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# Toward a framework for the emergence and monitoring of Innovation Lab Networks

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**Abstract - Innovation labs are considered important orchestrators of innovation processes in multi-stakeholder settings. This is a phenomenon that has grown rapidly and exponentially world-wide, despite concerns on the measurable impact they produce and the necessary means to sustain their operation over time. The multiplication of these labs in the same territory could be analyzed as a risk of increasing competition and thus increasing the number of failures of these labs. Very few authors have addressed inter-innovation lab collaborations and how such interactions can facilitate their work and thus sustain their existence over time. These places have a strong culture of sharing, collaborative innovation and co-construction, which is why in this paper we put forward the assumption that the intention to create real collaborations between these places could allow them to identify themselves and feel involved in these relationships. This paper proposes a framework for creating sustainable connections between innovation labs. Drawing on existent literature on inter-organizational networks and collaborations, our proposition aims to establish a methodological basis for the design and implementation of innovation lab networks. A design method, quality function deployment, was adapted and partially applied to this study.**

**Keywords - Innovation Lab network; Collaborative network; Collaborative success factors; Innovation**

## I. INTRODUCTION

Tackling societal issues and climate change requires considering a maximum of stakeholders of a territory and to combine various skills and knowledges. These conditions will allow to create more systemic and sustainable innovations [1]. Moreover, innovating towards sustainability requires multiple societal actors to be in line with societal issues [2], [3] and needs of the territories. Innovation labs (ILs) have become key entities on territory. They are organizational forms composed by a group of people providing innovation support and develop innovation projects [4]. Moreover, ILs are meeting point of actors [5], this allows to have different views which can identify issues and trends on societal problems [1]. This is particularly important, as a local territory is ultimately composed by the interaction between a variety of actors such as companies,

entrepreneurs, governmental institutions, associations, academia, etc. [6]. Then, the set-up of an IL network could spark the emergence of an innovation ecosystem fostering and facilitating interactions between the labs with their users, citizens and to all the actors of a territory [7]. Nevertheless, as the number of ILs across local territories increases exponentially so raises the concern about how do ILs work together and how to guide and monitor the emergence of IL networks?

Recent studies have acknowledged the commonalities but also the diversity in terms of functional roles and services provided by ILs. Indeed, multiple ILs within a local territory offer an array of innovation support services that are often fragmented, dispersed, or duplicated [8], [9]. Some develop creativity to develop new innovations for a company [10], others to include citizens in urban planning [11] or to accompany the public sector to improve public processes through innovation [12], [13]. While it has been argued that a single IL is not capable of dealing with complex problems standalone, this implies also that actors of a territory could face difficulty when searching, requesting and integrating the required support. So, if ILs do not consider other ILs and actors in their territory, and therefore their strategy does not allow them to differentiate themselves and/or be complementary, there will be a greater risk of failure [14]. A focus on the complementarities and common points of each IL [8], [15] could allow ILs to offer a better or broader range of services without increasing their internal skills [4]. A framework to manage this type of interactions is needed to create sustainable collaborative networks because there are lots of success factors to consider (such as complementarities, strategy, interaction process, roles, level of trust, kind of facilitation) and it takes a long time to set up [16]. Considering all these factors will reduce the risk of failure [17]. Moreover, because of their varied mission [10]–[12], networking them would allow to develop in the same sustainable direction all the aspects of a territory [7]. Networking them will allow ILs to feel integrated into more global issues through their experimentation with a local community and resources [18]. Indeed, they will be able to obtain other experimentation fields [19] and to have feedback on experiments carried out in other contexts.

This article aims to provide a process for setting up a network of ILs at local territorial scale to be in a certain geographical proximity and thus facilitate exchanges [20]. Thanks to an exploratory literature review, on inter-organizational network, four frameworks to manage an inter-organizational network were compared. Moreover, we suppose that collaboration is the most suitable means to maintain a network of ILs. Indeed, ILs have a strong culture of collaboration [21]. Drawing from the selected frameworks and the success factors for collaboration, we propose a new framework to assist in the emergence of inter-organizational collaborations among ILs and their territories.

The remainder of this paper is organized as follows. First, we develop the notion of IL network and the complex interactions inherent to them. This is followed by our exploratory review on organizational networks leading to the key elements and alternatives when setting up a new network. Next, in the second section we present our design research. Then we introduced our proposition for the design and implementation of an innovation labs network. This is followed by the development of each one of the phases that compose our framework. Finally, we conclude with a discussion on the relevance of establishing a structured framework to the creation of IL networks.

## II. STATE OF THE ART

### A. Innovation Labs

An IL is a place with the competences to facilitate part or all the innovation process: creativity, testing, experimenting or prototyping [10], [22]. ILs offer support to produce different forms of innovations: organizational, product, social, services or combination of these forms of innovation. Furthermore, innovation in these ILs can be for creating knowledge, experimenting or testing product or create new social interaction. They apply different mechanisms to facilitate the innovation process: workshops, ideation sessions, hackathons, prototype testing, entrepreneurship cycles, co-constructed, user centered, collaborative, integrating citizen, industry, political...[5], [10], [23], [24]. Their culture is oriented towards the development of collaboration and resource sharing. ILs are characterized by involving the actors in the territories, listen to them and make their voices heard to initiate systemic changes [1], [25], [26]. They can be frequented by actors with very different profiles: citizens, entrepreneurs, public policies, experts, researchers, etc [27].

The multiplication of these places on territories with similar characteristics and features underlines the importance of making them work together to avoid redundancies or to exploit them [8]. One of the particularities of ILs is that they are composed by a large variety of actors and have their own ways of working. Indeed, these places often have very different structures [4]. One of the challenges is to find an approach that enable these spaces with their own resources, actors, equipment, approaches, and objectives to work together. Fostering collaborations between them could give access to new skills or knowledges. They could thus be able to propose new service offers or better-quality services [4]. There are therefore several types of ILs: Living Lab, Fablab, Urban Living Lab, Systemic ILs, Makerspaces, Hackerspaces...

Since these ILs are new, they do not always have means to operate in a way that allows them to be sustainable, whether because of financial resources or the activities of the space [14]. These ILs are very often subject to the uncertainties of their supporting structure and their often-combined sources of financing. These places can be led by a private or public structure, their governance is often very different from one place to another [5]. Moreover, each of these places is specialized in a part of the innovation process, so they have specific skills and strategies (reaching the public, reaching entrepreneurs, sharing knowledges, sharing spaces) [8]. A priori, they are already in several networks (FabLab, EnoLL, Learning Lab network...) and prioritize their development and sustainability before sharing and creating common projects. The network created must have a real added value for the IL, to show them that these elements are not incompatible. It is therefore necessary to establish a flexible networking framework that can take all these elements into account.

### B. Organizational Networks

A network is the structure that governs interactions between actors or organizations. A network is composed of nodes (which are the members of the network) linked together by weak or strong ties [28]. In this work we focus on the inter-organizational networks. These nodes and relationships can take several forms and thus be structured as centered, multiplex-distributed, distributed, stable, dynamic, federated [29]–[31].

In the literature, a network can be set up for various reasons to share costs and risks, to develop multi-disciplinary innovations, to obtain complementary resources etc. [32]. A network is generally set up over a long period of time [16]. Organizations may want to create a network because of a market or technology evolution or a desire to develop an innovation for which they lack certain skills or knowledges [16]. Moreover, many steps are proposed by the authors and many elements are to be considered. To enable a network to function optimally, the ideal is to prioritize and identify the most important steps and elements.

The creation of a network comes from the evolution of the organization's environment because this leads it to question and change its ways of operating. Organizations will then seek to identify complementarities in other organizations [16], [20], [33], [34]. The network initiator defines a general objective for the network to give a clear idea to the future network member [16]. To find potential members, some authors have shown that it is interesting to rely on interpersonal relationships that can coexist before the creation of the network [20], [34], [35] or to go towards organizations that have certain aspects in common with the initiator [20], [34]. Generally, after this first step, the members organize themselves, define the rules, the objectives of their networking, the frequency of interactions etc. [16], [36]–[38]. The detailed and operational steps are not always identified. Some authors then recommend verifying the effective functioning of the network by analyzing the network's operation and results, using, for example, indicators identified at the time the network was created [37]–[39]. Following these results, certain improvements can be made in the operation of the network to optimize its results.

This last step shows the importance of having an agile and flexible operation allowing to adapt quickly. These different steps can be seen as cyclical [16], [38] or linear [20], [36], [37].

There are several ways to sustain a network and to create ties between network members. These range from developing the minimum of interactions between members (networking) to the maximum which is collaboration [15]:

0. Coexistence: IL works in isolation from the others, i.e., different ILs exist but have no information about the others [4].
1. Networking: When an IL seeks to learn about other ILs. This stage is characterized by awareness of the existence of the skills, services, and resources of others. Interactions are minimal; there is simply some sharing of information [4], [40].
2. Cooperation or Alliance (only between 2 organizations): In this stage, the ILs identify common interests and engage in short-term mutual activities. This may include conducting short-term research activities together, supporting each other to achieve individual goals, or working on third-party projects (indirect collaboration). Communication during this stage is formal and frequent [4], [40].
3. Partnership or coalition or consortium: This level refers to the initial stage of collaboration between ILs. At this stage, communication is formal and frequent. However, the relationship exists for the duration of a particular project [4], [41].
4. Coordination: consists in managing resource dependencies and proposing new ways of managing activities. They are integrated in a common innovation process, they work together to develop projects [30], [42].
5. Collaboration: ILs engage in long-term collaboration, creating collaborative network. All resources such as information, expertise and physical tools are shared and used in the independent projects of the participating ILs [4]. They regularly set up and carry out projects together.

The steps to make the transition from one level to another is not yet well studied in the literature. Moving towards collaborations allows for more sustainable interactions over time. However, it is the most difficult level to reach because it is necessary to succeed in developing a strong level of trust, involvement, commitment and recognition between the actors. To reach this level, it is therefore necessary to know all the success factors to be brought together.

In the literature, there are very few operational approaches to implement and enable the network to reach the level of collaboration to be more sustainable over time. [43], these authors have provided tools for evaluating and monitoring a network. Some other authors have focused on the process of setting up a network and collaborations [16], [36]–[38], [40], [44] but not with concrete tool to operationalize the network and manage collaboration. These authors take very little account of the emergence phase of the network, certainly because of the difficulty in identifying them as they are spontaneous and not plannable [35]. [20], [33]–[35] propose elements favoring the emergence of a network: the tendency towards cumulative advantage, the

inclination towards multi-connectivity, the preference for diversity, the propensity for homophily, and the inclination to follow trends, characteristic and reputation of the potential member, informal interpersonal relationship, geographical proximity, evolution of the market, of the society: opportunities. These emergence factors can be used for the emergence of a future collaborative network. The challenge is to integrate all these elements into a comprehensive method. The process of setting up a network is a long and complex one, integrating many factors and the collaboration is the level with the highest level of interactions. Many collaborative networks fail because one or more of these factors are not respected, such as: the capacity for action of each member is not considered, roles and responsibilities are not clearly defined, the strategy and objectives are not shared, a member loses their autonomy and independence etc. [17], [20]. This shows that the creation of a network takes place over a fairly long period of time [20]. [16] confirmed that setting up a network is a long cyclical process by defining 5 steps: network initiation, network configuration, network implementation, network stabilization, network transformation. However, these authors consider that a network has an end when the objectives are reached but, the ambition of this publication is to create a sustainable collaborative network in a local territory for give a key role to the ILs on its territory.

#### C. Key features to consider integrating an IL into a network of ILs.

This part allows to cross the key elements to create a network and the specificities to consider in the case of ILs. This is the key part because if the specificities of each place are not considered they will not be fully involved in the collaborations [17] and they will not be able to take full advantage of them. In addition, it will help to establish a sustainable network that adds value for ILs. It will be able to offer better services, develop systemic innovations that require a wide range of skills, spread their knowledge more easily and thus raise awareness of current issues. The role of ILs is to support and develop innovation. Indeed, their impact on creativity has been demonstrated [10]. They are known to be innovation intermediaries [5]. Thus, one of their challenges is to be able to support innovation on all themes and in all fields. Networking them would allow to create a greater added value to all field of a territory (companies more innovative, innovative project to address systemic issues, public policies closer to social issues...). Thanks to their diversity of actors, they are very connected to their context.

We assume that the type of network that seems most meaningful to ILs is collaboration because it's in their culture. Indeed, these ILs are already used to working on collaborative projects. Moreover, they are already in a dynamic of sharing, exchange and trust [11], [21], [22], [45]. Presenting to them an approach that aims to achieve this type of dynamic at a territorial level could be a factor that encourages their involvement. In this context, a climate of trust and shared decision-making take longer to develop between stakeholders. That is the main disadvantage. It would be relevant to follow a clear structured approach that considers all the success factors and all the characteristics of ILs to improve this process. [46], [47]. However, to limit these disadvantages, it would be relevant to follow a

structured approach that considers all the success factors and all the characteristics of ILs. Authors in [8], have focused on the structure that an IL network might take. They have also assumed that collaborations would be appropriate for these places. However, they do not propose a structured approach or framework to implementing it.

### III. METHODOLOGY

An exploratory literature review about inter-organizational network was realized on one of the most used databases, Web of Science. This field is already thoroughly studied and we assume that ILs are organizations in their own right [9], [15]. This original combination allows to identify identified four frameworks for creating a network. The different findings highlighted the importance of identifying the key elements to implement and sustain a network. Moreover, the different means to develop a network were identified as different levels of interactions. We then conducted a second exploratory review on IL. This review used the keywords “Inno\* space” OR “Inno\* lab\*” OR “living lab” OR “fab lab” OR “fablab” OR “fablabs” OR “makerspace” OR “hackerspace” OR “coworking space” OR “third place” OR “social lab” OR “creative space” OR “open lab” OR “co-design platform”. This second review allowed to identify the particularities of ILs to consider. This allowed to highlight that the culture of collaboration is inherent to these places. We therefore set up the assumption that this aspect had to be considered to create a network of ILs in which they recognize themselves and get involved. We assume here that having the ambition to reach a collaborative network was the most suitable for these places. As the literature is not very rich on IL networks, we seek to transpose and adapt the frameworks of inter-organizational networks and collaborations between universities and industries to our subject. The collaborative success factors are used to collaborative network of IL and one factor has been added “context analysis”. Indeed, IL fits into territorial dynamics and the actors who compose it are from the context close to the IL. Moreover, the network must be very flexible because of the large diversity of ILs structure and missions. They have very different funding, different governance, very different actors, different types of innovations.

Therefore, we furthered our research to identify the factors for successful collaboration. A fifth framework was identified. It analyses the elements to be taken into consideration to reach the level 2 of cooperation. This allowed to identify the importance of considering the emergence phase of a network. The emergence factors (EF) were therefore identified. They are necessary and/or facilitate the potential creation of a network (identification of trends, complementarities, commonalities...). The level 3, 4 and 5 can be reached with deeper interactions and thanks to the success factors of a collaboration (SFC). Some of the factors for the emergence of cooperation are identical to the factors for the success of a collaboration because they are necessary for every transition from one level to the next. In the results section the identical factors will be in bold (communication, trust and context analysis) and they will therefore be among the most important factors.

Finally, we compared these factors with the different steps that make up the five frameworks identified in the literature, thanks to the adapted QFD method. This allowed to identify

the key steps to consider all these factors and thus implement a collaborative network.

The process was as follows:

The first step was to consolidate and synthesize all identified factors: 21 success factors of collaboration and 9 emergence factors of a network.

Then we compare the different phases of the five frameworks identified in the literature. This corresponds to twenty-eight phases. Then, each phase was analyzed to identify the presence or absence of SFC and EF with the support of a simplified version of the structured approach Quality Function Deployment (QFD). This allowed to identify which steps will consider all the factors.

The methodology followed a simplified process inspired by functional and value analysis, the QFD [48]. This method allows to design a solution considering several requirements that are customers’ needs. It allows to compare several functionalities of solutions with the requirements in order to identify which functionalities seem the most relevant. We use this method because it allows us to consider a very large number of requirements. In this case, there are 30 EF and SFC factors that are considered requirements. To build our new framework of IL network, five frameworks identified in the literature were compared, in a matrix (see table 3). Only one framework considers EF [20].

Each of the factors was added to each of the steps in the process. When this factor was explicitly presented in the framework, we gave it a score of 9, when it was implicitly present in the text, a score of 3, and when it was intuitively present, a score of 1.

In addition, each of the factors was compared 1 by 1 to evaluate the importance of each factor. Assigning 2 if the factor in the row is more important than the one in the column, 1 if their importance is equal and 0 if it is less important (see table 2 and 3 in the appendix section).

The figure 1 synthesizes the research steps.

Following this analysis, we have identified the consideration of the changes, the trends of the environment as being very important. Indeed, the authors address this notion of environment, of context regularly [16], [33], [34], [49]. Moreover, the ILs being very much linked to their context, we decided to add this element as a key success factor for creating a collaborative network of ILs.

### IV. FINDINGS

#### A. Criteria and framework comparison.

Thanks to our methodology, the key steps to be implemented were identified. The key steps correspond to the steps with the highest score. This score is calculated by

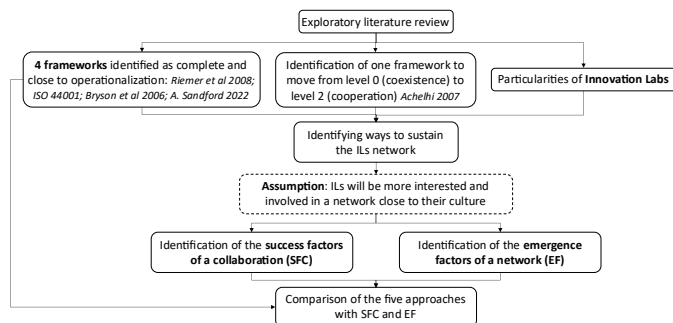


Fig. 1. steps to build the IL network framework

multiplying the importance of the factor with the score assigned (9, 3 or 1) in each step. Steps with a score that stands out from the others were considered important. The score at which we consider that the step stands out is 700. In fact, this score is the first one that stands out from the low scores.

To validate this selection, a verification phase was carried out to ensure that all the SFC and EF were considered. All these steps allow to consider all the EF and SFC. Only three factors were never explicitly identified in the articles: formalization, recognition and reward. These factors can be considered as optional because their importance is low.

Finally, after an in-depth analysis of each of the stages proposed by the different authors, a combination phase was carried out. We have assigned a color per step that considers the same factors (see colors in the table 3). Thanks to this combination we can identify a phase of emergence (red), structuring (orange), dynamization (purple), analysis and improvement (grey). The phase of emergence is composed by the step 5 (consideration of the context) of the framework proposed by [16] and the step 1 (selection of partners) of [20]. The phase of structuring is composed by the step 2 (network strategy), 3 (network organization) of [16] and step 5 (working together) of [38]. Then, the phase of dynamization of the network is composed by the step 4 (Network information management) [16], step 7 (maintain the network) [38] and step 2[37]. The analysis and improvement phase is composed by the step 4 (identify the structure's KPIs, measure and capitalize on them) [36].

## B. Creating a framework to generate and monitor network of ILs.

This section presents the phases to be set up to achieve a sustainable network of ILs on the territory. Each of these steps can be divided into different operational activities to be implemented. The initiator of the network can be an IL, a public organization, an economic development agency, an association or a private actor.

### 1. Emergence phase

This phase is often done unconsciously and merged with the step of choosing members in the structuring phase. It consists in identifying potential synergies that could be created on the territory. The initiator of the network can identify commonalities or complementarities by analyzing the other organizations present in this territory. If the initiator identifies all the emergence factors by analyzing the current dynamics and weak signals, the pertinence of the network is validated. This phase also includes a step to identify the trends in the evolution of the environment which can facilitate or support the network.

### 2. Structuring phase

The structuring phase begins with the definition of the members. This includes a phase of choosing the members with different selection criteria defined with the initiating team of this network. The internal functioning must be studied to understand how each IL functions and what its level of maturity is. Finally, it will be necessary to analyze the history of collaboration of each of the IL to understand if they are already open to this type of dynamic or if it is a new exercise for them.

Secondly, the network's objectives must be defined. To do this, the team behind the network will have to analyze individual strategies to take them into account in defining the

network's strategy. This phase is very important to include all the ILs in the network and for them to ensure that their participation serves their different strategies. Moreover, these places being very anchored in local dynamics it is important to take into account the context of these places. Indeed, geographical proximity is one of the barriers of collaborative project and it's an emerging factor [20], [24]. However, in order to be complementary to the other actors and not to add competition, it is necessary to go beyond the simple geographical proximity and to analyze the role and the evolution trends of each actor of the local territory (close to the IL). They must analyze the strategies of the territory where the network will be located as well as identify trends/issues of the stakeholders of this local territory (communities, companies, universities...). Moreover, to identify which actors have the power to act, to block.

Then, a workshop could be organized with all the ILs to define a vision and operational objectives shared by all the potential members. Moreover, to have a network that has real added value and thus have actors involved and motivated, the expected impacts must be identified during this workshop. This helps to create meaning in the integration of this network. These impacts have to be specific, measurable, attributable, realistic, targeted [50]. Finally, following this workshop, the network's initiators will have to synthesize all the elements collected during the first workshop.

In the third phase, based on the strategies and objectives identified in the previous step, the organization of the network must be defined to answer the following questions: How will the network function? How will the governance be structured? And what economic model will support this network? Indeed, the governance structure depends on the desired objectives [31]. Moreover, because of the very variable activities of these places, the structure will have to be flexible and adaptable in order not to constrain these places that already have a lot of constraints in terms of their governance and their financing. Indeed, the management of the network must not be too institutionalized. Each IL must have the feeling of freedom/autonomy while recognizing itself in a common dynamic. Next, the members of the network will co-designed roles and responsibilities according to their innovation process, interests, stakeholders, skills and functioning (such as orchestrator, communicator, facilitator, gatekeeper, visionary/weaver or active member inspired by the roles already present in the ILs so as not to create difficulties in identifying these roles) [5], [16], [51], [52]. Ideally, these roles should be assigned to the ILs and the initiator of the network (if not an IL) should not take on a role in order to let the network function in an autonomous and flexible way. This will then define the process of interaction and innovation that the network will have.

Finally, one of SFC is to formalize the network. So, the formalization can take the form of a detailed manifesto which resume the shared goal and all the decisions taken during the previous steps. This step permit to keep track of the commitment of each IL in the network.

Types	Factors	References	Solution 1: Reiner et al 2008					Solution 2: Sandford 2022					Solution 3: ISO 44001					Solution 4: Bryson et al 2006					Solution 5: Achelli 2007							
			Step 1	Step 2	Step 3	Step 4	Step 5	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9	Step 1	Step 2	Step 3	Step 4	Step 5	Step 1	Step 2							
SFC 1	Organization of the internal functioning, acceptance of difference	(11)-[13], [42], [44], [46]-[49]	9					9	1														9							
SFC 2	History/experiences of collaboration	(12), [30], [44]-[50]	9					9															9							
SFC 3	Shared common goal	(17), [42], [46]-[48], [50]-[52]	9					9	1														9							
SFC 4	Flexibility	(44), [48], [50]	3	9				3	3	1													3							
SFC 5	Defined interaction process / innovation process	(8), [17], [42], [48], [51]								9	3	9											9	9						
SFC 6	Roles and complementarities	(11), [12], [30], [42], [46]-[48], [50], [51], [53]	9					9		3	3	1											3	3						
SFC 7	Strategy definition	(11), [12], [46]	9					3	3	1																				
SFC 8	Facilitators	(12), [48]-[50]						1	9																					
SFC 9	Management commitment, involvement, and support	(12), [44], [49], [53]						1																1						
SFC 10	Formalization	(11), [30], [45]-[48], [53]						1																3						
SFC 11	Project management	(12), [44], [45], [48]-[50]						9	3															3						
SFC 12	Resources sharing	(12), [42], [45]-[48], [50], [52], [53]						9		3	1													3						
SFC 13	Communication	(11)-[13], [42], [44], [47]-[50], [53]	3					3	3	1	3													9						
SFC 14	Decision-making	(12), [50], [51]						9		3	3																			
SFC 15	Conflict management	(12), [30], [42], [48], [52]	3	3				3	3																					
SFC 16	Outcomes and impacts	(12), [30], [44], [45], [47], [49], [52]						3	9															9						
SFC 17	Performance assessment (satisfaction, commitment...)	(32), [36], [42], [47], [48]						3																3						
SFC 18	Knowledges management	(45), [46], [48], [53]						9																						
SFC 19	Trust	(12), [13], [30], [39], [42], [44], [46]-[50], [52], [53]						9	3															9						
SFC 20	Recognition, reward	(44), [45]	1					1																						
SFC 21	Context analysis	(11), [30], [31], [42]	2					3																3						
EF 1	Geographical proximity	[13]	3					9	3																					
EF 2	Relationship management capacity	[28]						1																						
EF 3	Resources, knowledge, skills and capacity of the structure	[13], [28]	9	3				1																						
EF 4	Transitivity: One actor already has links with another, facilitates collaboration with an other	[13], [27], [28]																												
EF 5	Reciprocity : identity complementary element	[13], [26], [27]	3	1																				3						
EF 6	Homophily : identity commonalities	[13] [27]	3					1																						
EF 7	Reputation of the partner	[13]																						1						
EF 8	Informal interpersonal relationship	[13]																						1						
EF 9	Evolution of the market, of the society: opportunities	[26], [27]	3					9	3															9						
			37	36	50	59	35	24	18	36	31	17	19	9	4	22	11	70	12	36	6	24	35	56	22	7	18	111	21	24
			381	843	1283	1295	713	345	516	623	714	325	493	177	100	245	131	1499	249	783	157	570	438	1314	428	137	462	1128	627	567

TABLE I. MATRIX OF COMPARISON OF STPE AND SFC AND EF.

### 3. Dynamization phase

During this phase, the members of the network will have to define what type of animation they want (monthly meeting, thematic day, conference, creativity day to make collaborative projects emerge, proposal of project ideas by the initiators of the network following an active watch, open events on the territory to make communication). This phase is certainly the most complex because it is necessary to consider the already very dense individual workload in these ILs. This network should not add work to these places but rather find a way to make their life easier to find new projects, new funding, new knowledge etc.

Thanks to the phase 1, each of IL's needs and particularities will have to be considered and the orchestrator, gatekeeper and facilitator have to develop a process of resource sharing, knowledge management and decision-making process shared with the network members, accordingly these particularities. Defining all these elements in advance should reduce the occurrence of problems and should facilitate future decisions making.

This phase will have to be monitored continuously to adapt the functioning to facilitate interactions and exchanges. Furthermore, the IL have to learn how to overcome conflicts and thus maintain the involvement of all members.

### 4. Analysis and improvement phase

This phase must first be carried out with all the actors concerned by this network dynamic. Indeed, each of them will have to participate in the selection of indicators that will be used to analyze the evolution of the dynamics. The choice of indicators will be essential for a good monitoring of the network. The indicators will have to allow the analysis of the quality of the network functioning as well as its impacts. Finally, the members of the network will have to define by which means the data will be collected and how the results will be presented. This phase can be managed by the orchestrator.

Setting up a network is an iterative process, it can start with the structuring phase, the emergence phase or the animation phase. The emergence phase is not always explicitly carried out. The figure 2 presents a synthesis of the method designed to monitor a network.

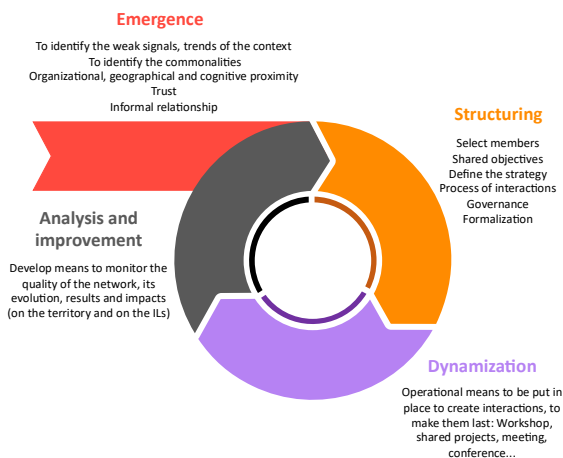


Fig. 2. Framework to monitor a network of ILs.

## V. CONCLUSION AND DISCUSSION

This article describes a networking framework designed for ILs. We supposed that the involvement of ILs could be promote by collaboration. However, we have to implement and analyze this novel framework in several real context to confirm or not this assumption, model and overcome one of the limitations of this research.

We assume the proposed framework is flexible enough to be adapted to the operation of ILs. Indeed, it considers the specific elements of these ILs (complex governance, varied strategy, financial stability, variety of actors, culture of collaboration and sharing, diversity of context).

After the identification of the factors of success of a collaboration, the comparison of five frameworks permitted to build a framework allowing to consider all the factors of emergence and success of a collaboration. Further research is needed to develop each phase of this framework to identify operational and concrete means to animate and maintain the collaborative network. Having a visual representation of the different sequences to follow can make the process more operational for stakeholders involved in daily activities.

Further research is needed to monitor the evolution of the IL network and their impact, indicators could be used. But in the literature, there is still little investigation of the impact assessment issues of these ILs [7], [9], [63]. These ILs are real catalysts of innovation [9] and each IL being specialized in one of the dimensions of the territory (economic, political, ecological, and social) [10], [12], [64], networking them would allow to develop the territory at the same time and with the same ambition all these aspects of a territory. The added value they could bring to a territory by working together and combining their strengths is not yet studied enough. While, due to the complexity of the current transition issues, the impact of these places on creativity [10] and innovation [9] is the key to developing disruptive systemic innovations, but this is still little studied [1], [12]. With this work we wish to contribute to fill these gaps, by taking maximum advantage of all the diversities of ILs which can be present on a territory.

Many questions still need to be explored: how to avoid the risk of institutionalizing a network whose success depends a priori on the appropriation that its members will make of it? how to avoid falling into a top-down process, which is counterproductive to collaboration? how to encourage collaboration and not force it?

### MATCH & CONTRIBUTION

Nevertheless, this paper contributes to the Field of Interest of IEEE Technology & Engineering Management Society (TEMS) thanks to this original contribution related to a transitioning management of the innovation labs on a local territory. This novel framework could permit to increase the socioeconomic impact of different ILs. This collaborative network has the ambition to facilitate the emergence of innovative projects that ask for multi-stakeholders' involvement and the crosspollination of various skills and knowledges such as the need for territorial issues (climate change, social and economic transition, etc.) This proposal to provide ILs with keys to better collaborate at the scale of local territories is a new trend in the literature.



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## REFERENCES

- [1] S. Zivkovic, “Systemic innovation labs: a lab for wicked problems,” *Social Enterprise Journal*, 2018, doi: 10.1108/SEJ-04-2018-0036.
- [2] L. Kutter, P. Wolf, and C. S. Rothbarth, “Shall we dance? How systemic intermediaries coordinate interaction within local sustainability initiatives over time,” *Creativity and Innovation Management*, no. January, pp. 1–17, 2023, doi: 10.1111/caim.12544.
- [3] M. Bergmann *et al.*, “Transdisciplinary sustainability research in real-world labs: success factors and methods for change,” *Sustain Sci*, vol. 16, no. 2, pp. 541–564, 2021, doi: 10.1007/s11625-020-00886-8.
- [4] A. B. Memon, K. Meyer, M. Thieme, and L. P. Meyer, “Inter-InnoLab collaboration: An investigation of the diversity and interconnection among Innovation Laboratories,” *Journal of Engineering and Technology Management*, vol. 47, pp. 1–21, 2018, doi: 10.1016/j.jengtecman.2017.11.003.
- [5] F. Osorio, “Management of innovation labs: an enabling methodological approach for strategic intent design,” PhD Thesis, Université de Lorraine, 2021.
- [6] M. Bel, “Compétences et dynamiques territoriales: Quelles interactions?,” *Geographie Economie Societe*, vol. 11, no. 3, pp. 213–232, 2009, doi: 10.3166/ges.11.213-232.
- [7] K. P. W. Kok, M. G. van der Meij, P. Wagner, T. Cesuroglu, J. E. W. Broerse, and B. J. Regeer, “Exploring the practice of Labs for sustainable transformation: The challenge of ‘creating impact,’” *J Clean Prod*, 2023, doi: 10.1016/j.jclepro.2023.135994.
- [8] A. B. Memon, K. Meyer, and M. N. Tunio, “Toward collaborative networking among innovation laboratories: a conceptual framework,” *International Journal of Innovation Science*, 2022, doi: 10.1108/IJIS-04-2021-0069.
- [9] G. Schiuma and F. Santarsiero, “Innovation labs as organisational catalysts for innovation capacity development: A systematic literature review,” *Technovation*, vol. 123, 2023, doi: 10.1016/j.technovation.2023.102690.
- [10] W. Magadley and K. Birdi, “Innovation labs: An examination into the use of physical spaces to enhance organizational creativity,” *Creativity and Innovation Management*, vol. 18, no. 4, pp. 315–325, 2009, doi: 10.1111/j.1467-8691.2009.00540.x.
- [11] L. Dupont, L. Morel, and C. Guidat, “Innovative public-private partnership to support Smart City: the case of ‘Chaire REVES,’” *Journal of Strategy and Management*, vol. 8, no. 3, pp. 245–265, 2015, doi: 10.1108/JSMA-03-2015-0027.
- [12] M. McGann, E. Blomkamp, and J. M. Lewis, “The rise of public sector innovation labs: experiments in design thinking for policy,” *Policy Sci*, vol. 51, no. 3, pp. 249–267, 2018, doi: 10.1007/s11077-018-9315-7.
- [13] P. Meister Broekema, E. A. M. Bulder, and L. G. Hurlings, “Same same, but different...? The emergence of Public Sector Innovation Labs in theory and practice,” *Management & Marketing. Challenges for the Knowledge Society*, vol. 17, no. s1, pp. 344–363, 2022, doi: 10.2478/mmcks-2022-0020.
- [14] M. A. Ondiek and C. Moturi, “An assessment of the sustainability of Living Labs in Kenya,” *Innovation and Management Review*, vol. 16, no. 4, pp. 391–403, 2019, doi: 10.1108/INMR-08-2018-0058.
- [15] F. Pruvot, L. Dupont, and L. Morel, “Collaborative networks between innovation spaces,” *IEEE International Conference on Engineering Technology and Innovation*, pp. 1–8, 2022.
- [16] K. Riemer and S. Klein, “Chapter 2 Network Management Framework,” in *Managing dynamic networks*, Springer, Berlin, 2008.
- [17] J. J. Porter and K. Birdi, “22 reasons why collaborations fail: Lessons from water innovation research,” *Environ Sci Policy*, vol. 89, no. December 2017, pp. 100–108, 2018, doi: 10.1016/j.envsci.2018.07.004.
- [18] A. Fasoli and S. Tassinari, “Engaged by Design: The Role of Emerging Collaborative Infrastructures for Social Development. Roma Makers as A Case Study,” *The Design Journal*, 2017, doi: 10.1080/14606925.2017.1352819.
- [19] C. Scholl, J. de Kraker, and M. Dijk, “Enhancing the contribution of urban living labs to sustainability transformations: towards a meta-lab approach,” *Urban Transform*, vol. 4, no. 1, 2022, doi: 10.1186/s42854-022-00038-4.
- [20] H. Achelhi, “Le pilotage du processus d’émergence d’un réseau coopératif: analyse des réseaux de proximité géographique,” 2007.
- [21] C. Garnier, “Les FabLabs, un réseau mondial et en croissance d’organisations collaboratives: une analyse des modes de coordination intra et inter-organisationnels,” pp. 1–340, 2020, [Online]. Available: <https://tel.archives-ouvertes.fr/tel-03105756%0Ahttps://tel.archives-ouvertes.fr/tel-03105756/document>
- [22] F. Osorio, L. Dupont, M. Camargo, P. Palominos, J. I. Peña, and M. Alfaro, “Design and management of innovation laboratories: Toward a performance assessment tool,” *Creativity and Innovation Management*, vol. 28, no. 1, pp. 82–100, 2019, doi: 10.1111/caim.12301.
- [23] N. G. Manuel Zacklad, Béa Arruabarrena, Anne Berthier-Ponce, “Les labs d’innovation interne: typologie des innovations, approche plateforme, rôle du design,” *DICEN IdF | « Approches Théoriques en Information-Communication (ATIC) »*, pp. 127–161, 2021.
- [24] L. Dupont *et al.*, “Collaborative Innovation Projects Engaging open communities: a Case Study on Emerging Challenges,” *23rd ICE/IEEE Inter-national Conference on Technology, Management and Innovation*, 2017.
- [25] U. Pawlicka-deger, “A Laboratory as the Infrastructure of Engagement: Epistemological Reflections,” *Open Library of Humanities*, 2020.
- [26] E. Wascher, C. Kaletka, and J. Schultze, “Social innovation labs - a seedbed for social innovation,” *Ecosystem and infrastructure for social innovation*, 2019.
- [27] M. Hossain, S. Leminen, and M. Westerlund, “A systematic review of living lab literature,” *J Clean Prod*, vol. 213, pp. 976–988, 2019, doi: 10.1016/j.jclepro.2018.12.257.
- [28] D. J. Brass, J. Galaskiewicz, H. R. Greve, and W. Tsai, “Taking stock of networks and organizations: A multilevel perspective,” *Academy of Management Journal*, vol. 47, no. 6, pp. 795–817, 2004, doi: 10.2307/20159624.
- [29] C. L. Cantù, D. Schepis, R. Minunno, and G. Morrison, “The role of relational governance in innovation platform growth: the context of living labs,” *Journal of Business and Industrial Marketing*, vol. 36, no. 13, pp. 236–249, 2021, doi: 10.1108/JBIM-02-2020-0114.
- [30] F. Fulconis, B. Meurier, and G. Paché, “Capacités dynamiques, réseaux et chaînes logistiques,” *Revue internationale des sciences de l’organisation*, pp. 43–78, 2019, doi: 10.3917/riso.007.0043.
- [31] S. Leminen, A.-G. Nyström, M. Westerlund, and M. J. Kortelainen, “The effect of network structure on radical innovation in living labs,” *The Journal of business & Industrial Marketing*, 2016.
- [32] J. Hagedoorn, “Inter-firm R&D partnerships: an overview of major trends and patterns since 1960,” *Res Policy*, vol. 31, pp. 477–492, 2002.
- [33] B. Kogut, “The network as knowledge: generative rules and the emergence of structure,” vol. 425, pp. 405–425, 2000.
- [34] Y. Atouba and M. Shumate, “Interorganizational Networking Patterns Among Development Organizations,” vol. 60, pp. 293–317, 2010, doi: 10.1111/j.1460-2466.2010.01483.x.
- [35] G. Levanti, “Governing Complex Strategic Networks:,” in *Governing Business Systems*, 2018, pp. 49–65. doi: 10.1007/978-3-319-66036-3.
- [36] A. Sandford, “Proposition d’une méthode de conception et de gestion de structures collaboratives inter-filiales: Application à la création d’offres innovantes pour les territoires de demain,” 2022.
- [37] J. M. Bryson, B. C. Crosby, and M. M. Stone, “The design and implementation of cross-sector collaborations: Propositions from the literature,” *Public Adm Rev*, vol. 66, no. SUPPL. 1, pp. 44–55, 2006, doi: 10.1111/j.1540-6210.2006.00665.x.

- [38] ISO, "Collaborative Business Relationship Management Systems complete package," *Guidance (ISO Standard No. 44001)*, pp. 1–6, 2019.
- [39] P. Graça and L. M. Camarinha-Matos, "Performance indicators for collaborative business ecosystems — Literature review and trends," *Technol Forecast Soc Change*, vol. 116, pp. 237–255, 2017, doi: 10.1016/j.techfore.2016.10.012.
- [40] P. J. P. Garbade, "Management of Innovation in Networks and Alliances," *PQDT - Global*, p. 127, 2014, [Online]. Available: [https://www.proquest.com/dissertations-theses/management-innovation-networks-alliances/docview/2580961584/se-2?accountid=13042%0Ahttp://oxfordfx.hosted.exlibrisgroup.com/oxford?url\\_ver=Z39.88-2004&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:dissertation&genre=dissertation](https://www.proquest.com/dissertations-theses/management-innovation-networks-alliances/docview/2580961584/se-2?accountid=13042%0Ahttp://oxfordfx.hosted.exlibrisgroup.com/oxford?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:dissertation&genre=dissertation)
- [41] J. Hope Corbin, J. Jones, and M. M. Barry, "What makes intersectoral partnerships for health promotion work? A review of the international literature," *Health Promot Int*, vol. 33, no. 1, pp. 4–26, 2018, doi: 10.1093/heapro/daw061.
- [42] E. Giangreco, L. Marasso, V. Chetta, L. Fortunato, and C. Perlangeli, "Modeling tools of service value networks to support social innovation in a Smart City," *Innovation and the Public Sector*, 2014, doi: 10.3233/978-1-61499-429-9-206.
- [43] J. P. Cap, E. Blaich, H. Kohl, A. von Raesfeld, R. Harms, and M. Will, "Multi level network management – A method for managing inter-organizational innovation networks," *Journal of Engineering and Technology Management - JET-M*, vol. 51, no. August 2017, pp. 21–32, 2019, doi: 10.1016/j.jengtecman.2019.02.001.
- [44] V. Mankevich, "Managing Innovation Networks: Exploring Coopetition Dynamics in Innovation Ecosystems," *Research grant*, pp. 1–31, 2014.
- [45] L. Dupont, J. Mastelic, N. Nyffeler, S. Latrille, and E. Seulliet, "Living lab as a support to trust for co-creation of value: application to the consumer energy market," *Journal of Innovation Economics & Management*, vol. n° 28, no. 1, pp. 53–78, 2019, doi: 10.3917/jie.028.0053.
- [46] M. O'Dwyer, R. Filieri, and L. O'Malley, "Establishing successful university–industry collaborations: barriers and enablers deconstructed," *J Technol Transf*, no. 0123456789, 2022, doi: 10.1007/s10961-022-09932-2.
- [47] K. G. Provan and P. Kenis, "Modes of network governance: Structure, management, and effectiveness," *Journal of Public Administration Research and Theory*, vol. 18, no. 2, pp. 229–252, 2008, doi: 10.1093/jopart/mum015.
- [48] Y. Zare Mehrjerdi, "Quality function deployment and its extensions," *International Journal of Quality & Reliability Management*, vol. 27, no. 6, pp. 616–640, 2010, doi: 10.1108/02656711011054524.
- [49] M. R. A. Esmaili, B. Damari, A. Hajebi, N. Rafiee, R. Goudarzi, and A. Haghshenas, "Basic Criteria, Models, and Indicators of Intersectoral Collaboration in Health Promotion: A Scoping Review," *Iran J Public Health*, 2021, doi: 10.18502/ijph.v50i5.6103.
- [50] P. J. Gertler, S. Martinez, P. Premand, L. B. Rawlings, and C. M. J. Vermeersch, *Impact Evaluation in Practice*, no. January. 2010. doi: 10.1596/978-0-8213-8541-8.
- [51] A. G. Nyström, S. Leminen, M. Westerlund, and M. Kortelainen, "Actor roles and role patterns influencing innovation in living labs," *Industrial Marketing Management*, vol. 43, no. 3, pp. 483–495, 2014, doi: 10.1016/j.indmarman.2013.12.016.
- [52] V. Krebs and J. Holley, "Building sustainable communities through network building," *Social Network*, no. October, p. 17, 2002.
- [53] M. Hanid *et al.*, "Critical success factors (csfs) in university–industry collaboration (uic) projects in research universities," vol. 15, no. 2, pp. 1–23, 2019.
- [54] M. F. Ramli and A. A. Senin, "Factors Affecting Effective University Industry Collaboration During the Development Research Stage," *International Journal of Management Studies*, 2021, doi: 10.32890/ijms2021.28.2.6.
- [55] V. Pertuz, L. F. Miranda, A. Charris-Fontanilla, and L. Pertuz-Peralta, "University–industry collaboration: a scoping review of success factors," *Entrepreneurship and Sustainability Issues*, vol. 8, no. 3, pp. 280–290, 2021, doi: 10.9770/jesi.2021.8.3(16).
- [56] Y. Kim and K. Lee, "Technological collaboration in the Korean electronic parts industry: Patterns and key success factors," *R and D Management*, vol. 33, no. 1, pp. 59–77, 2003, doi: 10.1111/1467-9310.00282.
- [57] C. Yoon, K. Lee, B. Yoon, and O. Toulan, "Typology and success factors of collaboration for sustainable growth in the IT service industry," *Sustainability (Switzerland)*, vol. 9, no. 11, pp. 1–20, 2017, doi: 10.3390/su9112017.
- [58] C. Wohlin *et al.*, "The success factors powering industry-academia collaboration," *IEEE Softw*, vol. 29, no. 2, pp. 67–73, 2012, doi: 10.1109/MS.2011.92.
- [59] P. W. Mattessich and B. R. Monsey, *Collaboration: What makes it work?* 1992.
- [60] C. Newell and A. Bain, "Defining Collaboration and Previewing Success Factors for Effective Collaboration," pp. 9–27, 2018, doi: 10.1007/978-981-13-1855-9\_2.
- [61] C. A. Moya Sedan, "Développement de la capacité à open innover des fournisseurs," 2021, [Online]. Available: <http://www.theses.fr/2021LORR0006>
- [62] K. Väyrynen and M. Kinnula, "Differences between success factors of IS quasi-outsourcing and conventional outsourcing collaboration: A case study of two Finnish companies," *Electronic Markets*, vol. 22, no. 1, pp. 49–61, 2012, doi: 10.1007/s12525-011-0079-6.
- [63] K. Bronson, R. Devkota, and V. Nguyen, "Moving toward generalizability? A scoping review on measuring the impact of living labs," *Sustainability (Switzerland)*, vol. 13, 2021, doi: 10.3390/su13020502.
- [64] F. Kasmi, F. Osorio Bustamente, L. Dupont, B. Marche, and M. Camargo, "Innovation Spaces as Drivers of Eco-innovations Supporting the Circular Economy: A Systematic Literature Review," *Journal of Innovation Economics & Management*, 2021, doi: 10.3917/jie.pr1.0113.

APPENDICES

	EF 1	EF 2	EF 3	EF 4	EF 5	EF 6	EF 7	EF 8	EF 9	Importance of the factor
EF 1	1	0	0	0	0	0	0	0	0	5
EF 2	1	1	0	0	0	0	1	2	0	5
EF 3	2	2	1	0	0	0	1	2	0	9
EF 4	0	1	0	1	0	0	1	1	0	3
EF 5	2	2	2	2	1	1	2	2	1	14
EF 6	2	2	2	2	2	1	2	2	2	15
EF 7	2	1	1	1	0	0	2	2	0	7
EF 8	0	0	0	1	0	0	0	2	0	1
EF 9	2	2	2	2	1	0	2	2	2	13

TABLE II. CALCULATION OF THE IMPORTANCE OF EF .

	SFC 1	SFC 2	SFC 3	SFC 4	SFC 5	SFC 6	SFC 7	SFC 8	SFC 9	SFC 10	SFC 11	SFC 12	SFC 13	SFC 14	SFC 15	SFC 16	SFC 17	SFC 18	SFC 19	SFC 20	SFC 21	Importance of the factor
SFC 1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
SFC 2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
SFC 3	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30
SFC 4	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23
SFC 5	1	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
SFC 6	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
SFC 7	2	2	1	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
SFC 8	1	2	0	1	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	21
SFC 9	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
SFC 10	0	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	5
SFC 11	1	2	1	1	2	1	1	1	2	2	0	0	0	0	0	0	0	0	0	0	0	26
SFC 12	1	2	0	0	0	0	0	0	2	2	1	1	1	1	1	1	1	1	0	0	0	10
SFC 13	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	30
SFC 14	2	2	1	1	1	1	0	0	2	2	1	2	1	1	1	0	0	0	0	0	0	21
SFC 15	2	2	0	1	1	1	0	0	2	2	1	1	1	1	1	0	0	0	0	0	0	23
SFC 16	2	2	1	0	1	1	1	1	2	2	1	2	2	2	2	2	2	2	2	2	2	32
SFC 17	2	2	0	0	0	0	0	0	2	2	1	2	2	2	2	0	0	0	0	0	0	22
SFC 18	2	2	0	1	1	1	0	0	2	2	1	2	1	1	1	0	0	0	0	0	0	22
SFC 19	2	2	2	2	2	2	2	2	2	2	2	2	1	1	2	2	2	1	1	1	1	35
SFC 20	0	1	0	0	0	0	0	0	1	1	0	1	1	1	0	0	0	0	0	0	0	6
SFC 21	1	1	0	1	2	2	1	1	2	2	0	2	0	0	0	1	1	2	1	2	2	22

TABLE III. CALCULATION OF THE IMPORTANCE OF SFC .