboratory, product laboratory, consulting laboratory, co-working space, business incubator, network coordinator, living laboratory, fabrication laboratory, or a research and development laboratory (cf. Memon *et al.*, 2018) for more details). Furthermore, the InnoLabs belonging to the same category also differ from each other concerning other structural and functional attributes (Puttick, 2014; Memon & Meyer, 2017; Memon *et al.*, 2018; Schmidt, 2009) such as innovation object they focus to innovate, part of innovation process they assist in, resources they facilitate, type of innovation they focus, the extent of maturity of their methodological approach, business model, management structure, thematic focus, and geographic orientation (cf. Memon *et al.*, 2018) for more details and different field configurations).

2.2 Inter-InnoLab collaboration

Considering the abovementioned diverse nature of InnoLabs, inter-InnoLab collaboration is defined as the interchange and utilization of diversified knowledge, skills, competencies, and other resources along with the sharing of responsibilities and risks among the independent, geographically apart located, and structurally and functionally similar or dissimilar Innovation Laboratories. Accordingly, there become two forms of inter-InnoLab collaboration possible. The first form of inter-InnoLab collaboration can be among InnoLabs who offer similar kinds of innovation services and thus belong to the same InnoLab category. This form can be regarded as horizontal inter-InnoLab collaboration and would result in the increased competencies and better quality of service of participating InnoLabs as they have access to diverse and complementary assets, skills, and technical tools of each other. The second form of inter-InnoLab collaboration can be among InnoLabs who offer different kinds of innovation services and therefore belong to different InnoLab categories. This form can be regarded as vertical inter-InnoLab collaboration and would result in extended service portfolios and invasion of new markets of participating InnoLabs. The motivating factors and potential benefits resulting from inter-InnoLab collaboration for the InnoLabs participating in collaboration, business organizations (the customers of participating InnoLabs), and the innovation environment are summarized in Figure 1.

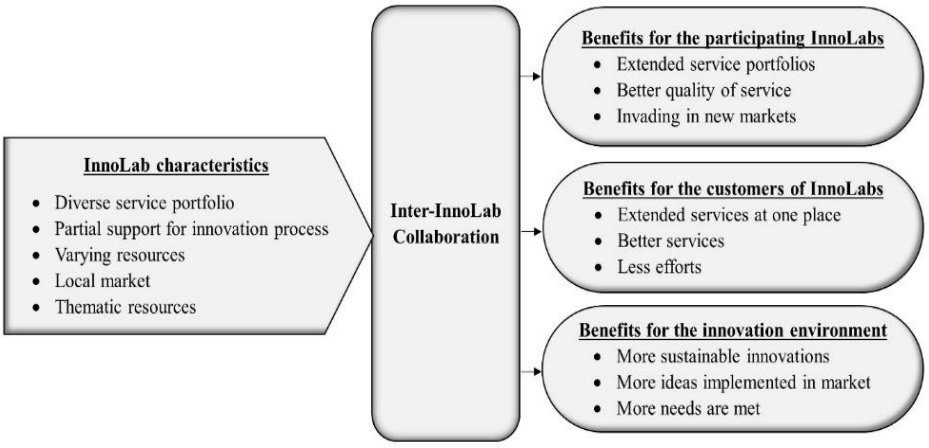

Figure 1 Motivating factors and potential benefits of inter-InnoLab collaboration (Authors' illustration - Memon et al. (2018))

The inter-InnoLab collaboration process encompasses various mutual activities and thus different degrees of mutual integration. The process starts with the coexistence of InnoLabs whereby they do not possess any information of each other and lasts till long-term collaboration among participating InnoLabs where they align in long-term contracts with equal sharing of risks and rewards. In this study, we consider the inter-InnoLab collaboration roadmap given by Memon *et al.* (2018). They organize inter-InnoLab collaboration activities along five stages of InnoLab integration (cf. Figure 2).

1. *Coexistence*: the level of coexistence means that different InnoLabs exist but they are unaware of the existence and competencies of other InnoLabs.
2. *Networking*: the level of networking indicates that InnoLabs possess information about other existing InnoLabs but do not substantially interact with each other.
3. *Cooperation*: the stage of cooperation characterize the identification of mutual interests and goals and thereby engaging in short term mutual activities.
4. *Partnering*: the stage of partnering encompasses the undertaking of mutual innovation projects while sharing the costs, risks, and rewards of innovation projects. This stage is characterized by formal and frequent communication/interaction among participating InnoLabs.

5. *Collaboration*: the stage of collaboration refers to long-term alliances between participating InnoLabs whereby they leverage all resources of each other including information, expertise, and physical resources in their mutual as well as individual projects.

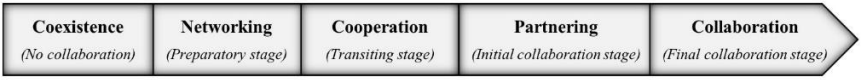

Figure 2 Inter-InnoLab collaboration roadmap (Memon et al., 2018)

3. Research Methodology

To investigate the current state, motivating and inhibiting factors, and means of interconnection among existing InnoLabs, the present study employed a qualitative approach utilizing in-depth expert interviews with the facilitators running InnoLabs.

3.1 Sample selection and demographics

Interview participants were selected following a purposive sampling technique which allows them to select information-rich cases who seem to provide the most relevant data concerning the research subject(Patton, 1990). The participant's search and selection started with a list of around 200 existing InnoLabs identified by Meyer *et al.* (2015). Given this list of existing InnoLabs, initially, a couple of InnoLabs who seemed to offer varying types of innovation support were chosen based on the information available on their official websites. Following this, the participants were selected based on their degree of differentiation with already interviewed InnoLabs. As a result, a sample of 21 InnoLab facilitators was interviewed. Table 1 presents the distribution of our interview participants in terms of their location, foundation year, organizational structure, and mode of interview. It is important to note here that some of our interview participants also work in other parts of the world. The distribution shown here is based on the location of their headquarters. Therefore, while geographically our findings represent a North America and central Europe centric view, we believe that the findings are equally applicable to InnoLabs existing in other parts of the world.

Table 1 *Distribution of Interviewed Participants*

Characteristics		Number of participants	Percentage (N=21)
Location	USA	8	38.09%
	Canada	1	4.76%
	UK	1	4.76%
	Hungary	1	4.76%
	Germany	9	42.85%
	Denmark	1	4.76%
Foundation year	Until 2000	3	14.28%
	2001-2005	3	14.28%
	2006-2010	9	42.85%
	2011-2015	6	28.57%
Mode of interview	Face-to-face	15	71.42%
	Online	6	28.57%
Organizational structure	Educational institute	**7**	33.33%
	Business organization	3	14.28%
	Privately owned	11	52.38%

3.2 Interview method and instrument

Owing to the explorative nature of the present study, a qualitative approach was employed using in-depth expert interviews (Coombes *et al.*, 2009)designed in a semi-structured manner (Knox & Burkard, 2009) with InnoLab facilitators. Accordingly, a questionnaire comprising of a set of pre-determined questions was used to guide the discussion between researchers and interviewees. The questionnaire mainly consisted of two types of questions – one relating with collaboration and mutual activities (such as number and type of labs connected with, formality and frequency of interaction, reasons of interconnection, mutual activities, number and nature of collaborative projects, perception on the importance and benefits of collaborations, etc.) and the other concerning with the use of technical tools in connecting (such as type and frequency of different means of interaction, perceptions on the usability and effectiveness of existing tools, etc.). The participants were interviewed at their workplaces (i.e. within the labs) as well as online; however, the majority of interviews took place face-to-face. Interviewing participants at their labs enabled the researchers to simultaneously explore the working environment and technical facilities of participant InnoLabs. All interviews were tape-recorded with the permission of participants and hand-written notes were also taken at the time of the interview.

3.3 Data analysis

The interview data were analyzed in several steps. At first, interview tapes were transcribed in the spreadsheet. The transcription was mainly done in researchers' words, however, wherever necessary actual words of interviewees were also quoted. The data was recorded concerning different categories aligning with interview questions. Table 2 shows the categorization scheme of collected data. After the recording, the interview data was revised and expanded with the hand notes. Following this, the conclusions were drawn based on recurring responses and corresponding statistical computations were made.

Table 2 *Interviews Data Categorization for Data Analysis*

Theme	Categories	Sub-categories
Extent of Interconnection	Awareness	Number of other InnoLabs that the InnoLab is aware of
		Names of other InnoLabs that the InnoLab is aware of
		Locations of other InnoLabs that the InnoLab is aware of
	Connection	Number of other InnoLabs that the InnoLab is connected with
		Purpose of interconnection with connected InnoLabs
		Frequency of contact with connected InnoLabs
		Mutual activities are undertaken with connected InnoLabs
		Source of first contact with connected InnoLabs
	Collaboration	Number of collaborative projects
		Number and names of InnoLabs that the InnoLab has collaborated with
		Main role of InnoLab in collaborative projects
Means of interconnection	Means	Interaction methods used to connect with other InnoLabs
		Technical tools used to interact with other InnoLabs
		Frequency of using different available interaction tools
	Perceptions	Perceived completeness of selected means of interaction
		Effectiveness of selected means of interaction
		Observed shortcomings of selected means of interaction

4. Results and Discussion

4.1 The current extent of inter-InnoLab collaboration

In response to our interview question, "how is your lab connected with any other labs?" Participants reported varying forms of interconnection. Figure 3 shows the reported mutual activities of interviewees along with their occurrence rate in the interview sample. The results reveal that about one-third of the interview sample possesses an awareness of other existing InnoLabs, while about half of the interview sample engage in informal communication with other InnoLabs in sporadic meetings. These two forms of interconnection correspond to the Level of networking of the inter-InnoLab collaboration model given in Figure 2meaning that most of the existing InnoLabs are still in the preparatory phase towards inter-InnoLab collaboration.

Interestingly, the interview participants rarely mentioned the higher levels of inter-InnoLab collaboration. While about one-fifth of interview participants do mention undertaking collaborative projects with other InnoLabs. However, the projects undertaken by these labs are either research-based projects whereby InnoLabs jointly attempt to investigate some innovation related question and thereby teach and train each other, or third party sponsored projects regarding the development and implementation of an innovative product where other InnoLabs are indirectly connected. Increasingly, the project-based and long-term inter-InnoLab collaboration for mutual customer projects have also been rarely indicated by interview participants. Such activities are mainly undertaken by the InnoLabs who are connected in larger networks thus work collaboratively with each other. Surprisingly, no participant has exercised direct collaboration with other InnoLabs for innovation specific projects.

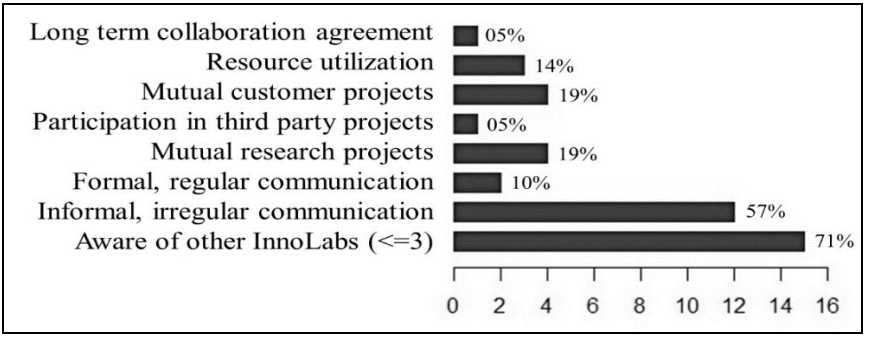

Figure 3 Inter-InnoLab collaboration activities exercised by participant InnoLabs (N=21)

It is important to note here that whilst some of the InnoLabs appear interacting with peers at the networking level, the interaction is sparse. In most cases, the number of InnoLabs they are aware of and connected with is a maximum of three. Moreover, the interaction is characterized by information exchange in a friendly manner in face-to-face gatherings that occur informally and at irregular intervals. Accordingly, it can be concluded that the awareness of and the formal and frequent collaboration between geographically apart and/or structurally and functionally diverse InnoLabs is still in its very emerging state.

4.2 Motivating factors for inter-InnoLab collaboration

The current interconnection among participant InnoLabs is based on five motivating factors (Figure 4). Out of these five factors, two factors indicate that the InnoLabs tend to interconnect out of their business competition while the other three factors indicate that InnoLabs tend to interconnect out of their inherent relationship with each other. The first motivating factor is the '*geographic proximity'* meaning that a certain InnoLab is connected with other InnoLabs who are located in nearby regions or at most within the country borders of the lab. This factor has been reported by 29% of our interview participants. The possible intention of such interactions based on geographic proximity is the business competition. Because in most cases the InnoLabs are serving local customers, they strive to be aware of the existence and offered services of other InnoLabs serving in the same region and are thus their competitors. The second motivating factor is the '*thematic similarity'* meaning that a certain InnoLab is connected with other InnoLabs who offer a similar set of services and/or are working for the same business sector as the lab itself. This factor has been found to exist among 43% of our interview participants. This factor also indicates that InnoLabs tend to interconnect because of their business competition with each other.

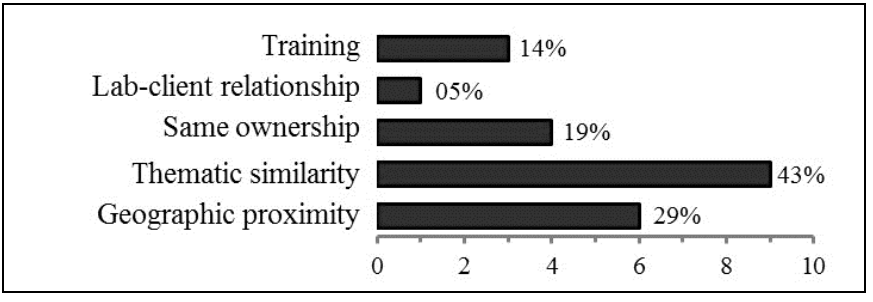

Figure 4 Motivating factors for inter-InnoLab collaboration (N=21)

The third motivating factor is the ‘same ownership’ meaning that a certain InnoLab is connected with other InnoLabs managed by the same organization (an academic institution such as a university or a business organization) as the lab itself. Such type of interconnections motivated by the inherent relationship among InnoLabs has been reported by 19% of our interview participants. The fourth motivating factor is the 'lab-client relationship’ meaning that a certain InnoLab is connected with the labs (research or innovation labs) hosted by its customers. Such type of interconnections are also based on their inherent relationship and has been reported by 5% of our interview participants. The fifth motivating factor is the ‘training’ meaning that a certain InnoLab is connected with other InnoLabs who have supported each other during the establishment through training and other assistance. Such type of interconnection is also based on their inherent relationship and has been reported by 14% of our interview participants.

4.3 Inhibiting factors for inter-InnoLab collaboration

The descriptive analysis of our interview data indicates that the extent of inter-InnoLab collaboration is largely curtailed by three obstructions. The first and foremost of these obstructions is the business competition among InnoLabs that mainly resists the horizontal collaboration between InnoLabs offering similar kinds of innovation services and is thus primarily competitors of each other. Due to business competition, despite having a substantial awareness of the competencies of others, the InnoLabs do not collaborate. They do not disclose their methodological and procedural approaches as they are afraid that their shared information may reach to their competitors who may leverage it in improving their services and eventually take over their customers. As one of the interviewees responded "*But at the moment I would not like to do it [referring to cooperation]. Because I know they could then immediately also go to the customers we target*”.

The second factor hindering the InnoLabs from collaborating is the inadequate information for searching and selecting the collaborators among homogeneous (having identical focus and offering similar services) as well as heterogeneous (having diverted focus and offering diverse services) InnoLabs. As one of the interviewees reported "*[After mentioning two names] I don't know with whom else one should cooperate. And who else has expertise in [name of the country where the lab is located]*". The availability of useful information for discovering and contacting other InnoLabs is limited due to the limited openness of InnoLabs to share their knowledge out of the business competition, and also because of no proper advertisement (other than booklets and local media) of InnoLabs' products and services. Also, the InnoLabs catch

customers through word-of-mouth recommendations and thus the information remains in the hands of people who get access to it locally. As one of the respondents quoted "*We do not actively go to people, it is like you know the people and through them, the others reach out*".

Thirdly, the InnoLabs possess fractional know-how of other kinds of innovative services that a certain InnoLab is currently not offering itself. Given that the concept of InnoLabs is currently emerging, the ways of supporting business organizations in developing innovative products and services are continuously being highlighted. On the other hand, the existing InnoLabs are currently focusing on a particular type of innovation support, they largely remain unaware of other types of innovation support. Therefore, the InnoLabs are not seeking the opportunities of connection with heterogeneous InnoLabs who focus on a varied innovation challenge and thereby offer different services.

4.4 Use of technical tools for inter-InnoLab collaboration

When we asked our participants that 'how do they connect with other InnoLabs', most of the interconnections were found to be undertaken in physical meetings such as conferences, scientific expos, and the like where the InnoLab facilitators meet each other occasionally and engage in an open and friendly exchange of information and new ideas. Increasingly, a part of follow-up interaction also takes place through web-based (technical) tools. To this esteem, it is interesting to note that the most recurrently mentioned tools by the interviewees are the standard web-based communication tool and associated platforms. Figure 5 presents the rate of occurrence of web-based tools mentioned by interview participants.

Likely, the InnoLabs would also be using communication tools other than they mentioned. Nevertheless, the statistics given in Figure 5 are based on the tools mentioned by respondents as their means of information sharing with others. It was further elaborated from the participants' views that there is no dedicated online platform known to them that may function as a network facilitator and support the cross-exchange of required knowledge while maintaining the security and transparency of shared information. Whilst the existing tools are believed to possess the substantial potential for supporting inter-InnoLab collaboration, they are not capable of facilitating the representation of domain-specific characteristics of InnoLabs and handling the concerns of business competition and required data privacy.

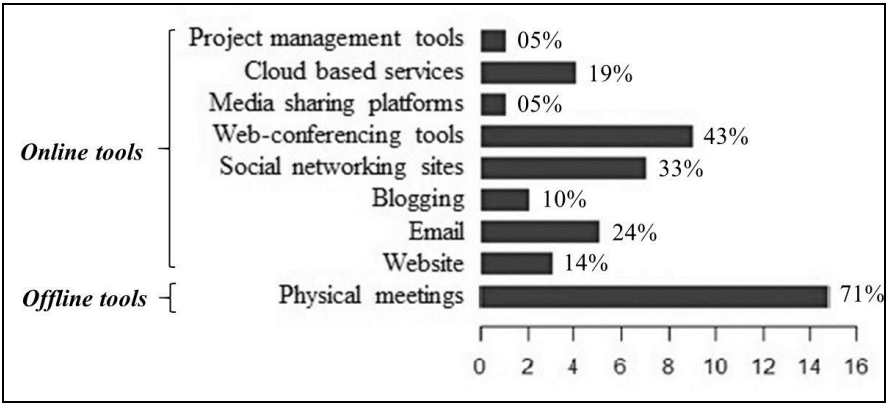

Figure 5 Means of interconnection among participant InnoLabs (N=21)

5. Conclusion

As the number of InnoLabs offering diverse and partial innovation services around the globe is increasing, it becomes necessary to understand how they are collaborating. In this regard, based on the interviews with 21 InnoLab facilitators this paper has explored that the current state of interconnection among InnoLabs is very sparse. Only a few InnoLabs (who are mainly located nearby or are serving similar business domain) are currently engaged in a friendly exchange of information. Furthermore, it has been found that the inter-InnoLab collaboration is largely hindered by business competition among InnoLabs, inadequate awareness of others' competencies, and fractional information of other types of innovation support being offered by InnoLabs. Furthermore, this research has explored that the primary means of interconnection among InnoLabs are the physical meetings in addition to usual web-based communication tools.

5.1 Future research agenda

The findings discussed herein opens up two research directions worthy of further pursuit. One, there is a need to devise a systematic model of inter-InnoLab collaboration that may advance the understanding of different types of InnoLabs on how they can connect and thereby leverage their diverse competencies in course of an innovation project. This will not only motivate the existing InnoLabs who are currently not interacting with inter-InnoLab collaboration but also guide and strengthen the existing interconnections, and thus raise the overall extent and degree of inter-InnoLab collaboration. Second, there is a need to conceptualize and successively develop dedicated supporting technical artifacts for InnoLabs that may help them to locate the opportunities

for, plan and execute, and measure the collaborative activities. Such artifacts are necessary to interconnect geographically apart InnoLabs to bring cross-geographical and cross-disciplinary inter-InnoLab collaborations.

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