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Authors	Elena LÓPEZ-GUNN, Julian SWINKELS, Mara DEKSNE
Institution Email	Elopezgunnicatalist.eu



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List of contributors

- Gerardo ANZALZUA (Ecologic Institute, Germany)
- Sebastiano CARRER (Thetis, Italy)
- Conceicao COLACO (ISA, University of Lisbon, Portugal)
- Sergio CONTRERAS (FutureWater, Spain)
- Alexandru GHEORGE (Rumanian Waters, Romania)
- Adrian GEORGICA (Rumanian Waters, Romania)
- Marco HARTMAN (HKV, Netherlands)
- Nensi LAJAJ (AKPT, Albania)
- Hugh Macdonald (Ecologic, Germany)

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1. Rationale

This document presents the draft paper that will be submitted as a Paper for a Special Issue on the THE FUTURES OF COMMUNITIES - Call for Papers for the Futures Journal (<https://www.journals.elsevier.com/futures/call-for-papers/the-futures-ofcommunities>)

Guest editors: Fabrice Roubelat, University of Poitiers, Graduate School of Business fabrice.roubelat@univ-poitiers.fr Anne Marchais-Roubelat, Conservatoire National des Arts et Métiers - Paris anne.roubelat@lecnam.net Jamie Brassett, Central Saint Martins, University of the Arts London j.brassett@csm.arts.ac.uk

It provides a summary of the work undertaken during the BRIGAIID project in relation to the creation of Communities of Innovation since the onset of the project.

It introduces the concept of communities of innovation, their context in an innovation ecosystem to then present the results from a process of evaluation and reflection on these communities of innovation, how these COIs emerged, their main roles and their main outputs and lessons learnt.

2. Draft Paper (overleaf)

Communities of Innovation for climate change adaptation and disaster risk reduction: market creation and anticipation¹

Authors: Elena LÓPEZ-GUNN^{a2}, Julian SWINKELS^b and Mara DEKSNE^b,

Contributors and Future Co-authors: (to be validated): Gerardo ANZALZUA, Manuel BEA, Sebastiano CARRER, Conceicao COLACO, Sergio CONTRERAS, Alexandru GHEORGE, Adrian GEORGICA, Marco HARTMAN, Nensi LAJAJ, Hugh Macdonald and Marta RICA.

"Innovation will drive the future of our economy. What happens in your community will largely be determined by you. The communities that position themselves to take advantage of the entrepreneurial sector and companies, businesses and individuals that have the education, background and ability to generate innovation are going to drive the economy in the future. They're going to create the jobs and the opportunities for our young folks.-

STEVE CARTER Iowa State University Research Center and Pappajohn Center for Entrepreneurship.

"There is no power for change greater than a community discovering what it cares about." – Margaret J. Wheatley

1. Introduction

A community of innovation (COI) is one of the most relevant organizational forms to support innovation (Montoro-Sanchez et al., 2011). COIs are defined as a subset of 'Communities of Practice' that are dedicated to fostering innovation (Cooke and Smith, 2007). These Communities of Innovation (COIs) are conceived as social networks, composed by several geographically connected actors in one field or in different disciplines but with a common goal or aim. The network of COIs can provide valuable input, feedback and support for the creation of innovations. These networks of organizations and individuals combine business, policy, funding, finance and management sectors, focused on bringing new products, new processes and new

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² Corresponding author: elopezgunn@icatalist.eu

forms of organization. Whilst COI's were initially introduced as a concept for organisations, it has also become a relevant tool for governments to initiate innovative projects for local development (Elia et al. 2016). Additionally, COIs ideally involve innovators, managers, practitioners, researchers, funders and decision-makers in search of solutions. The actors involved for vulnerability reduction on specific conditions and hazards, bringing innovation to address climatic events with a focus on adaptation solutions.

This paper explores the role of Communities of Innovation (COI) in bringing innovations to market and anticipating threats in the field of disaster risk reduction. The paper is structured in the following way; first we present what is (and what it is not) for a Community of Innovation, and its framing within an innovation ecosystem, to then discuss the added value of Communities of innovation, the second section presents the methods used, based on a literature review and an innovative method, the use of Samoa circles with experts to help characterise the key elements of our emerging communities of innovation, the third section presents our results based on in depth qualitative interviews with the leaders of communities of innovation, to then conclude in the final section.

In the context of this paper, innovation can be defined as the “production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome” (Edison *et al*, 2013). In 2020, there was an agreement reached by ISO ISO 56000 Fundamentals and vocabulary (2020) which defines “innovation as new or changed entity (4.2.5), realizing or redistributing value”, where ‘New or changed entity’ corresponds to ‘a new or improved product or process, or combination thereof, that differs significantly from the unit’s previous products or processes’ and ‘Realizing or redistributing value’ corresponds to ‘and that has been made available to potential users or brought into use by the unit’. In this definition of innovation it is important to also consider the specific case of social innovation, From a social innovation perspective, COIs would also include “the generation and implementation of new ideas about how people should organize interpersonal activities or social interaction, to achieve one or more common good goal” (Mumford, 2002). Therefore, these Communities of Innovation would be considered successful if their activities support innovative activities (process) or results (outcomes) like the ones outlined in Box 1.

The main elements or ingredients defining the COI are: a) champions and their networks, b) safe places (real or virtual) for the creation and support of innovative ideas and c) focus on a common goal, not because of orders from their superiors, but because these different actors form a community convinced on their common cause. In this paper we focus specifically as a specific future oriented type of Community of Innovation namely those that are focused on creating, accelerating and scaling solutions to the potential impacts from climate change.

KEY DESCRIPTORS FOR A COI	BRIGAIID D&C STRATEGY
CHAMPION(S) OF THE COI	Who leads, who supports, nature and type of social network
NATURE OF THE COI	Who participates; composition diversity of actors; level of interaction; interdependency)
FOCUS OF THE COI	Thematic common objectives and motivation
SCALE OF THE COI	Local, regional, national, international
TYPE OF INNOVATION	Technological, social, socio-technical, etc

Table 1. Key descriptors used for Communities of Innovation

In terms of the typology of actors in this network - and of their champions - one of the main defining elements as a working hypothesis is that a successful community of innovation has a triangular structure composed of actors on the demand side, those that face specific problems, in our case related to climate change impacts like floods, droughts or other extreme weather; those that offer specific solutions to these problems (in our case climate change impacts) like for example rainwater harvesting for drought, inflatable barriers for floods or smart roofs that cool houses for e.g. heat waves. The final element is the funder or financier that invests in these innovations in their different stages of development (from ideation to replication and upscaling). In some cases the end user or problem owner might become the funder, but this is not always necessarily the case, thus we deal with on the one hand risk reduction emerging from the

solutions provided but also the risk inherent to innovation and how this is shared between the actors to allow innovation to happen in emerging fields, like climate change impacts, which are inherently highly uncertain in both time and space.

Box 1: COI functions- potential innovation activities and outcomes from Communities of Innovation (source: Horizon 2020 programme)

- innovation that results from research and development (R&D) activities
- developing new business models
- new uses or combinations of existing technologies
- new ways of interacting with users
- commercial introduction of a new or significantly improved product or service,
- non-commercial applications e.g. better public services
- innovations to address social needs ('social innovation')
- renewal and enlargement of products, services, and markets

1.1. What a Community of Innovation is and is not, in comparison to an innovation ecosystem

The challenge of innovation management has evolved from technology-based product and process management to much more open, network-based value creation which now merges with ecosystem thinking, i.e. the innovation ecosystem. Thus the functionality of an innovation ecosystem can be compared with that one of a natural ecosystem (Jackson, 2011). Natural ecosystems are based on a complex set of relationships among the living resources and habitats that maintain a balanced state. In a similar way, an innovation ecosystem models the complex relationships that are formed between actors or entities whose goal is to enable technology development and innovation, in our case the creation and support of an innovation ecosystem around climate change adaptation.

What makes ecosystems of innovation different to the other concepts, is the dynamism and complexity of the relationship between its different components. The context for the whole ecosystem (see figure 1) is determined by the regulations, standards and the fiscal environment set by public authorities. In the so-called six generations of innovation, the focus is on the open innovation model based on the assumption that 'innovation is a distributed process across many

actors, companies and other organisations, and is influenced by regulation, policy and social pressure. Innovation occurs in the context of an ecosystem, with different actors taking part in the process:

- large and small companies, including start-ups, that commercialise innovations;
- universities and research-performing organisations that train people and produce new knowledge;
- venture capital, research-funding organisations and other financial institutions that provide funding for R&D activities and business development;
- government actors influencing the innovation environment through policies, regulations and the adoption of standards.

The establishment of Communities of Innovation (COIs) at different scales is based on the potential for first, providing structured opportunities either physically or virtually, for networking, second their role to facilitate interaction between the actors that make the COI and third, provide an opportunity for a deeper exploration with these actors on what are the key elements (drivers and opportunities) to sustain this interaction over time in order to achieve the end goal: create a viable innovation ecosystem for climate change adaptation that stimulates market creation (supply and demand) for solutions to climate change impacts for increased resilience.

It is also important conceptually to differentiate COIs from other types of organisational structures like Clusters of innovation, Living Labs, Innovation Accelerators or Incubators. Innovation clusters have a much more formal structure and are often supported by a public body and are much more geared to specific production chains. An innovation cluster is composed by a series of regional actors, with different modes of creation, financing, and operation, depending on the country and the given region. Innovation has proved to perform better in clusters (Muro and Katz, 2010), and have become a popular instrument for innovation policy activities at regional scale. Clusters are economic networks of firms, knowledge producing agents, bridging institutions and customers, linked to each other in a value-adding production chain. The focus is on the linkages and interdependence between actors in the network of production when generating products and services and creating innovations. Communities of Innovation meanwhile are less formal (or formalized) and are less geographically constrained, in the sense that COIs can focus on a local scale, a regional, national or international scale.

Meanwhile a Living Lab is a network that integrates both user-centred research and open innovation³. Following the open innovation approach means that for example a company can use external resources and in turn make available their own innovations to other organizations. The use of living labs has emerged as a novel form of creating competences and competitive advantage⁴. An increasing number of managers are interested in living labs to transform their conventional R&D organizations to follow an open-innovation model (Westerlund and Leminen, 2011).

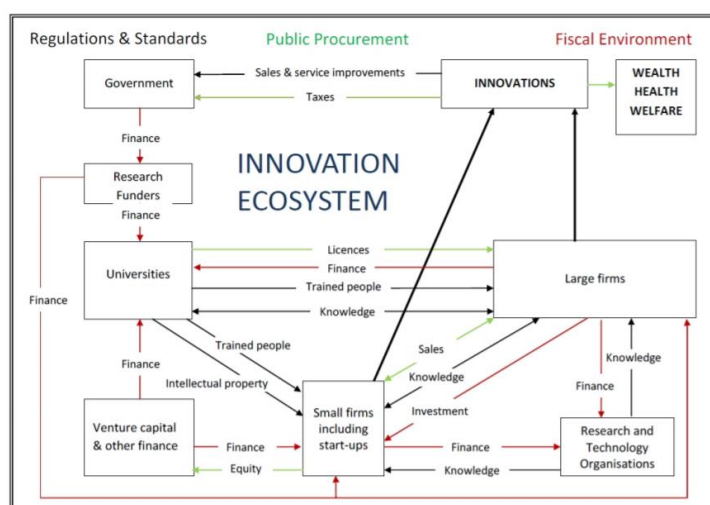


Figure 1. Innovation Ecosystem (source: Giorgiou, 2015)

³ Open innovation is “the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively.” There are two facets to open innovation. One is the “outside in” aspect, where external ideas and technologies are brought into the firm’s own innovation process. This is the most commonly recognized feature of open innovation. The other, less commonly recognized aspect is the “inside out” part, where un- and under-utilized ideas and technologies in the firm are allowed to go outside to be incorporated into others’ innovation processes. (Chesbrough, 2011)

⁴ A good example is the Massachusetts Institute of Technology (MIT) with its Media Lab first explored the concept of living lab, and now promotes research and innovation through different living labs, like the City Science project in Andorra³, where the MIT Media Lab’s City Science research group, the University of Andorra, and national and international companies are collaborating in order to bring an innovative ecosystem into the capital of Andorra, engaging local stakeholders on how to improve urban development and planning

Open innovation builds on intense co-development with users and the end result is expected to better solve customers' needs and wants. Therefore, users are innovators, co-designers, co-producers, and entrepreneurs regarding new products and services (Pascu and van Lieshout, 2009). The main differentiating elements of a COI to a Living Labs involve a broader end-user involvement and often follow a structured process of needs assessment, ideation, strategy and implementation. COIs have similarities and differences with Living Labs, similarities in terms of the process and (some COIs) operate at a local scale followed and some differences since COIs are more narrow in the scope of participants (end users with specific problems, funders and financiers as key actors, and also the specific focus on innovation and the creation and sustainability of an innovation ecosystem).

Finally, the term 'innovation ecosystem' is a group of actors who are interconnected and interdependent and set for the co-creation of value. The term 'innovation ecosystem' originally stems from 'business ecosystem' but has increasingly come to replace the concept within academic literature (de Vasconcelos Gomes et al., 2018). One of the core differences is that a business ecosystem refers to value capture whereas an innovation ecosystem predominates value creation over value capture. Both ecosystems comprise two distinct economies, the research economy, which is driven by fundamental research and the commercial economy which is driven by the marketplace (Oh et al., 2016).

1.2. The expected added value of Communities of Innovation

One of the main added values from the creation and development of established Communities of Innovation is that these can help to facilitate the market outreach and uptake of innovative and operational products and solutions to climate change adaptation which is highly place- and context-specific case. Thus, each COI as was mentioned earlier aims to involve and bring together several actors, -specifically innovators, end users, leading sectoral users, investors and societal interest groups-, around common problems, e.g. risk reduction to a specific hazard or cluster of hazards, and environmental conditions. This is based on the premise that "innovation requires involvement from many actors and effective interaction amongst these, whilst recognizing the influential role of institutions in shaping how actors interact". COI's emerge as a set of networks of actors focused on bringing new products, new processes and/or new forms of organization into climatic events structures around adaptation solutions. In short, the key focus

and aim of our COIs is on innovations for climate change adaptation, thus their nature has to be open, emergent and flexible to adapt themselves to a dynamic, highly uncertain context. The value that is created predominantly lies in the rapid development of intellectual capital.

2. Methodology

This section will reflect on similar experiences in setting up CoPs and COIs that tackle issues related to climate change. The cases that will be examined come from the H2020 project Bringing INnovation to onGOing water management (BINGO) - a better future under Climate Change (2015-2019) which aimed at providing practical knowledge and tools to end users, water managers and decision and policy makers affected by Climate Change to enable them to better cope with all climate projections, including droughts and floods (Bingo, 2018). The CoPs were located across six research sites in Cyprus, Germany, Spain, Netherlands, Norway and Portugal.

The main reason for setting up a CoP in the case was to evolve researchers and stakeholders to start co-producing knowledge through shared visions that could serve both the stakeholders' concerns as well as a research purpose in subjects related to addressing climate change. In the setting up of a CoP, the Bingo project designed the following steps:

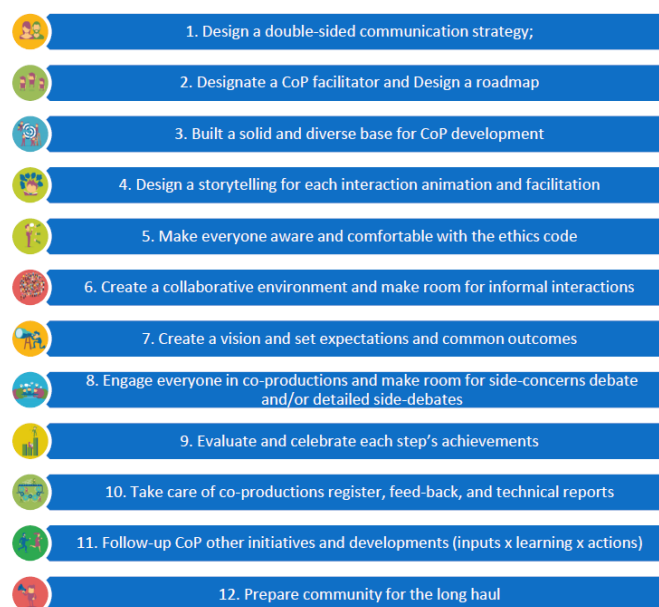


Figure 2. Development of Communities of Practice (source: H2020 BINGO Project)

Based on the outline above, the CoPs that evolved at each location identified actionable measures to tackle challenges specific to their region. For example, in The Netherlands, the CoP consisted of water authorities, organisation of private landowners, nature management organizations and on occasion also special interest groups such as tourist organisations and agricultural boards. Together, they identified and designed actions involving stakeholders through different collaborative platforms. Consequently, through sharing knowledge and perspectives and involving stakeholders in different collaborative platforms, the CoP managed to make groundwater a more prominent topic in the overall management of the Veluwe and also contributed to involving local stakeholders in different policy platforms.

Another example of a CoP in Wupper showed that the method described in figure X helped establish multidisciplinary working groups on the two most important issues for the Wupperverband: Urban Flooding in Wuppertal as well as Raw Water Shortage in the Große Dhün reservoir. Besides interests from stakeholders to participate in CoP workshops due to urban flooding, the CoPs also facilitated bilateral connections that helped to overcome barriers in data collection which was not always possible to pursue during discussions in the formal meetings with several stakeholders at once. In summary, the CoP gave multiple stakeholders facing the same risks a forum to discuss and work on adaptation strategies and measures.

The reflections show that once the communities are successfully established, these continue to collaborate in the future, whether it is through monitoring implemented projects, writing new proposals together or acting as a starting point for collaborating in other opportunities, members of the various CoPs all saw value in the interdisciplinary approach that was developed through the CoP in order to co-produce knowledge and ideas (Bingo, 2019).

2.2. Samoa Circles with experts and Interviews

In order to analyse the learnings and reflections from the communities of innovation developed, a series of in-depth 1-2 hour interviews were undertaken with the Community leaders or champions (see Annex 1). The questions identified for the Interview Guide (see Annex 2) for the interviews undertaken come as a result of the typology of Communities of Innovation which is presented in the next section and the results of the three separate expert Samoa circles held over the last

year. A Samoa circle is a type of exercise with a fluid, no-hierarchical dynamic to collect ideas and opinions that emerges as the exercise progresses. The Samoa circles held were centered on identifying the main elements that would make a Community of innovation, identified based on expert knowledge of the people participating in the Samoa Circles



Figure 1: Samoa Circle (European Innovation Partnership Session, Zaragoza, Spain Dec. 2019)

The results on the key elements of a COI were analysed and a typology of key characteristics identified are presented below.

EVENT	CONTEXT	NUMBER AND TYPE OF ATTENDEES
1st Samoa Circle Cartagena	BRIGAIID Project	25-30
2nd Samoa Circle Bucharest	Think Nature project	20
3rd Samoa Circle Zaragoza	EIP Water	15

Table 2. Samoa Circles hosted to obtain key elements in COIs based on expert knowledge

3. Results and Discussion

Communities of Innovation can be classified and thus characterised according to several criteria, namely the hazard, the scale and the anticipation through innovation of solutions to likely climate change regional impacts.

3.1. Typology of Communities of Innovation

In relation to type of hazards, we considered eight separate hazards that are going to be impacted under climate change, namely river floods, coastal floods, droughts, heavy precipitation, storms, hail, heatwaves and wildfires, which in turn we have grouped into three clusters of hazards: Floods, droughts and extreme weather. These COIs benefit from the work undertaken to map the future market scope for innovators in climate change adaptation in terms of the hazard increasing due to climate change. This is because in the case of climate change adaptation is often local and context specific and very dependent on the spatial variability of the expected impacts. Building on the work undertaken by ESPON-Climate project (ESPON, 2011) a map of the “typology of climate change regions” which clusters groups of European regions according to expected changes in eight climate variables, i.e. annual mean temperature, mean number of summer days, precipitation in winter and in summer months, days with snow cover, heavy precipitation, evaporation, and number of frost days. By clustering regions according to these variables, five clusters with different climate change profiles were identified, namely Northern Europe, Northern-Central Europe, Northern, Western Europe, Southern-Central Europe and Mediterranean region (see Figure 1A). This classification was adapted by considering the seven maps of potential impact for the hazards considered into the market scoping exercise and upscaling the classification from NUTS3 to NUTS2 level. Six different regions in terms of expected climatic changes and expected impact from the hazards were therefore considered as seen in an adjusted, finer resolution resulting map

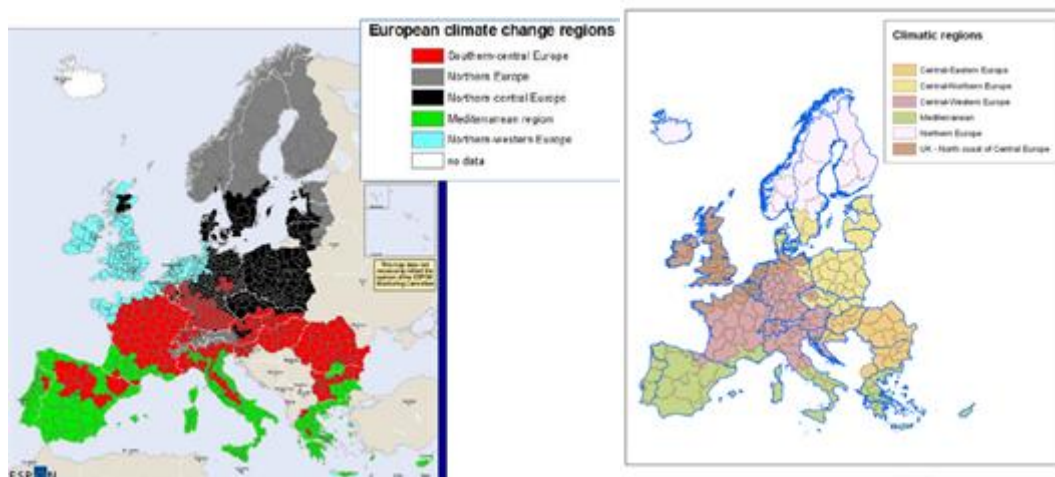


Figure 2 and 2B: European climate regions according to ESPON (2011) NUTS 2 level and BRIGAIID (2018) NUTS3 level

Therefore these maps on impact per hazard produced as part of the market scoping exercise can provide information on the relevance of building a COI as an anticipatory measure to build capacity and resilience as part of preparedness for future anticipated higher climate change impacts in the area.

In relation to scale, this is a relevant variable for the creation of the COI's since it can define the scale of operation. Adaptation is often a local or regional process that is based on the application of solutions either at city or municipality level, or even at the regional scale to deal with specific problems. The creation of local COI's in a city can act in a similar way to a Living Lab. The main differentiating element as outlined earlier is that a COI at local level has a specific remit: innovation to anticipate climate change impacts, plus the need to involve end-users and local communities in the co-creation and exploration of emerging ideas and innovative solutions, that will often need risk sharing in terms of both the effectiveness of the innovation itself but also in terms of funding through the ideation to the full implementation/replication funnel. In fact one of our COI has been designed around the actors testing solutions in one specific testing facility in Romania, replicating a similar process in the Netherlands (flood proof Holland to flood proof Romania).

Yet one of the elements of flexibility in COIs is that these can also zoom out and can operate at a broader scale. For example, national institutions have the potential to drive innovation through a wider resource availability, i.e. national adaptation plans, and their capacity to facilitate interaction

among stakeholders. A thematic COI operating at regional or national scale as an innovation cluster and supported by a public management body can provide an effective contribution to technology transfer, networking and dissemination of outputs and innovations. A regional/national COI should usually involve a bigger number of actors than a local COI and requires a larger critical mass of these to be effective. A marked difference to local emergent COIs is that the activity of large scale COI's may follow a top-down approach to inform other actors on the main findings and lessons learnt. Therefore, for both zooming in and out from this top down or bottom-up processes will often require the contribution of 'scale agents' or institutions that can facilitate the knowledge transfer to actors operating at a different scale.

Therefore an important analytical element for the effectiveness of COIs from creation, to growth and maturity could relate to scale and scalability, and to analyse the advantages and constraints linked to the scale of operation of each COI, as well as the drivers for the knowledge transfer across actors operating at different scales.

Several BRIGAD COI's emerged as a result of the activities being conducted by BRIGAD project. This process for the definition of COI's was supported through several activities and meetings, e.g. workshops on end-user over the last 3 years. All these are considered as the "frontrunner COI's" and provide a good representation of the different possibilities for the development of COI's in terms of hazards considered, scale of application and climatic regions in terms of expected impacts and changes. A new project (Act on NBS) will now build on this experience to try to develop local communities of innovation.

COMMUNITIES OF INNOVATION STUDIED	HAZARD	SCALE	CLIMATE CHANGE REGION	
			(ESPON, 2011)	(BRIGAD, 2018)
COI Cartagena	Droughts	Regional (Murcia)	Mediterranean	Mediterranean
COI Wildfires	Fires	Binational (Spain and Portugal)	Mediterranean	Mediterranean
COI Albania	All hazards	Albania	No data	No data

COI Antwerp	Pluvial floods	City of Antwerp	Northern western Europe	UK North coast of central europe
COI VP Delta	All Floods	Global	Northern western Europe	UK North coast of central Europe
COI Venice	Floods	regional	Mediterranean	Central western Europe
COI Rumania	Floods	national	Southern central Europe	Central eastern Europe

Table 3. Communities of Innovation

Lippitz et al (2012) summarizes what defines a COI, and includes two points related to the learning component:

Focus on learning and building capabilities to manage innovation and entrepreneurship, versus seeking specific business, macroeconomic or social results

Emphasize sharing and mutual learning among regularly involved participants from diverse organizations, industries and/or countries, toward building trust and relationships, as opposed to largely one-way instruction, as in training classes.

By taking into consideration this approach, there were two separate levels at the learning process produced as a consequence of the direct interaction of different actors within the COI's, on the one hand Internal learning produced within each COI valuable to manage and foster innovation, and on the other hand, mutual learning among COI's and identification of issues to be considered to facilitate a potential replication of activities from one COI to another, e.g, analysis of what worked well and what did not. In order to achieve this replication, the differences and commonalities in the context of each COI shall need to be determined and considered.

3.2. Key elements for the Characterization of Communities of Innovation

As was stated earlier the key elements used to characterise the communities of innovation was based on both the literature review undertaken as well as the results of three Samoa circles hosted with experts in three different locations. All these Samoa circles had two things in common: first, the Samoa circles were hosted during innovation, research and transfer events, and second, the participants came from different European countries. Table xx below summarises the key elements that are used below to discuss the main results that emerged from the interviews with our Community of Innovation leaders.

CODES	KEY ELEMENTS
Aims	Goals Problem ownership
Key elements	Awareness (ground/basic conditions) Facilitation and mediation/ Dialogue Leadership Trust
Space	Spatial focus Scale up the communities of innovations interCOI learning Meeting spaces (virtual or real)
Timescale	Gap between pilot and market
Cross actors	Gap between actors Interdisciplinarity/transdisciplinarity
Triangle	Key actors (innovators, end users and funders/financiers/investors)

Supply- Solutions (innovations)	From the supply side (innovator) Supply side- innovators Early stage TRL (TRL development stages) Middle TRL (TRL development stages) Public funds (early stages of innovation) Code of practice- commitment to development process
Demand- problems	From the Demand side Public Sector
Investors- Risk	From the investor side- effectiveness From the investor side Effectiveness of solutions supplied (insurance they work, guarantees)
Developing a COI	Creating a COI Sustaining a COI COI support Tools

Table 4. Key elements analysed in the Communities of Innovation

I. Main goals and scale

The main goals of the COIs centred on innovation and the adoption of innovation which was a stated focus for half of our COIs, together with climate change and environmental protection. Also important was the creation of a collaborative environment and investment into innovation, and cost savings from prevention

In our COIs four worked at the national level (Albania, Netherlands, Romania and Portugal) and three at regional or local level (Berlin, Venice and Mar Menor). In most of our COIs the possibility of scaling up was being considered. The reasons mentioned were various, from trying out implementation in different contexts and “exporting” the knowledge and lessons learnt, to having additional funding. In two cases case this was not considered since it was very locally based (Berlin and Mar Menor).

II. Composition and structure

The key stakeholders in the communities of innovation included innovators; government agencies; research institutes; industry; NGOs as business or farmers associations; general public; city planners. From this wide spectrum of stakeholders, all interviewees mentioned at least one governmental institution and innovators as the key stakeholders. The degree of involvement from the civic society ranged from none to communities open to parties outside the original structure (as in Romania or Berlin). In our context one of the key findings was the so called COI Triangle of the roles of innovator, end user and funder/financier which are fluid, i.e. end users can be innovators and often investors can find innovative financial structures.

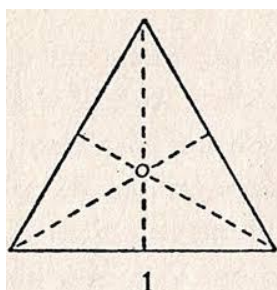


Figure 3: the COI Golden Triangle

Problem ownership was widely attributed to government agencies, as the problems central to the COI's impact the whole society, and it is seen as the responsibility of the government to protect from natural impacts like fires, floods, and other climate change outcomes. Other views of problem ownership were observed in Berlin, with rotating problem ownership, and ownership depending on the problem and expertise in Portugal.

A common feature illuminated by various respondents is that the organisational structure should be legally protected to display legitimacy. Some of the interviewees preferred informal, rotating leadership structures, while some believed that the governmental institutions should take the initiative in creating a sound structure. The "three ring" scheme was mentioned by Spain's COI representative: creating a core group, inner circle, and outer circle as a basis for the organizational structure.

Interview participants were asked how they could relate their community of innovation to the triangular structure of a COI that includes the demand side, innovation suppliers, and funding parties. A common feature in the answers was the lack of involvement from the investor's side or even a lack of this element in the equation. This could be explained by looking at the government's position as both the problem owners and funding parties that procure innovations for these problems.

Transdisciplinarity of expertise amongst the community members was observed in almost all COI's interviewed. For the COI of the Netherlands, only people dealing with water management were involved, however, their skill sets were still diverse. In all interviews transdisciplinarity was seen as a benefit for the community, and at times even a necessity, because the problems in focus were those of great complexity. An example was given by the project in Portugal, where the central issue - fire hazards - demanded solutions of technical, governmental, and psychological nature, therefore having a diverse crowd of community members was crucial for efficient problem solving.

III. Supply side- Innovators and innovations

In over half of the COIs (4 out of 7) we interviewed, solutions were provided (at least partially) by research institutions. Several COIs also mentioned that they collaborate with research institutions. 1 out of 7 also stated that they collaborate with private institutions to develop innovations. The solutions that are provided vary greatly within the COIs as some report to work mostly with early stage innovations with a technology readiness level (TRL) between 2-5 and others reported that they have innovations within their community that have already entered the market and have a TRL of around 8-9.

Funds for scaling innovations also impact the maturity of the COI as the more advanced regions claimed to have a local toolbox of funds they could tap into from either municipalities or other public authorities. The less advanced COIs claimed to be competing for funds at an EU level which makes it more challenging to make progress. Most progress with innovations is made once there is local commitment to accelerating these innovations.

In the quantitative survey we carried out to determine how advanced COIs perceived themselves to be, the results indicate that COIs perceive their greatest strength to be the facilitating and sharing of knowledge and bringing or generating new opportunities. At the other end of the spectrum, the least developed skills within the COIs was the development of new business models.

	Netherlands	Spain	Albania	Berlin	Venice	Romania	Portugal	TOTAL
Scouting new opportunities	2	3	4	4	2	3	5	23
Creating new business models	2	1	2	3	2	3	2.5	15.5
Bringing innovations to market	2	2	3	3	3	4	3	20
Innovation that results from R&D activities	4		3	5	3	5	4	24
New users or combinations of existing technologies	1	2	3	4	3	4	3	20
New ways of interacting with users	4	2	3	4	2	4	4	23
Commercial introduction of a new or significantly improved product or service	4	3	3	4	3	2	3.5	22.5
Non-commercial applications	1	3	3	3	3	3	5	21
Innovations to address social needs	4	2	4	4	3	3	3	23
Renewal and enlargement of products, services and markets	4	1	3	4		3	3.5	18.5
Development of new methods of production	2	1	5	1	2	4	na	15
Establishment of new management systems	3	3	4	4	2	3	3	22
Facilitate the sharing of knowledge	4	4	5	5	3	3	5	29
Bringing or generating opportunities	4	4	4	5	4	4	4	29
Incubation and prototype creation	4	1	4	4	3	2	3	21
Dissemination and upscaling of ideas	4	3	4	4	2	4	5	26

Figure 4: Innovation activities quantitative results from COIs (self- evaluation)

IV. Demand side. problem owners and investors

In the survey a specific section was targeted towards the problem owners to further define the role they occupy within a community of innovation.

To begin with, the COIs were asked what issues they had to deal with in relation to the problem owners and if the problem owners were always public institutions.

The communities of innovation that we interviewed were centred around disaster risk reduction and therefore, in most cases, the problem owners were public institutions. As public institutions have often existed for a significant amount of time and regularly have old-fashioned structures in place, problems that the COIs often faced were that public institutions tend not to have a culture of accepting innovative solutions yet. The methods in place were often outdated and in one case there was even a national law in place that restricted innovative procurement by the public sector. Several COIs mentioned that when dealing with the public sector an underlying structural issue is that innovative solutions are often costly and not immediately rewarding which makes it difficult to find a public representative who is willing to take the lead in implementing these costly innovations. In many cases the public sector is also dependent on receiving funding from research proposals.

There were also signs that in several COIs the public entities are starting to become more aware of the new climate challenges that lie ahead and exploring means to prepare themselves. In one specific case the COI identified other possible problem owners within the private sector such as hoteliers who saw the cost benefit of implementing innovative solutions to reduce the risk of climate related disasters.

Whilst only a few of the COIs that we interviewed had been in touch with investors, those that had established contact explained that investors play a key role in bringing innovations to market. Within the field of disaster risk reduction the main issues lies around responsibility and liability once the disaster occurs. So far, there is still an inherent uncertainty that is driving investors away. Once rules and scenarios have been embedded this will also reflect back on the willingness of investors. A COI brings added value here as they can confirm the feasibility and potential of the solution which will likely increase the interest from investors.

Finally, the involvement of the insurance sector is also starting to develop. As areas are starting to be governed by specific people who carry responsibility, there is an increasing trend in

securing houses and agricultural areas. Several COIs have pointed out the potential of the insurance sector as a problem owner but the majority of COIs is still exploring discussions on how to engage them in the best possible manner.

V. Main activities

In terms of activities most of our COIs undertook a series of actions, most of them (5 out of 7) had testing facilities for their innovations. In the case of Albania for example it was one of the last free rivers in Europe to test innovations and in the case of Romania it was a replication of a polder in Holland, with the idea to become an international testing facility. It is therefore a testing facility for innovation, as the biggest test lab in Europe, on a scale of 100 m long x 25 metres wide and 3.5 depth, and pumps that simulate different floods inside the polders and adjust the height and test different types of materials. Equally most of them run demonstration events for their innovations, and a series of workshops and side events

In terms of the main activities in the COIs there was quite a variation, from the case of Netherland which was more of an informal network, to the case of Albania which had regular activities focused on the maintenance of the networking and with some ideas on how to consolidate a basic functioning structure. It achieved a relatively stable structure, with organised meetings with the innovations and webinars, with innovators exposed to contact with technical people from other countries. In Venice, the timing was difficult since there is a national government debate ongoing about lagoon governance

In relation to the creation of the COIs there was no common pattern. Some were based on personal connections, relying on more informal and unofficial connections, whereas others reflected on the importance and usefulness of having some kind of “official or administrative” champion.

In order to further develop the COIs a number of factors were identified, from having support from clients adopting innovations, to support from grants or development of testing facilities, to having real implementation and success stories, to getting stakeholders interested and engaged in real issues that affect them.

In terms of sustaining the COI “keep costs low in the beginning and then find the funding, e.g. particular interaction with the public authorities...low cost bare bones approach” (Berlin COI) “a way of discussing things, a way of working and designing, ... a way to share visions, the good solutions, best practices, all these processes could be sustained by a COI. All these should be done as a virtuous cycle” (Venice COI).

In terms of what were the main missing elements in a COI there was a range of issues, some COIs commented how a minimal level of support could have made the COI stronger, like a semi formal structure. Interestingly, in those COIs located in the north of Europe what was emphasised was the need for a more nimble, informal structure, whereas in our southern countries, a kind of champion or lead was perceived as important. In the case of the Netherlands, a take away was that it might have provided additional value to focus on emerging problems like drought or water scarcity, when flooding is already a mature innovation space, and thus there was more to gain from exporting the innovations and knowing how to other countries. In the Rumanian Co the lack of investors was commented on, how “innovators only want to get funded and investors only want equity” A differential across Europe in countries like Holland and Germany that invest a lot of money to test, and others do not test. The underlying acceptance of the risk and that sometimes these innovations work and sometimes they do not. That is the importance to have investors to test innovations. Meanwhile in the case of the Portuguese COI, the main comments were on the “formalisation” of the COI. In other words “if it started again, we would create a strong network with people and schedule regular meetings with them that connects the COI. Perhaps tie it to an institute so that it has more status. Know each other, can discuss things, so had meetings in different conferences, to meet with people and work with it.

VI. Key elements

The interviews also explored the views about the key characteristics of COI's and their relation to the specific cases. When talking about awareness, most interviewees agreed that it is crucial, but some improvements could be made, for example, for people to recognize that their work is an innovation. In the case of Berlin, different levels of awareness in the community was seen as refreshing, bringing new views to the table.

The facilitation and discussion elements are seen as crucial for problem definition and achieving goals in the COI's in all cases, while some downsides are also described, as, for example, in the case of The Netherlands, there is a lack of balance between discussions and actual showcasing and practical applications of the discussion outcomes. In Portugal, however, COI representatives wanted to be even more involved in discussions, but lacked the human resources for it due to the high workload.

The next element – leadership – presents two types of answers. Representatives of Berlin and Albania indicate that sufficient leadership in their COI was achieved by multiple thematic leaders or a group of people who share the leadership duties. Other respondents linked their answers to the public authorities' responsibility to lead or facilitate the procedures and be in the mindset of accepting innovations.

Another key element is trust, and all respondents emphasized the importance of public trust, trust within the network, and trust in the innovations created within the network. Trust must be earned and maintained with actions and evidence of working technology.

Besides these four elements, respondents rated the level of skill-set, knowledge, funding, and capacity of their COI. Out of these elements, knowledge and skill were rated the highest on average, while funding is the element that is rated lower than 3 (on a 5 point scale) in 5 out of 7 cases, indicating a common hurdle COI's face in their operations.

	Netherlands	Spain	Albania	Berlin	Venice	Romania	Portugal	TOTAL
Skills	4	3	3	5	4	3	4	26
knowledge	4	3	2	5	4	4	5	27
Funding	1	1	3	1	5	2	2.5	15.5
Capacity	5	1	4	3	4	4	4	25

Figure 5: Key elements quantitative results from COIs (self- evaluation)

VII. Learning and reflections

In terms of learning across the COIs, leaders commented how it had not really happened in a structured way, but rather it has emerged from personal contact, or informal communication, or by observing and learning, and being inspired. For example, the Venice COI commented how they had the impression from one of the COIs “that was more specific, well developed and this could be important to try to focus on specific items”. However, all saw the potential for interCOI learning, like for example the Dutch COI commenting “Would be useful to have more insight into the challenges and solutions of others. We only looked at the innovator point of view, while Spain looked more at the client view”. Equally, the Portuguese COI commented how there was never any exchange of challenges on methodologies. How could it have been done? Maybe through a webinar, every 2 months, the steps that they have taken, the challenges they have faced, the solutions, discussing the problems, need an umbrella that made them share, putting more in context.

In terms of main takeaways, the COIs emphasised the openness, the search for common solutions, the community itself, the actors and the collaborative space created. The central role of trust, and the inherent flexibility that makes it adaptable. The importance of spending time in “relationship building”. The Rumanian COI commented on “for the innovators the COI is good platform to contact investors and to get funding and even get in touch with end-users; Public awareness is crucial, and COIs help in the creation of this awareness. There would be a lot of newer innovators that come out of it”. Meanwhile the Portuguese COI reflected on the importance of having a champion and how to “grow” the COI. The commercial application of innovations is more challenging that we thought. Having a good facilitator is crucial We would have asked for time (i.e. dedicated specific human resources). To have it evolve to a more formalised structure, that people recognise that it is gathering of people to work together in innovation, to get funding, and to minimise the hazard, with financing for new innovations to take the first steps. To give them the energy, and the starting point

Finally, in terms of lessons learn from the COIs, the Albanian COI commented on their role to first, get Albanian innovators have to understand the problem better, and second, the additional help innovators received for disseminating in a proper way, and the need to do a market analysis. The innovations in Albania needed this to develop. Meanwhile in Germany the key was discipline, to know about community building, keeping deadlines, communication. The Venice COI led by a company commented on the importance of public institutions and the specific roles of each actor.

Meanwhile the Rumanian COI led by a national agency commented on how: "We have learnt that we need to be fast because climate change is faster than us now. We need to fill this gap as soon as possible. We need to test more as well because once you test you know what innovations are better. We had a small competition and the best idea received a prize. Finally, in Portugal special emphasis was placed on the human side, and people management and skills: "You always need to be in contact with people. You also need to have a lot of patience to deal with a lot of egos... You need to manage different opinions and egos. Collaboration instead of competition. Another important aspect was to reflect on "what is innovation" i.e. often it was more a case of remembering what was already known, e.g. in relation to nature-based solutions, it is in fact things that their grandparents were doing. However, this same knowledge, in this case dealing with wildfires management for a different region of Europe, it probably would be innovative. The importance of getting this knowledge documented and institutionalised. Is not the person but rather the institution, like e.g. civil protection and fire brigade. If you look at the risk cycle, different types of roles, e.g. recovery both institutionalised and individual, other phases except emergency are not institutionalized.

4. Conclusions

In terms of Communities of innovation, what have we learnt so far? How could this type of community which is geared and focused on innovation by innovative in itself? Have learnt several things:

- First, in relation to the innovation ecosystem we have seen rich communities that are flexible and adaptable enough to incorporate government agencies; research institutes; industry; NGOs. However two ingredients are key, at least one governmental institution and innovators. One important learning is that a focus for a community of innovation, on a specific problem can help it to go faster by focusing the attention of solutions providers and problem owners. Here the COIs perceive this is one of their greatest assets, the possibility to share knowledge and facilitate common spaces to do so, which in turn can generate new opportunities. Furthermore, due to the inherent complexity of many climate change problems, the transdisciplinarity of expertise amongst the community members was a big advantage. COIs emergence showed no common pattern (personal connections, "official or administrative" champion, etc). The pattern if anything was

cultural and institutional, where COIs located in the north of Europe expressed a preference for nimble, quick structures, whereas in our southern countries, a kind of public or institutional champion or lead was perceived as important. All however COIs decided that a minimal level of support could have made the COI stronger, like a semi-formal structure. Here we saw a gap between countries like Holland and Germany that invest a lot of money to test, and others do not test, and the importance to have investors to test innovations. Also that COIs themselves are not static but rather “evolving” institutions themselves: *“To have it evolve to a more formalised structure, that people recognise that it is gathering of people to work together in innovation, to get funding, and to minimise the hazard, with financing for new innovations to take the first steps. To give them the energy, and the starting point”*

- Second in relation to the creation of a collaborative environment, local drive and awareness most progress with innovations was made once there was strong local commitment to accelerate these innovations. Then it is much easier to tap into local funds from either municipalities or other public authorities. One of the most critical elements was to ensure a better balance beyond mere discussions on innovation to go much further into actual showcasing and practical applications of the discussion outcomes.
- Third in relation to innovation itself, the support to innovators and the acceleration of innovations, there was a big diversity, with innovations at early stage, all the way to those that have entered the market. Importantly the COIs saw innovation and the adoption of innovation as a clear stated focus for our COIs, together with climate change and environmental protection. Communities were flexible enough to support clients to adopt innovations, grants, development of testing facilities, all the way to real implementation and success stories, getting stakeholders interested and engaged in real issues that affect them. One important lesson to emerge from our COIs, is that those that are already mature could do well in turning their attention to new issues. For example, in the Netherlands, on drought of water scarcity, or in the case of Portugal sharing their expertise on fires with northern countries that are facing these new challenges. Thus there was a lot to be gained from exporting the innovations and know how to other countries, or from mature innovation ecosystems to enlarge the range of issues addressed. Sometimes it is even the question of what innovation is, i.e. often it could be more a case of remembering what was already known, e.g. in relation to nature-based solutions. Our

COIs also drew attention to an especially important aspect, innovation is also about people human side, and people management and skills

- Fourth, who takes the risk Investors /funds /Business models contact explained that investors play a key role in bringing innovations to market and yet this was the main weakness in our COIs and boding ill for innovation and the scaling of innovation. A common feature was the lack of involvement from the investor's side, compounded by the low skills within the COIs on the development of new business models. So far, there is still an inherent uncertainty that is driving investors away. Once rules and scenarios have been embedded this will also reflect on the willingness of investors. A COI brings added value here as they can confirm the feasibility and potential of the solution which will likely increase the interest from investors, like the example mentioned on the hoteliers engaging directly with the public authorities.
- Fifth, in relation to the issue itself of climate change, Climate change and public goods/ exposure, there was a consistent message across COIs. In the field of climate change and disaster risk reduction the problem ownership was widely attributed to government agencies, as the problems central to the COI's impact the whole society, thus the central responsibility of public agencies. Also their legitimacy. Thus it becomes absolutely critical that these "public" problem owners further define the role they occupy within a community of innovation as "drivers" of innovation: public authorities' responsibility to lead or facilitate the procedures and be in the mindset of accepting innovations. Thus the catch 22 COIs are often faced were that public institutions tend not to have a culture of accepting innovative solutions yet. In fact in one case, with a national law in place that restricted innovative procurement by the public sector. When innovative solutions are costly and with delayed rewards this makes it difficult to find a public representative who is willing to take the lead in implementing these innovations. Thus, arenas like testing facilities for innovations are a useful asset in a Community of Innovation
- Sixth, the magic ingredient Trust, relationship building and main takeaways, the COIs emphasised the openness, the search for common solutions, the community itself, the actors and the collaborative space created. The central role of trust, and the inherent flexibility that makes it adaptable. The importance of spending time in "relationship building".

Thus if there is one take away as to the most important key element for a Community of Innovation this would be trust: trust within the network, and trust in the innovations created within the network. Trust must be earned and maintained with actions and evidence of working technology.

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Annex 1: Community of Innovation Leaders interviewed

COI	COI Lead	Type of Organisation	Contact
COI Albania	AKPT	Public agency	Nensi Lajaj
COI Antwerp	KU Leuven	University	Patrick Willems
COI VP Delta	HKV	Company	Marco Hartman
COI Venice	THETIS	Company	Sebastiano Carrer
COI Rumania	NAAR	National Agency	Alexandru Gheorge and Adrian Georgica
COI Cartagena	FutureWater	Company	Sergio Contreras
COI Wildfires	ISA	University	Conceicao Colaco
COI Berlin	Ecologic	Research Think Tank	Gerardo Anzaldua and Hugh Macdonald

Annex 2: Question Guide used for Community of Innovation interviews

Interviewees details	
Name	
Date of Birth	
Gender	Male / Female
E-mail	
Phone number	
Location of community of innovation	

1. Please provide a brief introduction to your COI (scale, hazard, focus).
2. What key stakeholders are involved?
3. What activities have you conducted since the development of your COI?
 - a. Test facilities (yes/No) Testing covers the technical effectiveness of innovations, insight in the realized risk reduction in socio-economic sectors, post-implementation requirements and operational, organisational and governance needs.
 - b. Demonstration events (Yes/No)
 - c. Organisation of workshops (Yes/No)- specific meetings round of interviews involving innovators, end-users and other relevant actors to gain insight in end-users' needs as well as drivers and barriers
 - d. Specific side events or activities i.e. Venice (November 2017), Romania (January 2019) and The Netherlands (February 2020).
 - e. Other social media (Yes/No)
 - f. Support through Climate innovation window (Yes/No)
4. Are there still ongoing activities within your Community of Innovation? If so, please describe.
5. Please name a few concrete outputs that came out of your COI.
6. What are you most proud of?
7. What is still missing from your COI in order to further stimulate value creation?
8. What organisational structure do you think is ideal for maintaining a COI?
9. What are some of the lessons learnt from building a COI?
10. What are the aims of your COI?
 - g. What are the Goals?
 - h. Who is taking problem ownership?
11. What are some of the key elements necessary to develop a successful COI?

- i. Awareness (ground/basic conditions)
 - j. Facilitation and mediation/dialogue
 - k. Leadership
 - l. Trust
- 12. Is there a spatial focus?
 - a. What is required to scale up the geographical focus of the COI?
 - b. Has there been any interCOI learning?
 - c. What meeting spaces do you use? (virtual or real)
- 13. Timescale – is there a gap between pilot and market?
- 14. Cross actors – is there a gap between actors interdisciplinary/trandisciplinarity?
- 15. Who are the key actors and elements within the COI triangle?
- 16. Supply
 - a. Who is supplying solutions
 - b. What solutions are being provided
 - c. Which solutions fall under early stage TRL
 - d. Which solutions fall under middle stage TRL
 - e. What public funds are there? In other words, what code of practice – commitment to the development process is there?
- 17. Demand
 - a. What problems are there from the demand side?
 - b. What problems are there from the public sector?
- 18. Investors
 - a. How do investors perceive the risk?
 - b. How does the investor perceive the effectiveness of the solution?
 - c. Are there and insurances/guarantees in place?
- 19. Any feedback on the development of a COI?
- 20. Any feedback on the creating a COI?
- 21. Any feedback on sustaining a COI?
- 22. Are there any COI support tools?
- 23. What are three take-aways from developing a COI?

ALL INTERVIEWEES COMPLETE THE NEXT SECTION

Please indicate for each of the following how strong you would rate your COI. Kindly tick one value per row (1 – Very Weak, 5 – Very Strong)

	1	2	3	4	5
Skills					
Knowledge					
Funding					
Capacity					
Scouting new opportunities					
Creating new business models					
Bringing innovations to market					
Innovation that results from R&D activities					
New uses or combinations of existing technologies					
New ways of interacting with users					
Commercial introduction of a new or significantly improved product or service					
Non-commercial applications e.g. better public services					
Innovations to address social needs ('social innovation')".					
Renewal and enlargement of products, services, and markets					
Development of new methods of production					
Establishment of new management systems					
Facilitate the sharing of knowledge					
Bringing or generating opportunities					
Incubation and prototype creation					

Dissemination and upscaling of ideas					
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In case the list above is missing one or more skills/knowledge that you think is valuable for a COI, kindly list it here.