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General Editors	Eugen Popa, Wageningen University and Research, The Netherlands Vincent Blok, Wageningen University and Research, The Netherlands Renate Wesselink, Wageningen University and Research, The Netherlands
Contributing Authors (alphabetical order)	Alfonso Alfonsi, Fondazione Adriano Olivetti, Italy Claudia Colonnello, , Fondazione Adriano Olivetti, Italy Eugen Popa, Wageningen University and Research, The Netherlands Johannes Starkbaum, Institute for Advanced Studies, Austria Renate Wesselink, Wageningen University and Research, The Netherlands Robert Braun, Institute for Advanced Studies Vienna, Austria Vincent Blok, Wageningen University and Research, The Netherlands
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Abstract

The RiConfigure Project

This report presents the lessons we have learned during the first twenty months of the RiConfigure Project (http://riconfigure.eu/). The overall aim of the project is to obtain a better understanding of collaborations in R&D between the following four sectors of society: industry, academia, policy and civil society. These collaborations are referred to as *quadruple helix collaborations* (QHCs). In these collaborations, the participation of civil society is of particular interest because both theory and practice have suggested that civil society is, more so than other helixes, absent from R&D. The RiConfigure project is coordinated by the Danish Board of Technology (DBT, http://tekno.dk/) and organized around five *social labs* (SL) that take place in five different countries: Austria, Germany, The Netherlands, Denmark and Colombia.

Methodology

A social lab is the platform through which RiConfigure members interact with real-life cases of QHC. Through social labs, on the one hand, we obtain a better understanding of QHCs and specifically the presence of civil society in QHCs and, on the other hand, we help the QHC foster the interaction and inclusion of all helixes into the R&D process. The RiConfigure social labs are driven by the philosophy of *responsible research and innovation* (RRI) where stakeholder inclusion is associated with more robust innovation products and a better understanding of the risks and benefits associated with these products. Every social lab is designed with the following three questions in mind: the first one concerning the praxis of QHC, the second one concerning the relationship between QHCs and RRI principles, and the third one concerning the relationship between QHCs and the governance context in which these QHCs are active.

1. How do case partners from the four different sectors ('helixes') interact within the QHC and what contributes to this interaction's success?

2. To what extent do the parties engage in practices, and develop competences, that foster responsible research and innovation? (RRI)

3. What is the influence of public governance frameworks on the creation and success of QHCs?

Results

Regarding practice the main lesson we have learned is that the theory of QHC (E. Carayannis & Campbell, 2010; E. G. Carayannis & Campbell, 2009; Meissner & Carayannis, 2017) is quite different from the practice of QHC. Once applied in practice, the theoretical idea of four helixes collaborating together in research and innovation stumbles upon a myriad of real-life barriers such as funding, role distribution, incentives, power structures and path dependency. These

barriers, which are detailed in section 2, can sometimes be overcome. Yet in order to do so, the in-between step of *reflecting* upon these barriers and their origin is crucial. Simultaneously, QHCs present us with a series of opportunities and 'enhancers' that can be further exploited to get the best out of such a collaboration. Specifically when it comes to civil society, participation of citizens can help experts 'learn' the language of the laymen or at least realize that they do not necessarily speak the same language. These and other results described in the present report seek to create a more developed picture of the barriers and opportunities for QHCs.

Regarding the RRI competences for QHC (see section 3), it can be stated that in general stakeholders are much more flexible and adaptive than the theoretical four-fold categorization would suggest. In fact, when it comes to systemic innovations that are unavoidably impactful for society as a whole, it is almost a 'job requirement' that one be skilled in navigating the RRI competences distinguished in the RRI literature, e.g., systems thinking, moral competence, learning skills (Ploum, Blok, Lans, & Omta, 2018).

Regarding the relationship between governance frameworks and QHCs (see section 4) it can be noticed that this relationship is not yet a very strong one. Policy is not, at this moment, written with the specific aim of fostering quadruple helix collaborations nor is it in any clear way the driving force behind existing QHCs. When QHC are formed, they spring into existence not because of some compelling policy framework but rather because of a mutually recognized benefit of the presence of stakeholders from all sectors.

Conclusion

The QHC theory and models can benefit from a closer investigation of empirical reality. The promised benefits that would ensue form QHCs, from increased problem-solving capacity to moral robustness, can only be achieved if we first obtain a more realistic picture of how QHCs work in reality. In this report we have highlighted several preliminary results from our interaction with our social labs. These results suggest that the QHC movement is generally regarded with positive attitudes by representatives of all four sectors but that as a social configuration QHC needs further encouragement and study.

1.

Introduction and overview of the report

A quadruple-helix collaboration (QHC) is a form of collaboration in research and development (R&D) between the four major sectors of society: industry, government, research institutes, and the public (Andrews & Entwistle, 2010; Brink & Madsen, 2016; Bryson, Crosby, & Stone, 2006). These collaborations are seen, by theorists and practitioners alike, as sources of solutions to complex problems such as sustainable energy and affordable healthcare (E. G. Carayannis & Campbell, 2014). When systematic change is needed towards solving these complex problems, and individual organizations alone cannot deliver, it is these collaborations, or maybe sub-sets such as the 'triple helix collaborations', that promise more effectiveness and responsibility. In short, quadruple-helix collaborations are expected to succeed where sectors alone would fail (Bryson et al., 2006, p. 44). As novel inter-organizational configurations, QHCs present us with three themes that require further empirical examination.

First, the actual practice QHC has many unexplored areas. What we know to date is that QHCs are significantly different than, say business or research alliances. We know that QHCs present some specific interactional challenges because of their composition in stakeholders with different worldviews and backgrounds (Ahonen & Hämäläinen, 2012; Fernandez, Desroches, Marquis, Turcotte, & Provencher, 2017; Gutiérrez, Márquez, & Reficco, 2016). When the profit-oriented activities specific to businesses need to be reconciled with the publication-oriented activities of knowledge institutes, the policy-oriented activities of the government and the rights-oriented activities of the public, parties experience "clashes in expectations and/or identities" which predispose the collaboration to "distrust, conflict, and premature failure" (Le Ber & Branzei, 2010, p. 163). We want to know more about these interactional challenges and whether that influence the success of QHCs. Hence, we formulate our first question:

> Question 1. How do case partners from the four different sectors ('helixes') interact within the QHC and what contributes to this interaction's success?

Second, the contribution of QHCs to a more inclusive R&D process requires further study. QHCs are expected to generate innovations that are more carefully attuned to the needs of different sectors of society – a more 'RRI' form of innovation (Owen, Bessant, & Heintz, 2013). Yet it is not clear whether, and how, QHCs are generating this more responsible form of innovation. The received view goes as follows: when each sector is present at the proverbial round table, the outcome is 'checked' by more than just one sector and thus better attuned to each sector's specific needs (Ahonen & Hämäläinen, 2012). But is this really the case? And if so, what are the contributing factors to this QHC-RRI relationship?

> 2. To what extent do the parties engage in practices, and develop competences, that are in line with the model of RRI?

Third, we want to know what type of governance frameworks at regional, national and European level, are relevant for QHCs. More specifically, we want to know to what extent the politico-economic context fosters or hamper QHCs. We are thereby interested in funding schemes, power structures and other governance activities that have an influence on QHCs and whether the parties engaged in QHCs are aware of these inflences. Our third question is thus:

> 3. What is the influence of public governance frameworks on the creation and success of QHCs?

In order to tackle these themes in concrete cases, but also capture any additional data and insights that can arise from practice, RiConfigure has partnered with five projects/organizations that are engaged in innovation activities. The cases are briefly described in Figure 1 below.

Figure 1 The RiConfigure Cases of Quadruple Helix Collaborations

1. Smart Factory OWL (Germany)
SmartFactoryOWL is a LivingLab for Industry 4.0 technologies in East Westphalia-Lippe and offers companies and research institutions comprehensive services for the development and testing of new products and technologies. It also functions as an open research and demonstration platform for the digital transformation. Together with companies from industrial production, industry chambers, research organizations and universities, regional political actors, trade unions and works councils, the aim is to jointly develop new solutions and strategies for the future of work in industry 4.0.

2. GIGAWATT (The Netherlands)
In the GIGAWATT project (GW henceforth), a consortium of companies, universities and knowledge institutes discuss the design of an industrial-scale electrolysis plant that would produce 'green hydrogen' (i.e., hydrogen produced with green energy) on a gigawatt scale. The partners in the Gigawatt Elektrolyser project will together explore what is needed to build such an electrolysis installation in the Netherlands in the upcoming years. The project is being coordinated by the Institute for Sustainable Process Technology (ISPT), with support from by TKI Energy & Industry, and partners include i.a. Nouryon, Shell, Yara, and OCI Nitrogen.

3. Open Innovation within Austrian Railways (Austria)
This project has a public sector perspective and works with the Austrian Railways. The core of the project is observing and participating in extending open innovation practices to create a new mobility innovation space that involves and engages actors from all four areas of the quadruple helix. Austrian Railways is a publicly owned major corporation with multiple responsibilities, a.o. experimenting with new forms of innovation ecosystems. The social lab aims at observing and assisting change in order to disrupt traditional forms of technology driven innovation structures, involve and engage new innovation players, create a less top-down and more cooperative and bottom up innovation environment while also maintaining and developing operation excellence and bettering user experience through-out the company and its services.

4. Climatorium (Denmark)
The Climatorium has the aim to establish an innovative showroom for climate development and climate tourism where knowledge, business and tourism on climate change adaptation aspects are gathered. The Climatorium is pivotal to the establishment of a climate change adaption cluster on coastal environment in the region. The purpose of the Climatorium is to gather knowledge, business and tourism on climate change adaption aspects within an innovation house. The objective is to increase innovation through day-to-day interaction and planned in house seminars. The Climatorium expects to facilitate a minimum of 10 companies and organizations situated in the house.

5. Ideas for Change (Colombia)
This case implements a scientific-technological solution that allows, from the social appropriation of science, technology, and innovation, the development of a collective strategy that provides energy and social welfare to the Kanalitojo community. The project aims to transform of the living conditions of the participating communities through the collaborative construction of a science, technology and innovation solution.
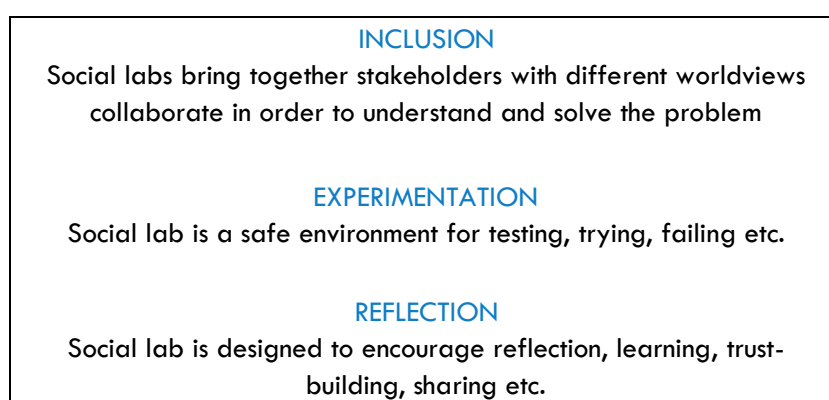
*Aside from these main cases, empirical data was gathered form 100+ cases of QHC through desk research or semi-structured interviews. These 'reference cases' provided a significant empirical strengthening of the insights we gathered from our 5 'main cases'.

A social lab is typically a long-term process (six months to several years) in which individuals from different sectors of society work together in order to tackle shared problems and draw lessons from their struggles. The Social Lab process thus consists of recurring learning circles (Kolb, 1984), constituted by three workshops/panel meetings and small pilot projects aiming to support the QHC and the inclusion of the civil society

In approaching these cases, we used a Social Lab methodology (Hassan, 2014). What is a social lab? Generally speaking, the social lab is a method for solving complex problems thorough stakeholder interaction. Complex problems are problems that are not clearly defined and whose solution does not fall within the responsibility and expertise of any single organization. While methodologies for designing and implementing social labs differ, the following core features can be identified:
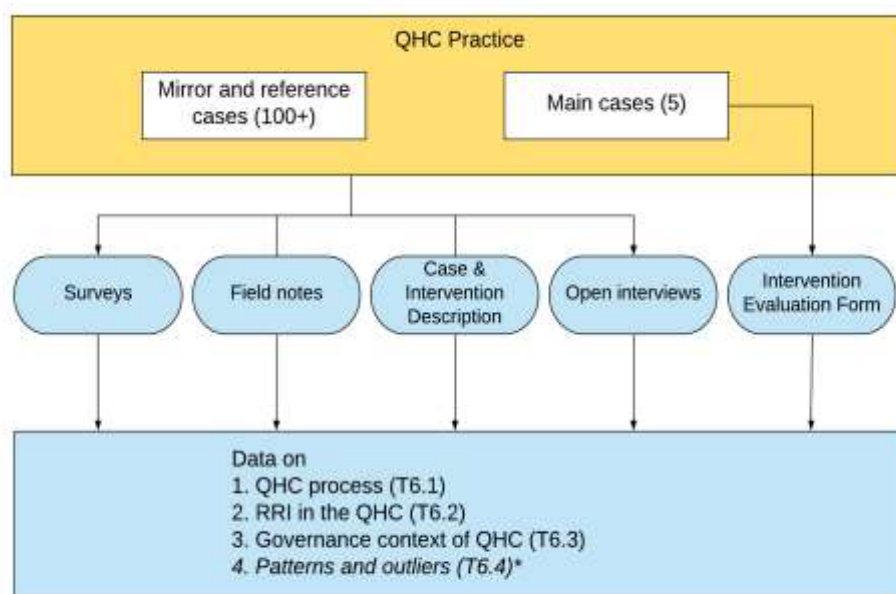
Figure 2 *Aims in a social lab*

INCLUSION
Social labs bring together stakeholders with different worldviews collaborate in order to understand and solve the problem

EXPERIMENTATION
Social lab is a safe environment for testing, trying, failing etc.

REFLECTION
Social lab is designed to encourage reflection, learning, trust-building, sharing etc.

The RiConfigure Social Lab with these cases consisted of a series of preliminary interactions that were designed to obtain a better understanding of each case and its specific needs followed by a series of *interventions* that were designed to help the case tackle one or more QHC issues identified in the preliminary interactions. Often the preliminary interactions consisted of interviews and face-to-face discussions while the interventions consisted of smaller workshops (2-3 hours) or larger whole-day meetings. Some social labs adjusted to the practical limitations of their case and thus deviated slightly from this norm while keeping in mind the SL aims.

In addition to that, RiConfigure Social Labs interacted with other similar cases, that we call 'mirror cases' or 'reference cases' in order to create a broader understanding of QHCs in other contexts. In these mirror and reference cases, data was gathered through desk research or interviews and no interventions were carried out. All these contact points with the cases – whether main, mirror or reference cases - produced valuable data on quadruple helix collaborations and its relation to RRI. The variety of instruments that were used to collect this data is shown in Figure 3 below. In the figure it can be seen that all cases delivered certain type of data on governance, quadruple helix interaction process and responsible research and innovation, whereas only the *main* case also delivered data on the intervention – since the intervention was not carried out in other cases.

Figure 3 Cases, instruments and data in the RiConfigure project

The foundation of our analysis is the RiConfigure Theoretical Framework which is based in QH, RRI and cross-sector collaboration literature (Schroth et al., 2019). In doing so, our project borrows insights from fields such as Responsible Research and Innovation (Blok & Lemmens, 2015) and Science and Technology Studies (STS) (Douglas, 2003; Felt & Fochler, 2010), but also higher-level macro-economic analyses of QHCs (Campbell and Carayannis, 2018; Monteiro and Carayannis, 2017; Campbell et al., 2015) and regional innovation systems (Kolehmainen et al., 2016; Kriz, Bankins, & Molloy, 2018).

The present report is organized as follows. In section 2, we provide the results of our analysis concerning the quadruple helix collaboration process (T6.1 in the figure above). There we highlight the elements that foster the interaction and help the collaboration as well as those that hamper the collaboration or complicate it. In section 3, we provide the results of our analysis concerning the relationship between RRI and the quadruple helix collaboration process. This analysis will focus on the RRI competences of the participants involved, the effectiveness of the leadership in creating boundary-crossing interactions and the learning process created by our interventions. In section 4 we provide the results of our analysis concerning the relationship between the governance context (political and socio-economical) and the QHCs we have interacted with. In this section we take a look both at the regulations that actually impact the collaborations in questions as well as the participants' perception of this impact. As Figure 2 shows, the present report will not provide a general statement of patterns and outliers but rather postpone this task for the last phase of the project when more data will be available.

As a final note, it is worth recalling – accordingly with the plan of the activities designed by the SLs within the project – that the empirical basis for the comparative analysis is still under construction and that it will be completed during the next 10 months of the project (through the

implementation of the last round of Panel Meeting workshops, the analysis of several reference cases on which the data gathering is still on-going in this period and with the running of the second Dialogue event on next May 2020).

2.

The praxis of QHCs

As explained in the introduction, there is a need for a closer investigation of actual QH praxis. Typically, research on this topic focuses on the macroeconomic level and regional development and -innovation systems (RIS). Such a high level of abstraction does not allow us to take a closer look at the actual interactions between representatives from each Helix or the interactions between the QH participants and their respective organizations and socio-political contexts. Furthermore, the inherent normative claim that civil society must be engaged does not explicate the actual role that civil society plays in such constellations.

Involved project partners have by now analyzed, based on desk research and structured qualitative interviews, 54 cases of QHCs across Europe and Colombia. Five QH main cases in Germany, Austria, Netherlands, Denmark and Colombia have been selected. Major aim of this approach is to learn about the main case, to exchange knowledge and to initiate (institutional) change. The data for this section is extracted from the following resources: (a) a praxis-analysis-template that includes a number of qualitative and quantitative questions based on the Theoretical Framework; (b) The Social Lab reporting templates, and (c) the case reports on the 54 QH cases, all of these filled-out by the five partners responsible for the Social Labs.

The observed cases are diverse as they have been initiated by stakeholders from different Helixes, have different financial structures, and work towards different types of output, ranging from commercial products to social innovation. Many of these cases struggle with actively involving the different partners, securing funding for all partners, and aligning the (implicit) interests. QHC is thus challenging and its success dependent on a large number of factors. Furthermore, we see that the involvement of the fourth Helix (civil society) is more often given in cases that are funded by public funds, and also in those cases that aim for social innovation. We have organized our findings along four major dimensions that are identified in the theoretical framework of our project: building structure, foster interaction, learning and adaptation.

2.1 Building structure

The importance of building institutional structure for the QHC has been highlighted in the literature on QHCs and reaffirmed in our theoretical framework: "In order to effectively build a structure for QH-collaboration, formal procedures for partner selection, reporting, and communication have to be developed, (…) [additionally] a common goal has to be identified and agreed upon" (Schroth et al. 2019, p.8). The initial phase of any QH action has impact on

its further progress. Building structure can thus be seen as a key element for managing collaborations across four sectors and for maintaining it over time. These include formal and organizational structures as well as setting up a common vision and ensuring trust. We should stress that building structure is not a one-time exercise but needs regular efforts and adaption throughout the collaboration.

Securing (mid-term) funding, and thus establishing a financial framework, is one of the key perquisites for QHCs, and, in many cases, decisive for its maintenance. Many of the QH cases observed in RiConfigure were at least partially funded by public means, which constitutes a temporary stable funding framework that provided resources for all four Helixes to actively participate in innovation processes. Particularly the fourth Helix often lacks sufficient financing and then depends on the other partners. While there are a number of policy documents that herald the necessity for QH type of innovation (BMWFW & BMVIT, 2016; ERAC, 2019), actual funding instruments are often less explicit and merely follow traditional innovation models or Triple Helix approaches (i.e. policy-research-industry collaborations). In some observed QH cases, lack of financial resources was compensated by efforts of individuals who performed work "on top" of their daily business. In other cases, support was offered beyond the collaboration by external partners who provided knowledge or infrastructure to the QHC. Financial contribution of partners is closely related to the (often tacit) power structures that emerge in QH constellations; the funding partner sometimes assumes the responsibility of 'running the show', thus often dominating discussions or agenda setting processes.

The selection of the partners is also dependent on financial resources, as these can determine which partners enter a collaboration, and which ones not (often those with no financial or time resources). Furthermore, those partners who initiate a collaboration also hold decisive power about the inclusion of other partners. The fourth Helix is oftentimes the last one to enter this process. The theoretical model of QH, when implemented in a Social Lab setting, was of use to remind partners of the participation of civil society. Existing ties, for example from former cooperation or regional proximity, determine the partner selection in many cases, as a certain trust base is given. Face to face meetings, on a regular basis, are a key element for *building trust* and for aligning expectations – however this, again, can be more easily facilitated on a regional or local basis. Face-to-face meetings help to "speak a common language", to commit beyond duties (of single partners), and to include voices of all Helixes. Furthermore, openness in communication and knowledge-sharing is beneficial for strengthening the ties between the partners. The same effect can also be achieved through formal contracts that trigger a high level of commitment and trust.

In order to plan and organize the collaboration process, various legal and governance frameworks were named as useful by a number of cases, as it allows to foster trust, to define responsibilities and (shared) goals. While a number of cases worked on the basis of rather lose legal and governance frameworks, these also emphasized that clearer guidelines helped the collaboration process. Examples for such frameworks include non-disclosure agreements (NDAs), letters of intent (LOIs), and written workplans. However, in some cases, civil society partners were not used to these kinds of contracts, which caused irritations. Yet, these contracts are not necessarily restricted to the partners of a collaboration, but may be established with external bodies, such as funding agencies or external governance boards, in order to secure their support. This is particularly relevant if a collaboration is dependent on a

single actor that provides specific kind of resources. Legal and governance frameworks (within and beyond the QH) are particularly important once unforeseen events may threaten the collaboration, such as individuals or partners leaving the collaboration, withdrawal of support by external forces, changes in governance boards (e.g., of holding companies), or local security issues. A solid framework may give guidance and secure financial and political support past such events.

Finally, a common vision and shared goals are named as one of the most relevant elements for QHCs to "work" and to overcome barriers. This includes working towards a specific kind of value output that may consist of a tangible product or a social innovation. As one of our partners put it: "if objectives are clear, barriers will be workable". While sometimes there are conflicting goals among partners, it is repeatedly acknowledged that the involvement of all Helixes in a collaboration process increases the potential for creating meaningful value. Common vision and shared goals are not restricted to the concrete QHC but are often complemented and guided by wider goals such as national R&I strategies or the UN SDGs. Envisioning even idealist perspectives may help to motivate partners to overcome barriers by aligning goals and potential values. Particularly goals of organization and holding companies beyond the QHC are relevant for securing their financial and political support. It is thus also important to make progress and output visible to the outside world. It is to add that many QHCs had an explicit or implicit economic drive, with aims for creating commercial products or fostering regional growth. This emphasizes the importance of legal frameworks for managing profit.

2.2 Foster interaction

During our interactions with the cases, we have observed a number of methods to foster interaction within QHCs. Regular personal meetings and events of different kinds are identified as key resource for QHC, as they help aligning goals, fostering trust, and making processes transparent. Furthermore, they help overcoming communication barriers (e.g., understanding scientists) and power gaps (e.g., industry partners holding financial and infrastructural power). Such meetings also ensure the involvement of all Helixes, and raise awareness for needs of partners. Furthermore, knowledge gaps among partners may be addressed, including space for mutual feedback. While these meetings are often organized as internal events, neutral moderators can be beneficial for overcoming communication barriers and for ensuring involvement of all Helixes. This role was, in several cases, taken on by an academic partner who offered a reflexive and critical perspective, but can in principle be fulfilled by any actor with the necessary skills.

Different forms of management help aligning and fostering interaction across the collaboration. These may consist of formal steering committees or a more loosely organized group that fosters decision making. If decisive power is manifested in a policy or governance framework, distribution of tasks and responsibilities are more transparent and often better allocated across the four Helixes. This element is, however, closely linked to financial resources. If one of the partners is dominant in providing resources, this partner may easily control leadership roles and create frustration and potential dropping out from the collaboration by partners who may feel that their voices are not heard.

The active involvement of the civil society in innovation is, in many cases, a challenge. Of the 54 cases considered in this practice analysis, only 24 actively included the fourth Helix across

the collaboration process and included these in relevant decision-making processes (see Table 1). As the fourth Helix is often the last to complete an new QHC, we observe a power relation where citizens/CSOs enter collaborations on conditions already established by other partners and/or are merely consulted along the innovation process. While many cases expressed openness towards civil society, we also experienced reluctance to extend the involvement of civil society, paired with the fear that these may slow down the innovation process. Similar fears were expressed for partners of the public sector. The biggest challenge for extensively including actors from civil society is a lack of knowledge on how to do this and which methods to apply. Additionally, the fourth Helix is often constituted by selective and privileged types of publics such as civil society organizations (CSOs) or users of a specific product or service, and marginalized groups of civil society are often less visible. Citizens who enter QHCs need to have the resources and motivation to engage in such activities besides their work and private/family responsibilities. We thus see very different understandings of what civil society really is.

Figure 4 Number of cases that actively include civil society across the collaboration

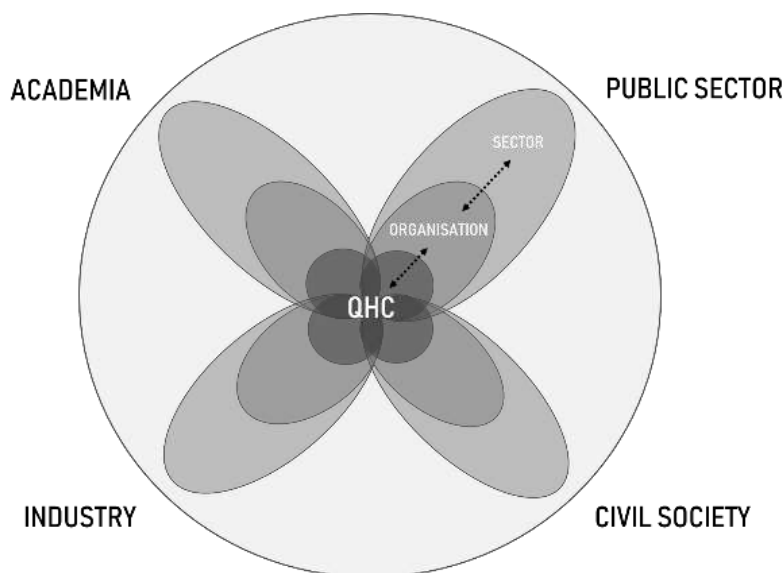|	FH	WUR	IHS	DBT	ACAC	SUM
Cases included in the analysis	6	25	12	7	4	54
Cases that actively include civil society	3	1	10	6	4	24

2.3 Learning and adaptation

The cases we interacted with showed eagerness to learn about how to collaborate and to integrate helixes in the collaboration process. For this reason, many cases have exchanged experiences with other QH endeavors, particularly in earlier phases of the respective innovation projects. Dialogue events for exchanging experiences, such as the annual Austrian Open Innovation Stakeholder Meetings, as well as publicly available collections of (good practice) cases, are thus meaningful policy instruments to support exchange of knowledge. Some cases have reached out to existing networks in order to learn about how others collaborate. Respective training programs have also been initiated to overcome knowledge and culture gaps within the collaboration.

Regular reflection concerning the collaboration process have been described as useful in order to align goals and to ensure the involvement of all Helix partners. The RiConfigure Social Labs and pilot projects are one example of creating spaces to critically reflect the collaboration and, respectively, to adapt its working modes. This reflection is not limited to internal questions but also relevant for aligning with goals and expectations of the environment (e.g., of governance boards beyond the collaboration, R&I policy actors, etc.), to gain new ideas and to enrich perspectives of the QHC.

2.4 Align with external goals and expectations

Our empirical analysis of QHC cases reveals the importance of considering expectations and goals of actors other than those actively involved in the collaboration process. External actors may have great impact on the QH practice and therefore need to be considered in order to maintain the collaboration. The strategic alignment, financing, structural support, as well as the general support of entering and proceeding with a QHC often depends on forces beyond the collaboration. This might include parts of companies or organizations beyond the units that are engaged in a QHC (respectively their governance boards), as well as forces stemming from the wider Helix such as other companies or (local) governments. The following figure visualizes these layers based on the example of the public sector.

Figure 5 Quadruple Helix flower model: layers of the public sector based on the QH model by Carayannis and Campbell (2009)

In this example, the dark inner circle of the public sector Helix could be a unit of a larger publicly owned company that is part of a QHC with a specific aim for value-creation. The larger lighter-gray ellipse then represents the whole company including governance board and its wider corporate strategy. The larger ellipse represents the public R&I sector including relevant parts of the government, ministries and other public bodies. These define goals for R&I and issue respective funding, which impacts governance strategies of publicly owned companies. Goals and funding opportunities are – at both, organizational and sector level – subject to change, which then might demand adaption by the QHC in order to secure political and financial support from this Helix. We can observe similar layers in other Helixes such as industry including, e.g., questions of intellectual property (IP), technical and financial support.

Relevant decision-making power is often located outside the QH constellations, in governance boards of the involved entities or even beyond (e.g. governments, holdings, associations). External impacts typically intensify once QHCs grow in size and/or in importance, as these then begin to impact the finances, branding and governance of their environment. QHCs thus

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need to maintain support of their environment(s) by illustrating their value, and, in the same move, by minimizing possible risks (e.g. costs, branding issues, etc.). Beyond that, aligning and interacting with external actors also helps including further perspectives and finding new ideas in order to stimulate internal collaboration processes.

Finally, we have seen that external actors may take key roles for QHCs by pushing their agenda and by providing other types of support. Examples for this type of external support are CEOs or regional politicians that support a QHC and its endeavor in political arenas beyond the collaboration.

3.

Responsible Research and Innovation in QHCs

As explained above, QHCs are expected to generate innovations that are more carefully attuned to the needs of different sectors of society – a more responsible form of innovation (Owen, Bessant, & Heintz, 2013). Yet the relationship between this ideal of RRI and QHC remains fairly unexamined in current research and practice. In order to understand the relationship between RRI and QHC, we needed to focus on some aspects of RRI that are the most relevant for the QHC setting. We therefore focused on the following two aspects of RRI:

RRI competences are skills or knowledge that allows participants to engage in, or create, responsible research and innovation. Borrowing insights from the study of competences for sustainable development we define RRI competences as individual competences (or 'skills') that are known to be linked to achieving responsible innovation. We thus assume that, in order to be part of an effective RRI process, stakeholders need a set of skills that are different than their 'business-as-usual' skills they use in their daily work. The competences we focus on are thus: systems thinking, transdisciplinary thinking and moral competence. These will be further defined below in discussing results.

RRI leadership has been noticed as an alternative to classical notions of leadership that do not apply as such to cross-sectoral collaborations (Crosby & Bryson, 2010b).The change in team composition, when moving from organizational leadership to cross-organizational leadership, gives rise to a change in context: it is now a "shared-power, no-one-wholly-in-charge world" (Crosby & Bryson, 2010a) RRI leadership is leadership that can adapt itself to the needs of a multi-stakeholder project. By leadership we mean the activity of the organization (or organizations) leading the QHC. The aforementioned idea of a 'round table' presents us with a paradox for there seems to be little or no managerial roles in such an ideal egalitarian model. How does the leading organization escape or resolve this paradox?

In the theoretical framework of the RiConfigure project, we also discuss RRI outcomes and explain that the RRI dimensions should not only be assessed based on the 'right' starting points, namely competences and leadership, but should look at actual co-constructed products. The RiConfigure framework can be found on the RiConfigure website (www.riconfigure.eu/). However, we leave this dimension aside for the moment and postpone an analysis of RRI outcomes until the final research report in 2021.

3.1 RRI competences in the five QHCs

Systems thinking

The systems thinking competence refers to the "ability to collectively analyse complex systems across different domains (society, environment, economy, etc.) and across different scales (local to global), thereby considering cascading effects, inertia, feedback loops and other systemic features related to sustainability issues and sustainability problem-solving frameworks" (Wiek, Withycombe, & Redman, 2011) .

We begin with the general remark that our case partners proved to be skilled in understanding the concept of RRI and engaging in reflection and discussion around this concept. A prototypical example is the identification and analysis of stakeholders. In one form or another, all social labs interventions had involved some form of stakeholder analysis in this first phase. Participants turned to be capable, with some individual variation and under the coordination of a social lab facilitator, to put their organization/project into context by identifying relevant stakeholders. Moreover, participants sometimes gave our facilitators the feedback that engaging in such analyses was experienced as a useful exercise. Furthermore, as it will be seen in section 4 on governance, participants turned out to be skilled in identifying the influence of the 'landscape' on their everyday life.

Whether it was the situation of the QHC being influenced by institutional movements within the mother organization or the QHC being influenced by larger ('landscape') movements at a national and international level, the explicitization and discussion of such issues turns out to be within reach for participants of various backgrounds. In Figure 3 below we show the results of such an analysis taken from the Gigawatt case (The Netherlands). The figure contains all the actors identified by the case participants as actually or potentially (in the future) having an impact on the hydrogen economy. As it can be seen, individuals that are not necessarily trained to undertake system analyses of their project can deliver a fairly rich image of what QHC actors influence their everyday jobs. Furthermore, although this is not captured in Figure 3, each of the mentioned actors was in fact discussed briefly in terms of their power, their interests and their predicted behavior.

Figure 6 Example of Stakeholder Analysis output from Dutch Social Lab

Another example of system-analytical competences is the participants' ability to modify their strategies based on higher-level movements in the landscape. In the social lab initiated by government, the activity of the QHC was heavily influenced by unexpected movements in the organizational hierarchy and a change of political context due to elections. These were perceived as major systemic events that affected the organization's ability to take any radical decision or to invest major resources. The QHC participants reflected on this new organizational and political context, and concluded that the quadruple helix innovation process can best be realized by engaging less impactful, more stabilizing activities. This means that they analyzed the system in its new configuration and concluded that it is more practical to go for the 'low-hanging' fruits instead of trying to trigger a more impactful change. The turn in strategy, from performing in organization's eyes to performing in broader societal eyes, is a good example of how taking a QH perspective can in fact help a QHC legitimize its activities. By focusing on building a QHC community outside the organization and in this way having an impact outside the organization – both of which are principal RRI competences – the QHC in question seeks stability within its own organization.

At the same time, however, it must be said that the competence of understanding your system and seeking partnerships and communities within this system can still be significantly hampered by uncertainty at an organizational and political level. From this example we can conclude that RRI competences are often trumped by the larger context: they can be of help in acquiring (external) legitimacy and reputation, but might not be enough to resist larger, inevitable changes and movements at an organizational and political level.

Diversity and transdisciplinarity

Transdisciplinarity competence refers to the ability to "structure relations, spot issues and recognize the legitimacy of other viewpoints in business decision-making processes regarding environmental, social and economic issues, to involve all stakeholders and to maximize the exchange of ideas and learning across different groups (inside and outside the organization) and different disciplines (inter-disciplinarity)" (Lans, Blok, & Wesselink, 2014)

Our QHC partners showed a relatively good ability to think in terms of other approaches and disciplines. One example of transdisciplinary came from the social lab initiated by academia (Fraunhofer), where the parties acknowledged the difficulties involved in 'translating' technical aspects of their work for the general public. The QHC partners experienced this as a challenge because the 'general public' remained the source of useful competences regarding moral matters, personal experiences and societal perspectives. The ability to recognize other disciplines but also to ascribe value to these disciplines falls therefore within the category of transdisciplinary thinking.

A second example came from the social lab initiated by the industry where the case meetings consisted of people from many different disciplines taking part in the discussion of green hydrogen in a certain region. In general, the stakeholders that end up participating are representatives of the many industries that are (and presumably will be) involved in the hydrogen economy in the future in that area: energy grid operators, gas infrastructure, energy providers, industries, ports and industry terrains. Stakeholders are encouraged to participate and to voice their own concerns from the perspective they are representing (or other perspectives). The discussion often is segmented into topics (e.g., 'water', 'transport', 'storage') on which the stakeholders then react and try to bring their insights. These topics are briefly presented by one stakeholder (typically a consultant) after which the parties begin the discussion. The QHC managers were particularly skilled at bringing all these views together and often 'translating' between them for the ones present.

Transdisciplinarity can also occur in the form questioning standard concepts coming from management science and even concepts stemming from our own project (RiConfigure). In two of our social labs, participants noted a difficulty in drawing a concrete line between the case and its context. As one manager noted, when the innovation process is in a constant dialogue with the landscape and is heavily influenced by that landscape, both the participants and the social lab managers might in fact experience difficulties in delineating insiders and outsiders. The term 'collaboration' is not helpful in this case because, under one interpretation, the partners are constantly collaborating with their environment, often beyond contractual agreements. A similar note was placed by other social lab managers who in fact had to undertake a more radical switch. Being constantly confronted with the impossibility of saying

specifically where the innovation lies and who is the group in charge of the innovation, the SL managers switched form investigating a concrete innovation *project* to investigating an innovation *process.* In other words, the viewpoint was broadened from one explicit agreement, with a start date and an end date (i.e., the Gigawatt *project*), to the more general societal agreement on the need and value of innovation (i.e., the hydrogen innovation *process*). As we will explain in the next section, this ambiguity regarding the innovation process itself 'spills over' to create ambiguity in leadership.

Moral competence

Sometimes referred to as 'ethical competence', moral competence is "the sensitivity of managers and professionals to moral issues in their organizational structures followed by moral judgment and actions" (Pohling, Bzdok, Eigenstetter, Stumpf, & Strobel, 2016).

We encountered significant difficulty in evaluating the moral competence of the participants according to the established methodology. It is true that all our partners were aware of the importance of taking societal values into consideration in research and innovation – indeed, otherwise they would not have accepted the partnership in the first place. Yet it turned out difficult to assess whether the answers that were given regarding the social and ethical impact of their project were influenced by our presence during the interventions. Since responsibility and ethics are such compelling subjects and powerful themes, it is expectable that they influence those asked to speak about them and compels them (indirectly) to go for the 'standard treatment'. Nevertheless, some notable highlights can be mentioned.

For example, some stakeholders experienced the power relationship between the stakeholders in some projects as relatively unfair. On the one hand, the government puts forward expectations on other stakeholders to create change and stimulate transitions; on the other hand, the government is too rigid to move clearly with the dynamic field of practice. Evaluating this situation as 'not practicing what is preached' and reflecting upon can be done in order to stimulate a more fair distribution of power is a form of moral competence. In hearing this, one partner also mentioned that not only the government but also civil society exhibits such unfair 'not-practice-what-you-preach' behavior.

On the one hand, society is pressuring other stakeholders to change and to improve (e.g., when it comes to sustainability and CO_2 reduction). However, when it comes to changing their own behavior, representatives of industry and government sometimes perceive civil society as being quite rigid, often needing systematic guidance and examples before they budge in a specific direction. This rigidity of the civil society is also shown in their unwillingness to accommodate the fact that responsibility (or sustainability) is not the only value on the plate and that other values must play a part if a fair decision-making process is to take place. These are thus some examples where stakeholders were exhibiting the competence of assessing a situation based on shared principles (in this case, fairness).

3.2 RRI leadership

RRI leadership is the leadership that can adapt itself to, but also encourage, the production of RRI outcomes. By leadership we mean the behavior of the organization (or organizations) that

have a leading role within the studied. Recent scholarship has proposed the concept of integrative leadership as a solution for creating responsible innovation in cross-sectoral collaborations (Silvia & McGuire, 2010). The main idea of integrative leadership is that the leader functions as a catalyst more than as a manager: "So the question becomes why in some cases does a reaction occur (integration; partnerships that create public value), whereas in other cases it does not? The answer lies in the presence of a catalyst or catalysts. Catalysts are those parts of the system that enable a reaction, or in other words, bring together the different pieces at the right time' (Morse, 2010). The 'RRI leader' is seen as someone who functions more as a catalyst than a managecr with administrative tasks: catalysts are those parts of the system that enable a reaction, or in other words, bring together the different pieces at the right time' (Morse, 2010).

In practice, however, the application of these terms was hampered by significant complexity in answering the 'who-is-in-charge-question'. In an ideal QHC, with a clear identifiable leader and a series of managerial tasks that belong to that leader, leadership can be isolated as a variable in the big QHC picture. However, most of our cases exhibited a much more complex picture of leadership than the organizational terminology might suggest. Before explaining this further it is important to relate this ambiguity to the previously mentioned ambiguity regarding the QHC process itself. Indeed, when innovation is diffuse either because it is grands-scale and systemic or because it is shared by a variety of actors, the question of leadership needs to be reformulated. The traditional (mainly organizational) concept of a leader becomes too rigid.

In all social labs, the leaders were observed organizing boundary events and taking initiative in establishing or maintaining contact between the collaborating partners of the QHC and other actors. These events consisted in a variety of episodes in which participants from a variety of sectors get to share their worldview with the partners in the QHC. However, as we were told, the creation of these episodes is particularly restrained in the context of innovation that is primarily industry-oriented (B2B). Nevertheless, it became clear that the views of civil society do 'trickle down' into B2B context through media and discourse about risks. As regards the second one, discourse about risk, the employees of the industry engaged in the B2B relationship become something like a 'sample' of civil society which the leaders of the QHC need to take into consideration. In most cases, the strong presence of one or two helixes creates a powerful gravity point which leaves little space for other helixes to commit resources to the project. The strong presence of the initiating helix can in this sense be a deterrent for other helixes to commit resources to the project. As with the RRI competences, a leadership's effectiveness in crossing boundaries and bringing helixes together is very much dependent on the institutional context and the 'landscape' variables at any particular moment.

When enough resources *are* present and the nature of the QHC is such that it is meaningful for other helixes to participate, the leaders were shown to take advantage of the situation and create trans-disciplinary episodes. In one of the social labs, the participants organised day-length meetings in which all helixes were present. The organizations selected for participation were either industrial partners related to the QHC or regional government or an agency related to the theme. In general, the stakeholders that end up participating are representatives of the many helixes that are (and presumably will be) affected by the innovation process lead in question. These meetings are not only useful for sharing visions and discussing questions stemming from each helix but they constitute good networking opportunities from which new

QHCs can be created. Yet, to stress the point above once more, these meetings could not be organized without the other helixes being ready to commit some of their resources (time, energy, finances) to these boundary-crossing events.

4.

The impact of governance on QHCs

As explained in the introduction, the third aim of the RiConfigure project is to compare findings about the observable impacts of public governance frameworks (at Local, Regional, National, European and International level) on QH-collaborations. This is carried out in order to ascertain the institutional conditions under which QHCs are fostered and encouraged or instead hampered and discouraged.

What do we mean by governance? Governance is a mode of government that variously emphasizes co-regulation, co-steering, co-production, cooperative management and co-creation on the borderline between government and society (Archon, 2006; Guston, 2013; Kooiman, 1993; Van Asselt & Van Bree, 2011). Governance approaches are especially attractive to organizations with limited capacity for direct management of the societal phenomena they seek to steer. Such is the case for instance of public authorities who seek to shape the course of research and innovation (R&I) in their territories. We take as a point of departure a standpoint accepted in transition management, namely, that some governance structures are more appropriate than others for enabling sustainable development. In other words, there are aspects of the policy making that function as input of the QHC and influence QHCs irrespective of the topic of the collaboration or other processual factors (e.g., the partners' skills).

The question of the effective governance structures that stimulate a more inclusive, sustainable and ultimately just socio-economic environment has been discussed intensively in the past two decades. A variety of contexts have been studied from waste management, agriculture, energy supply and healthcare. Overarching tenets that cover all these specific sectors are of course difficult to establish and subject to interpretation. However, past research has shown a series of trends and several proposals have been advanced for how the governance context is to relate to practice (broadly construed) in order to enable a more responsible R&D environment and inhibit traditional dynamics that typically push away from responsibility . We distinguish between four types of interactions between the governance structure and, in our case, the QHC: the strategic, tactical, operational and reflexive levels (Loorbach, 2007).

Governance efforts often overlap at various levels within one and the same territory – for example, in the EU local-, regional-, national-, and European-level efforts to govern research and innovation can come to clash with one another. To enhance collaborative research and

innovation, rather than counteract it, governance framework must therefore seek an alignment between R&I agendas (including agendas of individual organizations) and more general innovation policy agendas at these various levels. This means at least that smart specialization strategies in the regions (RIS3); national research and innovation strategies coordinated within the ERA cooperation; and European strategies for stimulating the emergence of science-with-and-for-society approaches (such as RRI and Open Science) must work in conjunction and enable each other. If such synergy between different R&I-governance levels is achieved, each level will be better able to both gain from and contribute to the emergence of new constellations, institutions, and actors.

Focusing on governance frameworks for QHCs, we seek to understand the policy conditions that are relevant for establishing, maintaining, and working successfully within a QHC (see Introduction).

Figure 7 Three different levels of governance that can influence QHCs

1. Strategic governance level – Are there governance structures that enable vision development, strategic discussions, and long-term goal formulation?

2. Tactical governance level – Are there measures that enable the creation of concrete QH constellations, alliances and networks?

3. Operational governance level – Are there measures for funding and steering specific short-term innovation projects that include all four helixes? Are the SL participants making use or being aware of such measures?

In order to understand this relationship between the governance framework and the QHC, two types of data have been used, making a distinction between the *objective presence* of factors of influence at the three levels – i.e., the extent to which relevant institutional factors can be found through desk research – and the *subjective presence* of factors of influence at the same levels – i.e., the extent to which participants in the Social Labs make use, or are at least aware, of the relevant institutional factors. Of course, the data gathering in the SLs will continue through the life-time of the SLs and is expected to yield more relevant information on the impact of public GFs for QHCs which will allow for a deeper understanding of these dynamics. At a later stage, the analysis will also lead to identify the different roles that public governance actors who are outside of the collaboration itself play in relation to its development over time.

4.1 Governance frameworks – first insights

The following observations represent the first insights on the observable interactions and impacts of Governance frameworks on actual QHCs obtained by crossing the description of the existing governance measures around each SL and the recorded attitudes and points of view of the SL participants about their impacts on the collaborations in which they are actually involved. Our observations are thus presented in the form of building blocks of our current understanding of such interactions that will be further developed in close exchange with the SL managers during the next steps of the project.

The environment of governance frameworks concerning QHCs is rather fragmented.

There are currently no specific national frameworks with impacts on the overall formation and development of Quadruple Helix Collaborations (QHCs). Even when there is a general strategy that directly or indirectly promotes QHCs, the actual funding schemes for the most part seem to be designed in prevalently Triple Helix or Open Innovation 1.0 mind-sets and subsequently broadened to reach for inclusion of civil society. In fact, the QHCs seem to move in a governance environment offering a variety of more or less relevant funding opportunities, of which they are not always fully aware. This fragmentation is due partly to the intersection and overlapping of different levels (e.g. national, regional, local, European) but also to intersectoral dynamics and to the interaction of diverse governance bodies. In the SLs it was also lamented the risk that changes in the political landscape at local or national level can cause major shifts in the focus of interest and in the allocation of resources. Furthermore, it has been observed that the collaboration can be hindered by a confusing funding landscape, bureaucratic impediments and conflicts of competence among different governance actors.

QHCs are rarely activated by QHC-supporting policies.

QHCs do not seem to be triggered by specific policies that are specifically designed for them. Furthermore, it must be considered that not all the relevant frameworks and policies are "bona fide" Quadruple Helix instruments. First of all, the very term "Quadruple Helix" is seldom used. The most noteworthy exception in this regard is the 2016 Austrian Open Innovation strategy[1], which actively addresses the inclusion of civil society and openly advocates the need to broaden the TH model to a QH model. In most cases, instead, several instruments and policies make a more or less explicit reference to the collaboration among the actors included in the four components of the "helix", or simply to the need to involve civil society in innovation processes.

This happens, for instance, in the climate change strategy in Denmark, in which the involvement of civil society is mandated in many instances but the term "quadruple helix" is not used. In the Danish SL, it was even found that the term in itself appears to confuse the participants while concepts like "intersectoral cooperation" or "co-creation" were more mobilizing. Furthermore, these indications can be formulated as a recommendation or a requirement within diverse sectoral policies, whose primary objective is not the promotion of collaborative innovation, but to address challenges such as climate change, sustainable transportation, etc.

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[1] BMWFW, & BMVIT. (2016). Open Innovation Strategy for Austria. Goals, Measures and Methods. Report by the Austrian Federal Ministry of Science, Research and Economy (BMWFW) and the Austrian Federal Ministry of Transport, Innovation and Technology (BMVIT): http://openinnovation.gv.at/wp-content/uploads/2015/08/OI_Barrierefrei_English.pdf. The strategy is the result of a broader process of consultation of actors from research, Industry, Public and Civil Society. Here the "agency" of the Public actor as driver of a general process of governance of the transition from Mode 2 to Mode 3 and from the paradigm of OI1.0 to OI2.0.

QHCs are more often generated through a patchwork of measures supporting collaboration.

So real-life QHCs appear more as the result of a complex contextual interaction among specific actors (each bearing their own "good reasons") that "meet" with various governance frameworks at different moments and in diverse configurations, resulting in a sort of "patchwork" of measures and legal arrangements from which to get resources and support. This interaction might occur at different levels, for instance at the strategic level, when already motivated actors in a certain sector meet overarching strategies that empower and provide them with symbolic support and inspiration, while the actual resources for their collaboration come from different sources. This seems the case, for instance, of the situation examined in the Dutch SL, where the Dutch Climate Agreement and the Paris Climate Agreement empower the industry and research actors in Green Hydrogen programs[2], which in turn support their projects with a mix of resources, but find some difficulties in fully including civil society.

Conversely, for most of the cases involved in the Austrian SL, the National Open Innovation Strategy explicitly promotes the QH concept and approach and provides resources to implement them. At the tactical level, in Denmark, within the overarching favorable cultural context towards sustainable climate change adaptation, there is a national Action Plan that makes it mandatory for Municipalities to prepare local action plans and to partner with Utilities, the civil society and other actors to implement it (e.g. the C2C Program C2C – Coast to Cost Climate Change [3] from the Danish Coastal Authority that has provided State and European Funds to enact several collaborations considered in the Danish Social Lab).

Nature and features of QHCs largely depend on the actor (or the actors) initiating the collaboration.

The actual form that any given QHC takes and its peculiar interaction with the impinging governance frameworks seem to be related to the kind of actor (or actors) that initiates the collaboration. This includes, as observed in the SLs, the nature of the actor (industry, CSO, research organization, local authority, etc.), the sector in which it acts, the interests of the actor, the objectives it is pursuing, the actual motivation it has in activating a QHC and the kind of policy measures it uses for activating it. For example, an actor could be motivated to create a coalition and using a policy measure for doing it. However, in other cases, an actor could be motivated prevalently by a specific interest and using for matching them a policy measure, which also imposes the cooperation with other actors. At a first assessment, it appears that the collaborations in which civil society is more steadily present are those initiated by public actors[4], while strong industry-research collaboration might find more difficult to effectively integrate civil society in their projects. Up to now, very few of the observed cases have been genuinely initiated by civil society. Furthermore, in some instances (e.g. in some Columbian cases) there seems to be a difficulty to maintain the involvement of the other actors in a long-term effort, once the actual project which originated the collaboration is over. In other cases,

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[2] 'Klimaatakkoord'National Climate Agreement - The Netherlands, presented to the House of Representatives on the 28th of June 2019: https://www.klimaatakkoord.nl/documenten/publicaties/2019/06/28/national-climate-agreement-the-netherlands
[3] C2C - Coast to Cost Climate Change (Link: https://www.c2ccc.eu/english/about/. It is a 6-year (2017-2022) climate adaption project with the aim of creating a climate robust region of the western Jutland.
[4] This applies to several Columbian cases connected to the National strategy for the appropriation of Science, Technology and innovation, public policy led by COLCIENCIAS in Colombia, based on an Inclusive approach to Innovation and Competition, http://www.appropriate.colciencias.gov.co/sites/default/files/2018-08/Poli%CC&81tica_ASCyT_final.pdf

civil society is present in the form of specific interest groups, like Trade Unions, tenants associations or land-owners.

QHCs should be understood as a coalition-building process

What we observed so far leads us to think that QHCs can be interpreted as a coalition-building process, i.e. a process aimed at establishing and constantly reproducing a new collective actor, of a temporary nature, based on a balance among the concerned actors. This balance could involve the culture of each of them, the motivation (or agency) pushing them into the QHC, their action (what they do and how they do it) and their identity (i.e., their capability to manage their relations with other actors). All these aspects determine the capacity of single actors to exercise control over their internal and external environment and thus the capacity to, e.g., preventing risks, seizing existing opportunities, influencing other actors, or actually pursuing their objectives.

There is a prima facie prevalence of enabling roles by external governance actors.

From an initial analysis of the available data on the external role played by public governance actors outside of the collaborations, some general observations can be done at this stage of the itinerary. Firstly, the prevailing role played seems that one of the *Enabler*, as the funder of projects and programs implemented by the collaboration or by its initiator, or as the provider of infrastructures. Secondly, from the practitioner's side (Social Labs Panel meeting, survey, case analysis, first dialogue event), some expectations are expressed about the need of other kind of roles covering other functions, like for instance those of building trust, quality control, or providing symbolically effective vision able to raise awareness and mobilize the various actors around a common challenge. A further understanding of these expectations and needs will be achieved, at the later stage of the T6.3 analysis, leading to the revision or broadening (if necessary) of the typology of the actual roles played by the external GF actors. This will be also useful in view of providing possible suggestions for the improvement of existing public GF external to the QHCs.

5.

Conclusion and steps forward

The QHC phenomenon, with its promises of increased effectiveness and reasonableness, is in the making. With these preliminary results from our Social Labs, we seek to bring this increased understanding in what it means to broaden the scope of innovation in the way our case partners did. We have focused on challenges and prospects of betterment regarding the QHC practice (section 2), on the relationship between RRI and QHC (section 3) and on the governance context in which these QHC collaborations are active.

The interaction between partners is difficult, but constant building and maintenance of the organizational structure around the QHC can help. For example, establishing a financial framework in which all four parties are included and in which their role is clearly determined is almost a *sine qua non* condition, given that in most of the analyzed project, the civil society does not have access to sufficient finances and thus depends on the other partners in this regards. Under such conditions, a conscious selection of partners, in which the initiator *begins* with the stakeholders-to-be-included can create the necessary platform for creating a QHC. That said, such processes can also take time and slow down the innovation process which can in fact generate tensions even before the kick-off. Finally, making sure that the partners share a common vision and shared goals, beyond the official narrative everyone is adhering to 'by default', is essential in maintaining QHCs and ensuring their effectiveness. Once these structural elements are taken care of, facilitators and managers can then work on the small-scale variables such as frequent interactive events that can ensure goal-and-expectation alignment and reflective learning. In addition, management styles that allow an allocation of responsibilities across the four helixes (as opposed to letting one helix take ownership/responsibility of the entire setting) can help maintain a high interest and avoid fundamental disruptions in the QHC.

On the topic of RRI competences, we have noticed that navigating the four helixes through systems thinking is not particularly challenging. Stakeholders whose daily work consist of this necessary 'placement in context' have acquired these skills before themes such as public engagement and citizen science became popular. That said, it is doubtful whether navigating public-private partnerships or even triple-helix partnerships (research, industry, policy) is on a par with navigating quadruple helix partnerships. Often bracketed in the former but essential in the latter, the capacity to discuss transdisciplinarily (i.e., between experts of various kinds, including the lay public) seems to still present some difficulties. Not all stakeholders are convinced of the benefits of integrating society 'upstream' in the innovation process and as such do not see the need to develop skills and methods for engaging in this practice.

As emerged from the analysis of real-life QHCs cases, they often appear more like a spectrum of interaction among the four components, than a clear-cut coalition of equal partners. Sometimes one or more "helixes" are scarcely present or altogether missing. This is particularly true for the civil society component that can be substantiated in a very diverse way and about whose role there are diverging positions among the representatives of the other "helixes". In fact, as observed in the Danish SL, the participation of civil society often seems to play a marginal role or intervene at a later stage of the collaboration. In this regard, governance frameworks can play an important role both at the strategic level and at the tactical and operational ones, since they may envision civil society as major strategic actor or can make the participation of CSOs a requirement for the provision of funds to the collaboration (as for instance in the Columbian SL). Even when such requirements are in place, however, resistances or difficulties to properly include civil society by other actors of the collaboration have been observed (this seems a common issue expressed, in different forms, in all the SLs). Moreover, motivations towards the establishment of the collaboration and the use of the available governance instruments may largely vary among the involved actors according to their different interests and attitudes.

References

Ahonen, L., & Hämäläinen, T. (2012). CLIQ: A Practical Approach to the Quadruple Helix and More Open Innovation. In S. P. MacGregor & T. Carleton (Eds.), *Sustaining Innovation: Collaboration Models for a Complex World* (pp. 15-29). New York, NY: Springer New York.

Andrews, R., & Entwistle, T. (2010). Does Cross-Sectoral Partnership Deliver? An Empirical Exploration of Public Service Effectiveness, Efficiency, and Equity. *Journal of Public Administration Research and Theory, 20*(3), 679-701. Retrieved from http://dx.doi.org/10.1093/jopart/mup045

Archon, F. (2006). Varieties of Participation in Complex Governance. *Public administration review, 66*(s1), 66-75. doi:doi:10.1111/j.1540-6210.2006.00667.x

Blok, V., & Lemmens, P. (2015). The Emerging Concept of Responsible Innovation. Three Reasons Why It Is Questionable and Calls for a Radical Transformation of the Concept of Innovation. In B.-J. Koops, I. Oosterlaken, H. Romijn, T. Swierstra, & J. van den Hoven (Eds.), *Responsible Innovation 2: Concepts, Approaches, and Applications* (pp. 19-35). Cham: Springer International Publishing.

BMWFW, & BMVIT. (2016). *Open innovation Strategy for Austria. Goals, Measures and Methods.* Report by the Austrian Federal Ministry of Science, Research and Economy (BMWFW) and the Austrian Federal Ministry for Transport, innovation and Technology (BMVIT): http://openinnovation.gv.at/wp-content/uploads/2015/08/OI_Barrierefrei_Englisch.pdf.

Brink, T., & Madsen, S. O. (2016). The triple helix frame for small- and medium-sized enterprises for innovation and development of offshore wind energy. *Triple Helix, 3*(1), 4. doi:10.1186/s40604-016-0035-8

Bryson, J. M., Crosby, B. C., & Stone, M. M. (2006). The Design and Implementation of Cross-Sector Collaborations: Propositions from the Literature. *Public administration review, 66*(s1), 44-55. doi:doi:10.1111/j.1540-6210.2006.00665.x

Carayannis, E., & Campbell, D. (2010). Triple Helix, Quadruple Helix and Quintuple Helix and how do knowledge, innovation and the environment relate to each other?: a proposed framework for a trans-disciplinary analysis of sustainable development and social ecology. *International Journal of Social Ecology and Sustainable Development (IJSESD), 1*(1), 41-69.

Carayannis, E. G., & Campbell, D. F. (2009). 'Mode 3'and'Quadruple Helix': toward a 21st century fractal innovation ecosystem. *International journal of technology management, 46*(3-4), 201-234.

Carayannis, E. G., & Campbell, D. F. (2014). Developed democracies versus emerging autocracies: arts, democracy, and innovation in Quadruple Helix innovation systems. *Journal of Innovation and Entrepreneurship, 3*(1), 12.

Douglas, H. (2003). *The Moral Responsibilities of Scientists (Tensions Between Autonomy and Responsibility)* (Vol. vol. 40). North American Philosophical Publications: University of Illinois Press.

ERAC. (2019). *ERAC Standing Working Group on Open Science and Innovation.* Retrieved from Brussels:

Felt, U., & Fochler, M. (2010). Machineries for making publics: Inscribing and de-scribing publics in public engagement. *Minerva, 48*(3), 219-238.

Fernandez, M. A., Desroches, S., Marquis, M., Turcotte, M., & Provencher, V. (2017). Facilitators and barriers experienced by federal cross-sector partners during the implementation of a healthy eating campaign. *Public Health Nutrition, 20*(13), 2318-2328. doi:Doi: 10.1017/s1368980017001264

Guston, D. H. (2013). *Understanding Anticipatory Governance.* USA: SAGE publications.

Gutiérrez, R., Márquez, P., & Reficco, E. (2016). Configuration and Development of Alliance Portfolios: A Comparison of Same-Sector and Cross-Sector Partnerships. *Journal of Business Ethics, 135*(1), 55-69. doi:10.1007/s10551-015-2729-7

Hassan, Z. (2014). *The social labs revolution: A new approach to solving our most complex challenges.* San Francisco: Berrett-Koehler Publishers.

Kolb, D. (1984). *Experiential learning as the science of learning and development.* Englewood Cliffs NJ: Prentice Hall.

Kolehmainen, J., Irvine, J., Stewart, L., Karacsonyi, Z., Szabó, T., Alarinta, J., & Norberg, A. (2016). Quadruple helix, innovation and the knowledge-based development: lessons from remote, rural and less-favoured regions. *Journal of the Knowledge Economy, 7*(1), 23-42.

Kooiman, J. (1993). *Modern governance : new government-society interactions.* London :: Sage.

Kriz, A., Bankins, S., & Molloy, C. (2018). Readying a region: temporally exploring the development of an Australian regional quadruple helix. *R&D Management, 48*(1), 25-43.

Lans, T., Blok, V., & Wesselink, R. (2014). Learning apart and together: towards an integrated competence framework for sustainable entrepreneurship in higher education. *Journal of Cleaner Production, 62*, 37-47. doi:https://doi.org/10.1016/j.jclepro.2013.03.036

Le Ber, M. J., & Branzei, O. (2010). Value Frame Fusion in Cross Sector Interactions. *Journal of Business Ethics, 94*, 163-195. doi:10.1007/s10551-011-0785-1

Loorbach, D. (2007). Governance for sustainability. *Sustainability: Science, Practice and Policy, 3*(2), 1-4. doi:10.1080/15487733.2007.11907996

Meissner, D., & Carayannis, E. G. (2017). Value generation from industry-science linkages in light of targeted open innovation. *Journal of Knowledge Management, 21*(2), 295-307. doi:10.1108/jkm-11-2016-0510

Morse, R. S. (2010). Integrative public leadership: Catalyzing collaboration to create public value. *The Leadership Quarterly, 21*(2), 231-245.

Owen, R., Bessant, J., & Heintz, M. (2013). *Responsible Innovation: Managing the responsible emergence of science and innovation in society.* UK: WILEY & Sons,Ltd. , Publication.

Ploum, L., Blok, V., Lans, T., & Omta, O. (2018). Toward a validated competence framework for sustainable entrepreneurship. *Organization & Environment, 31*(2), 113-132.

Pohling, R., Bzdok, D., Eigenstetter, M., Stumpf, S., & Strobel, A. (2016). What is ethical competence? The role of empathy, personal values, and the five-factor model of personality in ethical decision-making. *Journal of Business Ethics, 137*(3), 449-474.

Schroth, F., Häußermann, J., Ruhrmann, H., Kaiser, S., Nielsen, R., & Degnbol, D. (2019). RiConfigure D1.1: Analytical Framework. v4.0.0. http://riconfigure.eu/wp-content/uploads/2019/10/D01.1_Analytical-Framework_v3.0.3-1.pdf.

Silvia, C., & McGuire, M. (2010). Leading public sector networks: An empirical examination of integrative leadership behaviors. *The Leadership Quarterly, 21*(2), 264-277.

Van Asselt, M. B. A., & Van Bree, L. (2011). Uncertainty, precaution and risk governance. *Risk Research, 14*(4), 401-408.

Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: a reference framework for academic program development. *Sustainability science, 6*(2), 203-218.