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Exploring Quadruple Helix

Outlining user-oriented innovation models

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Final Report on Quadruple Helix Research for the CLIQ project

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Executive Summary

Introduction

This is the final report of the Quadruple Helix (QH) research conducted for the CLIQ project commissioned by the EU INTERREG IVC. This summary provides a brief description of the context, goals and results of the QH research.

The overall long-term aim of the CLIQ project was to optimize the benefits of globalization and innovation to SMEs and entrepreneurs in medium-sized towns. The main objective was to strengthen local authority policy and the capacity of local authorities to support innovation more effectively.

The task of this research was to explore and further define the Quadruple Helix concept in innovation as well as to explore the roles of various stakeholders within it with a particular focus on local-regional government.

Quadruple Helix (QH), with its emphasis on broad cooperation in innovation, represents a shift towards systemic, open and user-centric innovation policy. An era of linear, top-down, expert driven development, production and services is giving way to different forms and levels of coproduction with consumers, customers and citizens. This also sets a challenge for public authorities and the production of public services.

Along with this, the QH debate is directly connected to the Europe 2020 Strategy for smart, sustainable and inclusive growth, and thus to the shifts towards a better connection between stakeholders and a smarter use of resources.

Research results

After analysing the Quadruple Helix (QH) concept, we discovered that it is not yet a very well-established and widely used concept in innovation research and in innovation policy. Some existing conceptions are very close to the Triple Helix (TH) concept, some of them deviate more radically from it, and many are somewhere between these two extremes. What is

common to all conceptions of QH innovation is that in all of them a fourth group of innovation actors has been added into the TH model. However, there are different views as to of whom or what this fourth group consists; in other words, its membership can range from intermediate innovation enablers to different users of innovations.

"User-driven" innovation approaches are seen as an essential element in the new broad-based innovation policy approaches, of which the Quadruple Helix is a part. Therefore our choice as the fourth helix is the user understood in the broad sense. Choosing the user as the fourth helix of QH in our research can also be justified by the long-term practical aims of the CLIQ project, which include optimizing the benefits of globalization and innovation to SMEs and entrepreneurs in medium-sized towns. However, we find the concept "user-driven" problematic in the sense that it suggests a bigger role to the user than what there actually often exists. Following the suggestions coming from the innovation debate, we prefer to use the concepts "user-centred" or "user-oriented" interchangeably.

On the basis of this we formed a general definition of the QH innovation model: it is an innovation cooperation model or an innovation environment in which users, firms, universities and public authorities cooperate in order to produce innovations. These innovations can be anything considered useful for partners in innovation cooperation; they can be, for example, technological, social, product, service, commercial, and non-commercial innovations.

Our research revealed that it is more useful and meaningful to consider Quadruple Helix rather as a continuum or space than as a single entity. Accordingly, it is more useful to talk about different QH models situated somewhere along the QH continuum or space. In order to make some interesting dimensions and possibilities of QH explicit, we constructed four different types of QH models: 1) the "TH + users model", 2) the "Firm-centred living lab model", 3) the "Public-sector-centred living lab model", and 4) the "Citizen-centred model". These models are ideal-type models and not meant for describing reality as it is. The purpose of these models is to bring forth some essential characteristics of the different QH models more clearly and to provide examples of the possible application possibilities of QH.

The TH + user model is otherwise same as the traditional TH model except for the systematic collection and utilization of user information. Its focus lies on the development of commercial

high-tech innovations based on latest scientific research knowledge. The owner of the innovation process is a firm, a group of firms, a university or a group of universities. In this model, the degree of user involvement could be characterized as ‘design for users’. Users are treated as informants, not as developers.

The Firm-centred living lab model also focuses on the development of commercially successful innovations. They can be based on latest research knowledge, on new applications or combinations of “old” research knowledge and/or on user knowledge. The owner of the innovation process is a firm or a group of firms. In this model users are treated as both informants and developers. In other words, they also participate in the development work, for example, of new products and services together with R&D experts.

The Public-sector-centred living lab model focuses on the development of public organizations and services. In this case the owner of the innovation process is a public organization or a group of public organizations. The goal of innovation activity is above all to develop public organizations so that they can function better and offer new and better products and services to their clients, to the citizens. In order to succeed in this, public organizations have to systematically gather information and feedback from the clients. This can be realized by means of more traditional information gathering methods (e.g. surveys, interviews) or by organizing dialogue forums (virtual and real) or living lab type of development environments for the citizens. Also in this model, users participate in the development work of public services together with R&D experts.

The Citizen-centred QH model focuses on the development of innovations that are relevant for citizens. In this innovation model, citizens are in the driver’s seat. The owner of the innovation process is a citizen or a group of citizens (i.e. a development community). In this model, the degree of user involvement could be characterized as ‘design by users’, i.e. new products, services and ways of doing things are developed by users. Besides making most of the development work, citizens also decide which kinds of innovations are needed and developed. The role of firms, public authorities and universities is above all to support citizens in their innovation activities (e.g. to provide tools, information, development forums and skills needed by users in their innovation activities). Firms and public organizations also utilize the innovations made by citizens.

QH has been applied in the private and public sectors as well as in several operational areas, including telecommunications, health, well-being, housing, tourism, energy, and governance. The reviewed QH cases suggest that QH has wide application possibilities. In addition to innovation, this concept plays also other roles, for example, in entrepreneurship and venturing, in technology transfer as well as in the promotion and development of cities and regions. QH development platforms and environments could be seen as a supplement to traditional cluster and regional innovation policy and as a new kind of intermediary organization that supports the involvement of users in the R&D&I activities. But there are also numerous challenges related to the transition from old research- and technology-driven innovation models (incl. the TH model) to more user-oriented innovation models. Some of these challenges are more connected with enterprises, others with universities, public organizations and users. This is a huge cultural change – be it in the public or private regime.

One of our research tasks was to find out whether or not QH can bridge the innovations gaps between civil society and innovation. An innovation gap in this context can mean a "technological innovation gap", a "trust/moral gap" and a "public sector innovation gap". A technological innovation gap means the insufficient capability of European firms to translate their technological know-how into successful business cases with significant commercial and societal impacts. A trust gap/moral gap means that citizens do not necessarily trust the breakthrough technologies developed by firms and public research organizations or that they can consider these technologies and the use of them unethical or unecological. A public sector innovation gap can mean the insufficient capability of local, regional and national authorities to involve citizens into the development of public services and organizations.

Our research indicates that user-oriented QH model has the potential to bridge, or at least narrow down, all these innovations gaps. The reviewed living lab cases demonstrate that by means of the QH model both firms and public organizations can develop products and services that really interest consumers, users and citizens. How much of this potential of QH will be actually realized, and how well this innovation model can succeed in narrowing down also other innovation gaps, besides the technology gap, depends on lots of things. It depends, for example, on how much influence firms and public authorities are willing to give to users/citizens and on how much influence users/citizens are willing and able to assume.

Our study demonstrated that there are several ways in which public authorities can support and assist QH actors in meeting these challenges and in implementing the QH innovation models.

Examples of these roles are presented in the following:

- Enabler
  - e.g. financier and provider of infrastructure
- Decision maker
  - e.g. maker of regional/local QH innovation policies (e.g. guidelines, financial incentives, R&D&I-programmes supporting user-oriented innovation)
- Supporter
  - e.g. to support the development of QH partners (e.g. firms, universities, users), the systematic collection and utilization of user information and the knowledge and capability development related to QH, to promote the empowerment of citizens and to assist citizens in their innovation activities
- Utilizer
  - e.g. to utilize the user-oriented development services provided by QH innovation environments by themselves (as part of the development of public services)
- Developer
  - e.g. to utilize user-oriented development methods in the internal development work public sector
- Marketer
  - e.g. to raise awareness of user-oriented innovation models and practices among citizens, businesses and public sector
- Quality controller
  - e.g. to support the development of "quality checks" or standards for QH type of activities and for other co-creation environments and to assess the quality of QH type of activities by means of these standards

It is noteworthy that the roles of public authorities are somewhat different in different QH models. Therefore, in addition to these general measures presented above, public authorities should also use QH-model-specific measures.

Recommendations

Local and regional authorities have an important role in QH, via strategic use of resources, integrating knowledge and skills in innovative thinking, community building, procurement, regulation, grants and rewards. However, in order to succeed in this, they also need to develop their own ability and skills to accomplish these and to cope with the constraints, inflexibilities and bureaucracies inherent in public organizations. This means that public authorities are faced with a double challenge of renewing themselves in order to be able to be an interesting partner in renewing the local-regional "innovation ecosystem".

A stepwise process, which is relevant for the context, of building awareness, connection, learning and mutual trust-building is advisable, and here the four QH models and the wealth of experiences already contained in relation to them could be helpful.

We recommend that each locality/region identify their particular stage of development, challenges and opportunities by means of the four basic QH models and the good practices identified in them, and designs and executes, together with the necessary stakeholders, a local-regional learning process with a distinction of a short-term and a long-term opportunity perspective. Thus, we recommend making a careful self-assessment against the different QH models, goals, types of innovations produced, and the roles, skills and activities needed from public authorities to support innovation.

1. Introduction

1.1. The innovation debate

Quadruple Helix as a model of innovation reflects in many ways several features common to new thinking in innovation process and innovation policy.

Innovation policies have recently been confronted by a multitude of pressures to change. Some of these originate from external developments, some from internal policy issues. National responses to the challenges include both structural and behavioural renewals in innovation policies. The reforms have also their local and regional consequences. An overall development trend is that the dominant innovation policy model, based on a linear view and a focus on science-push and supply-driven high-tech policy, is enhanced and complemented by a new and broader approach than before. Some have called this new emergent approach broad-based innovation policy (see Edquist et al. 2009, Viljamaa et al. 2009).

The broad-based approach means that also non-technological innovations, such as service innovations and creative sectors, are becoming more attractive as innovation policy targets. In addition, the notion of innovation is no more restricted to activities carried out by businesses. Broad-based innovation policy can be extended to encompass wider societal benefits and measures targeted to support service innovation in the public service production. One thing that also broadens the innovation policy activities is a shift of focus from the specialization and narrow spearheads of innovation to a variety of decentralized, horizontal and functional measures supporting innovation activities on a broader base and more comprehensively.

This new innovation policy approach includes also a general shift from planning-oriented policies focusing on innovation inputs towards a more flexible, enterprise-oriented policies focusing on market developments. This has meant a transition from policy models looking for general ‘best practices’ towards more customized policies and policies supporting the development of in-house competencies, in both private enterprises and public organizations.

The new broader innovation approach also takes into consideration that both demand and supply side factors influence the way in which innovations emerge and diffuse on the markets and within the wider society. The need for user-oriented innovation in addition to demand-oriented innovation is recognized. Users and user communities are seen to be increasingly important for business success and development for commercially successful innovations. The user-oriented innovation perspective is considered important also in the public sector where it is believed to support the renewal of public services.

A shift from a relatively narrow and supply-oriented innovation policy to a more broad-based one is a tremendous change in many respects. It necessitates, for example, the development and implementation of totally new policy instruments. It is also very likely that the roles of the different authorities supporting innovation activities (incl. local and regional authorities) have to be rethought. There still seems to be a bias towards support for technological innovation and policies, and measures for supporting "user-driven" innovation are only in their infancy. So far there are only few examples of how to integrate users systematically in the innovation processes by means of innovation policies. There is also not yet enough approved and researched knowledge about the procedures and instruments suitable for public authorities in supporting broad-based innovation activities at the international, national and local level.

1.2. The structure of the report

The introduction and presentation of the research design are followed by Chapter 3, which explores how Quadruple Helix (QH) is positioned in the context of the latest innovation research, distinctive to which is a shift from linear to systemic, open and user-centric innovation models. The concepts of user-oriented approach and user are explored and elaborated as a basis for the research and also for the search for good practices in QH.

Secondly, on the basis of a screening of the QH cases, a set of examples and learning points are presented. The examples are intended as "benchlearning" material with references for further study. Third, the main results of the Questionnaire and Case Reader comments of the CLIQ partners are given.

In Chapter 6 on results, four ideal types of Quadruple Helix are defined according to the goals, types of innovation produced and the roles of stakeholders. Next, in Chapter 7 on conclusions, a definition of Quadruple Helix and an assessment of the relevance and usefulness of the model(s) are provided together with the conclusions on the roles of public authorities. Finally, in Chapter 8 on recommendations, suggestions and guidelines are given with local and regional authorities in mind *vis-à-vis* the four QH models.

Chapter 1 introduces initially the location of Quadruple Helix in the innovation debate.

Chapter 2 introduces the research design and spells out the objectives, points of departure and the approach of the research.

Chapter 3 locates Quadruple Helix in the context of the innovation literature and explores the concept of Quadruple Helix from a theoretical point of view.

Chapter 4 provides an overview of selected QH cases illuminating various practical approaches and learning lessons from implementing QH type of innovation.

Chapter 5 offers a summary of CLIQ partner responses to a survey on user-centred innovation and a request to reflect on a set of examples of the QH practice.

Chapter 6 summarizes the research results concerning the QH model and its implementation. In this chapter the roles of public authorities (incl. the local ones) are also considered.

Chapter 7 is a summary on conclusions concerning the definition and essential characteristics of QH, the relevance of QH and the roles and possibilities of public authorities in promoting a QH type of innovation.

Chapter 8 gives recommendations for regional and local authorities on further investigation and promotion on a QH type innovation.

2. Research Design

2.1. The objective of the CLIQ Quadruple Helix research

The overall long-term aim of the CLIQ project is to optimize the benefits of globalization and innovation to SMEs and entrepreneurs in medium-sized towns. The main objective is to strengthen local authority policy and the capacity of local authorities to support innovation more effectively, exploring the possibilities of a Quadruple Helix innovation approach in establishing this.[1]

The overall aim of the research was to explore and further define the Quadruple Helix concept in innovation and to explore the roles of various stakeholders within it with a particular focus on local government. The results feed into CLIQ interregional learning and underpin exchange, shared understanding and local policy development. The target audience for the research is Local Authorities and innovation service providers in the European Union. The research themes were the following:

1) Exploring and defining the Quadruple Helix concept
2) Exploring the role of Civil Society in Quadruple Helix in connecting companies (particularly SMEs), civil society and innovation
3) Identifying good practices in implementing Quadruple Helix
4) Identifying roles and good practice for Local Authorities in promoting Quadruple Helix

2.2. Methodology

In our practical methodology, the research questions are interpreted to fall under two main research strands (see Figure 1): (1) Exploring and defining the concept and model of QH and (2) Identifying good practice in QH.

In our research, these categories feed into each other, i.e. discoveries in the conceptual research guide empirical findings, and vice versa.

[1] In the following, we will use the abbreviations QH for Quadruple Helix and TH for Triple Helix.

The research was conducted through the following five main elements:

(1) The first phase of the research was the exploration and definition phase by conducting a secondary analysis of the research literature concerning the QH type of innovation. First, a search of QH-related literature was made in two academic archives (EBSCO and Science Direct) as well as in Google. The following search terms were used: Quadruple Helix, user innovation, user-driven innovation, customer-driven innovation, public-sector innovation, client-driven innovation; user-centric innovation, customer-centric innovation, client-centric innovation; public–private partnership; service innovation, public service and innovation; local government and innovation, citizen and innovation, civil society and innovation, user involvement and innovation, public renewal and user involvement. The most important finding of this phase was that the concepts of user innovation and living lab were very closely related to the QH concept as to the criteria of four cooperative innovation actors and user involvement.

(2) On the basis of both conceptual and empirical basic studies, a critical screening for analysis of practices on the QH cases was conducted. The first and most essential selection criterium for the good QH cases was that the case was clearly different from the Triple-Helix-type of innovation activity and that it represented the QH type of innovation activities in which all four QH actor groups are involved and/or innovation activities in which users had an essential role, and the second selection criterium was that there was an in-depth and rich enough description available of the case and that this description entailed experience-based real knowledge of the case.

(3) A survey on QH was conducted among CLIQ partners, with a special emphasis on identifying the levels of user involvement in innovation in local–regional partner contexts.

(4) From the case analysis of QH, a set of examples illustrating different applications and learning lessons concerning QH were chosen for reflective comments by CLIQ partners.

(5) Finally, the literature and case analyses as well as the responses by the CLIQ partners to the survey and case examples provided the basis for our analysis of the QH model, conclusions and recommendations.

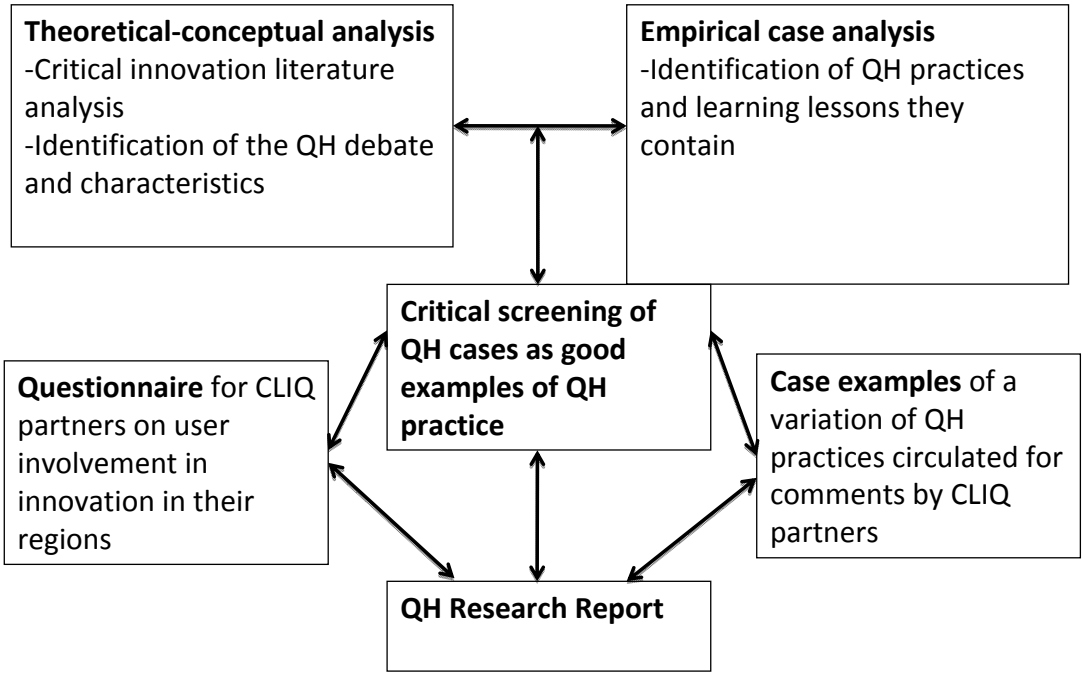

Figure 1. The research methodology

3. Quadruple Helix in the context of innovation research: From linear to systemic, open and user-centric innovation models

To approach Quadruple Helix as an innovation model it is necessary to locate it in the context of the innovation literature. Next we will describe the change in thinking of innovation processes from the linear innovation model to innovation systems to regional and territorial innovation models and to Triple Helix model, and finally, to user-centric and Quadruple Helix models.

According to Edquist and Hommen (1999), what is termed the linear model of innovation has been generally accepted throughout much of the period since World War II. A linear view of the innovation process means that science leads to technology and technology satisfies market needs. It conceives of commercial research and development as applied science and envisions a smooth, unidirectional flow from basic scientific research to commercial applications. In this kind of approaches, innovations were seen as great leaps of knowledge achieved by talented individuals or research groups. Innovations were also largely seen to be linear processes from basic research to market applications. There was even no feedback from several later stages of the innovation process (i.e., product development, production, and marketing) to the initial stage of research, nor was there feedback between any of the other stages.

Problems with the linear model of innovation have been summarized by Kline and Rosenberg (1986). According to them, the shortcomings and failures that are part of the innovation-creating learning process mean that in both radical and incremental innovation feedbacks and trials are essential. Furthermore they note that basic scientific research does not always lead to the design of innovations. Conversely, problems that emerge in the processes of designing and testing new products and new processes often spawn research and have in some instances even given rise to new branches of science. Technological innovations may also proceed independently of any interaction with science, although other types of interactions might be important.

The failures of the linear model have created a demand to foster other sources of innovation. The later theories of innovation have emphasized that innovations typically take place in normal, cooperative social and economic activities, being incremental, social and organizational changes as technological advancements as well as radical leaps. Therefore, the focus has shifted to interactive, non-linear innovation processes in multi-actor innovation networks. (Schienstock & Hämäläinen, 2001)

One way to take a more multi-faceted look at the innovation is the system-oriented theory and research of innovation (SI). This view of the innovation process explicitly recognizes the potentially complex interdependencies and possibilities for multiple kinds of interactions between the various elements of the innovation process. It also accords great importance to the demand side rather than concentrates primarily on the supply side (Edquist & Hommen

1999). The innovation system concept can be understood in both a narrow and a broad sense (Piirainen & Koski 2004). A narrow definition of the innovation system primarily incorporates the R&D functions of universities, public and private research institutes and corporations, reflecting a top-down model of innovation. A broader conception of the innovation systems is more interactive and bottom up, including 'all parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and exploring' (Lundvall 1992).

Edquist and Hommen (1999) argue that SI approaches provide a much more careful and detailed development of public policies for innovation than do the variants of the linear approach. From an SI perspective, policy is partly a question of supporting interactions in a system and identifies existing technical and economic opportunities, or creates new ones. The degree of innovation opportunity should be the deciding criterion in allocating support for certain types of interactions, and hence for certain technologies and sectors. Moreover, the feasibility of alternative directions for innovation must also be evaluated so that policy does not remain "blind" and support all alternatives in an indiscriminate way. Policy makers should develop the selection criteria, such as impacts on economic growth and employment, while supporting the creation of novelty.

Wise and Høgenhaven (2008) say that just now there is again a need for a paradigm shift. The role of users of innovations is growing fast, and one can even speak of user-driven innovation which refers to tapping users' knowledge in order to develop new products, services and concepts and the understanding of user needs and involving users more systematically in the innovation processes. Wise and Høgenhaven (2008) describe the evolution of innovation approaches as follows (see Figure 2).

Figure 2 shows how innovation perspectives have evolved over time, moving from linear to systemic models, and later to new modes of knowledge production. The later innovation theories and approaches stress that knowledge is increasingly created in broader, trans-disciplinary and in, besides economic, also social contexts in which users of innovations have a great role to play. These can be named open and user-oriented models of innovation.

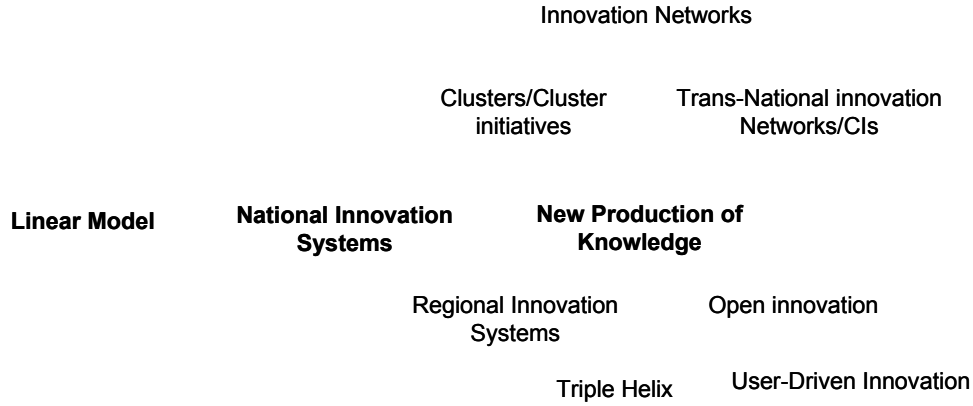

Figure 2. Evolution of innovation frameworks (Wise & Høgenhaven 2008)

In Section 3.1 we will take a closer look at the systemic and regional aspects of innovation. Then we move to the Quadruple Helix approach through the Triple Helix approach defining what is essential and perhaps also new in the Quadruple Helix approach compared to some previous innovation models.

3.1. Innovations in their environment: Regional innovation systems

In the literature on innovation processes and policies the local and regional dimension has grown in importance in post-Fordist "learning economies" (Asheim 2007, Asheim et al. 2003, Cooke et al. 2004). The main underlying argument is that territorial clustering provides the best context for the promotion of innovative firms based on sticky knowledge and localized learning. Governments and agencies at all spatial levels are seeking to stimulate innovation, and, consequently, innovation policy is put at the centre of policies for promoting regional and national economic development. At the regional level, clusters and regional innovation systems have been looked upon as policy frameworks or models for implementation of long-term development strategies initiating learning-based processes of innovation, change and improvement (Asheim 2007).

To illustrate thinking of the regional dimension of innovation one may take a closer look at one of the most popular approaches, regional innovation systems. According to Asheim (2007), the regional innovation system (RIS) can be thought of as the institutional infrastructure supporting innovation within the productive structure of a region. An RIS is in place when the following two subsystems of actors are systematically engaged in interactive learning (Cooke et al. 1998): first, the regional production structure or knowledge exploitation subsystem which consists mainly of firms often displaying clustering tendencies; second, the regional supportive infrastructure or knowledge generation subsystem which consists of public and private research laboratories, universities and colleges, technology transfer agencies and vocational training organizations. Furthermore, Cooke et al. (1998) emphasize the mainly informal institutional context (i.e. norms, trust and routines) in which such interactive learning takes place.

Asheim (1998) distinguishes between three types of RIS (see also Cooke, 1998). The first type may be denoted as territorially embedded regional innovation systems, where firms base their innovation activity mainly on localized, inter-firm learning processes stimulated by the conjunction of geographical and relational proximity without much direct interaction with knowledge generating organizations (i.e. R&D institutes and universities). This type represents a market-driven non-systemic model, where demand factors determine the rate and direction of innovation. Cooke (1998) calls this type a 'grassroots RIS'. These territorially embedded systems provide bottom-up, network-based support through, for example, technology centres, innovation networks or centres for market research and intelligence services, to promote adaptive technological and organizational learning in a territorial context.

Another type of RIS is the regionally networked innovation system, where firms and organizations are also embedded in a specific region and characterized by localized, interactive learning. However, through the intentional strengthening of the region's institutional infrastructure – for example, through a stronger, more developed role for regionally based R&D institutes, vocational training organizations and other local organizations involved in firms' innovation processes – these systems have a more planned character involving public–private cooperation. The networked system is commonly regarded as the ideal type of RIS and is characterized by mixed supply/demand interaction: a regional cluster of firms surrounded by a regional 'supporting' institutional infrastructure. Cooke (1998) also calls this type a 'network RIS'. The creation of regionally networked innovation

systems through increased cooperation with local universities and R&D institutes, or through the establishment of technology transfer agencies, may provide access to knowledge and competence that supplements firms' locally derived competence.

The third main type of RIS, the regionalized national innovation system, differs from the two preceding types in several ways. First, parts of industry and the institutional infrastructure are more functionally integrated into national or international innovation systems, i.e. innovation activity takes place primarily in cooperation with actors outside the region. This type of RIS represents a science/supply-driven model in which exogenous actors and relationships play a larger role. Cooke (1998) describes this type as a 'dirigiste RIS', reflecting a narrower definition of an innovation system incorporating mainly the R&D functions of universities, research institutes and corporations.

In their critical review, Moulaert and Sekia (2002) use the concept of 'territorial innovation model' (TIM) as a generic name for models of regional innovation in which local institutional dynamics play a significant role. They list six territorial innovation models: innovative milieu, industrial district, regional innovation systems, new industrial spaces, local production systems and learning region. Moulaert and Sekia (2002) conclude that these approaches follow the market logic only and that they exclude some important dimensions of innovation. In their view, the regional development approach should be based on a multi-dimensional view of innovation, economic dynamics and community governance. Territorial development does not only mean enabling the local and regional market economy, but also empowering the other parts of the economy (public sector, social economy, cultural sector, low-productivity artisan production) as well as community life (socio-cultural dynamics as a level of human existence by itself, political and social governance of non-economic sections of society, cultural and natural life). The same deficiency can be found from national innovation system approach/literature. Almirall and Wareham (2008) argue that a close look at the most relevant activities presented in different national innovation systems descriptions easily reveals the absence of both user and societal involvement in the innovation process.

As the focus of this research is QH innovation, yet another systemic innovation model needs to be taken under closer scrutiny. It is the Triple Helix model (TH), which can be seen as a forefather of the QH model.

3.2. Triple Helix

In 1995 Etzkowitz and Leydesdorff proposed that the three major parties in innovation are industry (wealth generation), universities (novelty production) and public control (government). They observed that the new environment for innovation is characterized by the strong role of universities, the active engagement of all levels of government in formulating policies, the strategic alliances of firms in developing and marketing products and product and process innovation within industry, and the emergence of science-based technologies that originated in academia and were encouraged by government policies. (Etzkowitz 1998).

The Triple Helix model was initially derived from an analysis of the renewal of the Boston economy, through a university–industry–government collaboration for firm-formation from academic research in the 1930s (Etzkowitz 2002). A region with a cluster of firms, rooted in a particular technological paradigm, is in danger of decline once that paradigm runs out. It was already apparent in the early 20th century that it was necessary to replace firms whose technologies and products had been superseded, or whose businesses had moved elsewhere. The need to renew the industrial base is an increasing national and regional concern. It leads government, as well as companies and universities, to explore ways for knowledge producing institutions to make a greater contribution to the economy and society.

In the Triple Helix (TH) innovation model, academia (colleges, universities), government and industry constitute the three helices which collaborate with each other in order to create or discover new knowledge, technology, products and services (see Figure 3). In this innovation model, universities and science-based technologies originated in academia play a strong role. The role of government is in formulating policies and supporting the development of science-based technologies, the strategic alliances of firms developing and marketing products and doing product and process innovations. (Etzkowitz 1998, 2003; Leydesdorff & Meyer 2006)

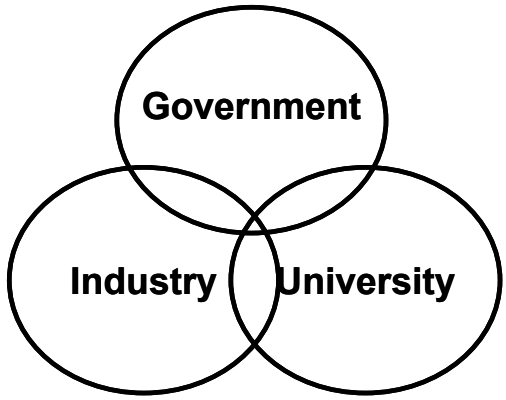

Figure 3. Triple Helix

The Triple Helix model has evolved and gone trough three different development phases. In Triple Helix I, the three helices are defined institutionally. In Triple Helix II, more attention is attached to communication within the system and to the different knowledge systems. The Triple Helix III focuses in the hybrid organizations of academia, government and industry. (Torkkeli et al. 2007).

The Triple Helix model introduces a lateral approach to innovation policy, conceived of as collaboration among the institutional spheres. Thus, as in the RIS approach, rather than only as a 'top-down' initiative of national government, innovation policy should also be seen as a cumulative result of interaction among local and regional governments at various levels, business people, academics, and NGOs with their memberships from all of these spheres, especially at the regional level. Networks are generated from a variety of sources; they may emanate from collaborations between large firms and academic researchers, or they appear informally among firms in a common area of activity which then may be formalized into a 'valley' through the organization of an association.

As an innovation approach and innovation policy instrument the TH model has its limitations. For example, Etzkowitz and Klofsten (2005) have examined TH at the regional level and argued that relatively few regions have exhibited "self-renewing capabilities" created by the developed TH model, a continuous flow across technological paradigms, moving beyond creative destruction to creative reconstruction. (Etzkowitz & Klofsten 2005). More importantly, according to Yawson (2009), the Triple Helix of state, university and industry is missing an essential fourth helix, the public. Advances in biotechnology and nanotechnology are jeopardized by the virtual absence of this helix. Disciplinarity is no longer the dominant system for creating and organizing knowledge. Knowledge creation is now trans-disciplinary, more reflexive, non-linear, complex and hybridized. Furthermore, inclusion of the fourth helix becomes critical since scientific knowledge is increasingly evaluated by its social robustness and inclusivity. Public interest is important in this regard. The fourth helix highlights new discoveries and innovations that improve social welfare, e.g. eco-innovation. It helps to create linkages between science, scientists and education strategies. There are also some other reasons to replace Triple Helix with Quadruple Helix. These are examined in the next chapter which discusses the Quadruple Helix innovation model.

3.3. Quadruple Helix as a user-oriented innovation approach

The concept of Quadruple Helix (QH) is a not very well established and widely used in innovation research and in innovation policy. However, in analysing the innovation literature, we arrived at the conclusion that there is a wide range of conceptions that could be named as QH type of innovation conceptions. Some of them are very close to the TH concept, some of them deviate more radically from it and many of them are somewhere between these two extremes. What is common to all QH type of innovation conceptions is they all have included some fourth group of innovation actors into the TH model.

Some argue that it is the 4th pillar organizations that create links between the Triple Helix organizations that should be included in the TH innovation model (Liljemark 2004). Some have called these 4th pillar or intermediate organizations as innovation-enabler organizations (Liljemark 2004). They act as brokers and networkers between the TH organizations. This 4th pillar approach is only a minor step beyond the Triple Helix models and it resembles very much the innovation system concepts presented earlier. Yawson (2009) argued (see above)

that the missing fourth helix should be the public. Another candidate as the fourth helix is the user that is very close to Yawson's candidate, the public. This choice is supported by the opinions brought forward in recent innovation research and policy, which present user-driven innovation as an essential factor of success for both firms and public sector organizations (Eriksson et al. 2005, Lundvall et al. 2002, Thomke & von Hippel 2002, Schienstock & Hämäläinen 2001). One important reason for this is the changed competition situation of companies. It is seen that with increased global competition and cheaper sources of high-quality technological solutions, companies can no longer rely on maintaining a competitive advantage based on 'traditional' drivers of price and quality. Companies must strive to seek alternative sources of competitive advantage, and are therefore undertaking major transformations in their innovation processes and business models in order to deliver more valuable products and services to the market. These new innovation strategies of firms often involve increasingly open business models, a greater focus on understanding latent consumer needs, and more direct involvement of users in various stages of the innovation process. User-driven innovation practices are also believed to support the renewing of the public sector and public services facing financial difficulties (Finnish Ministry of Employment and the Economy 2009). The user-driven innovation approach is believed to promote the development of new more inexpensive public services and ways of operating them. (Wise 2008)

The user-driven innovation approach could be seen as one essential element of the new "broad-based innovation policy" approach (see Edquist et al. 2009). The broad-based innovation policy entails the broadening of the concept of innovation to include product innovations in services, as well as organizational process innovations, and relates to not only economic significance, but also to wider societal benefits, as well as measures targeted to support innovation in public services. This new innovation policy conception takes also all determinants of the development and diffusion of innovations into account when designing and implementing innovation policies. This would then include policy instruments operating from the demand side. It would also include acknowledging a wider spectrum of sources of knowledge and more versatile interactions with producers and users of knowledge. (Edquist et al. 2009)

The concept "user-driven innovation" was originally connected to innovations carried out by a consumer to increase the utility value of a given product, as opposed to a company innovation that only serves a commercial purpose. Recently the concept "user-driven

innovation" has often been used in the context of companies involving users in the innovation process in various ways (Wise & Høgenhaven 2008). The use of "user-driven innovation" as an umbrella concept for describing all kinds of innovation activities in which users are involved is slightly problematic. It suggests for the users a bigger role in innovation activities than their role often actually is. From this perspective, a more proper term could be "user-centred", as suggested by Bergvall-Kåreborn et al. (2009), or "user-oriented". This is why we prefer these two concepts instead of "user-driven" in this research report.

From the point of view of these new user-oriented innovation strategies, it is arguable that the fourth helix of QH should be user. This is also the approach we have chosen in our research. The concept "user" can be interpreted quite widely (see Section 3.4. Defining user and user involvement) and we have also done so. For example, the concept "public" can be seen to be included into this concept. Choosing the user as the fourth helix of QH in our research could also be justified by the long-term aim of the CLIQ project, which is to optimize the benefits of globalization and innovation to SMEs and entrepreneurs in medium-sized towns. The user-oriented QH-model is seen beneficial especially to SMEs (see below).

The Quadruple Helix type of innovation activity enables a larger variety of innovations than the Triple Helix model does. The Triple Helix type of innovation activity focuses on producing high-tech innovation based on the latest technology and research knowledge. Because of this, the Triple Helix model is considered to lend itself better for science-based high-tech companies than for other kind of businesses (see MacGregor at al. 2009). The Quadruple Helix type of innovation activity, instead, can focus on producing other kinds of innovations and applying existing technology and research knowledge and user knowledge as well. To SMEs, the increase in quadruple and user-oriented type of innovation activities could open up new possibilities to participate in innovation activity, as also other types of SMEs could participate than only strongly science-based ones or firms having science-based firms as clients. The representatives of the living lab approach, for example, even argue that the QH type of innovation activity in which users are highly involved in the innovation activity can help the SMEs to shorten the incubation time and to manage and minimize the risks associated to the development of new products and services (Santoro & Conte 2009). This type of innovation activity is also believed to be attractive to SMEs, micro-organizations and start-ups, who typically have problems acquiring venture capital, unless the market

attractiveness of ideas, concepts and products and services can be reasonably demonstrated (Eriksson et al. 2005). Many authors have pointed out that the development possibilities of SMEs are very much dependent on how well they can involve users in their innovation activities.

As to the relationships between RIS approaches and QH, one may note that QH is not an isolated phenomenon but it is located in an existing network of actors and RIS modifying it. Thus one may see QH as complementing or extending the other RIS approaches. From the viewpoint of RIS, QH represents itself as a complementary dimension in RIS-like innovation in taking notice of the user and the community at large (users, citizens) or simply a different kind of way to foster regional innovation. However, it is quite clear that not at all innovation processes or QH-models are spatially specific in the way described in the RIS literature. For example, social media is in principle placeless in a sense that is not bound to any particular place.

As TH can be seen as a systematic way of pursuing research/technology-driven innovations, also QH can be seen as a systematic way of pursuing demand- or user-oriented innovation. Quadruple Helix is a very wide and multidimensional concept referring to numerous different activities and actors. It seems that it is more reasonable to consider QH as a continuum or even as a space rather than as a single model. Therefore it could be more meaningful to talk about QH models than a QH model. At the end of this research report, we will form four different QH models which bring forth some interesting dimensions and challenges of QH type of innovation activities and environments (see Chapter 6. Research results).

3.4. Defining users and user involvement

Now we have concluded that users should be the fourth helix of QH. But what do we and the proponents of user-oriented innovation mean when we talk about users and user involvement in innovation?

Users can be defined in several ways (Figure 4). Depending on the context, users can be ordinary or amateur users, professional users, consumers, employees, residents, citizens, hobbyists, businesses, organizations, or civil society associations. Eason (1987), for example,

differentiates three categories of users: (1) primary users, those likely to be frequent hands-on users of the system; (2) secondary users, those who use the system through an intermediary; and (3) tertiary users, those affected by the introduction of the system or who will influence its purchase. One can also differentiate users from non-users, who are those who actively choose to limit, completely or partly, the use of some products or services in their homes and private lives (Selwyn 2003). One can also differentiate lead users from ordinary users. Lead users are defined as those who are in the leading edge of an important market and are therefore currently experiencing needs that will later be experienced by many users in the same market. In addition, they anticipate relatively high benefits from obtaining a solution to their needs, and may therefore innovate (von Hippel 2005, 1986; von Hippel 2001). A consumer is the person who both pays for and uses the product (Ståhlbröst 2008, 12–13).

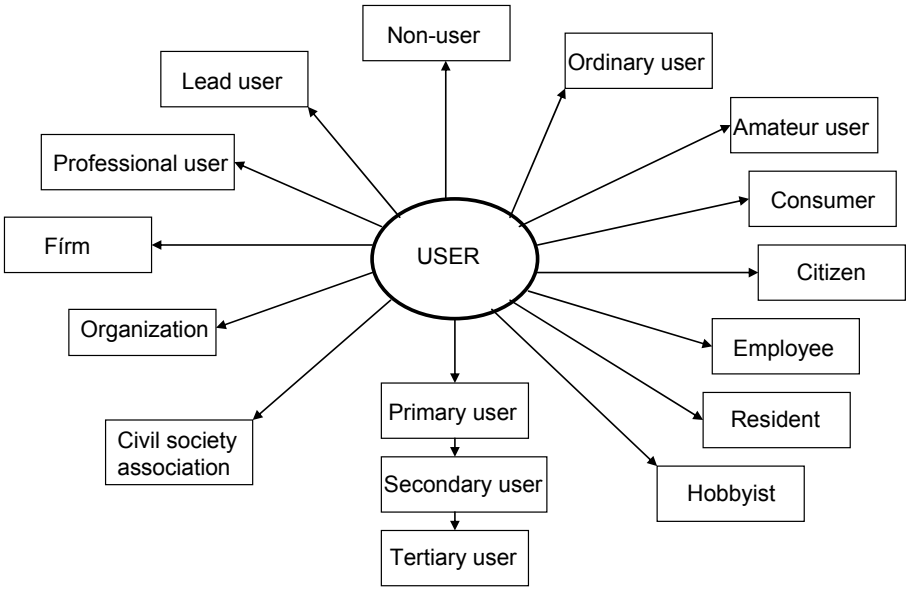

Figure 4. Different user groups

In addition to the fact that there are several different kinds of users, what makes the concepts of user-oriented innovation and QH user involvement even more multidimensional is the fact that there are also numerous different ways and degrees of user involvement. The numerous ways in and degrees to which users can participate in innovation activities range from very indirect ways of participation to very direct ways of participation. An example of one indirect way of participation is a user questionnaire which is sent to users in order to find out what kind of needs they have in relation, for example, to certain products or services. An example of a direct way of participation is that users participate in the development work of new services together with the R&D experts.

One simple (and practical) way to differentiate the various ways and degrees of user involvement is to divide the involvement into three categories: for, with, and by (Bekker and Long 2000, Eason 1987, Kaulio 1998). The first type, *design for users,* means that the product or service is developed on behalf of users. Data about users, general theories and models of user behaviour are used as a base for the design. This approach often includes specific studies of users, such as interviews or focus groups. In this perspective, users with focus on verifying requirement specifications and prototypes are involved relatively late in the development process (Ståhlbröst 2008). The second type, *design with users*, denotes a product development approach, focusing on users, utilizing data on user preferences, needs and requirements as in a design for approach, but, in addition, includes a demonstration of different solutions and concepts for users so they can react to the differing design solutions. Here users are involved throughout the process and are on equal terms in co-creation of future solutions based on their needs and experiences. This is represented by two people sitting next to each other in a car. In this perspective, the designer is active and in charge of design and development activities (driving the car) while the user is active and in charge of context and evaluation activities (reading the map and giving the directions). (Ståhlbröst 2008)

In the third type of user involvement, *design by users*, a product development approach is applied, in which users are involved actively and partake in the design of their own product. Here users are involved in the role of process initiators; hence, they drive the process. In this design perspective, users contribute with inspiration and ideas; they produce content and develop products or parts of products. The role of the designer is to be the facilitator, to sit in the front seat of the car and pave the way for the user driving the car. This means that

designers still have influence over what is possible to do or where to go, but users decides how, when, and where they want to go. (Ståhlbröst 2008)

Firms and universities have used some kind of consumer and user research as part of their development work for a very long time. Therefore it is arguable that users have been involved also in the Triple Helix type of innovation activities, even though their input is often left without explicit mention in the TH context. How then can we differentiate user involvement related to TH from user involvement related to QH? If the very indirect ways of user participation are included in the QH innovation model, then in practice it becomes very difficult to differentiate it from the Triple Helix innovation model. Rosted (2005) has argued that one can talk about user-driven innovation when a company utilizes in its innovation process knowledge on user needs collected through scientific and systematic surveys and tests. This can be considered also as a minimum requirement for user involvement related to QH innovation model. In other words, user involvement in the QH innovation model can range from the systematic collection and utilization of user information to the development of innovations by users themselves.

As far as the umbrella concepts describing all kinds of user involvement (e.g. user-driven) are concerned, Bergvall et al. (2009) argue that the concept “user-driven” should to be aligned only with the concept “design-by users”. In other words, this concept should be connected only with innovation activities in which the user or users are the true initiators of an innovation process. They also argue (2009) that “If we want a concept that brings all user involvement concepts under the same umbrella, we suggest the user-centric concept." As we have mentioned earlier, we use both user-centric and user-oriented concepts as an umbrella concept for user involvement in this research report (see Figure 5).

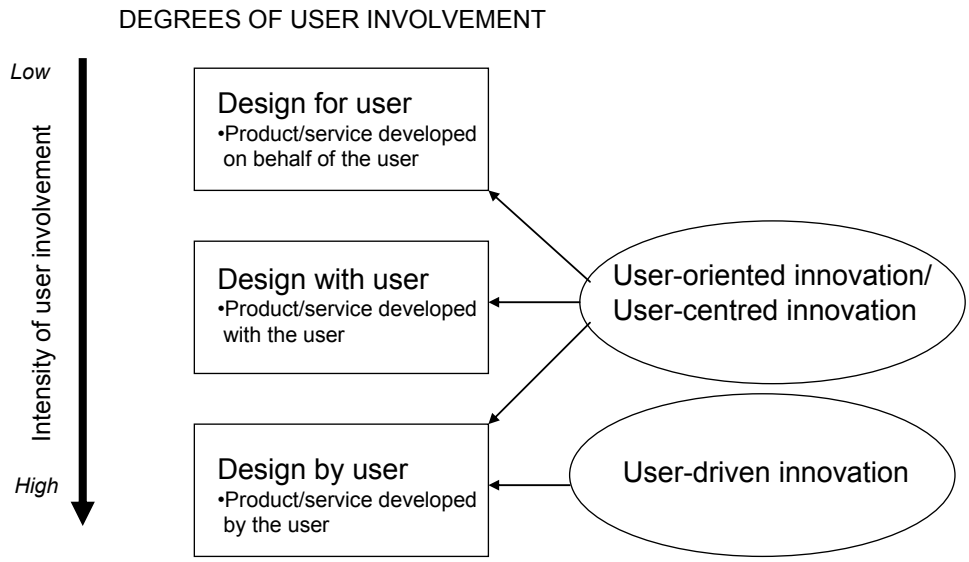

Figure 5. The difference between the umbrella concepts 'user-driven' and 'user-centric/user-oriented'

In the innovation literature users are often considered from the point of view of markets, firms and commercial activities. From this perspective, they are seen as consumers, buyers of products and services. Users can also be considered as active citizens who try to have an effect on the decision making done in the private and public sectors and concerning them. The role of users may be even more complicated in the sphere of public services. Dibben and Bartlett (2001) found in their study that in public services user involvement can be divided into two strands: a *consumerist* approach that focuses on the role of service users as mere consumers of services and a *collectivist* approach that emphasizes a clearer role for users in decision making. By focusing on the first approach and neglecting the second means that the issue of democratic decision making is not addressed. Hence, it does not change the position of those on the receiving end of services. Turning to the collectivist approach, which implies for users a role in decision making, this has been further divided into representative democracy and direct democracy. The former implies the role of counsellors as advocates, and the latter suggests that the public has a direct input into how services should be provided. Taking the idea of direct democracy further, Hoggett and Hambleton (1987) identify three types of strategy for involving the public in decision making: resourcing non-statutory

organizations, community development, and the involvement of user groups. However, the authors accept that both strands of the collectivist approach can be criticized. It has been argued, for example, that representative democracy might be paternalistic, passive and minimalist, and, on the other hand, that direct democracy could be sectional and parochial. Therefore, they recommend using a combination of both strands to compensate for the deficiencies in both of them.

Clarke and Stewart (1992) go even further and suggest that there should be a third facet to the user role: rather than being perceived as individuals, the public should be regarded as members of the community. They then link each of the three roles specifically to the idea of empowerment and explain the type of action that they might imply in practice. In this model, empowering the public as a customer involves extending choices or clarifying the service to which they are entitled, giving them the means to complain, and providing equality and ease of access. In contrast, by empowering people as citizens, the public is entitled to a share in decision making, which necessitates being clear about their rights. And, thirdly, empowering the public as a community means giving them direct control, and the right to determine wherever possible those issues affecting the community, with the creation of new democratic frameworks where appropriate. This seems to suggest, then, that whichever of these roles is addressed, there are implications for ensuring that relevant systems and procedures are in place in order to enable user involvement. Clarke and Stewart (1992) recommend that there should be a balance between the focus on the public as a customer, as acitizen and as a community.

Table 1 provides a summary of the different user-oriented innovation concepts presented in this chapter. We can see from it that both the concepts “user” and “user involvement” are very wide and multidimensional concepts. This means that also user-oriented innovation and QH are very wide and multidimensional concepts. For example, user involvement can range from developers making assumptions about user needs without actually involving users to users developing the final product or service themselves. (Ståhlbröst 2008) On one extreme one can talk about user-oriented innovation when a company utilizes in its innovation process knowledge on user needs collected through scientific and systematic surveys and tests (see e.g. Rosted 2005). This type of user-oriented innovation conception differentiates itself very little from the Triple Helix models. On the other extreme is the type of user-oriented innovation in which users have a very active and influential role in the innovation process and

they participate intensively in all phases of an innovation process (see e.g. Eriksson et al. 2005). In this type of user-oriented innovation users can be seen as co-producers of innovation and as having an equally important role in the innovation process than research organizations, public support organizations and businesses (Eriksson et al. 2005). These kinds of QH innovation activities differ quite significantly from the TH type of innovation activities. Furthermore, there are numerous other QH innovation approaches between these two extremes.

Table 1. Summary of different user-oriented innovation concepts

Different groups of users	• non-user • ordinary/amateur user • consumer • citizen • employee • resident • hobbyist	• lead user • professional user • firm • organization • civil society association	• primary user • secondary user • tertiary user
Different degrees of user involvement	***Design for user*** • Product/service developed on behalf of user	***Design with user*** • Product/service developed with user	***Design by user*** • Product/service developed by user
	User as consumer	**User as collectivist**	**User as individual or member of community**
Perspectives / possibilities of user involvement in public sector	1. Buys the product/service developed 2. Does not buy the product/service developed	***1. Representative democracy*** • Counsellors advocate users ***2. Direct democracy*** 1. Resourcing non-statutory organizations 2. Community development 3. Involvement of user groups	***1. Citizen is empowered by*** • Extending choices or clarifying services he/she is entitled to • Giving means to complain • Providing equality and easy access ***2. Member of community is empowered by*** • Giving direct control and right to determine issues affecting community

3.5. Practical user-oriented concepts

There are several perspectives on contemporary innovation and adoption processes which all share the relevance of the user. Pascau and van Lieshout (2009) have named three essential user-oriented innovation concepts as living labs, open innovation, and social computing. They compared these concepts with each other and argue that they all emphasize different aspects of contemporary innovation processes (see Table 2).

Table 2. Comparison between the relevant dimensions of the three user-oriented innovation concepts (Pascau & van Lieshout 2009)

	Living labs	**Open innovation**	**Social computing**
Main actors	Citizens-firms	Firms	Citizens
Main orientation	Improving on development of useful services through interaction in "daily life" setting between developers and users	Improvement on development of new services/products through cooperation between firms	Applications enabling interaction and collaboration, providing wider access to services and enabling users to become co-creators (not just end users)
Main concepts	"Mutual shaping" (Oudshoorn and Pinch) "User-centred innovation" (Steen)	"Open innovation" (Chesbrough)	"Long tail" (Anderson) "End-user innovation" (von Hippel)
Form/modus of cooperation	Geographically bounded innovation environments	Clusters of firms	Virtual cooperation
Role of government	Active engagement, public-private partnership	Stimulating, innovation policy	Reactive, responding to changing relations
Prime examples	European Network of Living labs Arabianranta (Helsinki) I-City Leuven	IBM Innovation Jam Linux	Blogging, social networking, including videosharing (e.g. Youtube) and photosharing (e.g.Flickr) Collaborative content (e.g. Wikipedia) Social tagging (e.g. deli.cio.us) Social gaming (e.g. Second Life) Shared product/service development (Vodafone, Betavine, Habbo Hotel)

Within Open Innovation it is usually clusters of firms that cooperate in open innovation processes. The concept "open innovation" was created by Henry Chesbrough (2003). According to him (2003), the open innovation paradigm can be understood as an antithesis of the traditional vertical integration model where internal research and development (R&D) activities of a firm lead to internally developed products that are then distributed by the firm. Chesbrough's open innovation approach treats R&D as a more open system and suggests that valuable ideas can come from inside and outside the company and can enter the market from inside or outside the company as well. This approach places external ideas and external paths to the market at the same level of importance as that reserved for internal ideas and paths to the market in the earlier idea. In Chesbrough's open innovation concept, the businesses are in the centre and typical users are other firms (buying the products or services produced by some other firm). It should be noted that there are also other kind of interpretations of open innovation than Chesbrough's firm-centric interpretation. For example, in von Hippel's (2005) open innovation concept, it is the lead users and user communities that are in the centre. In this user-centric context, open innovation means that these users share their development ideas with other users.

Within Social Computing virtual communities of users form the kernel of the innovation activities. These communities are usually fluid: users come and go, although a specific kernel of core users who are actively dedicated to maintaining an open periphery can be identified. Within social networking sites the number of real active users is limited, while the range of followers is much larger. The real active users are those that lead the others. However, contrary to innovation practices in firms, within social computing the number of potential lead users can be very large, leading to a very fragmented and segmented market with a large number of potentially interesting niches ("Long tail"). In Social Computing it is the user who is in the centre of this innovation model, and typical users are creative and active end-users of different ICT and mobile services.

Living labs are "innovation environments" or "innovation arenas" having participation of designers, engineers, users, suppliers, industrialists, public actors and other involved parties as a conscious principle (Pascau & van Lieshout 2009). Also living labs are often referred as an example of open innovation or open innovation environment. But in this context, although open innovation refers to open development and innovation cooperation between living lab actors, it does not necessarily mean same thing as in Chesbrough's definition (see above),

which refers mainly to open innovation cooperation between firms. Section 3.6 provides a more detailed description of living labs.

3.6. Living labs as user-oriented innovation environments

From the QH perspective, living labs could be considered to be a more interesting innovation approach than open innovation and social computing introduced above. The main reason for this is that in living labs all four important actor groups of QH model are actively present: users, firms, public research organizations and public authorities. Living labs are interesting also from the perspective of public authorities and SMEs. They are often public–private partnerships, and Pascau and van Lieshout (2009) argue that public authorities may have an important role within living labs. They can, for example, contribute to goal-setting and formulating public policies around them. Within open innovation the role of governments is more traditional and often related to creating beneficial conditions for firms to innovate and to realize economic prosperity (Pascau & van Lieshout 2009). In social computing the role of government is more modest and often limited to more generic policy activities (Pascau & van Lieshout 2009).

Santoro and Conte (2009) argue that there are some fundamental factors hindering the realization of SMEs innovation potential:

- insufficient ability of vertical integration of complementary competencies at SMEs level. SMEs must be organized in collaborative networks, which can aggregate pools of complementary resources and competencies;
- lack of mechanisms and processes for the use validation of business opportunities originated by the industry, especially if the targeted market is characterized by the classical dilemma concerning technology push or market pull;
- scarce availability and/or difficult access to knowledge resources, necessary to support the innovation process within SMEs;
- insufficient readiness to collaboration of SME workers, who are in general not used to collaborate with other SMEs;
- lack of legal competencies necessary to manage IPR created during the project and to leverage the background; and
- lack of consolidated processes for allowing the involvement of customers, end-users and citizens in the development process of new products and services.

Because of these bottlenecks hampering SME innovation, Santoro and Conte (2009) claim that there is a need to revise the current approach to regional innovation support going beyond traditional clusters and incubation support approaches. They also argue that a revised regional innovation model could benefit from the living labs concept and that the model should include the characteristics of user-driven open innovation, integrating elements such as creating thematic innovation communities, establishment of collaborative networks of SMEs, and building living labs innovation facilities (Santoro & Conte 2009).

Living labs have been seen as a first attempt to structure and provide governance to user involvement in a way that can be addressed by companies, research institutions, public organizations and policy makers. Living labs could be seen as a supplement to traditional cluster and regional innovation policy and as a new kind of intermediary organization to support the involvement of users in the R&D&I activities (Almirall & Warenham 2008).

The concept of living lab originates from Professor William Mitchell in Boston, MIT, and it was initially used when users were observed as they lived for a period of time in a smart/future home (Eriksson et al. 2005). Svensson et al. (2010) argue that today, especially in Europe, this concept is often used to "enhance innovation, inclusion, usefulness and usability of ICT and its applications in society". The application possibilities of living labs are not limited to ICT. They have already been used in several areas of development and business, including telecommunications, health, well-being, housing, tourism, energy, and governance. Besides business, this innovation model can also be applied in the public sector (incl. the development of public services). In addition to innovation, this concept plays also other roles, for example, in entrepreneurship and venturing, in technology transfer, in promotion and development of cities and regions (Almirall & Warenham 2008).

There are many definitions of what a living lab is. The concept of living lab can be seen as a methodology, an organization, an environment and/or a system (Svensson et al. 2010). Eriksson et al. (2005) have been describing a living lab as "a user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts". According to the European Network of Living Labs (http://www.openlivinglabs.eu/), a living lab is both a methodology for user-driven innovation and the organizations that primarily use it. The European project CoreLabs (http://www.amicommunities.net/wiki/CORELABS) defines living labs as "a system enabling

people, users/consumers of services and product, to take active roles as contributors and co-creators in the research, development, and innovation process". From this system perspective, living labs could be seen as small size regional innovation systems. This is supported by the fact that they are often situated in a certain geographical location, for example, in a city or a city district (Pascau & von Lieshout 2009). Ballon et al. (2005) present yet another definition of living labs: "An experimentation environment in which technology is given shape in real life contexts and in which (end) users are considered 'co-producers'."

In short, the goal of living labs is to create "innovation arenas" where multiple actors can experiment in an open, real life environment. Living labs could be seen as development platforms trying to promote user-centred R&D&I activities. This is done, firstly, by giving users a possibility to participate in the innovation process as co-designers and co-producers (Pascau & van Lieshout 2009), and secondly, by studying them and how they use certain products or services in real life contexts, i.e., in the environment in which users normally live and work. A living lab experimentation environment specialized in technological development typically includes (Eriksson et al. 2005)

- two or more state-of-the-art technologies,
- firms (large and SMEs),
- various organizations that utilize technology or are candidates to utilize technology in the vertical dimension of a value chain,
- public organizations,
- users/consumers/citizens, and
- research organizations.

Living labs provide a wide range of services and play diverse roles in the quest for articulating user involvement, from support to leading entrepreneurial users to needs-finding or user experience services (Almirall & Warenham 2008). They can also provide the same kinds of development and support services to businesses as science and business parks do. Almirall & Wareham (2008) argue that living labs are especially suitable for customization or localization exercises, explanatory exercises in large solution spaces with alternative technologies or interdisciplinary projects linked with organizational changes. According to Eriksson et al. (2005), by integrating consumers into the development process living labs ensure a highly reliable market evaluation, resulting in a significant reduction of technology and business risks. Therefore this approach is particularly attractive to SMEs, micro-

organizations and start-ups that typically have problems acquiring venture capital, unless they can demonstrate the market attractiveness of their ideas, concepts, products and services reasonably well (Eriksson et al. 2005).

Ballon et al. (2005) position living labs relative to field trials, prototyping, societal and market pilots as well as test beds (see Figure 6). The different test and experimentation platforms are defined in Table 3. According to Ballon et al. (2005), living labs share with test beds, field trials and prototyping the technological architecture and environment in which specific ICT products may be developed and tested. What they have in common with market pilots and social pilots is that they also experiment and test user preferences and viable business models (Ballon et al. 2005). The living lab concept is closest to concepts like prototyping and test bed by being situated somewhere between the design and testing phases. Pascau and van Lieshout (2009) argue that living labs differ from traditional test beds in that they are far less top-down controlled by designers and that they are made in a real-life context instead of a controlled laboratory-like context. Test beds and living labs differ from each other also in the sense that in test beds only technology is usually tested, but in living labs also the services, business models, etc., related to new technology are tested. (Ballon et al. 2005)

Living labs differ from field trials by being more open to different possible solutions and lasting longer. Field trials are also considered more appropriate for validating a technical solution being developed, as living labs are more appropriate for finding new unexpected solutions and for developing new services, products and uses of devices (Ballon et al. 2005, Pascau & van Lieshout 2009). Ballon et al. (2005) claim that living labs are breeding places for innovations which have not been considered earlier by designers, because they offer the opportunity to share risks and mitigate investments and foster dialogue between developers and users. According to Almirall & Wareham (2008), living labs have approved to be suitable for supporting the implementation of interdisciplinary projects with multiple alternatives and business models. (Ballon et al. 2005, Almirall & Wareham 2008).

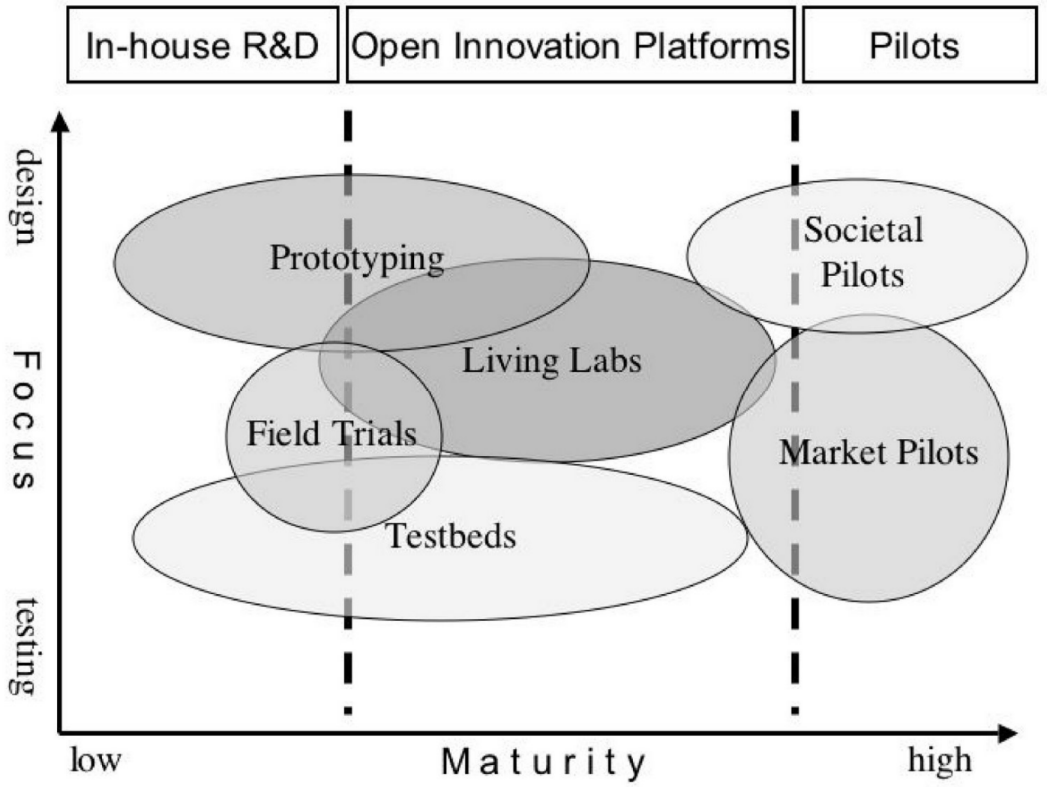

Figure 6. Conceptual framework of test and experimentation platforms (Ballon et al. 2005)

Table 3. Test and experimentation platforms (Ballon et al. 2005)

Prototyping platform	A design and development facility used prior to mass production and resulting in the first proof-of-concept of a new technology, product or service.
Test bed	A standardized laboratory environment used for testing new technologies, products and services and protected from the hazards of testing live or in production.
Field trial	A test of technical and other aspects of a new technology, product or service in a limited, but real-life environment.
Living lab	An experimentation environment in which technology is given shape in real life contexts and in which (end) users are considered 'co-producers'.
Market pilot	A pilot project in which new products or services that are considered to be rather mature are released to a certain number of end-users in order to obtain marketing data or to make final adjustments before the commercial launch.
Societal pilot	A pilot project in which the introduction of new products and services into a real-life environment is intended to result in societal innovation.

Følstad (2008) found that in the living lab literature co-creation and insight into the context of use are often seen as important keys to innovation. He believes that this perspective could serve to establish a unique living lab identity that could clearly separate living labs from related innovation environments. However, it should be noted that the actual living lab actors have interpreted and implemented the living lab concept rather freely and flexibly. In other words, in reality it is very difficult to differentiate living labs from other kinds of test and experimentation platforms like test beds, for example (see Følstad 2008, Orava 2009).

4. Good QH cases

On the basis of both theoretical-conceptual analysis and innovation literature review we conducted a critical "screening" of good practice QH cases for analysis. The aim of this chapter is to 1) help you to build a concrete conception of the QH type of innovation activities, 2) to introduce methods needed for creating user communities and for utilizing user knowledge in an organization's development work, and 3) to find challenges, good lessons and practices related to the implementation of the QH type of innovation activities and environments.

The selection criteria for the good QH cases were first and foremost

- that the case clearly differentiates itself from Triple-Helix-type of innovation activity, it represents the QH type of innovation activities, in which all four QH actor groups are involved and in which users have an essential role; and
- that there is an in-depth and rich enough description available from the case and this description entails experience-based real knowledge of the case.

As we went through numerous QH-related papers, we came into the same type of conclusion than Følstad (2008), who argues that there is a remarkable lack of in-depth descriptions and discussions of living lab processes. The same seems to go also with the QH type of innovation activities in general. This restricted our possibilities to select good QH cases. However, we managed to find an interesting and rich sample of QH cases, which hopefully elucidates, in

different ways, some key aspects, practicalities and challenges of creating user-oriented innovation and development models.

First, some approved methods of user involvement are presented. One of the key challenges of the QH type of innovation activities is related to the successful involvement of users. In order to succeed in this, one needs to know, for example, how to find the right users amongst a large group of heterogeneous users, how to motivate them to participate in the development work and how the information and ideas of users can be effectively and systematically collected and utilized.

It should be noted that the selection of cases has not been guided by the importance of certain sectors, industries or regions. Instead, each case is thought to illustrate some important dimension of the QH phenomenon at the general level and in that way may be helpful in building the QH type of innovation cooperation in specific cases related to different sectors (incl. the public sector), industries or regions. Accordingly, although three out of four user-involvement-method cases presented here are situated in the private sector, they all can provide good lessons also for the public sector. All user-involvement concepts and methods presented here can also be applied in the public sector (Ling 2002). Of course these methods cannot simply be transferred into the public sector. Differences related to innovation constraints in both the private and the public sector have to be taken into consideration. The three key differences between the public and private sectors in this respect are according to Hood and Rothstein (2000):

- Primary Unit: Within the private sector the primary unit within which innovation is assessed is the enterprise or cost centre, whilst in the public sector the primary unit is more likely to be a complex open system such as urban renewal or criminal justice.
- Value: In the private sector the ultimate driver of innovation is shareholder value, which is an extremely straightforward objective to define when compared to the public sectors' primary value objective which is to satisfy 'public interests'.
- Legislation: Whilst private enterprises have an obligation to operate in accordance with the law, legal constraints on public organizations and bodies (e.g. concerning freedom of information and natural justice) impose greater limits on the way that they can innovate.

Second, after presenting user-involvement methods, we introduce four living lab cases which provide good lessons and practices to be learned from the implementation of the QH type of innovation activities. From these cases we can learn, for example, what kind of important factors one should take into consideration as one is implementing or running QH type of innovation environments and how one can set-up a QH type of innovation environment or development platform.

4.1. Involving lead users

Target organization	3M company in USA
Date	1996
What is presented here	Lead user method/process implemented in 3M company
What can we learn from this case	This case provides details about what is termed a lead user method and takes you to the learning lessons of an intensive user-involvement process related to lead ("pioneer") users.

The lead user method is a user involvement method/concept that has been relatively widely applied (Ozer 2009). The theory behind this method was developed as early as in the mid-1980s by Eric von Hippel. The lead user theory was originally proposed as a way to selectively identify commercially attractive innovations developed by users (von Hippel 1986). The method has been used, for example, in the following areas of operation: construction, electronic home banking services, information technology, sports-related communities and products, and kite surfing (Ozer 2009).

The basic idea of the method is to systematically identify lead users and learn from them. The lead user method is designed to collect information about both needs and solutions from the leading users, leading edges of a company's target market and from markets that face similar problems in a more extreme form. This method is based on two major findings by innovation researchers: 1) many commercially important products are initially thought of and even prototyped by users rather than manufactures and 2) such products tend to be developed by "lead users" – companies, organizations, or individuals – that are well ahead of market trends and have needs that go far beyond those of average users. Although this method was

developed for the private sector, it is applicable also in the public sector where we can also find early adopters and forerunners (see Ling 2002).

By the mid-1990s, 3M's top managers were concerned that too much of the company's growth was caused by changes to existing products. There were too few breakthrough products. In 1996, 3M resorted to the lead user process/method (LU), which was designed to make the generation of breakthrough strategies, products and services systematic. The case describes an implementation process of the LU method at 3M. The role of the university was in this case to participate in the development of the lead user method and in the training of 3M's development experts to use this method. (von Hippel et al. 1999, Olson & Bakke 2004) The lead user process/method has five steps. These are represented in Table 4, which also presents short descriptions of the five steps of the LU process carried out at 3M.

Table 4. Five steps of the lead user method/process

Step 1 – Planning the project
The major goal of Step 1 is to identify product and market areas to focus product development efforts on. In addition, the identification and recruiting of the key stakeholders from various functional areas within the firm for the LU working team is done. The step is completed with a detailed project plan that includes goals for the innovation and a project kick-off. During the earliest stage of their LU project, the 3M team identified the kind of markets they wanted to target, as well as the type and level of innovations desired by the stakeholders within the company. 3M's initial goal was to "find a better type of disposable surgical draping". The development group spent the first month and a half of the project learning more about the cause and prevention of infections by researching the literature and by interviewing experts of the field. They then held a workshop with management in which they discussed all that they had learned and set parameters for acceptable types of breakthrough products.
Step 2 – Determine key trend(s)
The goal of Step 2 is to identify and thoroughly research the market and technological trends affecting development in the chosen product and market area. This process involves the identification and interviewing of experts inside and outside the firm that have expertise in the area of interest. Once the trends have been identified and researched, the LU team must prioritize them on the basis of their likely new product development impact and choose one or more trends that will be the focus of Lead User recruiting. 3M moved to the trend identification stage by interviewing experts with a broad view of emerging technologies and leading-edge applications in the area of important trends in infection control. Although the experts they talked to were very knowledgeable about the latest technology advances, they did not prove to have much understanding of the needs of medical professionals in developing countries, where infectious diseases are major

killers due, in part, to the lack of available funding for western-style technology. To remedy this problem, the LU team travelled to hospitals in Malaysia, Indonesia, Korea and India to learn how surgeons combat infections where disposable drapes and other more expensive aseptic measures are not widely available. The team realized that even if 3M could radically cut the costs of surgical drapes, most hospitals in developing countries simply would not be able to afford them. These insights led the team to redefine their goal and to find a much cheaper and much more effective way to prevent infections from starting or spreading that did not depend on antibiotics or surgical drapes.

Step 3 – Identify Lead Users

Step 3 uses a networking process to identify likely sources of Lead Users inside and outside the market under study. The contacting and qualifying of Lead Users and preliminary interviews follow this.

For the 3M LU team, identifying the needs of medical professionals in the developing countries caused the networking process to change its focus from high-tech arenas to those with extreme needs in both fighting infection and cutting costs. As is often the case, some of the most valuable Lead Users turned up in surprising places. For example, the team learned that specialists in some leading veterinary hospitals were able to keep infection rates very low despite facing difficult conditions and cost constraints. Another surprising source of ideas was Hollywood. One of the team members learned that make-up artists are experts in applying materials to skin that are non-irritating and easy to remove when no longer needed. These attributes were very important in the design of infection control materials applied to the skin.

Step 4 – Development of innovative ideas and product concepts

Step 4 includes workshops involving the recruited Lead Users and the LU team to further develop, refine and test ideas and concepts developed by Lead Users. Finished concepts are then prioritized based on technical feasibility and management priorities.

3M LU team invited several lead users to participate in a two-and-a-half-day workshop. They all signed over to 3M any property rights that might result from the workshop. The participants met for several hours at a time in small groups. In the end, the workshop generated concepts for six new product lines and a radical new general approach to infection control. The 3M LU team chose three product line concepts that they felt were the strongest to present to senior management. One key factor in choosing the three concepts was that they could all utilize existing 3M technology. Although only one of the three would actually be considered a breakthrough concept, all three ideas also had significant advantages over existing products on important product attributes such as lower costs, increased convenience, and improved infection prevention. The breakthrough product concept was for an “armour” anti-bacterial coating that could be used on medical instruments allowing 3M to enter the $2 billion market aimed at controlling blood-borne, urinary tract and respiratory infections

Step 5 – Concept testing

Testing of approved Lead-User-generated new product concepts on typical customers to determine “current” market acceptance.

After further testing with the potential customer demand, the 3M LU team prepared a report on all three concepts with details on their likely acceptance by customers and projected financial returns. The report was presented to

top management and an approval was given to develop the concepts into a physical product. At this point, the LU team was disbanded, although one member remained behind to guide the development process through to market launch so that the rich body of knowledge that was collected during the LU process could have a direct impact on the remaining steps of product development and marketing.

4.2. Involving ordinary users

Target organization	Telecom company in Sweden
Date	2001
What is presented here	Method for involving ordinary users in the development of telecom services.
What can we learn from this case	While the former case was based on lead-user involvement, this case illustrates working with 'ordinary users', consumers, in order to generate ideas for new telecom services.

Lead and expert users are not always the right target group for organizations pursuing better products and services. For example, if the new products and services are targeted to ordinary users, it could be better to involve them instead of expert users, because the needs of experts can differ even quite substantially from the needs of ordinary users. Here were present a user involvement method which is designed for ordinary users.

To come up with useful services, several companies in wireless telecommunications have begun to involve potential users in the innovation process in recent years. In 2001 an experiment was carried out in Sweden. It lasted 12 days and during this period three groups were given the assignment of generating useful ideas for new SMS-based services. SMS is the acronym for short message service, a technology for sending and receiving text messages via mobile phones. The goal of this experiment was to find out whether consumers can give valuable ideas for new end-user telecom services and how consumers can be involved in generating ideas for new end-user telecom services. The actual experiment consisted of four stages (Table 5). This experiment contains an approved method for involving ordinary users in mobile service development. Also in this case the role of the university was to participate in the development of method for involving ordinary users. (Magnusson et al. 2003, Kristensson et al. 2004)

One important lesson which can be learnt from this experiment is that it is not enough to merely ask the customers if they have any ideas. If the users involved in this study had been merely asked to come up with new ideas, it would probably have resulted in ideas already known or in variants of services already implemented. This is what seems to be the normal procedure when users are asked about their needs in interviews or surveys, for example. Customers only know what they have experienced and have trouble imagining the use of emerging technologies. In this experiment the users were activated into problem solving in their own day-to-day environments, bringing newly acquired knowledge of mobile phone technology with them. They were encouraged to discover new, yet unknown, needs; these needs would probably not have been discovered during a traditional inquiry process. This experiment therefore demonstrated that it is not enough only to involve ordinary users, what is also important is how it is done. This is a useful lesson, not only to firms developing products and services for ordinary users, but also to public authorities developing public services for citizens. (Magnusson et al. 2003, Kristensson et al. 2004)

Table 5. Method of involving ordinary users in mobile service development (Magnusson et al. 2003, Kristensson et al. 2004)

a) Start-up phase
In the start-up phase, participants were provided with information on the project and on the scope of the study. To give the participants a sense of how these services worked and to provide inspiration, a number of new mobile phone services already implemented were shown, and the application platform (US) for the study was demonstrated. The task was handed out to participants in both written and verbal forms. All ordinary user participants were presented with the task of creating service ideas that would generate added value for them. All participants received hands-on training on how to use the phone by testing the sample services.
b) Idea creation phase
The idea creation phase of the experiment lasted for 12 days. During this period, participants were expected to create ideas for new mobile telephony services and to log them in their diary. One of the user groups consisting of 4 to 5 people met a professional service designer for consultation for a period of 1 to 2 hours, whereas the other groups were able to manage the creation process without assistance.
c) Delivery phase
When the idea generation period was concluded, all participants were asked to transcribe their ideas from the diary into a more detailed service description. After that all groups were gathered together, and the ideas were delivered. Because the resulting service ideas were aimed at the same target group, they could be compared and ranked against each other, thus enabling the determination of the users' contributions when involving them in the idea creation process.

d) Evaluation phase
The Consensual Assessment Technique (CAT) developed by Amabile and colleagues was used for the evaluation phase. Six experts, experienced in evaluating mobile communications service ideas, constituted the panel of judges. The ideas were ranked on a scale of 1–10. For the three dimensions used (i.e., originality, user value, and producibility), a score of 1 represented the least original, least valuable, and hardest to produce. Similarly, a score of 10 corresponded to the most original, most valuable, and easiest to produce.

4.3. Involving online user communities

Target organization	Dell company in USA
Date	2007
What is presented here	Method for involving online user communities in product/service development
What can we learn from this case	This case presents, firstly, an approved and successful case and method for involving user communities in the product development of firm, and secondly, some important lessons learnt from this type of user involvement.

A growing number of firms are trying to utilize online user communities in their R&D&I activities (e.g. Audi, BMW, Lego, Sun Microsystems). Interaction with user communities is also used for other purposes, for example, for recruiting and for enhancing customer loyalty. User communities generally consist of individuals or firms interconnected by information transfer links that may involve face-to-face, electronic, or other communication. While user innovation communities are not a new phenomenon, advances in information and communication technologies (ICTs) have enabled end-users of an organization's products and services to organize and share innovations through the creation of online communities. (Harhoff & Mayhofer 2010)

On February 16, 2007, Dell invited end-users to share their ideas and collaborate with Dell to create or modify new products and services through an online community – Dell IdeaStorm (www. dellideastorm.com). With the launch of this website, Dell created a user innovation community where end-users can freely reveal their innovative ideas with community members and Dell. Through IdeaStorm, end-users contribute their business ideas to be

reviewed, discussed, and voted upon by the user community. In the first four months of operation, Dell adopted 11 ideas from a wide variety of areas, ranging from pre-installed Linux operating system to the introduction of a new Tablet PC. By April 2010, nearly 14,000 ideas had been posted and Dell has implemented 410 ideas. Some have called IdeaStorm an updated suggestion box. The IdeaStorm has been considered as one of the few cases in which a company has successfully managed to harness an online user community in its R&D&I activities. (Di Gangi & Wasko 2009).

In this case, the role of university was, firstly, to assess the IdeaStorm as a method of creating a user community and involving it in the product development, and secondly, to produce information that could be used for the development of this method. (Di Gangi & Wasko 2009).

A short description of how Dell's IdeaStorm works is presented in Table 6. Some important lessons learnt by Dell in involving online user communities in its product development are presented in Table 7.

Table 6. Description of the IdeaStorm (Di Gangi & Wasko 2009)

1. To participate, end-users create usernames and post their innovative ideas about how Dell can improve existing products and services and/or create new products and services. End-users can also post comments about an idea, promote or demote posted ideas (vote), and edit their own ideas.
2. When a user submits an idea, he or she provides a title and a description. Additionally, the user has the option to classify the idea from over thirty categories (e.g., Linux, Desktops, and Sales Strategies).
3. Once posted, other end-users are able to promote or demote the idea based upon whether they feel it should be adopted by Dell. When users promote an idea, points are awarded and ideas with more points are given special status in the community by the label "most popular status", which is shown on the front page of IdeaStorm.
4. Demoted ideas or ideas that no longer receive votes are automatically pulled from the popular ideas page after a specified period of time determined by Dell. Each idea submitted to the IdeaStorm website is used as an indicator of an innovation with the potential for adoption.
5. IdeaStorm uses an Ideas in Action page, which lists and describes all the ideas submitted by the community that have been or are being implemented.

Table 7. Lessons learnt from involving online user communities in the firm's product development (Di Gangi & Wasko 2009)

1. Benefits of delegating authority to the user community
Through discussion forums and user surveys the user community may try to have a bearing on what kind of innovations a firm should make into its product. The Dell IdeaStorm case demonstrated that a firm which is exploiting user innovation communities in its innovation activities must delegate some authority to the user community. While reducing organizational decision-making power may reduce the level of ownership and control an organization possesses for selecting which innovations to adopt, several benefits can be reaped from delegating some authority to the user innovation community. In the case of Dell IdeaStorm, Dell was able to capture further innovative ideas for the implementation phase of the idea; such as marketing plans and support mechanisms. Furthermore, because ownership of the idea originated within the community, several community members assumed responsibility for resolving potential issues that might arise from adopting such an innovation.
2. How the user community can make the organization to "steal their idea"
The members of the user community should learn how they can affect the decision making of a firm. The community's ability to apply pressure to an organization is based on both the clear description of what the idea requires (i.e., their ability to reduce the complexity of user concerns) and appropriately applied pressure based on the popularity of the idea within the site (i.e. change agent promotion efforts). If users want an organization to "steal their idea," the community must be able to articulate their needs precisely and come to a consensus quickly.
3. How organizations should respond to user community ideas
Organizations should carefully consider how they acknowledge and interact with user innovation communities. It is important to show to that the ideas presented by the user community are respected and taken seriously into consideration by the firm exploiting these ideas. The firm should • respond to the ideas presented by the user community quickly enough • to withstand the intensity of the community's demands • to have enough absorptive capacity to successfully incorporate the ideas presented within its boundaries

4.4. Involving citizens in the development of the public sector

Target organization	Public administration and service sector in the Netherlands
Date	2009
What is presented here	Citizen involvement method in relation to the development of e-Government services
What can we learn from this case	How citizens can be successfully involved in the development of e-Government services.

Besides developing commercial products and services of firms, the Quadruple Helix type of innovation activities and user involvement methods can also be used for developing public services. A good example case for this kind of activities is provided by van Velsen et al. (2009). Governments and political bodies across the globe are exploring the potential benefits of ICT for improving communication with citizens and stimulating participation and engagement in political and civic processes. These initiatives are often referred to as e-Government. The primary delivery method for e-government is the Internet, which could be used, for example, to voting electronically in local and national elections, and to the engagement of citizens in consultation and community planning. Several authors have argued that in order to achieve the e-Government goals of increasing citizen participation and improved speed and efficiency of the underlying processes, a participative approach to the design and delivery of e-Government is required.

van Velsen et al. (2009) argue that throughout the last decade, user involvement in e-Government service design has been virtually nonexistent. Over time, e-Government experts have begun to realize that these services would benefit from a citizen-centric requirements engineering approach. This has led to a demand for such an approach for this particular field. However, the actual e-Services that government agencies have provided in the last few years have fallen short of being citizen-centric due to a lack of representative user involvement in the design process. In order to design high-quality e-Government services that comply with the needs and wishes of citizens, a user-centred design approach needs to be developed within this context. In addition, e-Government services not only have to match the needs of the

citizens for whom they are intended, but should also correspond to the needs and work practices of the civil servants who provide and deliver the service in question. (van Velsen et al. 2009)

Table 8 presents a method for involving citizens and civil servants in developing e-Government services. The approach utilizes interviews, the formulation of requirements with a focus on concrete and measurable criteria, low-fidelity prototyping, and an evaluation by means of a citizen walkthrough. This method is based on the B-dossier project (http://b-dossier.telin.nl) of Novay, a joint research initiative with partners from government and academia, comprising the Dutch Tax and Customs Administration, the Municipality of The Hague, SVB, UWV, ING, ICTU, the University of Twente, and Delft University of Technology.

Table 8. Method for involving users/citizens and civil servants in the development of e-Government services (van Velsen et al. 2009)

1. Citizen and civil servant interviews
For the elicitation of user requirements for e-Government services it is wise to consult stakeholders with previous and direct experience of the service in question. Two stakeholders comply most with this profile: citizens who recently applied for the service and civil servants who are directly confronted with the applicants of the service. Recommended conversation topics of citizen interviews: – client demographics (age, housing situation, disabilities, etc.); – critical incidents that determine (dis)satisfaction with either the application process or how the application is managed, as experienced by the client; – the chronological service application process, as experienced by the client; and – expectations of digitalization of the service application and management processes. Recommended conversation topics of civil servants interviews: – typical client questions or situations and their translation into actual service; – the information required of the client; – different organizations in the service supply chain: their role, information-exchange processes and trust in the quality of information, supplied by others; and – expectations of digitalization of the service application and management processes.

2. Interview analysis

In order to generate input for the requirements formulation stage, the transcribed interviews need to be analyzed. Below are represented three relevant systematic analysis techniques. Combined they provide the requirements engineer with an overview of the critical issues that an e-Service needs to take into account, the decisions citizens and civil servants feel they have to make and that need to be facilitated, and finally, the relevant human factors.

a) *Critical factors analysis*. This analysis technique focuses on uncovering the factors that are critical for citizens to successfully complete a process or make decisions. If addressed in the interview, the analysis can also focus on experiences which citizens deemed critical for their satisfaction with a service. This way, the requirements engineer can identify the kind of information, or the manner in which it is communicated, that is vital for an effective and efficient system.

b) *Decision analysis*. By analyzing the service process, as experienced by citizens´, and focusing on the decisions they made, an overview of the information that needs to be provided to citizens, and at what moment, can be constructed. In order to do so, one first has to identify the (important) decisions in each process, identify the steps involved and, finally, the information that the citizen needed here.

c) *Human factors analysis*. This last analysis method concerns the search for issues that may hinder successful interaction between user and system. By taking the resulting human factors into account as user requirements in the system design, a greater fit between the system, the needs and wishes of the user, and the context can be achieved.

3. User requirements notation

Every critical factor, step in the decision process, or human factor, which should be taken into account in the e-Service design, should be formulated as a user requirement. Several formats for the documentation of requirements are available. What is presented here is the Volere method. Several features make this format superior to others in a user-centred design process.

1) The rationale behind each and every requirement needs to be written down. This will function as anecdotal evidence for the designers and, in this respect, increase the likelihood that the requirement will be implemented in the system design.

2) A fit criterion must be formed which specifies how the successful implementation of a requirement in (a prototypical version of) the e-Service design will be assessed, preferably by means of user evaluation. This fit criterion not only establishes the quality of the (prototypical) e-Service design, but can also determine the return on investment.

3) Next an estimation of customer satisfaction is done, in which it is estimated whether it is increased or decreased as a result of taking the requirement into account or not. This estimation serves as input to determine the requirements in order of priority and shows which user requirements should at least be taken into account in the final e-Service design.

4. Low-fidelity prototyping

Now that we have an initial set of user requirements, their relevance for stakeholders and the form in which they are to be implemented in the e-Service, interface and interaction design must be evaluated. We propose a strategy that uses citizen walkthroughs, facilitated by a low-fidelity prototype and a fictive scenario. This strategy is inexpensive and easy to set up and conduct.

A low-fidelity prototype can take the form of a set of pictures, displaying the main screens and functionality of a system. It does not have to be representative of the final system and can be made in programmes like Photoshop. Low-fidelity prototypes enable designers to quickly and inexpensively visualize the functionality and 'look and feel' of a future system, but limits the possibilities of showing the navigation within a system. The use of such a prototype has been found to be a fine trigger of user feedback and, because screenshots do not resemble a finished system in which a lot of time and effort has been invested, evaluation participants are less reluctant to provide negative feedback. Ultimately, the evaluation of a low-fidelity prototype will inform the requirements engineer whether he or she has missed some important user requirements and whether the visualized requirements are valid or not.

5. Citizen walkthroughs

During a citizen walkthrough, a participant is shown the low-fidelity prototype version of the e-Service and is asked to provide comments on the functionality, the interface and the interaction design. When confronted with important functions or steps in the service process, participants can be explicitly questioned about their opinion. These questions are to be drafted before conducting the sessions and should be posed to each participant at the same time during the walkthrough. Traditionally, these sessions are conducted with experts, but they can be held with regular users (citizens) as well.

We advocate a citizen walkthrough set-up in which a low-fidelity prototype, with a limited set of screenshots (approximately 15), is presented by means of a persona. At the end of each screenshot, the participant is asked about his or her impression of the screenshot, the completeness of the information provided, and the functionality displayed. At the end of the walkthrough, the citizen can be questioned about abstract issues such as trust, control and barriers to using the e-Service. Through this set-up, the issues of catering for a heterogeneous user group, incidental use, complicated content and interoperability are all accounted for.

6. Citizen walkthrough analysis

The citizen walkthroughs will result in a large amount of transcribed text. In order to generate meaningful results from these transcriptions, a systematic analysis approach is required. We present the following four analysis approaches.

a) *Process analysis*. This approach focuses on the user's overall perception of the e-Service process as well as the different steps it contains.
b) *Functional analysis*. This approach focuses on the typical features of the e-Service, derived from the user requirements.
c) *Question analysis*. This approach focuses on citizens' responses to questions, related to specific screenshots or functionality, posed during the walkthrough.
d) *Sensitizing concept analysis*. This approach focuses on concepts that are not interface-specific, such as trust in the system or the intention to use it.

7. Review of the initial user requirements
After the citizen walkthrough, one will have to review, and possibly revise, the initial user requirements, as some will prove not to be as important as expected or will not be accepted by citizens. When the requirements document is complete, one can start designing and programming the e-Service, which, according to user-centred design principles, should also be tested with prospective users.

4.5. Halmstad Living Lab

Target organization	Halmstad Living Lab in Halmstad University in Sweden.
Date	2007–2009
What is presented here	Experiences of a living lab from the perspective of SMEs
What can we learn from this case	This case provides some detailed learning lessons of building user involvement with focus on small enterprise partners. From this case you can learn, firstly, about the challenges small enterprises face when they participate in living lab activities, and secondly, about the things SMEs should take into consideration when they are trying to exploit users in their R&D&I activities.

Halmstad Living Lab (LL) was established in 2007 and it is situated in the City of Halmstad, Sweden, and hosted by Halmstad University. Halmstad Living Lab works within the application area of health technology and media with specific focus on small enterprise partners. In 2009, around 500 users have been involved in face-to-face activities and over 7000 users in online surveys. The partners of Halmstad Living Lab related to health technology include Halmstad Municipality, The Healthcare Technology Alliance, and several senior citizens and next of kin organizations. Furthermore, Halmstad Living Lab has a network of small enterprises working within the health technology field. Technology firms, newspaper organizations, advertisers and universities across Europe have participated tn the living lab projects related to media.

The focus of the living lab is to enhance innovation processes for companies as well as to provide value-adding IT-innovations for the consumer. Currently the living lab has four research-funded projects, of which three involves users together with SMEs that are creating and validating products and services aimed at supporting and empowering elderly people. The fourth project is within the media sector, where researchers, 7 newspapers and readers are

exploring the challenges of user-generated content with a living lab approach. Examples of the products and services developed in the living lab are special lock and alarm products and services for elderly people living at home, digital newspaper and ubiquitous media services. Users have participated in the idea, development and test phases of the innovation process, and the degree of user involvement can be characterized as design for and with users. (Svensson et al. 2010, Eriksson & Svensson 2009, Svensson & Eriksson 2009).

The production of commercially successful innovations is a challenging task, especially for small enterprises. They often lack the resources and knowledge that large organizations have, for example, about technological R&D, marketing and information about new trends in society and about the users/consumers. One way to strengthen SMEs' innovation capacity is to collaborate with other actors such as academia, the public sector and other enterprises. In Halmstad Living Lab, SMEs have participated in this kind of broad innovation cooperation, and they have met several challenges and important issues to consider which are related to the operations in the living lab. We have gathered some important challenges and lessons learnt by them in Table 9.

Table 9. Important lessons learnt by SMEs in Halmstad Living Lab

I From a small enterprise perspective four challenges need to be addressed in living lab activities (Svensson & Eriksson 2009):
1. *In what way can living lab activities contribute to expanding the competencies within the small enterprises?* It is important to provide the enterprises with knowledge to be able to perform user involvement activities of their own, but as most small enterprises are pressured with time, it is important to provide assistance from the living lab, when needed. It is good to have at least one enterprise representative present in living lab activities, to learn how to perform different activities independently.
2. *How to create openness between enterprises and other stakeholders regarding legal documents such as IPR and patent?* This is one of the most challenging tasks within the living lab. It is important to create an open positive arena that is based on trust, both between different enterprises and between enterprises and researchers as well as users. Competence within the legal area is needed and should be available within the living lab.
3. *How can the business model aspects be incorporated early on in the innovation process to involve all stakeholders?* To have a successful innovation that is being adopted by many, it is of vital importance to secure the business model early in the innovation process. In the health technology

application area there is a problem due to a strict public procurement procedure to hospitals and to municipalities. However, by involving the end-users other business model opportunities could emerge by identifying products and services that they themselves would be willing to pay for. After each activity possible business model opportunities should be discussed with the enterprises to be able to follow up on this subject in forthcoming activities.

How can small enterprises be stimulated to work in more consumer-oriented way, to involve the end-users in the innovation process? The researchers in the living lab are of vital importance in the initiation of user involvement activities. The small enterprises in living labs often consist of engineers without any experiences of methods and tools for user involvement. A good way to start is in research projects where the researchers can plan and carry out activities with the users. By involving representatives from the enterprise to observe and later on to be more active in these activities, the enterprises can get hands-on experience of both the benefits of the outcome as well as how to carry out such an activity.

II Regarding different kinds of user contribution, there are three important issues to consider in a living lab (Svensson et al. 2010):

1. *Required output.* It is important to consider which type of output is needed in the different phases to secure the right kind of user contribution. This is also dependent on the degree of user involvement in the innovation process, e.g. activities performed "by users" results in another type of output than activities "for users".
2. *Resources needed.* Different methods and techniques require different resources. It is important to take into account the resources needed to gather, analyse and summarize the provided input. For example, face-to-face activities are very resource demanding.
3. *Facilitator role.* The facilitator role is very important especially in the creation contribution activities, where the facilitator must be able to balance between dominant users that have a tendency of getting their point through more often than their more quiet and conservative counterparts.

III Four important issues that need to be addressed regarding different types of users in a living lab (Svensson et al. 2010):

1. *Composition of user group.* There is a need to consider the composition of the user group from three perspectives: the relation to the system, i.e. identifying primary, secondary and tertiary users; the competence to aid the innovation process, i.e. to consider users' different levels of knowledge; and the representation of the intended target group regarding gender, age, computer skills, etc.
2. *Different perspectives on innovation.* There is also a need to reflect on different perspectives on the innovation at hand. The involvement of these perspectives is a way to ensure that different user groups needs, wants and requirements are identified. Also, by acknowledging different views on

value and motives for use and working with these differences in the innovation process, the innovation is more likely to be considered usable by a broad range of users. This also supports identification of new ideas and unexpected business openings.

3. *Conflicting interests.* They need to be handled within the user group. In many ways, encouraging these to emerge and be discussed improves the dynamics of the group and often leads to a better result in the end.
4. *Identifying dedicated users (motivation).* It is important to have dedicated users taking part of the workshops. To get satisfying results from an activity the users have to be interested and dedicated to the cause.

4.6. Sekhukhune Living Lab

Target organization	Sekhukhune Living Lab in South Africa
Date	2008–2009
What is presented here	Different evolutionary phases related to the construction of a living lab and concrete methods needed in these different development phases.
What can we learn from this case	This case provides an overview of the evolution, different stages and critical phases of creating a collaboration and experimentation environment with micro-enterprises. The case also gives an example of R&D&I methods and tools needed in different stages of living labs' evolution.

The Sekhukhune Living Lab project was located in South Africa, in the Sekhukhune District in the Limpopo province. It evolved through the C@R (Collaboration@Rural) project, which was an EU-funded Integrated Project as part of FP6 and aimed to boost the introduction of Collaborative Working Environments (CWE) as key enablers catalyzing rural development. C@R addresses rural living labs. It aimed to develop and experiment a collaborative platform for enhancing working and living in rural areas, characterized by difficult but challenging social, economic and infrastructural conditions. The basic idea of Sekhukhune Living Lab was to develop services and applications (incl. GIS procurement application) which supported the development and growth of local SMEs. (Friedland et al. 2008, Mertz et al. 2009).

The overall vision of the Sekhukhune Living Lab interventions was to create an impact on the operational excellence of small and micro enterprises specifically with regard to:

- the establishment of economies of scale to overcome the problem of critical size,
- the bridging of gaps between players of the informal and formal economy supporting accessibility of profitable markets,
- the reduction of transactional costs caused by remoteness, bad infrastructure and limited resources, and
- the employment of entrepreneurs providing ICT services that have not been accessible in rural areas so far (the Infopreneur concept, developed by CSIR/Meraka).

The Sekhukhune living lab approach to user engagement could be characterized as a combination of the approaches called 'System of Innovation' (SOI) and the 'Community of Practitioners'. The 'community of practitioners' consists of a micro-franchise network of social entrepreneurs – called Infopreneurs. These rural "social" entrepreneurs run start-up service enterprises at different levels of complexity and size (hubs, nodes and satellites) within the local communities of Sekhukhune. The SOI consists of a number of institutional actors that carry out different, mainly research and technological development functions at different 'distances' from the "community of practitioners". The implementation of the rural living lab approaches is supported through tight cooperation between CSIR/Meraka institute and SAP Research. This partnership leverages know-how about African business processes with best practices in software engineering also reflecting the expertise of a consortium of further European technology providers.

This case brings forth the concrete methods needed in the different development phases of living labs. In Figure 7 we can see the different evolutionary phases of Sekhukhune Living Lab and the activities and methods used in each stage.

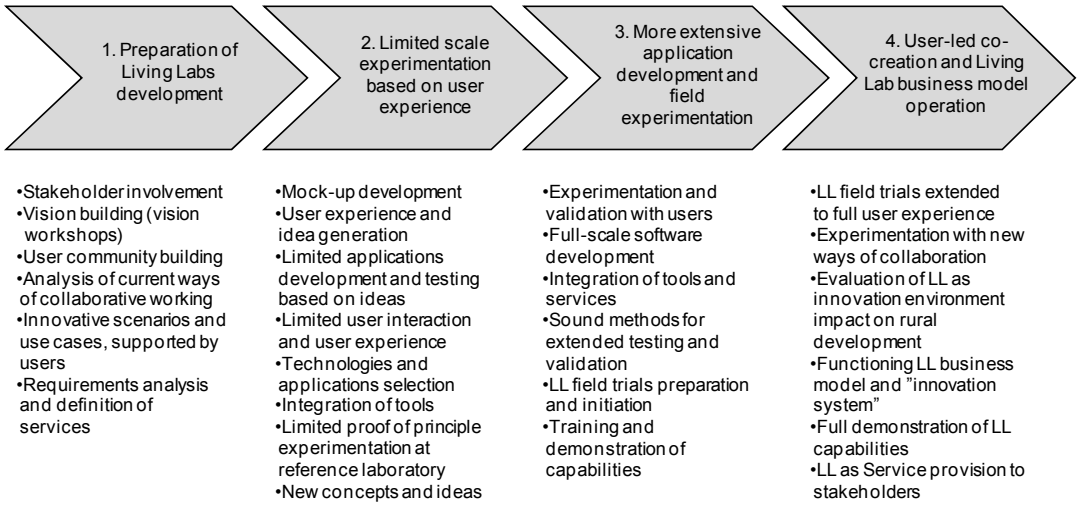

Figure 7. The different stages of living lab evolution (Friedland et al. 2008)

According to Friedland et al. (2008), moving forward through these different development phases necessitates a spiral development approach, which includes the following steps of action research:

1. Establishing various agreements among participants through an extended negotiation process and build long-term, established relationships amongst the different stakeholders (incl. the local communities)
2. Diagnosing the issues and challenges, doing interpretation and data collection leads to theoretical assumptions. In case of Sekhukhune this step has been clearly driven by the end users
3. Action planning: Specifying improvements and interventions, action plans, experimentations
4. Action taking: Implementing changes, carrying out experiments, continuous monitoring, and feedback to participants.
5. Evaluating: Collaborative evaluation of outcomes, problem redefinition
6. Specifying learning

4.7. Living Lab implementation guidelines

Target organization	Persons and organizations interested in the implementation of a living lab concept
Date	2009
What is presented here	Guidelines for implementing a living lab type of innovation environment
What can we learn from this case	This is a summary containing a wealth of experience of working with SMEs and provides a set of guidelines of establishing a user involvement environment enabling systematic user involvement.

Living labs could be seen as a systematic way of involving users in the innovation activities of private and public organizations. Santoro and Conte (2009) have formulated guidelines for implementing a living lab. These guidelines are based on the work done by a number of 6th FP RTD projects in the ICT domain as well as from the experience collected from the various living labs in Europe within the CO-LLABS Thematic Network. This implementation recipe is believed to be suitable for many different contexts and it contains the essential ingredients of a living lab. (Santoro & Conte 2009)

The construction of a living lab consists of two main phases: a) living lab set-up and b) living lab operations. The set-up of a living lab in a regional context implies a capability to establish the main mission objectives of the public–private partnerships, to identify the main stakeholders who are active in the regions, in the specific domain and sectors, and to develop the overall collaborative scenario for linking the various groups in an effective and optimized way. In the operation phase, the objective is to establish an "Innovation Vortex", through which the product and/or service is finalized as a concept developed in the living lab context, deployed for a reality check trial and evolved on the basis of the user feedback collected from the various living lab stakeholders. A more detailed description of these two phases is given in Tables 10 and 11. (Santoro & Conte 2009)

Table 10. The living lab set-up phase

Living lab set-up
1. Establishment of the community of service/technology developers in charge of designing and making available innovative products and services to be tested within the living lab environment.
2. Establishment of the community of public/social stakeholders which are the originators of the living lab in that region, with a view of generating economic value from the service/product ideas under trial, of providing better/added value services to the users and exploiters and of showing returns for the invested money.
3. Establishment of a community of professionals (from academia, public administration, industry and consultants) willing to provide advice and support to the definition and experimentation of the proposed service/products when available.
4. Establishment of a community of users willing to experiment and utilize the provided product and services, possibly grouped according to the specific interests and use intentions: o the final users of the proposed product and service (for instances, consumers, residents, students, citizens, associations, enterprises); o the organizations, which will make them available to the public (service providers, public administration, municipality, utilities).
5. Definition of the legal entity representing all previously mentioned **living lab actors** and suitable for implementing, updating and maintaining the Living Lab mission.
6. Set-up of a supporting IT collaborative platform suitable for: o *Facilitating communication* among the various components of the living labs; o *Collecting and framing the trial outcomes* in an objective and usable way; o *Supporting co-creation processes* among the various living lab groups; o *Providing virtual reality simulation tools* to support the experiencing and sensing of innovative projects. The specific configuration of the IT supporting platform depends on the domain of applications and services which the living lab is targeting as well as on the typologies of constituency and expected use scenarios.
7. Identification of a Living lab performance model suitable for collecting, assessing and evaluating the performance of the public funding invested in the living labs in terms of social outcomes.

Table 11. The living lab operation phase

Living lab operations
1. Identification of idea development and/or demand creation mechanisms suitable for providing new ideas to be tested within the living labs. Examples of such mechanisms: o spontaneous proposals from the community of service/technology developers; o requests from the user community, which can express a need not yet fulfilled; o business/idea competition and awards, in which the regional development agency organizes a competition relevant to innovative business ideas to generate new companies and new jobs.
2. Identification of a specific group of service/technology developers willing to subject a specific product/service to a living lab trial, for either market validation or co-creation/open innovation design purpose.
3. Identification of the living lab trial tutor in charge of coordinating and facilitating the implementation of the trial inside the living lab.
4. Identification of the living lab trial requirements by the trial tutor, by analyzing the product/service features and interpreting users expressed needs.
5. Identification of a specific user group by the trial tutor, extracted by the overall user constituency, willing to conduct the experiment activities and to provide feedback.
6. Identification of a Virtual Team of experts by the trial tutor, representative of the disciplines and competencies needed to support the conduction of the trial, in charge of providing suggestions on how to operate the service and/or to adapt it to the practical/real life situations encountered.
7. Establishment of the living lab trial plan, including the preparation of it, the activities to be performed by the various actors and the operational metrics (different from the impact metrics), to be collected to achieve the market validation of the proposed product and services.
8. Set-up of the living lab trial IT environment specific to support the operation of that specific trial. The living lab trial IT environment provides support for collecting use scenario metrics.
9. Conducting of the living lab trial under the supervision and coordination of the living lab trial tutor.
10. Results analysis of the living lab trial by the living lab trial tutor. This can be an iterative process, depending on the strategy of the specific living lab trial and the level of accuracy of market behaviour prediction required by the service/product developers.

4.8. Finnish Living Labs

Target organization	Finnish living labs
Date	2009
What is presented here	Study of Finnish living labs
What can we learn from this case	This case provides a general overview of the concrete characteristics and development challenges of Finnish living labs.

Følstad (2008) reviewed the living lab literature (32 papers in total) and arrived at the conclusion that this literature was characterized by a remarkable lack of in-depth descriptions and discussions of living lab processes and of innovative methods for end-user involvement. In addition, he found that none of the papers provided critical discussions or investigations of existing living lab processes. This makes it difficult to find out what the living labs are really made of.

One of the few in-depth descriptions of living lab was made by Orava (2009), who conducted a study of Finnish living labs in 2009. The study is based on a survey in which 25 actors participated in May 2009. The questionnaire was sent to Finnish organizations and networks which called themselves as living labs. This case provides a very good overview of the concrete characteristics of Finnish living labs. Although this study was made in the Finnish context, our case study, which includes several living labs illustrated, implies that the results of Orava's study might have wider significance and reflect some of the characteristics typical of living labs also in other countries.

About half of the Finnish living labs in question operated in the area of health and well-being, nine in construction and habitation, eight in ICT and media, five in tourism and accommodation, and three in public services. Most of the studied living labs were projects and had a fixed-term project funding. Typical of them was also that they were relatively recently created and did not yet have a permanent operations model and permanent processes. A clear development challenge for Finnish living labs seems to be how they can secure their continuity and establish their structures and operations.

A majority of Finnish living labs had also no recognizable leader; they were led by a project manager, a co-ordinator or a facilitator and guided by a steering group. Orava (2009) argues that in project-type living labs the essential decisions are often made by their financiers. All these living labs were operated by less than ten persons, but the total number of people in the living lab network was much larger.

The public sector had a rather strong role in Finnish living labs. Almost all of them were financed largely through public funding and a majority of them were also public organizations. About third were both private and public organizations and only two were private organizations. Typical financiers of Finnish living labs were cities, municipalities and federation of municipalities and Tekes (the Finnish Funding Agency for Technology and Innovation). In most cases, a polytechnic or (regional/local) development corporation was the accountable organization. Other typical accountable organizations were universities or some public actors.

What do the living labs actually do? We can get some idea of this by examining the services that living labs offer to their clients. Typical services provided by Finnish living labs were

- project planning and projecting,
- innovation and development services for firms,
- living lab tools for carrying out cases,
- environment for piloting and innovating,
- administrative services for projects,
- finance applications,
- supporting services for businesses,
- evaluation of usability,
- mapping user needs,
- fast network as a test bed for producers of programmes and equipments,
- online focus group discussions,
- prototyping,
- testing of prototypes,
- evaluation of scenarios,
- user need mapping,
- evaluation of product and service concepts, and
- product development.

Living labs were realized in different operational environments; they were carried out, for example, in a neighbourhood, a hotel room, on campus, in a living lab tool environment, in

farms and on fields, in service, technology and innovation centres and on the web portal. From this it can be concluded that most of the living labs operated in real environments, and only a couple of them were virtual living labs.

One very critical factor for living labs (and for other QH type of innovation environments) is whether they succeed in involving users in their innovation activities. Table 12 shows what kinds of users the Finnish living labs have managed to involve, what kinds of methods they have used in their user involvement activities, and how they have motivated the users to participate in the development work.

Table 12. Typical characteristics of Finnish living labs related to users and user involvement (Orava 2009)

Examples of different user groups	• adult students • ICT enthusiasts • mobile ICT experts • disabled, persons with mental disorder • senior experts • the technophobic elderly • young people who are conscious of the technological possibilities • the family carers in health and well-being sector
User involvement methods	• active/passive role play • ethnographic research • the InnoGame method • self-documentation/user diary • brainstorming • survey • usability testing • videotaping and analysing user activities • user observation • individual and group interviews • case studies • statistical analysis
Methods of motivating user involvement	• appealing to common goals and benefits of user and the LL project • offering free internet connection • offering a possibility to have a concrete effect on the product or service the users themselves use or their fellows use • giving an observable recognition, e.g. on the webpage of a firm, that the user has participated in the development work. • offering a possibility to use a new product or service before other people • arranging regular meetings to users and informing the users of a living lab (incl. results of the development work) • paying a reward to the user

Another special feature of Finnish living labs was that the innovation activities were often research driven; in other words, the idea to launch activities or cases came from developers, not from exploiters or users. In other words, the degree of user involvement in Finnish living labs could be characterized as design for and with users, but not by users.

Finnish living labs were rather closed networks in the sense that they typically functioned as autonomous or separate networks and they had very few international partners. Learning possibilities of living labs were also hampered by the fact that the activities of them were inadequately documented. The most urgent development goals and needs recognized by the living labs themselves are presented in Table 13.

Table 13. Development goals and needs of Finnish living labs (Orava 2009)

Development goals	• to network with the regional actors in order to support regional development • to have more functional and better organized co-operation concept • to ensure the funding for recruiting of employees and for the building and maintaining of operational environment • to specialize into a certain field of operation regionally and internationally • to connect the living lab activities as part of normal business activities
Development needs	• the most important deficit in special know-how is related to financing and business operations. • In addition, know-how is needed in connection with the exploitation of user-driven methods and experiences gathered using these methods

Table 14 summarizes some typical challenges confronted by Finnish living labs. Three of them are general challenges of living labs and the rest are related to certain development phases of living labs. These challenges are most likely typical of all innovation environments, in which firms, universities, public organizations and users are involved in co-operative innovation activities.

Table 14. Typical challenges for Finnish living labs (Orava 2009)

General challenges for Finnish living labs
• Different actors use different definitions of living labs; this can complicate the co-operation of these actors.
• How to make firms realize that they should use new development methods and have new development partners (i.e. to change over from a dual or triple model to a Quadruple Helix model).
• Results and benefits are expected too soon.
Challenges related to different development phases of living labs
Planning and initial preparation phase • definition of the cooperation model of LL, • creation of a trustful atmosphere among different actors, • creation of a cooperation network which is broad and versatile enough, and • to profile LL activities from the viewpoint of actual users that are not yet known in this phase.
Launching phase • the launching of first cases when there are practices and processes that are not yet approved, • the motivation of different partners to participate equally in the LL activities, • taking into consideration all different partners and constantly activating them, • the use of user-driven approaches instead of technology or researcher driven approaches, and • inadequate human and financial resources.
Establishing phase • keeping up of adequate innovation level, i.e., continuous development and maintaining an adequate level of ordinary user involvement, and • making LL activities economically viable.

On the basis of these challenges it is easy to conclude, that a multi-partner innovation cooperation model like QH is not easy to implement successfully and that it necessitates a great deal of know-how. Table 15 displays the most important lessons that Finnish living labs have learned. To avoid unnecessary risks of failure, everyone carrying out or planning to carry out the same kinds of innovation activities should take these lessons into consideration.

Table 15. Most important lessons learnt in Finnish living labs (Orava 2009)

Most important lessons learnt
• assess the operational risks; it helps in preparing for different sudden situations and for learning the responsibilities of a living lab actor;
• draw up a communication strategy, which is actively developed and disseminated in the region and among the users;
• plan a clear schedule for projects, so that different persons and organizations know their responsibilities and outputs;
• accurately describe the roles of different living lab actors in LL cases, so that everyone knows their role during the cases;
• consider carefully the motivation of user involvement (i.e. how to motivate users in different phases of innovation activities);
• draw up real time reports of the different phases of the cases through web pages; and
• after every case, make a critical evaluation of how it went, to learn and to be better prepared for the next cases.

5. Communicating with the CLIQ partners over QH

The research project received input from its partners via two ways: (1) A Questionnaire in January-February 2010 on Quadruple Helix actors and activities in the partner regions/local areas, (2) A Case Reader in April 2010 of examples of user involvement in innovation. A short article was also provided for the CLIQ e-Bulletin.

5.1. The Questionnaire on Quadruple Helix

The Questionnaire on QH comprised of questions on

- innovations produced in the area,
- how intensively different actors (firms, research institutions, innovation promoters, the business community, public authorities, users, consumers and citizens) are involved in innovation activities in the respective regions,
- who are the most important partners in innovation activities,
- examples of innovations produced by user involvement,
- the role of users in the example,
- role of local/ regional authorities in the example, and
- possibilities to support user involvement (citizens, customers, clients, consumers, employees, hobbyists, students, social media communities, civil society associations…).

Altogether 20 CLIQ partners responded, which covered the partnership quite well (the responses came from Jyväskylä, Girona, Catalonia, Manresa, Eskilstuna, Leeuwarden, Gävle, Mikkeli, Ulm, Beira, Cadiz, Pau, and Crete). Some partners provided more than one answer. Most of the respondents were local/regional authority representatives (11), others were innovation experts (5), innovation service providers (2), and innovation project members (2).

In the QH survey it turned out that on average the highest intensity actors in innovation activities in the partner regions are large firms, universities and polytechnics, national R&D institutions, science parks and business incubators (see Figure 8). A "mid-range" of involvement contains technology centres, business development centres, public national R&D financers and local and regional authorities. The lowest intensity was with consumers, citizens, employees.

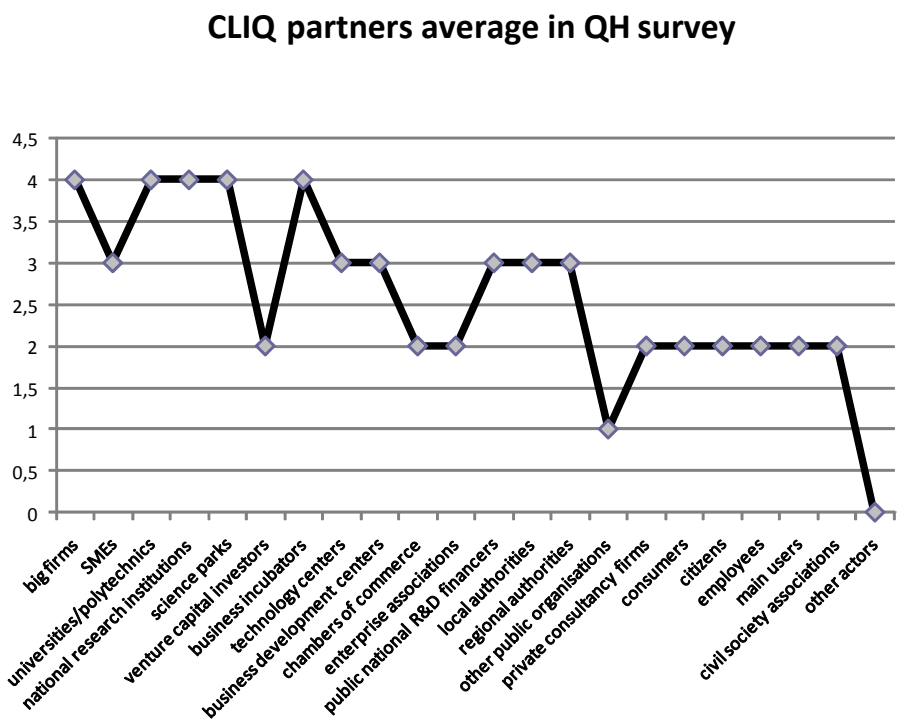

Figure 8. "How intensively are the following actors now involved in innovation activities in your region/ local area?"

The overall average of the results of the CLIQ QH survey thus seems to demonstrate that innovation activity among the partners is close to a "TH model". Looking at averages in such a small sample is of course only indicative, and its purpose was in fact only to get a quick glimpse at the degree of user involvement in innovation among the CLIQ partners. There is quite considerable variation among the CLIQ partners concerning this, but we want to leave the reflections over these for the partners themselves against the QH concept analysis, practice examples, overall conclusions and recommendations.

In fact, in many regions/cities of the CLIQ partners there is a wealth of examples of different levels of user involvement, also in the light of the Questionnaire answers (Figure 9). They vary from a minor involvement consisting of answering surveys via web forum participation to a high level of involvement in pilot testing, development groups and modifying or creating products. Most mentions about user involvement (14) were participation in pilot testing and user feedback. A simple tally of mentions of types of user involvement by the CLIQ partners in Figure 9 shows the overall numbers of mentions of user involvement.

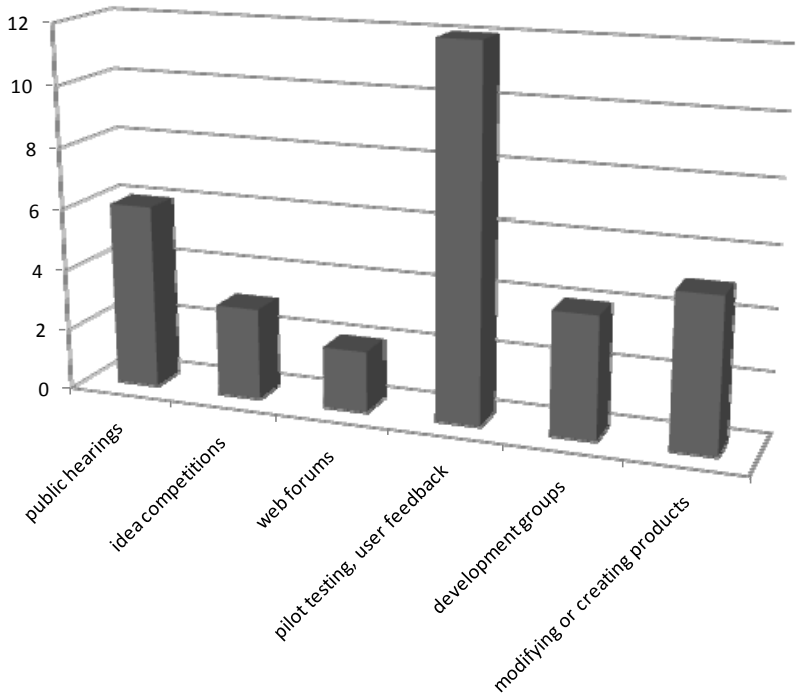

Figure 9. "What kind of role did users have in your example (on user involvement)?"

5.2. The Case Reader on User Involvement Examples

A Case Reader was circulated in April 2010 among the partners to prompt reflections on QH and user involvement. A few telephone interviews (6 in all) were conducted instead of, or to complement, the written responses.

The Case Reader on Quadruple Helix for the CLIQ partners was an excerpt of our ongoing search for good examples of QH. The main criteria for case selection was that the case clearly differentiates itself from Triple-Helix-type of innovation activity, and that it represents QH type of innovation activities, in which all four QH actor groups are involved and/or innovation activities, and in which users have had an essential role. Also, an important criterium was that there was an in-depth and rich enough description of the case available.

The Case Reader was by no means conclusive, but intended to work both ways – as a "conversation piece" from and to the ongoing research. It was intended for reflective comments from the partners, and also as learning material and food for further thought as such. The comments also advised the last stretch of the research as to what extent the presented cases "resonated" among the partners and how relevant they found them against their own ongoing work and challenges, and how to improve the presentation and coverage of cases for the final report.

At the point of time of the ongoing work we chose mainly 'living lab' (LL) experiences, which offered rich and concrete enough examples of Quadruple Helix-type of innovation activity, which clearly differentiates itself from the Triple-Helix-type. The examples were by no means exhaustive of the QH world and challenges, and not suggestive of delimiting QH to LL only.

On the basis of the Case Reader we asked for reflective comments in a short "essay form", reflecting on the material against each partner's own experiences – the experiences and challenges of enhancing innovation, and particularly user involvement in innovation in the region. A couple of "prompting questions" were provided:

(1) Do these cases illuminate the kind of experience and problematic that is relevant and useful in your regional context concerning building user involvement in innovation?
(2) Do you have any specific comments on the role and challenges of local/regional government in promoting user involvement in innovation?
(3) Is there something missing, from your perspective, that is relevant for you concerning enhancing user involvement in innovation in your region?
(4) Where are the efforts of building user involvement concentrated in your region right now and the near future?
(5) Is there an example you would want to share/point out, as an interesting new development in user involvement from your region, or elsewhere?

Altogether 13 reflective comments were given on the Case Reader representing 6 partners (Ulm, Girona, Jyväskylä, Gävle, Eskilstuna and Crete). Several people responded from Gävle and Eskilstuna.

It was clear from the comments that the degree to which QH, user involvement and living labs in particular are an actuality or relevant in the different contexts, varied to a great degree, corroborating also the picture attained in the Questionnaire. For those who had already more experience concerning the different aspects of QH kind of activities, including examples of intensive user involvement and living labs, many of the cases and learning points were found highly relevant. This does not mean that all the cases, or the way in which they were presented, were considered as relevant or adequate. In some comments it was emphasized that QH is not limited to LL, which was not the message of the researchers either.

The reflective comments brought up a rich set of themes and questions which were very helpful in terms of improving the final report. The ideas and aspects raised in the comments have been used to enrich our report, the cases, conclusions and recommendations.

Although they do not do full justice to the richness of the comments, some selected key themes and messages are presented here. These included in particular the following:

- The shift to citizen and user orientation is a big cultural change, not just a small operation – be it in the public or private regime – and must be underpinned with many different aspects and skills in order to be robust and sustainable.

- Local and regional authorities have an important role in QH, via strategic use of resources, integrating knowledge and skills in innovative thinking, community building, procurement and regulation, grants, rewards – but they also have big needs for their own ability and skills development and many constraints in terms of inflexibilities and bureaucracies.
- Involvement in the innovation process must be seen broadly enough, containing the possibility of being an individual idea resource even without being an actual user of a certain product, or even wanting to be one.
- The process of integrating knowledge of innovative thinking, user involvement, accessibility and inclusion empowers communities to become stronger drivers of innovation – and this in turn feeds into a more inclusive society, "as a bonus".
- On the other hand, there are also risks of selection mechanisms in user involvement (like levels of 'digital literacy') and participation, which need to be addressed.
- There is a need to be aware of and skilled in local and regional government to negotiate a good balance between organizing and controlling and "letting the people do it themselves" in participative processes, without stifling the processes.
- There is a whole set of important questions to be addressed concerning the ownership, commitment, rights and legal issues of the participative processes.
- Changes in web-based services can help to accelerate the processes of user involvement.

6. Research results

In this chapter we answer to the following research questions:

1) What is the Quadruple Helix (QH) innovation model?
2) Can QH bridge the "innovation gap" between civil society and innovation?
3) What kind of good practices are related to QH activities
4) How local authorities can promote QH activities, what kind of roles could they have in the QH environment?

We start by answering to the first question: What is the Quadruple Helix (QH) innovation model?

6.1. The Quadruple Helix Models

"Quadruple Helix" (QH) is not a very well-established and widely used concept in innovation research and in innovation policy. The concept does not have a well-established definition either. A clear springboard for this concept is of course the Triple Helix concept. Triple Helix (TH) describes spiral-shaped innovation cooperation between firms, universities and public organizations. The concept tries to capture the multiple reciprocal relationships of different innovation actors at different points of innovation process. Quadruple Helix adds another helix and actor group to the TH innovation cooperation model. After reviewing literature related to R&D&I activities, we arrived at the conclusion that there is a wide range of conceptions or approaches, which could be named as QH type of innovation conceptions. Some of them are very close to the TH concept, some of them deviate more radically from it, and many of them are somewhere between these two extremes. What is common to all QH type of innovation conceptions is they all have included some fourth group of actors into TH model. As we have already brought forth, we argue that this fourth helix should be users. Accordingly Quadruple Helix can be seen as describing innovation cooperation between firms, universities, public organizations and users.

Based on the above, we have formed a general definition of the QH innovation model: it is an innovation cooperation model or innovation environment in which users, firms, universities and public authorities cooperate in order to produce innovations. These innovations can be anything that is considered useful for innovation cooperation partners; they can be, for example, technological, social, product, service, commercial and non-commercial innovations.

As we can see, it is more useful and meaningful to consider Quadruple Helix rather as a continuum or space than a single entity. Accordingly it is more useful to talk about different QH models situated somewhere along the QH continuum or space. In each case, the QH model to be constructed depends on the perspective that one chooses. In this research report we consider it mainly from the innovation perspective, especially innovations related to the development of products and services either in the private or public sector. In order to make some interesting dimensions and possibilities of QH explicit, we have constructed four

different types of QH models: 1) the "TH + users model", 2) the "Firm-centred living lab model", 3) the "Public sector-centred living lab model" and 4) the "Citizen-centred model" (see Figures 10, 11, 12 and 13). These models are ideal-type models and they are not meant to describe reality as it is. The purpose of these models is to bring forth some essential characteristics of different QH models more clearly and to provide examples of the possible application possibilities of QH. The real QH innovation environments and cooperation models most probably contain elements from several different QH models.

Next we introduce these four models and their essential characteristics. Of the four QH models presented here, the first two (TH + users and Firm-centred living lab) seem to be very much reality already today in several countries. The public-sector-centred living lab model also seems to be in use at least in different projects related to the development of public services. At the moment the citizen-centred model is most likely the most infrequently utilized QH model of these four QH models. It provides the biggest challenges to firms, universities and public authorities that are not used to hand over the steering wheel/driver's seat to citizens in innovation activities.

6.1.1. Triple Helix + users

The Triple Helix + users model (Figure 10) is otherwise the same as the traditional TH model, except for the systematic collection and utilization of user information. The focus is on the development of commercial high-tech innovations based on the latest scientific research knowledge. The owner of the innovation process can be a single firm, group of firms, university, group of universities, or group of firms and universities. In this model the degree of user involvement could be characterized as design for users (see Section 3.4. Defining user and user involvement). The users participate either indirectly in the innovation process, i.e. give information about their needs through surveys, for example, or participate in the innovation process at very late phase when the developed products or services are nearly completed. Users are treated as informants, not as developers. In other words, they are treated merely as objects of innovation activities, not subjects of them. The information given by users is not taken at face value. The decisions and interpretations concerning the (real) needs of users (consumers) are made by experts working in high-tech firms or in universities.

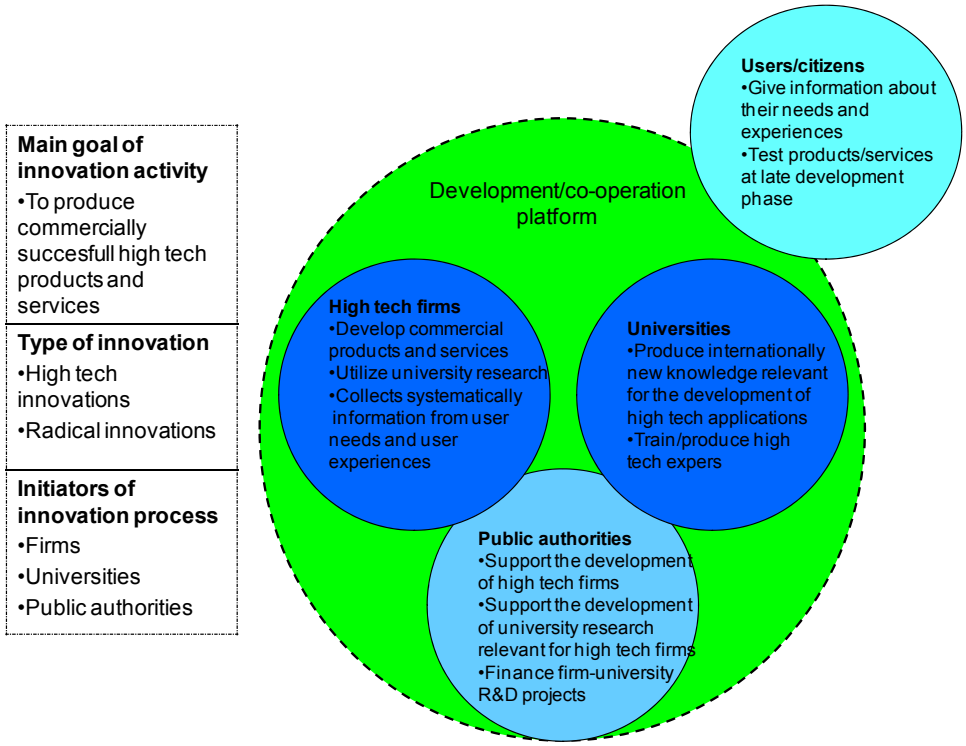

Figure 10. The Triple Helix+ users model

In the Triple Helix + users model, public authorities have the following kinds of roles:

- to support the development of high-tech firms and universities;
- to support the networking of TH actors;
- to finance R&D&I projects related TH + users type of innovation;
- to support regional and local development which supports the promotion and utilization of TH + users type of innovation;
- to market TH + users innovation environments for high-tech firms and researchers;
- to support research relevant for the development and commercialization of high-tech products/services and for the development of TH + users type of innovation environments and activities; and
- to support the systematic collection and utilization of user information (incl. the development and utilization the tools and methods suitable for this purpose).

6.1.2. The firm-centred living lab

In the Firm-centred living lab model (Figure 11) the focus is also on the development of commercially successful innovations, but in this case, innovation can be based on, in addition to latest research knowledge, also on new applications or combinations of "old" research knowledge and/or on user knowledge. In this case, user knowledge refers to knowledge both about the needs and problems users face in real life contexts and about these contexts of use. The owner of the innovation process is a firm or group of firms. In this model, the degree of user involvement could be characterized as design with users (see Section 3.4. Defining user and user involvement). Users are treated both as informants and as developers. This means that they participate also in the early phases of an innovation process, for example, in the idea and development phase. In this model, user knowledge can be as important as research knowledge.

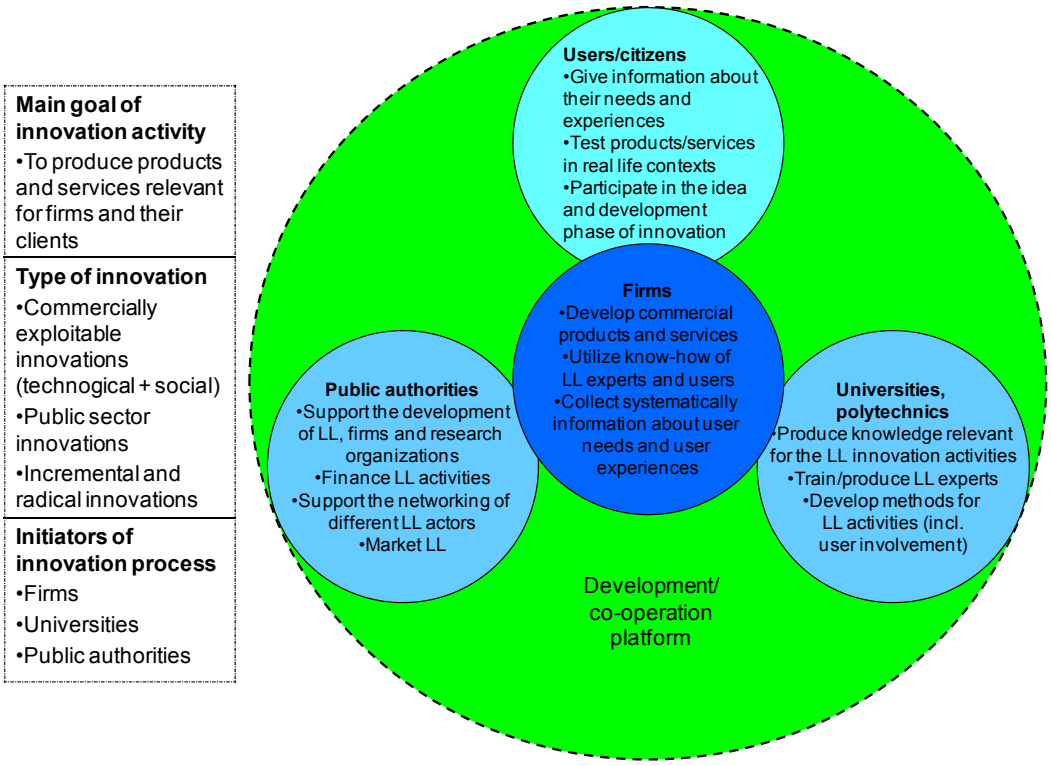

Figure 11. The Firm-centred living lab model

In the Firm-centred living lab model, public authorities have the following kinds of roles:

- to support the development of firm-centred QH innovation environments like living labs (LL) and the main actors of these environments (incl. firms and research organizations);
- to support the networking of firm-centred QH/LL innovation actors;
- to support regional and local development which supports the promotion and utilization of firm centred QH innovation;
- to market firm-centred QH/LL environments and the services they provide for firms, users and public organizations;
    - to increase the awareness of firms, especially SMEs, of these innovation environments and how they can utilize these environments and user involvement in their development activities;
- to support the development of research relevant for firm-centred QH/LL environments and activities;
- to finance R&D&I -projects related to firm centred QH innovation;
- to support the systematic collection and utilization of user information (incl. formation of user communities) relevant for firm-centred innovation; and
- to support the development and to improve the awareness of user-oriented development and research methods/tools supporting firm-centred QH innovation

6.1.3. The public-sector-centred living lab

In the public sector-centred living lab model (Figure 12), the focus is on the development of public organizations and services. Also in this case, innovation can be based on, in addition to the latest research knowledge, also on new applications or combinations of "old" research knowledge and/or on user knowledge. The owner of the innovation process is different than in the Firm-centred living lab model; in this case, it is a public organization or a group of public organizations. The goal of innovation activity is, above all, to develop public organizations so that they can function better and offer new and better products and services to their clients, to citizens. In addition to firms, also public organizations gather systematically information and feedback from the clients of their services, i.e. from citizens. This can be realized by means of

more traditional information gathering methods (e.g. surveys, interviews), or by organizing dialogue forums (virtual and real) for citizens. Also in this model the degree of user involvement could be characterized as design with users (see Section 3.4. Defining user and user involvement). In other words, users/citizens participate in the development work of public services together with R&D experts.

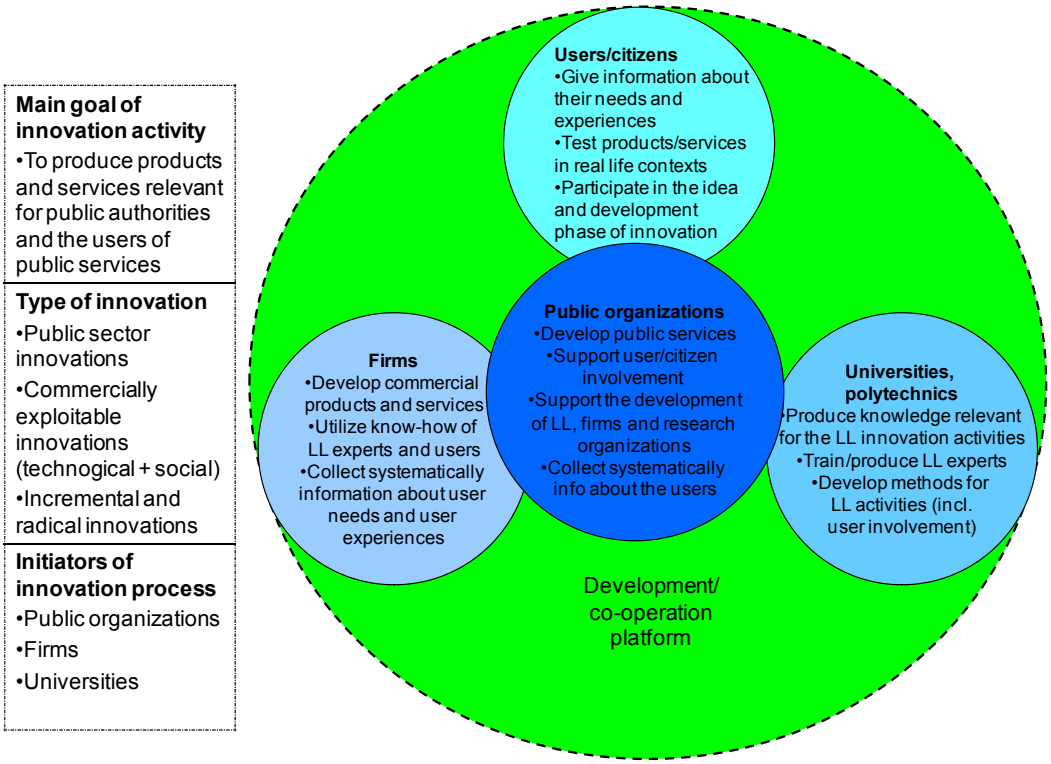

Figure 12. The Public-sector-centred living lab model

In the public-sector-centred living lab model, public authorities have the following kinds of roles:

- to support the development of public services by means of living labs and user-oriented development methods;
    - to support citizen involvement in the development activities of public organizations;

    - to collect and utilize systematically information about citizens' needs and experiences concerning the function of the public sector;
- to support regional and local development which supports the promotion and utilization of user/citizen-oriented QH innovation made in the public sector;
- to support the development of LL and the main actors of these environments (incl. public organizations, citizens, firms and research organizations);
- to support the networking of public-sector-centred QH/LL actors;
- to market QH/LL environments and the services they provide to public organizations, citizens and firms;
- to support the development of research relevant to QH/LL environments specialized in the development of public organizations;
- to finance R&D&I projects related to QH innovation in the public sector;
- to support the systematic collection and utilization of user information (incl. formation of user communities) from the public sector; and
- to support the development and to improve the awareness of user-oriented development and research methods/tools supporting QH type of innovation cooperation in the public sector.

6.1.4. Citizen-centred QH

In the Citizen-centred QH model (see Figure 13) the focus is on the development of innovations relevant for citizens. In this innovation model, citizens are in the driver's seat and the produced innovations can be based on the knowledge of citizens, firms, universities and/or public authorities. The owner of the innovation process can be a single citizen or a group of citizens (i.e. a development community). In this model, the degree of the depth of user involvement could be characterized as design by users (see Section 3.4. Defining user and user involvement), i.e. new products, services and ways of doing things are developed by users. Besides making most of the development work, citizens also decide what kinds of innovations are needed and developed. The role of firms, public authorities and universities is, above all, to support citizens in their innovation activities (e.g. to provide tools, information, development forums and skills needed by users in their innovation activities). Firms and public organizations also utilize the innovations made by citizens.

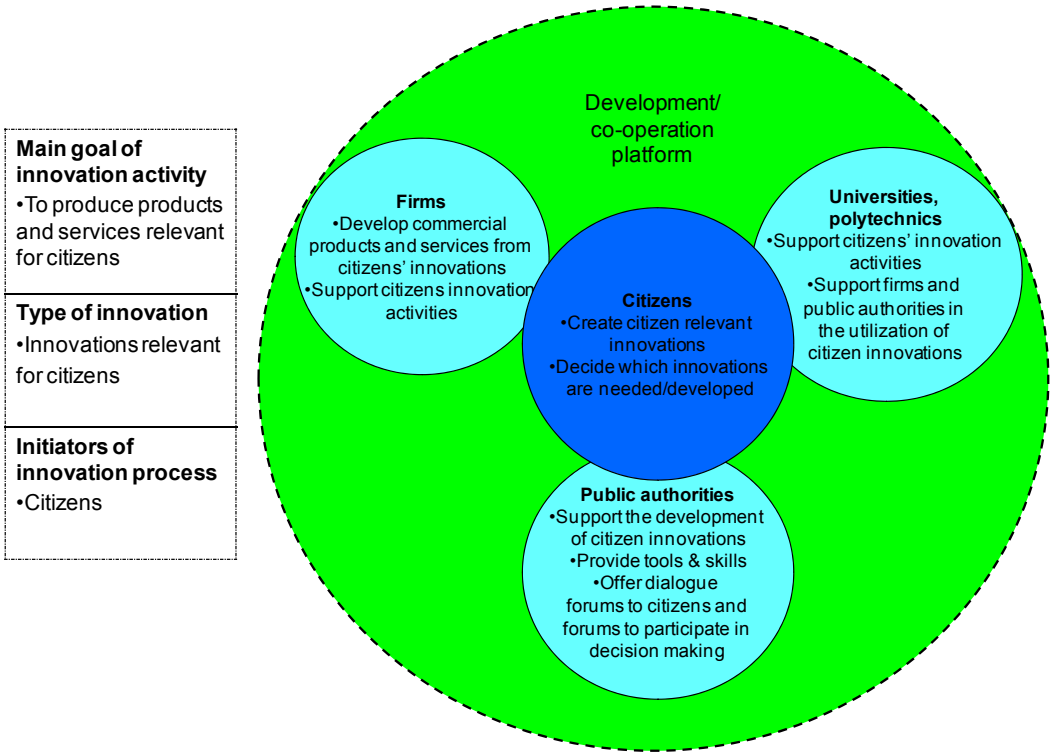

Figure 13. The Citizen-centred QH model

In the Citizen-centred QH model, public authorities have the following kinds of roles:

- to promote the empowerment of citizens and to assist citizens in their innovation activities;
  - to support the development of citizen innovations;
  - to provide tools and skills needed by citizens in their innovation activities;
  - to offer dialogue forums to citizens and forums to participate in decision making and to assist them in their innovation activities;
- to support the development of QH type of innovation environments able to support and utilize citizen-centred innovation activities;
- to support regional and local development that supports the promotion and utilization of citizen-centred innovation;
- to support the networking of citizen-centred QH innovation actors;

- to market citizen-centred QH environments and the services they provide to citizens, firms, and public organizations;
- to support the development of research relevant for QH environments specialized in citizen-centred innovation;
- to finance R&D&I -projects related to citizen-centred QH innovation;
- to support the systematic collection and utilization of information supporting citizens in their innovation activities (all kinds of information in addition to information related to citizens themselves); and
- to support the development and to improve the awareness of citizen-centred development and research methods/tools supporting citizen-centred QH innovation.

6.2. Civil Society and QH

The challenge to better connect civil society to innovation, or to bridge the 'innovation gap' of civil society and innovation, can be considered from two perspectives: from the perspective of firms and the perspective of local/regional/national authorities.

If this challenge is considered first and foremost from the perspective of firms, it can refer to the "technological innovation gap", and/or to the "trust/moral gap". A technological innovation gap means the insufficient capability of European firms to translate their technological know-how into successful business cases with significant commercial and societal impacts. One indicator of this innovation gap is the fact that the number of technology patents granted to European firms is much larger than the number of commercially successful products/services based on patented technology (Santoro & Conte 2009).

A trust gap/moral gap means that citizens do not necessarily trust the breakthrough technologies developed by firms and public research organizations, or that they might consider these technologies and the use of them unethical or unecological. This trust/moral gap has become visible in the case of nuclear energy technology and biotechnology. From the perspective of authorities, this innovation gap means that local, regional and national authorities are not able to sufficiently involve citizens in the development of public services and organizations.

Related to the main goals of the CLIQ project, we have paid keen attention to the perspective of firms considering the challenge of connecting innovation and civil society. This is in order to obtain focus and emphasis on practical company needs and to relate the challenges of local and regional authorities to these. With this emphasis, civil society mostly refers to users (consumers) who use the products and services produced by firms and services produced by public organizations. According to Santoro & Conte (2009), living labs type of innovation approach could bridge the innovation gap between technology development and the uptake of new products and services involving all relevant players of the value network via partnerships between business, citizens, and government. To what extent living labs really can bridge this gap remains to seen. There is not yet enough empirical research data related to living labs to make a reliable and valid estimation of this. The first two QH models, Triple Helix + users and the Firm-centred living labs, in particular, but not exclusively, provide examples and practices of bridging the technical innovation gap.

The innovation gap between civil society and innovation can also be understood as insufficient possibilities for citizens to have a bearing on the innovations developed by firms and R&D organizations. As mentioned earlier (see Chapter 3.4.), user involvement can be divided into two strands: an approach that focuses on the role of the service user as a mere consumer of services (consumerist) (see e.g. Brown, 1997) and an approach that emphasizes a clearer role of user in decision making (collectivist) (Hoggett and Hambleton, 1987). Criticisms have been raised against local authorities that apparently focus on the first approach, whilst neglecting the second, since although a consumerist approach might entail changing services to meet the needs of customers and ensuring also that those services are accessible, it does not address the issue of power (Leach et al., 1994). Hence, it does not change the position of those on the receiving end of services.

In the collectivist approach the role of service users in decision making has been further divided into representative democracy and direct democracy (Hoggett and Hambleton, 1987). The former implies the role of councellors as advocates, and the latter suggests that the public have a direct input into how services should be provided. Taking the idea of direct democracy further, Hoggett and Hambleton identify three types of strategy for involving the public in decision making: resourcing non-statutory organizations, community development, and the involvement of user groups. However, the authors accept that both strands of the collectivist approach can also be criticized. It has been argued, for example, that representative

democracy might be paternalistic, passive and minimalist, and, on the other hand, that direct democracy could be sectional and parochial. Therefore, they recommend using a combination of these two strands of the approach to compensate for the deficiencies of the other.

Clarke and Stewart (1992) go further and suggest that there should be a third facet to the role of the public: rather than being perceived of as individuals, the public should be regarded as members of the community. In this model, empowering the public as a customer involves extending choices or clarifying the service to which they are entitled, giving them the means to complain, and providing equality and ease of access. In contrast, by empowering people as citizens, the public is entitled to a share in decision making, which necessitates being in the clear about their rights. And, thirdly, empowering the public as a community means giving them direct control and the right to determine wherever possible those issues affecting the community, with the creation of new democratic frameworks where appropriate.

The Public-sector-centred living labs and Citizen-centred QH models, in particular, but not exclusively, provide examples and practices of addressing these broader community and democracy perspectives.

The situation in relation to the complex community, culture and democracy issues vary considerably between and within countries. The degree of decentralization and devolution between central and local government, the powers of the different tiers of government, etc., differ, and thus also the possibilities and relevance of connecting civil society and innovation. It is probable that the experience *outside* explicit innovation activities of the local and central authorities contain a wealth of practices that could feed positively into innovation, such as building platforms, interfaces and forums for participation in decision making. Good practices in involving and empowering customers, in public services likewise already contain a wealth of experience how to really involve people.

The issue of power is very seldom addressed in the QH literature, even if there is a clear (but implicit) in-built tension and a potential conflict of interest included in the QH innovation activities involving user: how much decision-making power is delegated to users and how much users can benefit from the innovations they have been co-developing vs. decision-making power and benefits that firms, QH experts and public authorities enjoy.

6.3. Good practices coming from the Good QH cases

6.3.1. Constraints in identifying good practice in QH

Based on our research results presented earlier, finding good practice in QH is a demanding task because QH is still far from an established model and because it is rather a continuum than a model/concept with clear boundaries. Furthermore, because comparatively little research and in-depth descriptions are made about QH type of innovation activities, this model is so far at its best more like a promising, or interesting, model than actual good – or indeed – best practice. Also, at the end of the day, good practice is always a locally embedded practice that cannot be simply transferred elsewhere as a commodity, but rather applied through a learning process. The more complex the practice, the more demanding and complex the learning process needed in between. Public authorities have an important role in promoting the platforms of such complex learning.

Furthermore, what is also clear is that the cultures, goals, stages of development and available resources in terms of structures, funds and actors differ considerably in different localities, regions and countries. This is apparent also among the CLIQ partners.

All this means that unequivocal identification of good practice, or recommendations concerning it in universalistic terms, is impossible. Rather, a contingency/configurational approach (Whittington et al. 2003) is needed, where there are several constellations of success. Here the only "universalistic" recommendation is to enhance the regional interactive learning process.

The observations and recommendations on good practice concerning QH are written with these constraints and points of departure in mind.

6.3.2. Good practices in various aspects of QH promotion

From our good QH cases (see Chapter 4. Good QH cases) we can find the following good QH practices related to the forming and implementation of QH development platforms/innovation environments and to supporting user involvement in QH type of innovation activities. The practices are assorted according to 1) the QH challenges they are related to and 2) the development phases of the QH innovation process.

Challenge: How to construct a QH type of innovation environment

In order to form a functional and successful QH type of innovation environment, one needs good and approved guidelines and a "checklist" for guiding the design and implementation of QH type of innovation cooperation environment. One good example of these kinds of guidelines is provided by Santoro and Conte (2009), who have formulated the implementation guidelines for living lab type of innovation environment. They argue that this implementation recipe is believed to be suitable for many different contexts and that it contains the essential ingredients of a living lab (Santoro & Conte 2009). They break down the guidelines and the construction process of a living lab into two phases: a) living lab set-up and b) living lab operations. A short description of these phases is presented in Tables 16 and 17. A more detailed description of these two phases can be found from Chapter 4. Good QH cases (Table 10 and 11) (Santoro & Conte 2009).

Table 16. The living lab set-up phase

Living lab set-up
1. Establishment of the community of service/technology developers
2. Establishment of the community of public/social stakeholders
3. Establishment of a community of professionals from academia, public administration, industry and consultants
4. Establishment of a community of users
5. Definition of the legal entity representing all living lab actors
6. Set-up of a supporting IT collaborative platform
7. Identification of a Living lab performance model

Table 17. The living lab operation phase

Living lab operation
1. Identification of idea development and/or demand creation mechanisms
2. Identification of a specific group of service/technology developers
3. Identification of the living lab trial tutor
4. Identification of the living lab trial requirements
5. Identification of a specific user group by the trial tutor
6. Identification of a Virtual Team of experts by the trial tutor
7. Establishment of the living lab trial plan
8. Set-up of the living lab trial IT environment
9. Conduction of the living lab trial
10. Results analysis of the living lab trial

Challenge: How to avoid possible stumbling blocks of QH activities?

Before launching a QH type of innovation cooperation environment it is also very useful to become acquainted with approved practices to avoid possible challenges related to this type of cooperation environment. Here we have collected some useful practices which can help to avoid these QH stumbling blocks:

a) QH partners in innovation should form a common understanding and definition of QH innovation cooperation/environment (e.g. what is meant by it, what are the goals of it, what kind of innovations are pursued).
b) It is also important to create an open positive arena that is based on trust between the QH partners.
c) The roles of different QH partners should be described accurately before the QH environment is launched.
d) QH partners should also make an assessment of operational risks related to QH activities/cooperation before the launching phase. This helps partners to brace themselves for coming spots of danger. The QH types of innovation activities involve many risks. Firms and public authorities must be prepared, for example, for risks associated with direct contact with users and citizens. User cooperation must

be managed correctly to avoid misunderstandings and disappointments on both sides. In the worst case scenario, users can turn against the organization utilizing them in its development activities.

e) QH partners should make a communication strategy concerning the QH environment and the achievements of this environment. This strengthens the brand and visibility of the QH environment they have created.

f) QH partners should learn to identify the different perspectives of QH partners on the innovation(s) at hand.

g) QH partners should also learn to make conflicting interests explicit and to discuss about them openly

h) QH partners should learn to use right methods in different development phases of the QH innovation process. An example of this is provided by the Sekhukhune Living Lab case presented in Chapter 4. Good QH cases.

i) QH partners should also draw up a clear schedule and division of labour in different QH projects and activities.

j) QH environment should utilize researchers widely in QH activities, especially research and researchers specialized in user involvement and in QH type of innovation activities in general should be made into one essential part of QH activities.

k) QH partners doing development work in QH environment should be trained to utilize user/citizen involvement methods. Examples of the approved user and citizen involvement methods are given in Chapter 4. Good QH cases. These cases present the lead user method, the method involving ordinary users, the method involving online user communities and the method involving citizens in the development of public services.

l) QH developer organizations should also learn to identify the right users in relation to the type of innovations they seek and to the target group of these innovations. (see Halmstad Living Lab in Chapter 4. Good QH cases)

m) A very important skill for QH developer organizations is the skill to motive users. To be able to find and involve users in their development activities, QH organizations have to be able to motivate users. Examples of tools for motivating users are given in the Finnish living labs case. One way to motivate users is to appeal to the common goals of and benefits for user and the QH project. Users can also be offered a possibility to concretely affect the product or service they

themselves use or their fellows use or they could be promised an observable recognition, e.g. on the webpage of a firm, that they have participated in the development work. From the case "Involving online user communities" we can learn that, to keep users motivated, organizations should carefully consider how they acknowledge and interact with user innovation communities. It is important to show to that the ideas presented by the user community are respected and taken seriously into consideration by the organization exploiting these ideas. An organization can prove this to users by responding to the ideas presented by them quickly enough, by withstanding the intensity of users' demands and by having enough absorptive capacity to be able to realize and apply the ideas presented by users.

n) In improving the QH activities and making the QH environment function better it is important that QH projects and activities are documented and reported well (e.g. real-time reports are made). Relating to this, it is also important that each QH case/project is evaluated.

Challenge: How to utilize ordinary users effectively in innovation activities?

It is not enough only to involve ordinary users; what is also important is how this is done. If developers and/or innovators do not want to content themselves with the ideas already known to them or variants of services already implemented, it is not enough to merely ask the ordinary users if they have any ideas. Customers only know what they have experienced and have trouble imagining, for example, the use of emerging technologies or practices. In the "involving ordinary users" method the users are activated into problem solving in their own day-to-day environments and they are given newly acquired knowledge related to the product/service to be developed. Users are thus encouraged to discover new, so far unknown, needs; these needs would probably not have been discovered during a traditional inquiry process.

Challenge: How can SMEs benefit from QH type of innovation activities?

SMEs need special support and help in user-oriented innovation activities. One good way of supporting them in this is to form a living lab type of innovation organization and environment that offers SMEs services supporting the utilization of users and user knowledge

in their innovation activities. But this is not enough: SMEs need also support in the utilization of QH type of innovation environment. Good practices related to this are:

- SMEs should have a representative in QH activities, so that they could learn how to perform different QH activities by themselves (see the case of Halmstad Living Lab).
- After each QH project, possible business model opportunities should be discussed with the enterprises so that they could better exploit these opportunities in their forthcoming projects and activities (see the case of Halmstad Living Lab).
- In order to stimulate SMEs to work more user-oriented and to involve users in their innovation activities, representatives of SMEs should be involved in research projects related to QH, so that they can observe and get first-hand experience in how researchers plan and carry out user involvement in those projects (see the case of Halmstad Living Lab). It is also important to train SME representatives to utilize different user involvement methods.

6.4. The roles of regional and local authorities in promoting QH

When the roles public authorities (inc. regional and local authorities) in promoting QH are considered, it must be noted that the role of public authorities and the ways they have been affected by the QH activities is still an under-researched and -documented topic. There is a lack of research, for example, on the roles of different public authorities – what kind of role different public actors, e.g. state, regional and local authorities have – in QH type of innovation activities and on the challenges user involvement sets to the public authorities. However, we can find good ideas and examples of the possible roles of regional and local authorities from the living lab literature, from our Good QH case studies, from the four QH models formed by us and from the user-driven innovation policy literature.

Rönkä and Orava (2007) have defined four main roles for the actors of Quadruple Helix (QH) and living lab (LL) type of development platform. These roles are: the enabler, utilizer, developer and user. Rönkä and Orava have a rather traditional conception of the innovation roles of firms, public authorities, universities and users. The roles and typical representative of them (as seen by Rönkä and Orava) are presented in Figure 14. Rönkä and Orava (2007)

also argue that, to function well, a QH type of development platform needs also some kind of manager, networker or moderator who acts as a node. Described at a general level, the task of the enabler is to make possible the development of the QH or LL process, for example, by providing funding or a building lot for LL development platform. The role of the enabler concerns, besides developers and utilizers, also users. Utilizers utilize products and services developed in the platforms in question. The task of the developer is to bring R&D&I know-how into living labs. The task of users is to provide information of their needs, experiences and ideas. (Rönka & Orava 2007)

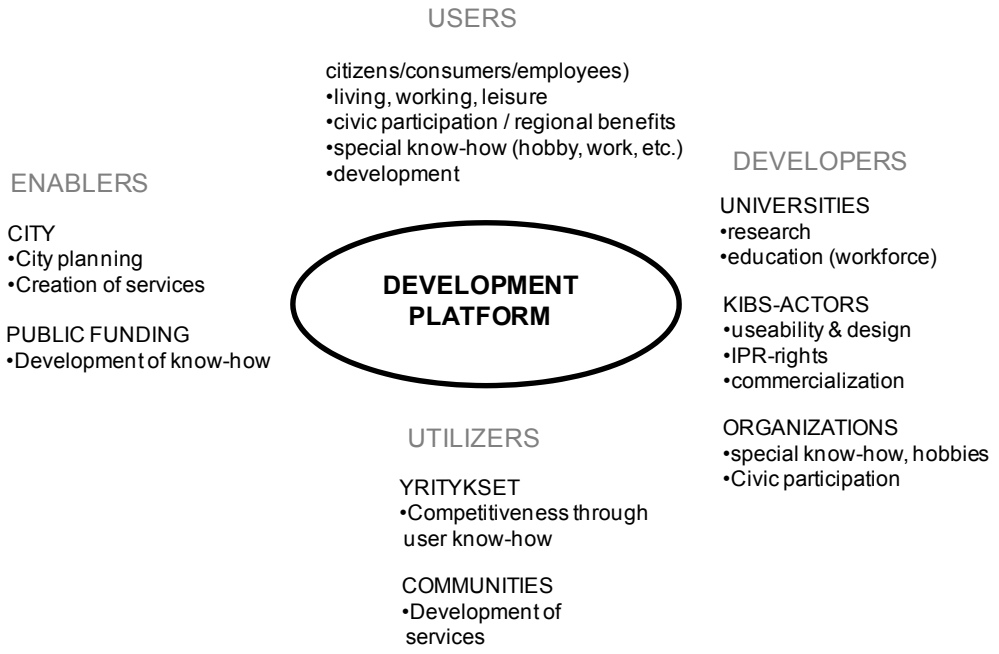

Figure 14. User-centric Quadruple Helix (applied from Rönkä et al. 2007)

Our study illustrates that this kind of rather fixed and oversimplified role map represented in Figure 14 can be somewhat misleading. In reality the roles of public authorities are much more versatile, and furthermore, these roles are not fixed and the same actors (e.g., users or the city) can have different roles in different contexts. For example, a consumer can be both a

user and a developer, a public organization like the city can, besides being an enabler, also be a developer and an exploiter, and a university can, besides being a developer, also be an enabler. Next we present the roles offered to public authorities by the living lab literature.

6.4.1 Roles offered to regional and local authorities by the living lab literature

We made a review of the living lab literature (e.g. Magnusson et al. 2003, Almirall & Warenham 2008, Pascau & Lieshout 2009, Orava 2009, Santoro & Conte 2009, Svensson & Eriksson 2009, Svensson et al. 2010, Wise & Høgenhaven 2008) and found out that the roles of public authorities in QH environment are much more diverse than those presented by Rönkä and Orava (2007). The reviewed living lab literature includes the living lab cases presented in Chapter 4. Good QH cases. The roles given to public authorities in the living lab literature are presented in Table 18.

Table 18. Roles offered to regional and local authorities for promoting QH by the living lab literature

1. Enabler
• financier of LL activities (incl. through project funding, ownership, investments and public procurements) • providing a building lot for living lab infrastructure • acting as regional developers and town planners (living labs have often been geographically bounded innovation environments, e.g. a part of a city, or a rural area)
2. Decision maker
• member of the steering group
3. Supporter
• supporting the development of LL firms • supporting the identification of the main stakeholders • supporting the establishment of communities of different LL stakeholder groups (e.g. service/technology developers, public/social stakeholders, community of users • supporting the linking and networking of different groups and stakeholders • acting as one member of LL professionals who give advice and support to the definition of LL and experimentation of the proposed service/products

4. Utilizer
• utilizing the development services of LL by themselves (as part of the development of public services)
5. Developer
• e.g. employees of public organizations participating in LL development activities
6. Marketer
• organizing business/idea competitions and awards • marketing LL to businesses, users, other financiers
7. Quality controller
• support the development of "quality checks" or standards for LL type of activities and for other co-creation environments • assess the quality of LL type of activities by means of these standards

6.4.2. Roles offered to regional and local authorities by the four QH models

We can also learn something about the possible roles of public authorities from the QH models presented above (see Section 6.1.). One important lesson to be learnt from these models is that the roles of public authorities differ in different QH models. Table 19 presents the main roles of public authorities in four different QH models.

In the Triple Helix + users model the roles of public authorities are to a large extent the same as they has been in traditional high-tech-centred technology, science and industry policies implemented in several countries. The main role of public authorities is to support the development of high-tech firms and universities, to support the development of university research relevant for high-tech firms and to finance firm–university R&D projects. In addition, public authorities and especially public financiers of R&D&I activities can also support the systematic collection and utilization of user information in this model.

In the Firm-centred living lab model the main role of public authorities is to support the development of firm-centred QH innovation environments and the promotion and utilization of these environments. Correspondingly in the Public-sector-centred living lab model one

essential role of public authorities is to support the development of public-sector-centred QH innovation environments and the promotion and utilization of these environments. Another important role for them is to support the development of public services by means of living labs and user-oriented development methods.

In the Citizen-centred QH model the one essential role of public authorities is to support the development of QH type of innovation environments which are able to both support and utilize citizen-centred innovation activities. Another important role is to promote the empowerment of citizens and to assist citizens in their innovation activities, for example, by providing tools and skills needed by citizens in their innovation activities, and by offering dialogue forums to citizens and forums to participate in decision making and to assist them in their innovation activities.

Table 19. Roles of regional and local authorities offered by the four QH models

	TH + users	***Firm-centred LL***	***Public-sector-centred LL***	***Citizen-centred QH***
to promote the development of	high-tech innovations developed in TH innovation environments by R&D experts	commercially successful innovations developed in firm-centred LL innovation environments	public sector innovations developed in public-sector-centred LL innovation environments	innovations developed by citizens by means of QH environments
to promote the networking of	TH actors (firms, universities and public authorities)	actors of firm-centred LL innovation environments (firms, universities, public authorities and users)	actors of public-sector-centred LL innovation environments (firms, universities, public organizations and users/citizens)	actors of citizen-centred QH innovation environments (citizens, firms, universities, public organizations)
to finance R&D&I – projects related to	high-tech innovation and TH + users type of innovation cooperation	firm-centred LL innovation and innovation environments	public-sector-centred LL innovation and innovation environments	citizen-centred QH innovation and innovation environments
to promote regional & local development supporting	application of TH + users innovation model for producing high-tech innovations	firm-centred LL innovation model/ environments for producing all kinds of commercially successful innovations	public-sector-centred LL innovation model/ environments for producing public sector innovations	citizen-centred QH innovation model and environments for producing innovations relevant for citizens and for other QH actors
to market	TH + user innovation environments	firm-centred LL innovation environments	public-sector-centred LL innovation model/environments	citizen-centred QH innovation model and environments
to promote research relevant for	development and commercialization of high-tech products/services in TH + users type of innovation environments	development of commercially successful innovations developed in firm-centred LL innovation environments and for the development of these environments	development of public sector innovations developed in public-sector-centred LL innovation environments and for development of these environments	development of citizen-centred QH innovation and QH environments specialized in citizen innovations
to support the systematic gathering and utilization of user/citizen info relevant for	high-tech-oriented TH + user innovation	firm-centred LL innovations	public-sector-centred LL innovations	Citizen-centred innovations
to support the development and improve the awareness of methods& tools relevant for	utilizing users for the development of high-tech innovations in TH innovation	utilizing users in firm-centred LL innovation	utilizing users/citizens in public-sector-centred LL innovation	supporting citizens in their innovation activities and for other QH actors utilizing these innovations

6.4.3. Roles offered to regional and local authorities by the user-driven innovation literature

It is argued that changing over from a research/technology-driven innovation models to a user-centred innovation models requires of organizations (incl. firms, universities, public authorities) a very big change, for example, in the ways their development employees (e.g. development experts) are used to think (perspectives) and do (development routines) things (see Wise & Høgenhaven 2008). As a result of this change the people working in these organizations have to learn an entirely new set of innovation skills and routines (Wise & Høgenhaven 2008). The public sector can play an important role in this transformation process. For example, it can support firms in this change in the same way as it did during the innovation of the Industrial Age, when the most important objective was to gain a technological advantage. There are several ways in which public authorities can support this change (and at the same time user-oriented QH activities). The challenges presented by the new innovation model do not limit themselves to businesses. User-oriented innovation is also a challenge for innovation-supporting agencies that aim at effectively helping enterprises to innovate faster and better.

Examples of the roles of public authorities in QH type of innovation activities can also be found from the recent discussions related to user-driven innovation policy (see Finnish Ministry of Employment and the Economy 2009). As the QH innovation models can be seen as one representative of the user-driven innovation model, it can be argued that the same type of policies can be used for promoting the QH type of innovation cooperation and environments that are suggested for boosting user-driven innovation.

Table 20 presents measures which are supposed to support the implementation of user-driven innovation in firms and in society at large. They have been broken down into four main themes: knowledge and capability development, regulatory reform, infrastructure improvements and incentives for user-driven innovation.

Some examples of policy measures presented in Table 20 (e.g. those related to legislation) concern authorities more at national and perhaps at the EU level than at regional and local

levels. However, most of the measures presented in Table 20 the kind that they can be promoted also at the regional and local level.

Table 20. Roles of public authorities in promoting user-oriented innovation (Finnish Ministry of Employment and the Economy 2009, Wise & Høgenhaven 2008)

1. Knowledge and capability development

• Building knowledge institutions with specialized skills in the area of user involvement
• Research
  o Attracting attention to challenges caused by change of focus from expert-centric to user/citizen-centric innovation
  o User-driven innovation in firms and other organizations
  o Indicators of user-driven innovation
  o Collection and description of additional company cases in order to better understand what methods can be used in which business contexts (and with what success)
  o Quality checks (or standards) for living labs (and other co-creation environments)
  o More detailed understanding of what approaches and business models can be appropriate to involve different types of users (including individual users, groups of consumers, customers, etc.)
• Education
  o Users'/citizens' skills as demanding, responsible and participative consumers;
  o Networking skills and the ability to identify opportunities to create value for the end user;
  o Emphasis on cultural and design competencies;
  o Creation, management and commercialization of intellectual property in an open innovation environment.
• Methods and tools
  o Methods related to the gathering and utilization of user information

2. Regulatory reform

• Better utilization of data collected by the public sector & user information
  o Protection and privacy regulations
  o Re-use of public sector information
• Collaboration with users
  o Regulatory reform to empower citizens influence and ability to make choices
  o Stimulus for partnerships in public service production
• Intellectual property

o Renewal of the institutional framework to make it more suitable and supportive for open and user-driven innovation o More consistent regulation of the intangible value and liabilities resulting from user-driven innovation activities
3. Infrastructure improvements
• ICT infrastructure o Open and interoperable ICT infrastructure supporting user-driven innovation especially within the public sector • Development platforms & environments for public private partnership o Creating collaboration between knowledge institutions and companies regarding innovation partnerships and user involvement • Renewal of public sector services o Applying user-driven innovation in welfare benefits and public services
4. Incentives for user-driven innovation
• Financial incentives o New instruments for supporting user-driven innovation o New funding criteria for existing instruments enabling better support for user-driven innovation • Building user awareness and channels of influence o Raising awareness of user-driven innovation among citizens, businesses and public sector o Stimulus for user influence through empowerment and improved channels of influence

6.4.4. Summary of the roles offered to regional and local authorities

To conclude, there are numerous ways in which regional and local authorities can promote QH. We have composed a summary of the different roles that these authorities can have in supporting the QH type of innovation activities. This summary is presented in Table 21. We have included in it those roles and measures that are common to all QH innovation models taking the users and citizens into account as real partners of innovation cooperation.

Table 21. Summary of the different roles of regional and local authorities for promoting QH

1. Enabler
• financier (e.g. through project funding, ownership, investments and public procurements) • provider of infrastructure (incl. ICT infrastructure, building lots)
2. Decision maker
• member of the steering group of QH innovation platforms • maker of regional/local QH innovation policies (e.g. guidelines, financial incentives, R&D&I programmes supporting QH- and user-oriented innovation)
3. Supporter
• to support the development of QH partners (e.g. firms, universities, users, public organizations) • to support the linking, networking and interactive learning of different groups and stakeholders (incl. collaboration with users) • to support the systematic collection and utilization of user information (incl. public sector data) • to support the knowledge and capability development related to QH (e.g. research, education, methods and tools) • to promote the empowerment of citizens and to assist citizens in their innovation activities
4. Utilizer
• to utilize QH- and user-oriented development methods in the internal development work of the public sector • to utilize the user-oriented development services provided by QH innovation environments by themselves (as part of the development of public services)
5. Developer
• to develop public organizations so that they can function better and offer new and better products and services to their clients, to citizens • to renew institutional framework in order to make it more suitable for user-oriented innovation
6. Marketer
• to raise awareness of user-oriented innovation among citizens, businesses and the public sector • to market user-oriented innovation models and practices to businesses, users, other financiers
7. Quality controller
• to support the development of "quality checks" or standards for QH type of activities and for other co-creation environments • assess the quality of the QH type of activities by means of these standards

7. Conclusions

7.1. What is QH

Our first task was to go and look for the Quadruple Helix (QH) innovation model, to see whether or not it exists and, if it does, to explore what it consists of and how it can be defined. We can conclude that Quadruple Helix does exist, but as a concept it is not very well-established and widely used in innovation research and in innovation policy and does not have a well-established definition. We also found out that there is not only one Quadruple Helix, but several different ones. What is common to all the QH type of innovation conceptions is they all have included some fourth group of innovation actors into the TH model. Based on the research literature on innovation and innovation policy, we argue that the fourth helix of QH should be a broadly understood user. Accordingly Quadruple Helix can be seen as describing innovation cooperation between firms, universities, public organizations and users.

Based on that, we formed a general definition of the QH innovation model: it is an innovation cooperation model or innovation environment in which users, firms, universities and public authorities cooperate in order to produce innovations. These innovations can be anything that is considered useful for the partners in innovation cooperation, for example, technological, social, product, service, commercial, non-commercial, private-sector and public-sector innovations.

The concept of user can be understood very broadly. Depending on the context, users can be businesses, organizations, civil society associations, lead users, professional users, ordinary or amateur users, consumers, employees, residents, citizens and hobbyists. Also in our QH research the user is defined and understood broadly. When the concept of user is understood widely, also the user-oriented QH innovation model is more widely applicable.

To conclude, what differentiates QH from TH is the participation of users in innovation cooperation. However, this kind of separation between these two concepts is not totally unambiguous and unproblematic. Firms and universities have used some kind of consumer and user research as part of their development work for a very long time. Therefore it is

arguable that users have been involved also in the Triple Helix type of innovation activities, even though their input is often left without explicit mention in the TH context. If and when some kind of user involvement has also been part of TH, then the borderline between TH and QH becomes vague and more an analytic than a real one.

In order to differentiate TH from QH, we have made a minimum requirement for user involvement related to the QH innovation model. One can start to talk about user involvement related to QH when the information related to users is collected and utilized systematically by the organizations doing the development work. Therefore user involvement in the QH innovation model can range from the systematic collection and utilization of user information to the development of innovations by users themselves.

In the innovation literature, users and user involvement are often considered from the point of view of markets, firms and commercial activities. Users can also be considered as active citizens who try to have an effect on the decision making that is done in the private and public sectors and that concerns them. The roles of users and user involvement may be even more complicated in the case of the public sector. There are at least three perspectives from which to look at user/citizen involvement in the public sector. First, users can be seen as consumers who buy or do not buy the product/service produced by the public sector. Secondly, users can be seen as collectivists who can have an effect to public decision making through representative democracy or through direct democracy. Thirdly, users can be seen individuals or members of a community. When they are seen as individuals, they can be empowered by a) extending choices or clarifying services they are entitled to, b) giving means to complain, and c) providing equality and easy access. When they are seen as members of a community, they can be empowered by the public sector handing over to them direct control and right to determine issues affecting the community.

QH can be seen as a systematic way of pursuing user-oriented innovation. Quadruple Helix is a very wide and multidimensional concept referring to numerous different activities and actors. It seems that it is more reasonable to consider QH as a continuum or even as a space rather than a single model. Therefore it could be more meaningful to talk about good and useful QH models than about one best QH model. Different QH models are suitable for different purposes and contexts. In each case, the QH model suitable for certain situation depends on various characteristics of innovation activity, for example, on the goals of

innovation activity, on the context of innovation activity, and on the initiator and owner of the innovation process.

In order to make some interesting dimensions and possibilities of QH explicit, we constructed four different types of QH models, 1) the "TH + users model", 2) the "Firm-centred living lab model", 3) the "Public-sector-centred living lab model" and 4) the "Citizen-centred model" (see Figures 10, 11, 12 and 13). These models are ideal-type innovation models and they are not meant for describing reality as it is. The purpose of these models is to bring forth some essential characteristics of different QH models more clearly and to provide examples of the potential application possibilities of the QH type of innovation cooperation.

The TH + user model (Figure 10) is otherwise the same as the traditional TH model except for the systematic collection and utilization of user information. The focus is on the development of commercial high-tech innovations based on the latest scientific research knowledge. The owner of the innovation process is a firm, a group of firms, a university or a group of universities. In this model the degree of user involvement could be characterized as design for users. Users are treated as informants, not as developers.

In the Firm-centred living lab model (Figure 11) the focus is also on the development of commercially successful innovations. They can be based on the latest research knowledge, on new applications or combinations of "old" research knowledge and/or on user knowledge. The owner of the innovation process is a firm or a group of firms. In this model, users are treated both as informants and as developers. In other words, they also participate in the development work, for example, of new products and services together with R&D experts.

In the Public-sector-centred living lab model (Figure 12) the focus is on the development of public organizations and services. In this case, the owner of the innovation process is a public organization or a group of public organizations. The goal of innovation activity is, above all, to develop public organizations so that they can function better and offer new and better products and services to their clients, to citizens. In order to succeed in this, public organizations have to gather systematically information and feedback from their clients. This can be realized by means of more traditional information gathering methods (e.g. surveys, interviews), or by organizing dialogue forums (virtual and real) for citizens. Also in this

model users participate in the development work of public services together with R&D experts.

In the Citizen-centred QH model (Figure 13) the focus is on the development of innovations relevant for citizens. In this innovation model, citizens are in the driver's seat. The owner of the innovation process is a citizen or a group of citizens (i.e. a development community). In this model the degree of user involvement could be characterized as design by users, i.e. new products, services and ways of doing things are developed by the users (see Section 3.4. Defining user and user involvement). Besides making most of the development work, citizens also decide what kinds of innovations are needed and developed. The role of firms, public authorities and universities is, above all, to support citizens in their innovation activities (e.g. to provide tools, information, development forums and skills needed by users in their innovation activities). Firms and public organizations also utilize the innovations made by citizens.

Of these four QH models presented here, the first two (TH + users and Firm-centred living lab) seem to be very much reality already today in several countries. The Public-sector-centred living lab model also seems to be in use at least in different projects related to the development of public services. At the moment the Citizen-centred model is most likely the most infrequently utilized QH model of these QH four models. It provides the biggest challenges to firms, universities and public authorities, which are not used to hand the steering wheel/driver's seat over to citizens in innovation activities. As a genuine bottom-up model it is also the most difficult innovation process to manage from the point of view of public authorities.

7.2. The relevance and usefulness of QH

As a model of innovation QH is relatively young and not very widely used. It is also an innovation model that is under-researched and under-documented. This makes the assessment of the relevance of this model at the very least challenging. However, on the basis of the user-oriented innovation literature and on the living lab literature (incl. living lab cases), we argue that QH as an innovation perspective and model(s) provide important additional value to innovation research and policy.

The reviewed living lab cases demonstrate that the QH type of innovation cooperation and environment can produce innovations relevant for the users and beneficial also to businesses and public organizations. These cases also show that the QH type of innovation environments can support firms, especially SMEs, and public organizations in developing user-oriented innovations.

It also seems that QH has wide application possibilities. QH has been applied in both the private and public sectors and in several operational areas, including telecommunications, health, well-being, housing, tourism, energy, and governance. In addition to innovation, this concept plays also other roles, for example, in entrepreneurship, venturing and technology transfer as well as in the promotion and development of cities and regions. QH development platforms and environments could be seen as a supplement to traditional cluster and regional innovation policy and as a new kind of intermediary organization supporting the involvement of users in the R&D&I activities.

When the user- or citizen-involvement methods are used in the public sector, the public-sector-specific barriers to innovation and user-involvement have to be taken into consideration. Examples of these are (Borins 2001, Mulgan & Albury 2003, Brand 2005):

- Delivery pressures and administrative burdens
- Short-term budgets and planning horizons
- Poor rewards and incentives to innovate
- Culture of risk aversion
- Poor skills in active risk or change management
- Reluctance to close down failing programmes or organizations
- Constraining cultural or organizational arrangements (incl. bureaucracy)
- Lack of user orientation and skill to utilize user involvement

Despite these differences, public entities like companies also hope that their "products" meet the needs of their citizens and are accepted by them – be they traffic infrastructures, safety measures, waste collection schemes, or public transport systems. If they succeed, people will adopt them into their daily routines in the sense intended by their "designers", i.e. politicians,

planners, etc. But in the case they fail, unlike in the context of consumer products, citizens cannot simply modify public policies or infrastructures and they cannot simply create a prototype of their ideal traffic system, for example. But they can vote with their ballot and with their feet. Currently the role of citizens in policy and infrastructure design processes is usually confined to commenting or voting on preconceived drafts and plans. Citizens are, in other words, often consulted after the arrow has left the bow. But citizen involvement methods could be used more often in the early preliminary stages of public design and policy-making processes, even though the inclusion of citizens in the process of administration often clashes with specialized, routine-oriented, hierarchical, and impersonal bureaucracy. Research has shown that clear benefits can be reaped by including citizens in the performance of public authorities (Holzer & Kloby 2005). (Brand 2005)

But one should also recognize that the motivation of users to participate in the development work can be even more challenging in the public sector than in the private sector. In motivating users to participate in the development work of the public sector, the following motivational factors or principles of motivation should be taken into consideration (see Airong & Chiang 2008).

1. *The principle of justice and justness*
   - Justice and justness are very important principles of motivation mechanism. Users/citizens must be treated so that they do not experience that they have been treated unfairly.
2. *The principle of instant*
   - Users/citizens should be responded to quickly and the co-developed measures implemented quickly.
3. *The principle of transparency*
   - The decision-making and implementation processes of co-developed measures should be open and transparent.
4. *The principle of flexibility*
   - Public authorities should be able to take into consideration the diversity of citizens' needs and characteristics. Public authorities should also be able to respond to changes in the needs and opinions of citizens.

One of our research tasks was to find out whether QH can bridge the innovations gaps between civil society and innovation. In this context the innovation gap can refer to a "technological innovation gap", a "trust/moral gap" and a "public sector innovation gap". The technological innovation gap means the insufficient capability of European firms to translate their technological know-how into successful business cases with significant commercial and societal impacts. The trust gap/moral gap means that citizens do not necessarily trust the breakthrough technologies developed by firms and public research organizations or that they do not consider these technologies and the use of them ethical or ecological. The public sector innovation gap can refer to the insufficient capability of local, regional and national authorities to involve citizens in the development of public services and organizations.

Our research indicates that the user-oriented QH model has potential to bridge, or at least, to narrow down all these innovations gaps. The reviewed living lab cases demonstrate that by means of the QH model both firms and public organizations can develop products and services which really interest consumers, users and citizens. How much this potential of QH will be actually realized, and how well this innovation model can succeed in narrowing down also other innovation gaps besides the technology gap, depends on lots of things. It depends, for example, on how much influence firms and public authorities are willing to give to users/citizens and on how much influence the users/citizens are willing and able to assume. Due to the scarcity of research on this topic there is not much to say about this topic at the moment. Power seems to be a sensitive subject in the innovation literature. Therefore it is not surprising that this topic is not addressed in the QH literature either, even though there are clear in-built tensions or even conflicts of interest included in the user-oriented QH innovation activities: how much decision-making power is delegated from firms, universities and public organizations to users and how the benefits of user-oriented innovations are shared between firms, public organizations, universities and users.

The QH model contains a clear possibility and threat that users will be exploited and promised too much. How much influence the user can have and how much the user can benefit from the QH model depends a great deal on the skills and knowledge of users and on how active they are. In other words, QH provides possibilities to those users who want to and are able to participate in and utilize QH innovation. One way to prevent users from being exploited is to make some kinds of rules and regulations concerning, firstly, the division of benefits related to QH innovation (how much different partners of QH innovation

cooperation, including users, should benefit from this co-operation), and secondly, sustainable and fair utilization of users in QH innovation (i.e. rules guaranteeing that users are not exploited in the QH innovation process).

Without a doubt QH has also its limitations. One factor limiting, or at least slowing down, the diffusion of this model is the fact that there are numerous challenges related to the transition from old research/technology-driven innovation models (incl. the TH model) into more user-oriented innovation models. Some of these challenges are more connected with enterprises, others with universities, public organizations and users. Some of these challenges are presented in Table 22.

Table 22. Challenges related to the transition from research-, technology- and R&D-expert-driven innovation models to QH models

Firms
• May necessitate a development of new business models. • Necessitates a huge change of culture, the R&D experts and managers of firms have to give up some of their decision-making power to users/consumers/citizens and apply user-oriented approaches instead of technology- or expert-oriented approaches. • Also the roles of firms' R&D experts may have to be changed; earlier they were the ones who knew best what was worth doing, in the QH model also users know this, R&D experts may have to become also supporters of user innovations instead of only being makers of R&D expert innovations. • Necessitates new skills and methods to find right users, to cooperate with users, to motivate them and to utilize the input of users. Therefore the QH model can be more easily applied by firms with better financial resources and therefore a better ability to acquire more QH know-how and expertise. • User involvement, especially in several phases of innovation, is also a time-consuming task; smaller companies may have difficulties to find enough resources to do this (even though it can lessen the risks associated with the development of new products). • User-oriented innovation models can be more easily applied by firms producing products/services for end users and consumers and therefore operate in areas in which innovation is more driven by end users (IT, mobile technologies, media and health care). • User-oriented innovation models can also be more easily applied by firms operating on markets where the competing products/services are developing fast. • Appliance of user-oriented innovation models can be easier for larger firms, where users have long been actively involved in product and services development (e.g. firms with strong brands or operating in the IT sector). • For SMEs, the advantages of "user-driven" innovation can be less obvious and more difficult to grasp.

Universities
• Also R&D experts working in universities have to give up some of their decision-making power to users/consumers/citizens and apply more user-oriented approaches instead of too technology- or expert-oriented approaches. • The roles of R&D experts working in universities have to change also, they role is no longer just to produce scientific knowledge which then can be utilized by the developers of technology. Their role is also to support users as they participate in innovation processes and participate in development work on their own. In other words, also R&D experts working in universities may have to become supporters of user innovations instead of only being makers of R&D expert innovations.
Public organizations/authorities
• Innovation policy measures expected from public authorities may increase significantly. After this transition, in addition to measures supporting the development of TH environments, they should implement also measures supporting the development of different QH environments. • QH is an under-researched and under-documented topic; therefore public authorities do not have enough reliable information about QH and good policy measures related to this model. • Open/citizen-centred innovation is in contradiction with top-down and bureaucratic practices of public organizations. • Necessitates a huge cultural change and also changes in the official regulations of public organizations. • May necessitate new public service models (citizen-driven models) • Necessitates new skills and methods at all levels in the public sector. • Different sectors of business may necessitate different incentives and support mechanisms. For example, sectors in which the innovation is driven by end users differ in this respect from sectors in which innovation is more dominated by business-to-business relations or public procurement. • Policies and measures for supporting user-oriented QH innovation are only in their infancy.
Users/citizens
• Necessitates new skills and know-how for citizens. • Those who already have better skills and know-how, related, for example, to web-based development tools, have more possibilities to have an impact on products/services to be developed. • Citizens have to be active; those who are not active are easily excluded from QH processes. • Citizens have to be aware of their possibilities to influence. • Citizens have to be aware of their rights (otherwise they could be exploited by firms and public organizations utilizing their ideas).

7. 3. How public authorities can promote QH

We have now concluded that QH is a relevant and useful model. But how can regional and local authorities promote the diffusion and appliance of this model? As shown in Table 22, user involvement not only is one of the biggest possibilities the QH models but also offers to the innovation activity of firms and public organization one of the biggest challenges related to the implementation and diffusion of these models. One thing that regional and local authorities can do is to support and assist firms, universities, users/citizens and public organizations/authorities to meet and solve the challenges presented in Table 22. Our study demonstrates that there are several ways in which these authorities can support and assist QH actors to meet the challenges and to implement QH innovation models. In Section 6.4 on the roles of regional and local authorities in promoting QH we summarized the different roles these authorities can take to support the QH type of innovation activities (see Table 21). A condensed version of this summary is presented in Table 23. In this summary we have included the roles and measures that are relevant for all QH innovation models considering users and citizens as real partners in innovation cooperation.

Table 23. Summary of the different roles of regional and local authorities for promoting QH

1. Enabler
• e.g. financier and provider of infrastructure
2. Decision maker
• e.g. maker of regional/local QH innovation policies (e.g. guidelines, financial incentives, R&D&I programmes supporting user-oriented innovation)
3. Supporter
• e.g. to support the development of QH partners (e.g. firms, universities, users), the systematic collection and utilization of user information and the knowledge and capability development related to QH, to promote the empowerment of citizens and to assist citizens in their innovation activities
4. Utilizer
• to utilize the user-oriented development services provided by QH innovation environments by themselves (as part of the development of public services)

5. Developer
• e.g. to utilize user-oriented development methods in the internal development work of the public sector
6. Marketer
• e.g. to raise awareness of user-oriented innovation models and practices among citizens, businesses and the public sector
7. Quality controller
• e.g. to support the development of "quality checks" or standards for the QH type of activities and for other co-creation environments and to assess the quality of the QH type of activities by means of these standards

As we have already learned from Section 6.4. The roles of regional and local authorities in promoting QH, the roles of public authorities are somewhat different in different QH models. Therefore, in addition to these general measures presented above, public authorities should also use the QH-model-specific measures.

8. Recommendations

The recommendations, suggestions and guidelines of this chapter are given with local and regional authorities in mind *vis-à-vis* the four QH models identified in this research.

In the short run, the examples of good practice addressing the different aspects of user-centric innovation can directly serve as learning material for the actors in the region. We recommend studying it and further exploring it, according to the particular needs and interests of the actors in the respective regions.

But as it was identified in the conclusions and also by the CLIQ partners in their reflective comments on the QH cases, the shift to citizen and user orientation is, at the end of the day, a big cultural change, not just a small operation – be it in the public or private regime – and must be underpinned with many different aspects and skills in order for it to be robust and sustainable.

Local and regional authorities have an important role in QH, via strategic use of resources, integrating knowledge and skills in innovative thinking, community building, procurement and regulation, grants, rewards – but they also have big needs for their own ability and skills development and many constraints in terms of inflexibilities and bureaucracies. This means that public authorities are faced with a double challenge of renewing themselves to be able to be an interesting partner in renewing the local–regional "innovation ecosystem". One could say that, in the long run, we need a shift to "Public Authority 2.0" in order to be a seminal partner in the "Innovation Ecosystem 2.0". Naturally there is variation in how far each and every local and regional authority is in this shift and how far the innovation ecosystem around it varies.

A stepwise process that is relevant for the context of building awareness, connection, learning and mutual trust-building is advisable, and here the four QH models and the wealth of experiences already contained in relation to them could be helpful.

We recommend that each locality/region identify their particular stage of development, challenges and opportunities by means of the four basic QH models and the good practices identified in them, and designs and executes, together with the necessary stakeholders, a local–regional learning process, with a distinction of a short-term and a long-term opportunity perspectives. Thus, we recommend making a careful self-assessment against the different QH models, goals, types of innovations produced, and the roles, skills and activities needed from public authorities to support innovation.

In the research results we identified four basic QH models, (1) the Triple Helix + users, (2) the Firm-centred living lab model, (3) the Public-sector-centred living lab model and (4) the Citizen-centred models.

These four models could be treated as potential possibilities for innovation development in the region. In this sense, each model could serve as a "thematic tool" to first explore the situation, and then move from designing an innovation network action plan to its execution.

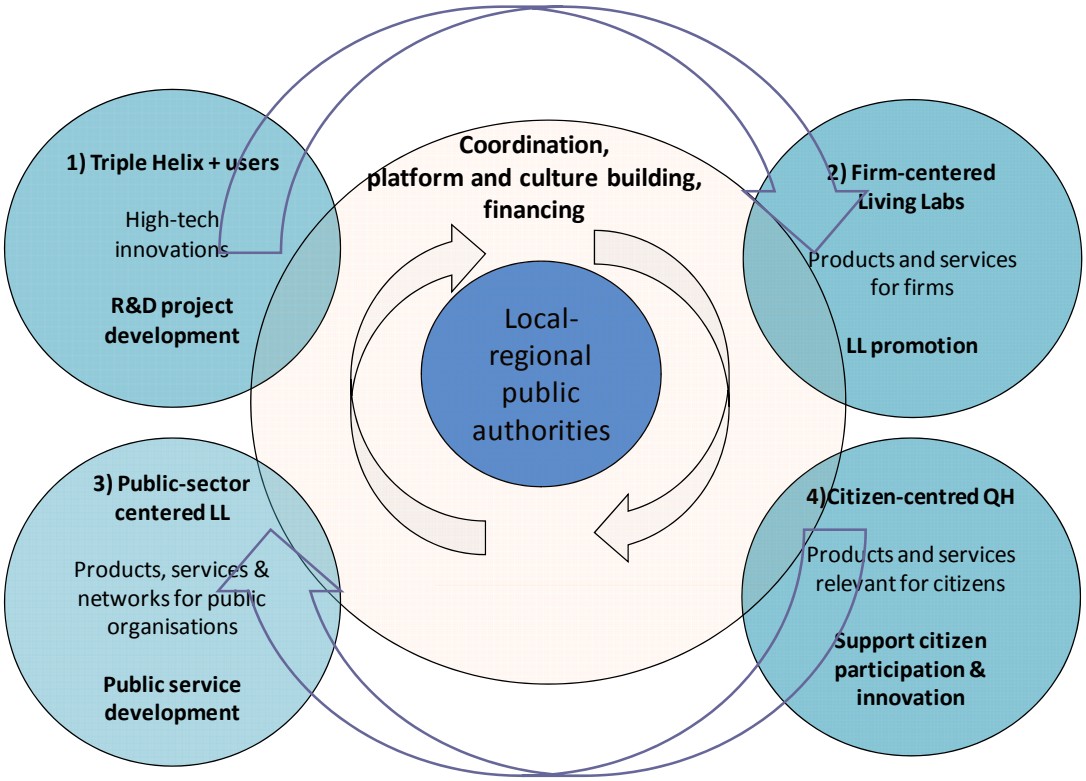

Figure 15. Local-regional public authorities and the four basic QH models

We do not believe that a linear developmental model of first building and securing a Triple-Helix model and then moving in a linear fashion to more and more radical departures from it is called for. Rather the reality in the various contexts probably is that there is a mixture of all these models –some further than others, some in an incipient stage, some more mature – existing or available for the regions. This is apparent also among the CLIQ partners. Likewise, the existing structures and prevailing practices and skills in the region provide different opportunities to address this hybrid and non-linear situation.

For public authorities promoting the Triple Helix + users model means mainly supporting the development of high-tech firms with the help of firm-industry R&D projects and financing.

Promoting the firm-centred living-lab type of activities refers first and foremost to supporting the network-building of LL actors and promoting the development and diffusion of LL.

Promoting the Public-sector-centred living lab kinds of activities refers to supporting the development of public service development.

Promoting the Citizen-centred QH development refers to facilitating citizen innovations, informing and promoting participation, developing decision-making interfaces and building individual capabilities.

This is a description from a 'primary task' perspective, but there is an overlap in the roles and means concerning the different models, and they can be mutually supportive.

The conceptual analysis in Chapter 3 and the cases in Chapter 4 offer insight into and examples of promoting innovation in this hybrid field of opportunities.

Overall, the role that is offered to regional and local authorities includes providing coordination and building platforms and forums for dialogue, participation and co-production, and of course, the more traditional role of a financier or co-financier. In terms of promoting participation, co-production and building forums and platforms for dialogue there is a wealth of approaches and methods to tap into, like the family of various dialogical and multi-stakeholder work conference methods and community building (Reason & Bradbury 2000, Emery & Purser 1996, Gustavsen 2002, Conklin 2006, Wenger 1998, among others), and also a rich discussion on the development of co-production concerning public services (e.g. Boyle & Harris 2009).

Each QH type has its main goals, initiators, and types of innovation it aims to produce. Against these, public authorities have different roles and sets of skills and practices needed to fulfil these partly overlapping and mutually supportive roles. We believe that in order to move ahead in user-centred innovation and to establish a solid learning region in innovation, progress in the longer run is needed in all the QH types, so that the different actors – scientific and business communities, public authorities and citizens – continue to move ahead in mutually supportive cooperation.

Table 24 provides a synoptic view of the QH types, corresponding goals and roles, practices and skills needed in innovation promotion for public authorities. The same table – *mutatis mutandis* – could be used for a synoptic assessment of the present status of the QH type innovation development in the region and for goal setting for further development.

Table 24. Synoptic view of the QH types and corresponding goals, roles and skills needed in innovation promotion

QH type	Goal of innovation activity	Type of innovation	Role of public authorities	Key skills, practices and tools needed for public authorities
Triple Helix + users model	Produce commercially successful high-tech products and services	High-tech and radical innovations	Support high-tech firms, university research, financing	Contacts to research, project and financing skills and tools
Firm-centred living lab model	Produce products and services for firms and their clients	Commercially exploitable technological and social innovations, public sector innovations, incremental and radical	Supporting development and networking of LL actors, support user involvement, develop public services	Product development, learning network and dialogue forum building skills and tools
Public-sector-centred living labs	Produce products and services relevant for public authorities and users of public services	Public sector innovations; commercially exploitable technological and social innovations	Support user/citizen involvement, public sector development, promote LL, provide information on users. Offer dialogue forums to users and forums to participate in decision making	Learning network and information infrastructure building for regional/local organizations
Citizen-centred Quadruple Helix	Produce products and services relevant for citizens	Innovations relevant for citizens	Offer information, training and tools needed by citizens in their innovation activities	Facilitation, individual capability and community building

The first step, of course, is to be aware of the particular challenges, opportunities and gaps existing in one's locality, against the models described here, and identifying the roles that public authorities can play in these. Further steps include building a multi-stakeholder learning network and forums to debate these findings, to set further goals and to make an inventory of existing practices and tools against these findings and goals. The QH practices

presented in this research report can provide material and gateways to further identify possibilities, practices and routes for further action.

Regional and local authorities could engage lead users in innovation processes by providing financial incentives for end users to cooperate with local firms. This is still a widely untapped area. They could, for example, issue innovation vouchers funded by regional development and innovation agencies to end users, with the view to test innovative solutions developed by cluster firms. This may be a promising approach, particularly in areas requiring high investments, such as energy efficiency or construction.

Another promising approach to support "user-driven" innovation is pre-commercial public procurement, where public authorities enter into direct relationships with enterprises to find innovative solutions for pertinent problems (Directorate-General for Enterprise & Industry 2009).

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