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Using the Quadruple Helix Approach to Accelerate the Transfer of Research and Innovation Results to Regional Growth

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Table of contents

List of acronyms

ADV	Advanced Innovators
BES	Business Enterprise Sector
CIV	Civil Society
COR	European Committee of the Regions
DAE	Digital Agenda for Europe
DESI	Digital Economy and Society Index
DIH	Digital Innovation Hubs
EC	European Commission
ED	Entrepreneurial Discovery
EER	European Entrepreneurial Region
ENoLL	European Network of Living Lab
EPO	European Patent Office
ERDF	European Regional Development Fund
ESIF	European Structural and Investment Funds
EU	European Union
EUR	Euro
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
GOV	Government
GP	Good Practices
HEIs	Higher Education Institutions
ICT	Information and Communication Technologies
IND	Industry
INT	Innovation Interaction
IPR	Intellectual Property Rights
IUS	Innovation Union Scoreboard
LL	Living Lab
LRAs	Local and Regional Authorities
MED	Medium innovators
MOD	Modest innovators
MS	Member States
NGO	Non-governmental Organisation
NR&D	Non-Research and Development
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
QH	Quadruple Helix
QHII	QH innovation index
QuiH	Quintuple Helix

RCI	Regional Competitiveness Index
R&D	Research and Development
RDI	Research, Development and Innovation
RIM	Regional Innovation Monitor
RIS	Regional Innovation Scoreboard
RIS3	Research and Innovation Strategy for Smart Specialisation
SMEs	Small and Medium Enterprises
S3	Smart Specialisation Strategy
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TM	Third Mission
TH	Triple Helix
UNI	University

Summary

Innovation and knowledge have been given different roles and weights in the growth economic theories of the last century. This report investigates the theory and the operationalization of the so called 'helices models' where the main protagonists of innovation-generating processes (industry, university, government, and, at a later stage, civil society) interact for accelerating the transfer of research and innovation results to regional growth. The analysis is principally carried out from the perspective of local and regional authorities (LRAs) and in the light of the potential impact that the operationalization at the regional level of such models may have on growth, in particular as reference for the development of Research and Innovation Strategies for Smart Specialisation (RIS3).

A thorough review of literature in Part 1 frames the Triple Helix (TH) concept and the Quadruple Helix (QH) approach into an historic perspective. The review highlights the main roles of the spheres and of their actors involved in knowledge and innovation creation and exchange, the changing of focus of these roles, or functions, over time, and the relationships among the key operational elements of the models. In a regional development perspective, the TH model provides an analytical framework for understanding the role of each helix in generating innovation in a territory and offers policymakers an operational tool on the basis of which growth strategies and paths are set according to the adaptation of the model to the contextual conditions (i.e. statist, *laissez faire*, or balanced regimes). The TH relies on technological paradigms and their cyclical renewal which, nevertheless, is rarely observed at the territorial level. To overcome this limitation and the absence of sensitivity to 'democratic additionality', improved innovation approaches are introduced which widen the TH concept with a societal perspective. This is done through the consideration of a 'fourth' helix. Against the several definitions of the fourth helix developed by the latest scholarly research (e.g. Arnkil *et al.*, 2010; Carayannis and Campbell, 2012), this study outlines a working definition which focuses on civil society. It also clearly defines the elements built into the operationalization of the QH approach which have regional development and growth as the innovation objective. By referring to these definitions, Part 2 of the study first determines a classification of European regions into 'innovator types' (ADV - advanced, MED - medium and MOD - modest). This is done with the computation of a 'QH innovation index' (QHII) and five sub-indexes, calculated on the basis of eighteen indicators which reflect the four spheres of the QH approach and a cross-cutting 'innovation interaction' category. Second, ten European regions are selected and compared in terms of innovation performance and according to both quantitative and qualitative information. For each region,

this information is structured into a 3-page 'regional profile' focusing, among other aspects, on the narrative overview of innovation polices and governance, strengths and weaknesses towards the operationalisation of the TH/QH approaches, structural interactions among helices, and references to bottom-up civic participation initiatives.

The characterisation analysis of the three innovator types across the whole population of European regions shows that the best pullers of innovation in **ADV** are Industry (IND), Civil Society (CIV) and innovation interaction (INT), while the structural performance of University (UNI) and Government (GOV) seem to be limited, although this finding possibly suffers from the poor representativeness of the indicators available for measuring the innovation performance of these two helices. Furthermore, ADV seem to be characterised by the reaching of a certain 'critical mass' of each of the spheres. Within the four selected ADV (Berkshire, Buckinghamshire and Oxfordshire, *Stockholm, Praha*, and *Utrecht*), different types of innovation-generation are reflected in radar charts which have clearly marked peaks, a circumstance which points to a 'pulling' effect of one or more of the spheres and which is affected by the type of regime of the helix model in force (i.e. statist, *laissez faire*, or balanced), by the structural conditions of the territory, and by its development paths. Through the assessment of the qualitative information of the four selected regions, ADV seem to have certain prevailing conditions in common, including governance conducive to innovation, science and knowledge excellence and/or assets, business concentration and/or hosting of world-leading businesses/companies, technology and/or knowledge intensive industries, relevant ICT-based industry, and the presence of hybrid organisations allowing a structural interaction among the various helices.

MED regions have the same pullers of innovation as ADV with an even more limited role of GOV and UNI. In fact, the University sphere appears as the weak link of the innovation performance in this type, with the strongest role apparently being played by IND, in line with traditional models where innovation is a prerogative of the business community. According to the qualitative information gathered in the regional profiles of *Stuttgart, Länsi-Suomi,* and *Lazio,* MED share less common features than ADV but they are all characterised by IND-related features such as the presence of business concentration, business networking, co-operation, and/or connection, and presence of hybrid organisations.

In **MOD**, the traditional spheres of the TH model seem to have lost the leading position in innovation performance in favour of CIV. Notwithstanding the maturity of the civil society, MOD regions have a limited innovation capacity in the three other helices (UNI, IND and GOV) and are not expected to experience

improvements unless at least one of the 'traditional' helices starts playing a pulling role. In addition, the three selected MOD (*Extremadura*, *Lubuskie*, and *Sud-Est*) do not show commonalities according to the qualitative information gathered in the regional profiles, a fact which reflects the lack of a structured strategic approach (e.g. by helices) for transferring research and innovation results to regional growth.

Finally, the comparison across the sample of ten regions in terms of structural conditions, such as area, population and GDP, points to a positive relation between a good innovation performance at the territorial level with a small physical size of the territory, high population density, high regional GDP and GERD, and high levels of broadband access.

Prevailing trends and challenges show that although LRAs seem to be increasingly aware of the strategic role played by the four spheres in the innovation process, policies and strategies applying the TH/QH models, including the involvement of civil society through well-defined mechanisms able to emphasise creativity and non-traditional innovation opportunities, are less common. The potential of S3 to concentrate TH/QH efforts on specific sectors in order to maximize the benefits to other sectors by means of spill-overs and side-effects is also insufficiently explored.

The third part (Part 3) of the study goes in depth on some specific themes connected to objective-based collaboration and functional substitution between spheres to achieve innovation. In particular, UNI is discussed with respect to its changing role and engagement with industry and society at large. Within the GOV sphere the emphasis is on eGovernment as a driver of innovation in the public sector which is leading, in turn, to enhanced information sharing and engagement of end-users. At the IND level, the focus is on the interactive innovation processes implied by entrepreneurial discovery. Finally, CIV is mostly discussed as one source of social innovation and experimentation with respect to some specific demographic challenges such as ageing and migration. Discussion and analysis are supported throughout by the collection of successful examples and initiatives. These good practices add evidence to the analysis conducted in Part 2 and are then used to draw recommendations on the applicability and possible use of the QH by LRAs.

On the theory of the helix models, this study highlights the need to better focus efforts on operationalisation aspects at the territorial level rather than on theoretical or academic reasoning. There is a need for populating the science-policy interface with easy-to-use instruments (e.g. the proposed QHII and its visual approach) which would facilitate both the understanding as well as the integration of these approaches into strategic regional development. There is an

urgent need to fill data gaps and, possibly, to define new indicators for a more accurate measurement of the innovation performance of the spheres. Other recommendations provided in Part 4 are specific to the three innovator types and built upon the success factors of experiences concretely implemented in several regions across the EU.

Part 1: Literature review

1.1 Behind the approach of the helices: knowledge and innovation

Both the Triple Helix (TH) concept and the Quadruple Helix (QH) approach are grounded on the idea that **innovation** is the outcome of **an interactive process** involving different **spheres** of actors, each contributing according to its 'institutional' function in society. Traditional protagonists of the TH are University (UNI), Industry (IND), and Government (GOV). Civil society (CIV) is the additional sphere included in the QH. Contribution to innovation is envisaged in terms of **sharing of knowledge and transfer of know-how**, with the helices models assigning and formalising **a precise role to each sphere** in supporting economic growth through innovation. As society becomes more and more interactive, the role of knowledge as well as the number and scope of spheres to be included in the innovation-generating process have been increasing over time.

Given its crucial role in economic growth and competiveness, innovation has been largely investigated and studied since the beginning of the nineteenth century. Following the seminal contribution of Schumpeter, ideas and theories about actors leading the innovation process grew and changed over time. According to the Austrian economist, **economic development** has to be seen as **a process of qualitative change driven by innovation**, which the author defined as **new combinations of existing resources** (Fagerberg, 2003). In '*The theory of Economic Development'* (Schumpeter, 1911) Schumpeter, essentially keeping the focus on the Industry sphere, considered the **entrepreneur** as the main protagonist of the innovation-generating process[1] and innovation as originating from business only[2]. In '*Capitalism, Socialism and Democracy'* (Schumpeter, 1942) **large enterprises** become the strategic stakeholders in the economic system, and **research and development laboratories**, intended as creators of knowledge from the intramural research and development activities, become an essential input for innovation. The latter can be considered as one of the first explicit recognitions of the knowledge relevance, including an indirect reference to the University sphere according to its role of knowledge producer within its second mission (i.e. research).

[1] While inventions can be carried out everywhere (e.g. universities) because commercial objectives are not expected, innovation, having a commercial purpose, necessarily has enterprises as the protagonists.

[2] In the process related to the creation of innovation, scientific and research progress is considered as exogenous to the economic system.

In the last century, most of the economic growth theories have been based on innovation-generating processes focusing on the role of productivity, technology change and knowledge, as well as on the role of the actors contributing to them. In the **Neoclassical Growth Theory**, as developed by Solow (1956) and his followers, economic growth in the long-run is the result, within the **industrial sphere**, of the combination of capital, labour and **technological progress** (accounted as an **exogenous element)**. Years later, the so-called **New or Endogenous Growth Theory** proposed by Romer (1986) and Lucas (1988) introduced the *"shift from a resource-based economy to a knowledge-based economy. It underscores the point that the economic processes which create and diffuse new knowledge are critical to shaping the growth of nations, communities and individual firms"* (Cortright, 2001). According to Romer (1993), *"under the new system, firms will increasingly take advantage of each person's innate curiosity and willingness to experiment…every worker in an organization, from top to bottom, can become a "knowledge" worker if given the opportunity to do so"*.

Relationships between knowledge and technological change and the role of the academic sphere became more evident in 1994, following the publication of the book *'The new production of knowledge - The Dynamics of Science and Research in Contemporary Societies'* (Gibbons *et al.*, 1994). The authors formalised **two ways of knowledge production**. 'Mode 1' refers to a knowledge production system led by universities performing basic research and interested in delivering educational content explanations structured in a 'disciplinary logic' and not focused on knowledge application (Gibbons *et al.*, 1994). 'Mode 2' refers to a knowledge production system **led by universities based on the principles that science is 'applied' and technology is 'transferred'**: *"It is our contention that there is sufficient empirical evidence to indicate that a distinct set of cognitive and social practice is beginning to emerge and these practices are different from those that govern Mode 1"* (Gibbons *et al.*, 1994).

In 1995, Etzkowitz and Leydesdorff introduced the **Triple Helix model**. The traditional actors in charge of creating innovation, in the Industry sphere, and the traditional actors in charge of creating knowledge, in the University sphere, interact with a third sphere, the **Government**, in order for the creation of innovation to be directly transferred at the territorial level in terms of economic growth through a **top-down approach**.

More than 10 years after the Gibbons' contribution on knowledge production and the definition of the Triple Helix model, Carayannis and Campbell (2006) introduced a third, more complex, mode for producing knowledge (Mode 3) which had a higher number of interconnections and actors involved. 'Mode 3'

entails the learning processes and dynamics of *Mode 2* while integrating them with a **bottom-up approach** including **civil society:** *"The Mode 3 Knowledge Production System architecture focuses on and leverages higher order learning processes and dynamics that allow for both top-down government, university, and industry policies and practices and bottom-up civil society and grassroots movements, initiatives and priorities to interact and engage with each other toward a more intelligent, effective, and efficient synthesis"* (Carayannis and Campbell, 2009). In parallel, the concept of **Quadruple Helix** was developed by maintaining the interaction of the spheres of the TH (UNI, IND, and GOV) and by formalising the role of **civil society** (e.g. Yawson, 2009). Academia and firms provide the necessary conditions for an integrated innovation ecosystem. Governments provide the regulatory framework and the financial support for the definition and implementation of innovation strategies and policies. Civil society not only uses and applies knowledge, and demands for innovation in the form of goods and services, but also becomes an active part of the innovation system. Information and communication technologies (ICT) work as an enabling factor of bottom-up participation of civil society.

The TH model and the QH approach added more than a theoretical framework to the economic growth theory. They were directly developed and implemented as **territorial innovation approaches** attempting to exploit the potential of socio-economic systems. For this reason, the **Triple Helix** has been applied in local and national innovation initiatives and the **Quadruple Helix** has been identified as the reference approach for the preparation and implementation of **Research and Innovation Strategies for Smart Specialisation** (RIS3) (EC, 2012).

1.2 The Triple Helix concept and the interactive perspective

Moving from Mode 1 to Mode 2, Gibbons *et al.* (1994) characterise knowledge production in terms of specific attributes: applicability, transdisciplinary, heterogeneity, heterarchicality, transientiency, social accountability, and reflexivity. **Universities** lose the exclusive role of knowledge producers in favour of a mechanism facilitated by **interaction** and relying on **communication and network connection**. Mode 2 implies "*an increase in the number of potential sites where knowledge can be created; no longer only universities and colleges, but non-university institutes, research centres, government agencies, industrial laboratories, think-tanks, consultancies in their interaction"*, as well as "*the linking together of sites in a variety of ways – electronically, organisationally, socially, informally – through functioning*

network of communication" (Gibbons *et al.*, 1994). Based on the same idea of interaction among innovation contributors, referred to as **institutional spheres** (University, Industry, and Government), Etzkowitz and Leydesdorff (1995) developed the Triple Helix model adopting *"a spiral (versus traditional linear) model of innovation that captures multiple reciprocal relationships among institutional settings (public, private and academic) at different stages in the capitalization of knowledge"* (Viale and Ghiglione, 1998). The new approach of interaction is characterised by: i) a key role of universities as the main producers of knowledge; ii) the strategic mission of enterprises in producing innovation through the improvement of organisational processes and the placement of products and services on the market; and iii) the crucial role of government in supporting the development of science-based technologies and in formulating innovation-targeted policies (Arnkil *et al.*, 2010).

The TH model implies an increasing complexity in terms of key operational elements, or **components**, and the **relationships** among these elements taking into account their **functions**. Ranga and Etzkowitz (2012, 2013) define as basic components (i.e. actors) individual innovators[3] and institutional innovators, Research and Development (R&D) innovators, and Non-Research and Development (NR&D) innovators, and, 'single-sphere' and 'multi-sphere' hybrid institutions. In this framework, components which make the difference in terms of interaction beyond the boundaries of the three spheres are:

- **R&D innovators** populate the three institutional spheres. In University, key R&D performers are the academic research groups and interdisciplinary research centres; in Industry, they are the company R&D divisions or departments; in Government, they are the public research organisations and mission-oriented research laboratories. In addition, R&D performers can be found in the non-profit sector (e.g. charities, foundations, non-profit organisations), and some artistic, cultural, and social activities can also be assimilated to scientific R&D in boosting innovation.

- **NR&D innovators** are mainly related to Industry even though they are present in various forms in Government and University as well. They intervene in "*design, production, marketing, sales, acquisition of technology or machinery produced elsewhere, customization or modification of products and processes obtained from elsewhere, personnel training and competence-building, interaction with users, acquisition of patents and licences, consultancy services, and so on.*" (Ranga and Etzkowitz, 2013).

[3] Individual innovators range from the concept of innovation organizer to the one of entrepreneurial scientist (Ranga and Etzkowitz, 2013).

– **Hybrid institutions (or organisations)**, defined as 'multi-sphere' institutions and representative of the 'balanced' TH regime (see below) in Ranga and Etzkowitz (2012). They are multiple-nature entities and synthesise features of University, Industry and Government. Organisations more aligned with university are, for example, interdisciplinary research centres, or technology transfer offices in universities. Those aligned with industry are firms' research labs, industry-university research consortia, business support institutions including science parks, and business/technology incubators. Those aligned with government are publicly funded research or innovation centres. 'Single-sphere' institutions (Ranga and Etzkowitz, 2013) remain within the boundaries of a single sphere and are specific to the *laissez faire* regime (see below).

Functions are *"competencies of the system components that determine the system's performance"* (Ranga and Etzkowitz, 2013). The overall function of the TH system is, in a broad sense, generation, diffusion and utilisation of knowledge and innovation (Ranga and Etzkowitz, 2013).

Finally, **relationships** among the TH components are based essentially on **objective-based collaboration** and on **functional substitution** in achieving innovation. Objective-based collaboration is guided by the convergence of interest of all the involved parties who have strategically chosen to cooperate while maintaining their functions. For Ranga and Etzkowitz (2012) substitution arises when, in addition to fulfilling their traditional functions, university, industry and government take each other's role. Examples are public agencies launching industrial investment programmes and providing public venture capital, or universities providing support and funds to encourage entrepreneurial activities, thus acting as industry (Box 1).

Box 1. Functional substitution in an entrepreneurial university

Functional substitution is at the basis of an 'Entrepreneurial University' as the university widens its traditional mission and operates according to the academic 'third mission'. The latter implies involvement in economic activities and in new business creation in addition to the traditional first mission related to teaching and to the second mission related to research. According to Etzkowitz *et al.* (2008) *"an entrepreneurial university is the keystone of the triple helix model, which comprises three basic elements: i) a more prominent role for the university in innovation, on a par with industry and government in a knowledge-based society; ii) a movement toward collaborative relationships among the three major institutional spheres in which innovation policy is increasingly an outcome of interactions among the spheres rather than a prescription from government or an internal development within industry; and iii) in addition to fulfilling their traditional functions, each institutional sphere also 'takes the role of the other' operating on a vertical axis of their new role as well as on the horizontal axis of their traditional function."*

Taking into account the types of relationship (i.e. objective-based collaboration and functional substitution) among the three components, an increasing body of literature has been developed around the theoretical TH concept and its operational implementation. Practitioners and policymakers started experiencing the original TH model in at least three types of application (Ranga and Etzkowitz, 2012):

- The **statist regime**, where government leads by driving the innovative capacity of academia and industry in a predefined policy framework.

- The **'*laissez faire*' regime**, where industry is leading the innovative capacity in a framework ruled by government and university is providing support in terms of knowledge.

- The **balanced regime,** where university and other knowledge production institutions become more and more relevant and promote joint initiatives and partnership with industry and government.

Balanced regimes favour new forms of interaction among the spheres and new 'spaces' of interaction such as new organisational types of actors that perform multiple roles (i.e. hybrid organisations). The different applications of the TH posit relevant implications for the theoretical models on interaction, but in particular they affect the actual set-up of the innovation policies and strategies at both national and regional level.

1.3 The Triple Helix model in the regional innovation system

The TH model provides an analytical framework to understand the role of key actors in a territorial system of innovation, offering to policymakers an operational tool to set growth strategies and paths according to the applications of the TH in the territory (i.e. statist, *laissez faire*, or balanced regimes). At the regional level, the joint action of UNI, IND and GOV has been formalised by Etzkowitz and Ranga (2010) who **moved from the concept of institutional spheres to** the concept of TH **spaces**: Knowledge, Innovation and Consensus Spaces.

According to Ranga and Etzkowitz (2013), the **Knowledge Space** *"encompasses the competencies of knowledge generation, diffusion and use of the Triple Helix components".* The knowledge space is in each sphere. For University, the space is determined by the same universities, academic research

groups and interdisciplinary research centres, as well as individual academics and entrepreneurial scientists. For Industry, the space refers to company R&D divisions or departments and for Government, the space refers to public research organisations, mission-oriented research laboratories, etc. The 'mission' of the Knowledge Space is the development of resources aimed at strengthening knowledge production.

The **Innovation Space** is made by hybrid structures operating mainly at the university-industry interface (i.e. technology transfer offices, science parks, business incubators, start-up accelerators) and by enterprises in the private sector and individual entrepreneurs, venture capitalists, business angels, etc. The 'mission' of the Innovation Space is the development of resources that *"facilitate knowledge commercialization, provide services and support structures, and partner with local city and regional governments to find resources for their objectives"* (Ranga and Garzik, 2015). The Innovation Space also encompasses the dimension of industrial specialisation which should be addressed by policy actions in order to develop the entrepreneurship potential and to ensure a competitive advantage for the territory.

The **Consensus (Governance) Space** *"includes government and non-government actors who come together to generate ideas and negotiate resources for the advancement of a knowledge-based regime, in a broad vision of governance where the cross-fertilization of diverse perspectives may generate results that are not likely to be accomplished individually"* (Ranga and Etzkowitz, 2013). Its main purposes are the definition of rules and regulations, the promotion of research and innovation programmes and policies, and the involvement of actors from other spheres in the interactive process. In addition, it has to promote innovation culture (Box 2) and boost continuous communication with the actors in the other spaces.

Box 2. Models for regional innovation and the role of innovation culture

For more than 20 years different authors have introduced a number of models to identify enabling and hampering factors of innovation and of its dynamics at the regional level. Innovation perspective became relevant in regional policies in the early 1990s, giving to territorial authorities a governance role in the interaction with strategic tangible local assets such as research excellence and industrial champions. The Green Paper on Innovation dedicated the Route of Actions 12 to "*Encourage innovation in enterprises, especially SMEs, and strengthen the regional dimension of innovation*" claiming that *"The local or regional level is in fact the best level for contacting enterprises and providing them with the necessary support for the external skills they need (resources in terms of manpower, technology, management and finance). It is also the basic level at which there is natural solidarity and where relations are easily forged"* (EC, 1995). Relevant regional innovation models with practical applications inspired such proposed action. Examples of

these models, as reported in Ranga and Garzik (2015), include '*milieu innovateurs*', 'industrial districts', and 'localised production systems'. Over time, regional governments have taken on the role of sustaining and maintaining the necessary conditions to support innovation, in particular those conditions **favouring the concentration of a critical mass of tangible and intangible assets** over their territories. While tangible assets relate to the intrinsic endowment of the industry and university spheres (e.g. sectoral specialisation, applied research laboratories), intangible assets relate more to the interactive approaches for innovation among stakeholders. With regard to intangible assets, literature places a great emphasis on **culture for innovation**. In regional innovation models, culture and its proxies are considered necessary conditions for interaction among research and innovation stakeholders (Table 1).

Table 1. Innovation culture in the regional dimension (Ranga and Garzik, 2015)

Definition and proxies	Reference Model	Reference Author
Trust and reciprocity	Innovative Milieus	Aydalot, 1986
	Industrial Districts	Bagnasco, 1977 Becattini, 1987 Brusco, 1986
Networking and social interaction	New Industrial Spaces	Storper and Scott, 1988 Saxenian, 1994
Part of a local society-culture nexus for development	Localised Production Systems	Bouchrara, 1987
Source of learning by interacting	Regional Innovation Systems	Edquist, 1997 Lagendijk, 1998
Part of the interaction between economic and social life	Learning Regions	Moulaert and Sekia, 2003
Culture as a key dimension	High-Tech Clusters	Saxenian, 1994; James, 2005; Saliba *et al*., 2012; Salo, 2014
	High-Density Art, Cultural And Media Clusters	Currid and Connoly, 2008
	Cultural Technology Districts	Di Pietro *et al*., 2014
	Cultural Districts	Le Blanc, 2010
	Open Innovation Environments	Todtling *et al*., 2011

Configured in such a way, the TH may be adopted as an operational approach to boost innovation activities at the territorial level. It is particularly functional for regions with a relevant knowledge-based economy, an innovation-driven industry and the presence of hybrid institutions, all of them supported by consensus action by the concerned LRAs. However, in regions where these necessary conditions are not met, the application of the TH may be scarcely effective. This can occur especially in regions which are less performing in

terms of economic growth, where innovative space is lacking due to the dominance of traditionally-run SMEs and/or where the knowledge space does not take advantage of universities focused on applied sciences, and/or where the consensus space suffer from a limited institutional support (Viale and Ghiglione, 1998). This is because the TH model relies on the existence in a territory of what is referred to as the '**technological paradigm'** generated by the interaction and exchange of (scientific/technical) know-how among the TH spheres (Arnkil *et al.*, 2010).

Technological paradigms are renewed in a cyclical way. The innovation process is composed of specific phases in which every sphere of the TH is changing its relative weight and role. For example, a form of GOV-IND co-operation may require the support of an entrepreneurial university (UNI) to boost the industry (IND) in its innovation effort. In the early growth phase of the technological paradigm, the role of both university and government is reduced to favour the industrial actors. As the existing technological paradigm reaches its maturity, university and government begin to play a leadership role again in proposing new technological paradigms and in starting to lay the groundwork for a new wave of innovation. Unfortunately, in their analysis, Etzkowitz and Klofsten (2005) found that relatively few regions have exhibited "*self-renewing capabilities*" creating a new technological paradigm through the innovation waves generated within the TH model.

Less than 10 years ago, researchers, practitioners and policymakers began experimenting with improved innovation approaches starting from the TH model and **trying to solve the limitations connected to the establishment of a technological paradigm**. One of the seminal contributions in this direction was from Yawson (2009). While building a new architectural framework for a National Ecological System of Innovation, the author introduced the **Quadruple Helix Theory**: *"The triple helix of state, university and industry is missing an essential fourth helix, the public."…"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"*. In their proposal of a QH approach, Arnkil *et al.* (2010) stressed the need to enlarge the innovation concept of the TH model with a societal perspective *"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"*. Since then, literature on innovation models based on helices approaches has flourished. In particular, the mainstream studies **moved**

from the concept of knowledge economy of the Triple Helix **to the concept of knowledge society/democracy** achieved with the addition of a fourth sphere.

1.4 The Quadruple Helix approach

The Quadruple Helix (QH) approach is far from being considered a well-established concept in innovation research and policy. Common to all of the proposed versions is the inclusion of a fourth sphere/helix to the TH model. Additionally, in the deriving frameworks, sources of innovation are no longer restricted to interactions between university, industry and government. Rather, they become closer to the 'spaces' approach as well as more heterogeneous and socially distributed.

Beyond specific versions (Table 2), *"the Quadruple Helix contextualizes the TH by adding as the fourth helix ''civil society'' and the ''media- and culture-based public.'' This is the understanding that additional perspectives must be added to comprehend innovation in the unfolding twenty-first century. In fact, democracy frames and changes our conditions of innovation. The TH is not really sensitive enough for this democratic additionality, whereas the Quadruple Helix reflects on this"* (Woo Park, 2014). This perspective allows territories to follow non-traditional innovation paths, such as those related to non-technological improvements, service creation and creativity exploitation. It also allows moving towards 'open innovation', where innovation becomes a process inclusive of "*all stakeholders as active players in jointly creating and experimenting in the new ways of doing things and creating new services and products*" (EC, 2015).

Table 2. Fourth Helix definitions in the literature

Reference author	Domain	Definition
Yawson (2009)	CIVIL SOCIETY	The **public** as user in user-driven innovation context and as an essential factor for firms and public sector organisations.
Arnkil *et al.* (2010)		**Citizens or users who give information about their needs and experiences**. Versions: ° The Triple Helix + user model. ° The firm-centred living lab model, where industry remains the key element. ° The public sector-centred living lab model, where the government remains the key element. ° The citizen-centred model, where citizen remains the key element.
Carayannis and		**The media-based and culture-based public and civil**

Reference author	Domain	Definition
Campbell (2012)		**society**. It also includes the following: culture and innovation culture; values and life styles; multiculturalism and creativity; media; arts and arts universities; and multilevel innovation systems (local, national, and global), with both universities in hard and soft sciences.
RIS3 Guide (EC, 2012)		Civil society as **innovation users** (NGOs and citizens' initiatives related to societal challenges for which innovative solutions would be helpful, consumers associations, etc.).
Baber (2001)	OTHER	**External scientific experts** who advised the Singaporean government during the early 1980s on science and industrial policy.
Mehta (2003)		Institutional actors and individuals forming an "***extended peer community***" (advanced scientific and technical areas, e.g. biotechnology and nanotechnology).
Delman and Madsen (2007)		**Independent, non-profit, member-based organisations** which combine funding from government and private sector.
Caduff *et al.* (2010)		**Arts and artistic research**, as a new form of creation and possibly also as a new form of knowledge creation.

Most of the proposed QH approaches focus on innovation generated by citizens. Social inclusion, user-centrality, and creativity have been encompassed in the knowledge production process as essential elements and civil society has been added as a fourth helix of the innovation system. Yawson (2009) formalised **the user** as a fourth sphere supported by the idea that innovation is driven by the needs of the users. Innovation in terms of products and services provided by IND and GOV and oriented to satisfy citizens' needs (user-driven innovation) realises *de facto* the socio-economic growth of the territory. This process implies two elements: an effective interaction between at least UNI and IND (i.e. the traditional technology-based innovation) and citizens' contribution to the innovation model. This entails **a shift from technical to social innovation**.

Arnkil *et al.* (2010) propose four different types of QH models adopting the Living Lab approach[4] and considering *"Quadruple Helix rather as a continuum*

[4] According to the 'Citizen-Driven Innovation: A guidebook for city mayors and public administrators' (Eskelinen *et al.* (eds.), 2015), the Living Lab concept derives from the idea that research and development in ICT benefit from the involvement of users/consumers/citizens in the innovation process. This means to innovate using a large number of ideas and experiences. *"In essence, a Living Lab takes research and development out of the laboratory and into the real world, engaging stakeholders, citizens, and end-users in the collaborative design*

or space than as a single entity". Each of the proposed models is characterised by a specific owner of the innovation process and by the involvement of the user[5]. The **'TH + user model'** is essentially an approach where innovation has a technical nature and knowledge a scientific one, and where the owners of innovation belong to the Industry or to the University sphere. The difference with the TH approach lies in the *"systematic collection and utilization of user information"* as innovation is **designed for users**. The **Firm-centred living lab model** includes all the potential sources of innovation based either on the frontier-research or on new applications or combinations of already-existing knowledge and/or on user knowledge. Although the owner of the innovation process remains the Industry sphere and users are considered as both informants and developers, innovation is **designed with users**. The **Public sector-centred living lab model** focuses on innovation in the public sector and its services. The owner of the innovation process is the Government sphere. Interaction of experts with users aims at improving the efficiency and effectiveness of public administration products and services for citizens. Also in this case, innovation is **designed with users** and feedback information from the citizens can be gathered with traditional methods (e.g. surveys, interviews), with dialogue events (e.g. virtual forums, events) or within living lab environments. Within the **Citizen-centred QH model** innovation is led by citizens with the support of the other three spheres. Civil society is the owner of the innovation process and innovation is **designed by users.** In practice, this last model is essentially a theoretical approach. In fact, Arnkil *et al.* (2010) report that only the TH + users model and Firm-centred living lab model have actual applications. Cases of the Public sector-centred living lab model have been also identified in some projects aimed at developing public services.

Carayannis *et al.* (2012) focused on the cultural aspects and on the sharing of these aspects when referring to the role of the public as a fourth helix of the innovation system. *"The fourth subsystem, media-based and culture-based public, integrates and combines two forms of 'capital'. On the one hand, this helix has, through the culture-based public (for example: tradition, values, etc.), a 'social capital'. On the other hand, the helix of media-based public (for example: television, internet, newspapers, etc.) contains also 'capital of information' (for example: news, communication, social networks"*. The authors stress the role of the public in the innovation process as owner and sharer of knowledge: *"Knowledge, as a resource, is created through creative processes,*

of new services. The immediate benefits of the Living Lab approach derive from this new relationship created between people and technology: by allowing citizens to design and create their own solutions, the resulting services find faster and improved acceptance, with end users gaining a greater sense of empowerment and ownership".

[5] The typologies of involvement of the users in terms of 'design' have been developed by Kaulio (1998).

combinations, and productions in so called 'Knowledge models' or 'Innovation models' and thus becomes available for society" (Carayannis *et al.*, 2012).

Within the RIS3 Guide (EC, 2012) the involvement of **the civil society is meant to boost the innovation potential** of the European regions. *"In the Open Innovation era, where social innovation and ecological innovation entail behavioural change at the individual and societal levels... the regional governance system should be opened to new stakeholder groups coming from the civil society that can foster a culture of constructive challenge to regional status quo."* **Innovation users**, representing the demand-side perspective, are included as a fourth group of actors in *"the traditional, joint-action management model of the triple helix, based on the interaction among the academic world, public authorities, and the business community."*

Recent studies have widened the TH/QH by including new helices to better explain and analyse innovation paths and related growth effects at the local and regional level (Box 3). The rationale behind this incremental tendency is that different enabling factors or drivers may substantially affect the framework conditions or provide new input in the knowledge production dynamic. As already experienced in the 'extension' of the TH, evolutions in helix-based innovation approaches have been done through the inclusion of additional helices and/or the disaggregation in sub-components of the helices already identified.

Box 3. Further extension of the helix-based innovation approaches

Moving beyond the concept of knowledge economy of the TH and the concept of knowledge society of the QH, the Quintuple Helix (QuiH) innovation approach proposed by Carayannis *et al.* (2012), besides UNI, IND, GOV, and CIV, includes the **natural environment** as *"decisive for a sustainable development"* and providing *"people with a 'natural capital' (for example: resources, plants, variety of animals, etc.)"*[6]. According to Carayannis and Campbell, 2010 *"[T]the Quintuple Helix furthermore outlines what sustainable development might mean and imply for 'eco-innovation' and 'eco-entrepreneurship' in the current situation and for our future"*.

1.5 A working definition of the fourth helix

For the scope of our work, a working definition for the fourth helix, entailing the main aspects embedded in the literature contributions reviewed above, is

[6] Carayannis *et al.* (2012) refer to the natural environment as the 'third' pillar (the fourth pillar being media-based and culture-based public, and the fifth pillar being the political system).

necessary to link the theoretical approaches with the existing policy strategies (i.e. the RIS3) aimed at transferring innovation results into regional growth.

The **fourth helix** is hereafter referred to with the term **'civil society'** and is defined as follows:

> 'A collective entity formed by individual users **living on a territory** and interacting with university, industry and government as customers, citizens or members of a community in order to contribute to build new innovation paths which are able to promote **the socio-economic growth of the territory**. Civil society demands that innovations are made according to its needs, releases feedback on products and services (and on their innovation value), and provides its own contribution in terms of knowledge, inventiveness and creativity. Civil society is constantly interacting with the other three helices as a result of enabling technologies for information and communication which make social inclusion possible in real time and at low cost.'

On the basis of the above definition, the operationalization of the **Quadruple Helix** approach within a regional context is characterised by the following elements: helices, components, contextual hypotheses, knowledge types, and innovation objectives. These elements are summarised in Table 3.

Table 3. Elements of the working definition of the QH in this study

Elements	Definition
4 helices	○ University ○ Government ○ Industry ○ Civil Society
4 components	○ R&D performers ○ Non-R&D performers ○ Hybrid institutions or organisations ○ Informal groups of users that may interact in exchanging knowledge and creating innovation
2 contextual hypotheses	○ Democracy and social inclusion ○ Pervasiveness of ICT in each one of the four helices
2 knowledge types	○ Science/technology-based knowledge ○ Creativity-based knowledge
1 innovation objective	Regional development and growth

As evidenced by the review of latest literature, the helix approaches are generally considered consistent with regional innovation policymaking (Box 4) and so is the working definition of the QH proposed in this study.

Box 4. Congruence of the QH with smart specialisation

Arnkil *et al.* (2010) note how the TH model introduces a "*lateral approach to innovation policy, conceived of as collaboration among the institutional spheres"* which is congruent with the interaction among the various stakeholders and levels envisaged in the RIS approach. The authors also highlight that the consideration of a fourth helix widens the types of innovations derived within the TH model, making a QH approach a 'complementing' or 'extending element' of the RIS approach, for example "*in taking notice of the user and the community at large (users, citizens)";* and that a QH approach is not necessarily 'spatially specific' as the RIS is, with the mentioning of social media as a tool enabling civil society involvement not bound to any physical place.

An upgraded articulation of the TH concept towards a QH approach is already envisaged in the last EC guidance document to RIS3 (EC, 2012). The reference to QH in the Guide relates to the Collaborative Leadership principle of strategy-making and to the governance structure set-up. Governance architecture affects the way stakeholders participate in RIS3 design, including the definition of strategic priorities. Hence, in order to achieve a wide conception of innovation which is at the core of each RIS3 the "*tripartite governance model based on the involvement of industry, education and research institutions, and government (the so-called Triple Helix model), is no longer enough in the context of smart specialisation*" (EC, 2012). Participation of a fourth group of actors is meant to include the demand-side perspective, i.e. the perspective of users, in the strategy development process. The inclusion of this fourth group is believed to strengthen the innovation process in general (traditionally based on R&D innovators) and the entrepreneurial discovery process in particular, as the needs of citizens are better understood and taken into account. The RIS3 guidance document makes a point of emphasising how the consideration of this fourth group of actors may result in "*securing better conditions to commercialise R&D efforts*" (EC, 2012).

Carayannis and Rakhmatullin (2014), in their analysis of the linkages between the helices approaches and the smart specialization strategies (S3), state that both the TH and the QH concepts are congruent with the operationalization of the strategies in the context of innovation, although the focus of the emphasis in the two concepts is different. The TH concept allows emphasising involvement, engagement, and the individual role of each of the three helices contributing to the creation and advance of a knowledge-based economy, i.e. it "*is a strong environment of parallel relationships between (national or regional) authorities, the wider business community (industry) and academia (including other research-focused institutions)*". The QH concept puts a greater emphasis on the co-operation in innovation aspect, in particular on "*the dynamically intertwined processes of co-opetition, co-evolution and co-specialisation within and across regional and sectoral innovation ecosystems…..that could serve as the foundation for diverse smart specialisation strategies (and introduce a move towards systemic and user-centric innovation structures)*". The S3 shall reflect an operationalization of the QH concept as regional innovation systems, which are at the core of the RIS, "*need to be conceptualised and implemented with a top-down view (integrating and differentiating across government, university and industry sectors and localities…) complemented and enhanced by a bottom-up set of insights coming from the civil society*" (Carayannis and Rakhmatullin, 2014). This integrated approach would allow fostering of not only science and technology innovation but also of other forms of innovation, such as social

innovation. According to the authors, the QH concept provides the proper architecture for the simultaneous inclusion of the four perspectives where "*The inter-sectoral and intra-sectoral as well as the inter-regional and intra-regional knowledge and learning interfaces that are embedded in the Quadruple Helix architectural blueprint determine its efficacy and sustainability*" (Carayannis and Rakhmatullin, 2014). The authors also highlight that the expression and consideration of the insights, perspective and/or value creation potential of the civil society need the proper mechanisms to be in place and these mechanisms need to be envisaged at the level of RIS3. Furthermore, a functioning multi-level governance structure is essential.

Also Markkula (2014) calls for the upgrading of the TH model and for the adding of at least a fourth helix, the community. This upgrade would make the approach more dynamic and responsive to the new societal challenges, and would allow the RIS to create synergic innovation collaboration. The author indicates congruence between regional innovation (eco)systems, the crucial role played by the fourth helix, and regional innovation strategies as "*Universities together with companies are, still, the drivers of co-creation and renewal. However, the best laboratories for breakthrough innovations today are no longer traditional university facilities, as such, but regional innovation ecosystems operating as test-beds for rapid prototyping of many types of user-driven innovations, based on transformative and scalable systems. Innovation communities operate as ecosystems through systemic value networking in a world without borders. Innovation processes are strongly based on demand and user orientation and customers as crucial players in innovations. Innovation strategies focus on catalysing open innovation and encouraging individuals and communities towards an entrepreneurial mindset and effective use and creation of new digitalised services*" (Markkula, 2014).

When innovation (eco)systems and their growth dynamics are approached by means of helix models and focused on civil society engagement, the innovation performance of each region strictly depends on the relevance and development of each sphere as well as on the strength of interaction among them. This is analysed further in the following Part 2.

Part 2: Comparative analysis of regional innovation performance

2.1 Methodological approach to analyse regional innovation performance

Part 2 of this study aims at comparing the innovation performance of European regions on the basis of the most updated data and indicators (quantitative analysis). Furthermore, it aims at highlighting - within a set of ten selected regions - those conditions which promote territorial development and growth through the helices approaches (qualitative analysis). In both cases, the reference of the analysis is to the working definition of the QH and of its elements provided in section 1.5 above. The underlying challenge of this exercise is twofold: identify and use appropriate indicators at the desired scale (NUTS2) which concisely reflect the maturity of each of the four helices; and gather useful information on the selected regions in order to investigate the presence of TH/QH approaches and their effectiveness in terms of regional innovation performance.

2.1.1 Data sources for regional innovation performance assessment

Various approaches are implemented at the European level to quantitatively assess a territory's innovation performance. Each of these approaches relies on different types of data and focuses on specific aspects of the innovation process. Table 4 indicates data availability within the main sources identified. In fact, the number of sources providing quantitative information on innovation performance (including enabling and hampering factors) at the regional level is limited.

Table 4. Sources of data for innovation performance assessment

Source	Last update	Geographical level	Type of information
Regional Innovation Scoreboard (RIS)	2014	Mainly NUTS2. NUTS1 for some Member States.	Each region is classified as modest innovator, moderate innovator, innovation follower, or innovation leader. Innovation scores by region are given on the basis of 11 indicators grouped under three headings (Enablers, Firm Activities and Outcomes). Sources of data for the indicators include Eurostat and the Community Innovation Survey.
Innovation Union Scoreboard (IUS)	2015	Country level (NUTS0).	Each country is classified as modest innovator, moderate innovator, innovation follower, or innovation leader. Innovation scores by country are given on the basis of 25 indicators grouped under three headings (Enablers, Firm Activities and Outcomes).

Innobarometer	2015	Country level (NUTS0).	Survey on activities and attitudes related to innovation within European businesses and civil society. Every year the specific focus/topic of the survey changes.
Digital Economy and Society Index (DESI)	2016	Country level (NUTS0).	The index reflects 30 indicators on Europe's digital performance grouped into five dimensions: Connectivity, Human Capital, Use of Internet, Integration of Digital Technology, and Digital Public Services.
Eurostat	Several years	NUTS2.	Several datasets, especially from the domains of regional education (t_reg_educ), regional science and technology (t_reg_sct), and regional information society (t_reg_isoc).
EU Regional Competitiveness Index (RCI)	2013	NUTS2 and country level (NUTS0).	The index reflects 73 variables related to different domains: Institutions, Macroeconomic Stability, Infrastructure, Health, Basic Education, Higher Education and Lifelong Learning, Labour Market Efficiency, Market Size, Technological Readiness, Business Sophistication, and Innovation.
Regional Innovation Monitor Plus (RIM+)	Last Annual Report 2014	200 regions (NUTS2) of 20 Member States (NUTS1 and NUTS2 level).	Information on regional innovation policy measures, policy documents, organisations, good practices in regional innovation, mapping of advanced manufacturing and relevant pilot/demo projects.
RIS3 Smart Specialisation platform	Updated online	167 regions (NUTS2) and 18 countries (NUTS0).	Guidance material and good practice examples for smart specialisation and innovation strategies, targeted information divided into six sections (S3 Themes, S3 Governance, S3 Targeted Support, S3 Actors, S3 Co-operation and S3 Communities), tools for regional comparison on structural similarities (Regional Benchmarking), Priorities (EYE@RIS3), and Inter-regional trade flows.
OECD database	Updated online	Large regions, mostly consistent with the NUTS2 level.	Among the most relevant datasets related to innovation performance are education level of labour force, R&D personnel by sector, R&D expenditure by sector, and patents applications.

Note: shaded cells indicate the data sources used in the study.

According to the study's scope of analysing regional innovation performance in terms of the presence/absence of the TH and/or QH, prioritised sources are those providing NUTS2 level information, indicators and data related to **each single helix** (i.e. university, industry, government, and civil society) **and to their formal and informal interactions**. Hence, the Regional Innovation Scoreboard (RIS) is the primary source used in this assessment. However, eight out of the eleven indicators considered within the RIS 2014 relate to the innovation potential of business. Because of this limitation, additional Eurostat regional statistics are used to take into account, or at least to be a proxy for, the contribution of the other helices to the regional innovation process. Eurostat indicators and data are sourced from both the online database (t_reg) and the

Eurostat Regional Yearbook 2015 (Eurostat, 2015).[7] One of the considered indicators is from the EU Regional Competitiveness Index. In the end, a total of **18 indicators** were selected (see Appendix I), referring to the four helices of the QH (IND, GOV, UNI, and CIV) and to a cross-cutting **'innovation interaction'** (INT) component. These indicators are used to define a '**QH innovation index**' **(QHII)**.

Finally, the Regional Innovation Monitor Plus (RIM+) and the RIS3 Smart Specialisation platform are the main sources of qualitative information for the deepening of the analysis in selected regions.

2.1.2 Computation of the QH innovation index and classification of regions

In order to single out the ten regions to be investigated in terms of the TH/QH application, first the following two steps were implemented: 1) computation for each European region of the QH innovation index; and 2) classification of each European region in terms of 'innovator type'.

- **Computation for each region of the QH innovation index**

The comparative analysis across regions is done according to the performance of each region against a set of indicators reflecting the **four spheres** of the QH approach. As previously mentioned, the considered set includes 18 indicators grouped into **five categories**: Industry (IND), with five indicators; University (UNI), with two indicators; Government (GOV), with two indicators; Civil society (CIV), with five indicators; and Innovation interaction (INT), with four indicators. Indicators are sourced from the RIS (7 indicators: 3 IND, 1 GOV, 1 CIV, 2 INT), Eurostat (10 indicators: 2 IND, 1 GOV, 2 UNI, 4 CIV, 1 INT), and the EU Regional Competitiveness Index (1 indicator: INT). The first four categories aim at mapping each sphere of QH approach. The **innovation interaction** category has been included to account for the structured processes of knowledge exchange and transfer of know-how among the actors of the helix models which are at the basis of innovation and growth. For each of the five categories, a sub-index ranging from 0 to 1 is calculated. The linear combination of the five sub-indices generates the **QHII** whose value ranges from 0 to 1 (Box 5).

[7] The RIS also relies on Eurostat data. In order to include the most updated information in our analysis, data behind the RIS and non-RIS indicators have been downloaded directly from the Eurostat online database.

Box 5. QH Innovation Index computation method

The Quadruple Helix Innovation Index (QHII) is computed for each of the 268 NUTS2 regions (population) considered (NUTS 2010 nomenclature). Data gaps at NUTS2 level have been filled as far as possible by considering the corresponding averages at NUTS1 or NUTS0 level. Each of the 18 indicators has been normalised on the maximum value of the population. As a result**, the value of each indicator ranges from 0 to 1**. The five sub-indices (IND, GOV, UNI, CIV, and INT) have been calculated as the average of the normalised values of the indicators attributed to each sphere (e.g. for the 'GOV' sphere, in each region the normalised value of the indicator *R&D expenditure in public sector* and the normalised value of the indicator *R&D personnel in GOV sector* have been averaged to obtain the GOV sub-index). In order to increase data robustness, those regions with limited information on sub-indexes were dropped. Namely, 8 regions with missing data for at least three indicators (out of the 18 identified), and another 13 regions which have at least 50% of missing data in one of the five sub-indexes were not considered. As a result, the population of regions having sufficient data for the comparative analysis includes 247 regions.

Each sub-index (IND, GOV, UNI, CIV, and INT) was then normalised on the maximum value scored by the sub-index in the population of the 247 NUTS2 regions. In such a way, **the value of each sub-index may range from 0 to 1**. In practice, the maximum value obtained across the selected population for each sub-index is always 1, while the minimum value varies depending on the sub-index:

- Min: IND = 0.082, GOV = 0.000, UNI = 0.013, CIV = 0.264, INT = 0.103.

Finally, the QHII is computed as the average value of the 5 sub-indices. **The QHII is calculated as the arithmetic mean because the weight of each helix in contributing to the innovation performance is assumed to be the same**. No literature theories or models, or acknowledged evidence, support the idea that one helix may potentially contribute more than the others to the overall performance. As underlined in the description of the regional profiles (section 2.4 below), the actual weight of each helix in contributing to innovation partially depends on the type of innovator to which the region belongs and, possibly, also to the types of application of the TH model as identified by Ranga and Etzkowitz (2012). This is because, in effect, different regimes (i.e. the statist, the '*laissez faire*', and the balanced) prioritise the development of different helices. For coherence purposes, the innovation interaction sub-index (INT) has also been given the same weight as the others in the computation of the QHII.

As a result, the **QHII is a synthetic index** which provides essential information on the level of QH maturity in each region and allows regions to be classified in terms of innovation types. The actual value of QHII across the 247 regions ranges from 0.122 (minimum value) to 0.761 (maximum value).

- **Classification of each region in terms of 'innovator type'**

The RIS refers to four innovation performance groups ('Innovation leaders', 'Innovation followers', 'Moderate innovators', and 'Modest innovators'). In the

attempt to outline success factors (presumably found in top innovators) and challenges (presumably faced by weak innovators) as clearly as possible in the application of the TH/QH models, we define only three innovator types: **Advanced innovators (ADV)** with QHII values ranging from 0.666 to 1, **Medium innovators (MED)** with QHII values ranging from 0.333 to 0.666, **and Modest innovators (MOD)** with QHII values ranging from 0 to 0.333.

The resulting groupings include the following: 13 'Advanced innovators' regions, 161 'Medium innovators' regions, and 73 'Modest innovators' regions (Table 5). The full list of regions by innovator type is reported in Appendix II.

Table 5. Classification of the regions according to the QHII

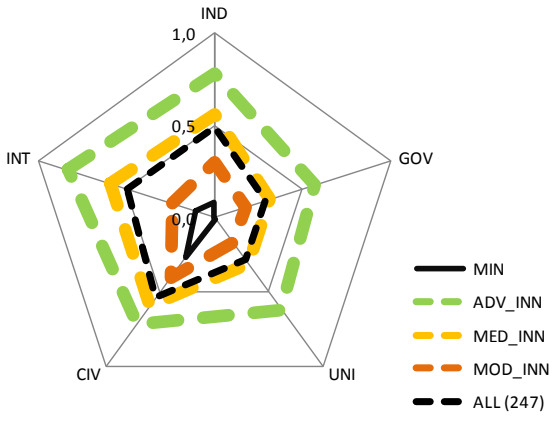
	Advanced innovators	**Medium innovators**	**Modest innovators**
QH index: threshold value	*≥ 0.666*	*0.333 ≤ QH < 0.666*	*< 0.333*
Number of regions	13	161	73
% on total regions (247)	5%	65%	30%

2.1.3 Comparison of innovation performance and topological representation

The comparative analysis of the 247 regions by innovator type is done against the values of the sub-indices. The analysis shows that, unsurprisingly, on average, the advanced innovators (ADV) (green line) perform better than the medium innovators (MED) (yellow line), and the latter, in turn, perform better than the modest innovators (MOD) (red line) (Figure 1).

The radar chart in Figure 1, reporting the sub-indexes values on axes from 0 to 1, indicates that the average values of all sub-indices (black dotted line) overlap with those of the regions belonging to the medium innovators (MED). The best performing indexes in terms of **average values** are innovation interaction (INT) and civil society (CIV) in the ADV and MED types.

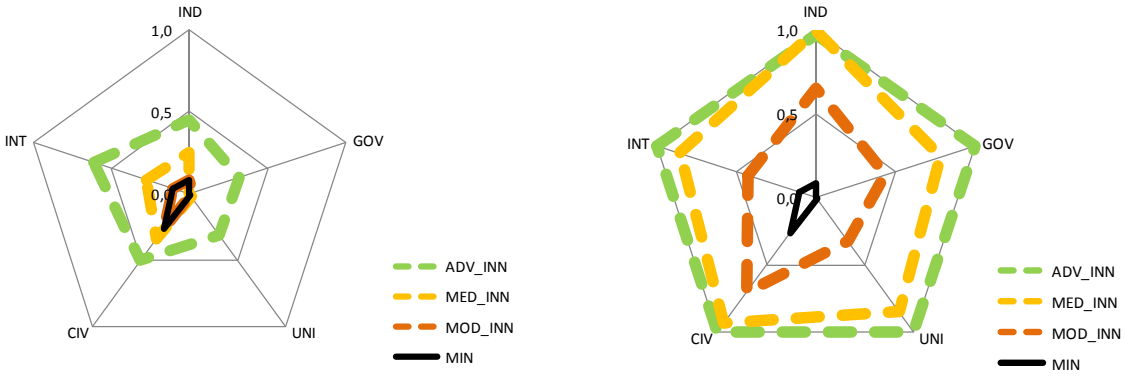
Figure 1. Comparison of average sub-indexes, by type of innovator



INT is the best performing sub-index when considering the minimum and the maximum values of ADV and MED. Among MOD, the largest role is played by CIV. In all the cases, UNI and GOV appear as the worst performers. The reason behind their limited structural performance may lie in the poor representativeness of the indicators used to calculate the UNI sub-index (i.e. *HEI R&D expenditure* and *R&D Personnel in HEI sector)* and GOV sub-index (i.e. *R&D expenditure in public sector* and *R&D personnel in GOV sector*).

When looking at the minimum and maximum values, as shown in Figure 2, the minimum values for ADV are largely higher than those of MED and MOD suggesting that advanced innovators are also characterised by a certain **critical mass** in each sphere. This is confirmed by the analysis of the maximum values: while the values of MED essentially overlap with those of ADV, MOD innovators seem to be structurally below a certain threshold.

Figure 2. Comparison by type of the minimum (left chart) and maximum (right chart) values of sub-indices



When analysing the regions in terms of leading sphere(s) (Table 6), almost 50% of them (120 regions) are led by the CIV sphere, one fourth is led respectively by IND and INT, while GOV and UNI lead very few regions. Looking at the type of innovators, the result is that in **ADV**, IND has the most relevant role and CIV and INT are both leading almost one fourth of the regions. Only a minority of the advanced regions (less than 8%) has GOV leading. UNI has a limited role in leading ADV (15.4%), yet UNI's leading role is found almost exclusively in ADV regions. About one third of **MED** regions are led by CIV as well as by INT, with a very limited share of regions relying on GOV and UNI. In **MOD**, the traditional spheres of the TH model seem to have lost the leading position in innovation performance in favour of CIV: in fact, in more than 80% of the regions of this innovator type, the CIV sphere scores the maximum value. Notably, in MOD, none of the regions have INT and UNI as the innovation leading sphere.

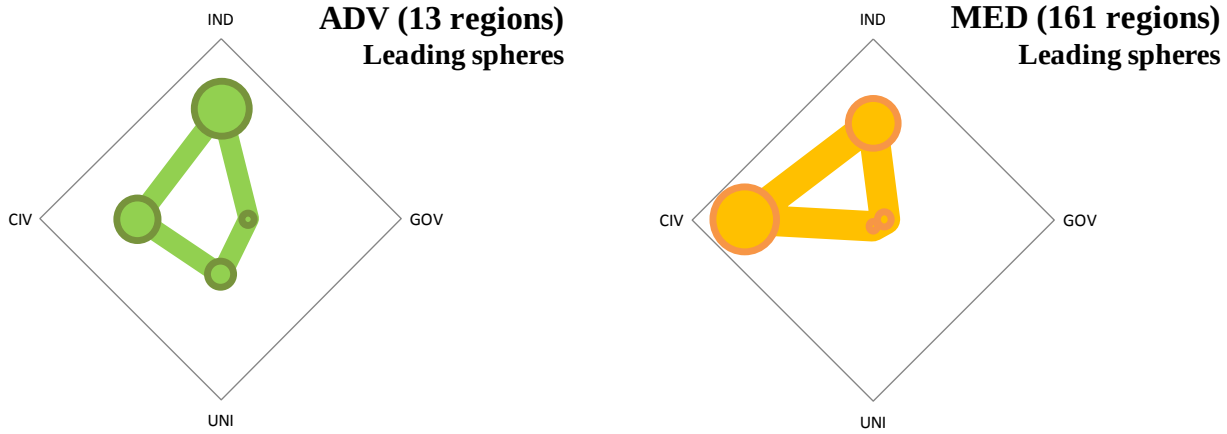
Table 6. Number and percentage of leading sphere(s) (including innovation interaction) in the innovation space, by innovator type

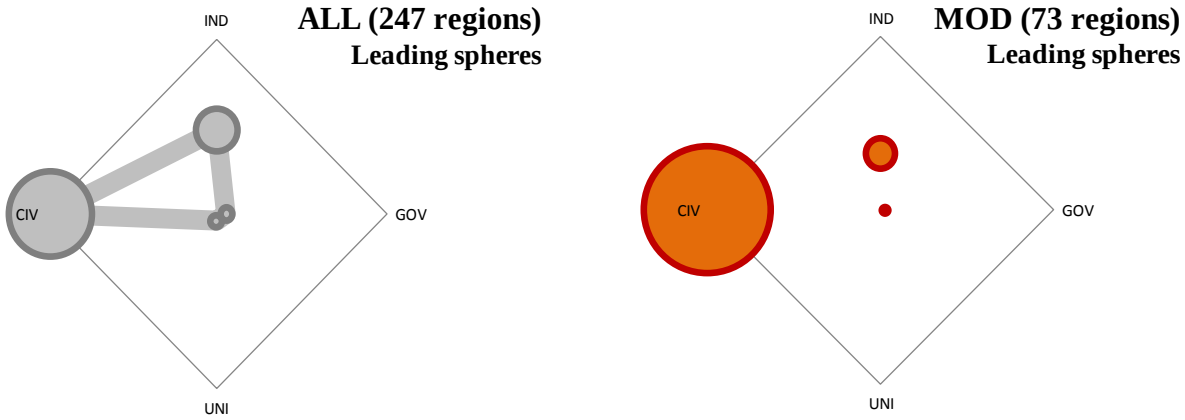
Innovator type	IND	GOV	UNI	CIV	INT
Number	59	7	5	120	56
ADV	**30.8%**	7.7%	15.4%	**23.1%**	**23.1%**
MED	**26.7%**	3.1%	1.9%	**35.4%**	**32.9%**
MOD	16.0%	1.4%	0.0%	**82.2%**	0.0%

Notes: in bold the leading shares by innovator type.

A **topological representation** of the leading spheres in the innovation space, for each type of innovator and within the population of the 247 analysed regions, suggests possible different geometries of the innovation processes of each type of innovating region (Figure 3). **The relevance of the four dimensions of the QH is represented by the size of the sphere and by the distance from the centre of the graph**, while **innovation interaction (INT) is indicated by lines connecting spheres and by their thickness**. Regions in ADV are IND sphere-dominated, with CIV also having a relevant pulling force. In MED, IND seems to lose the leading role in the innovation process as the weight of UNI is reduced. MOD regions lose innovation interaction leaders and have no defined geometry due to the fact that almost 80% of the MOD regions are led by CIV in their (limited) innovation generation. The overall topological representation shows a vertical 'crushing' of the spheres' structure moving from ADV to MOD (left-right-down direction in Figure 3).

Figure 3. Topological representation of leading spheres of the innovation space by ADV, MED and MOD regions in the EU





2.1.4 Selection of the ten regions for further comparative analysis

According to the specifications of the study, the comparative analysis of regional innovation performance is to be carried out on ten regions: four classified as 'advanced', three as 'medium', and three as 'modest' innovators. Since the comparative analysis is required to be both quantitative and qualitative, availability of data has been firmly considered as an essential criterion, even if it is at the expense of the representativeness of all regions and countries. As previously mentioned, 21 regions were excluded from the analysis because there was insufficient data for one or more of the sub-indexes considered. This implies that some Member States were also discharged in full from the final selection of the ten regions, namely Cyprus, Greece, Estonia, Latvia, Lithuania, Luxembourg, and Malta.

The overarching criterion applied to the selection of ten candidate regions relates to the requirement of 'geographical balance' across the EU. In particular, the following aspects are considered towards the selection of each region: i) belonging to ten different EU Member States; and ii) belonging to non-neighbouring countries within the same innovator type. In addition, priority is given to regions iii) which are among the best scored in at least one of the QHII sub-indexes. As a consequence, for sourcing, the **ADV** preference is given to the **United Kingdom** (including the best performing region in INT), and the **Czech Republic** (including the best performing region in GOV). **Sweden** has been considered as a source country because it is well represented in the ADV innovator type with three regions. Finally, a region from the Benelux (i.e. from **the Netherlands**) is included in the group to achieve a geographical distribution of the sample. For the sourcing of the **MED**, given the high number of countries and of regions falling in this group, preferences are mainly guided by a geographical differentiation resulting in the selection of regions from **Germany**, **Finland** and **Italy**. In the sourcing of **MOD, Romania and Poland** are preferred since almost all of their regions fall in this type. Finally, to reach a geographical balance across the group of modest innovators, one region from the

Iberian Peninsula is selected within those of **Spain**. Table 7 provides an overview of the types of innovators according to some characteristics of the 247 regions.

Table 7. Characteristics of regions by type of innovator

	ADV	MED	MOD
Number of regions	13	161	73
% of total (247) regions	5.3%	65.2%	29.6%
Member States represented in the group	AT, **CZ,** DE, DK, **NL, SE, UK**	AT, BE, CZ, **DE**, DK, ES, **FI,** FR, HR, HU, IE, **IT**, NL, PL, PT, RO, SE, SI, SK, UK	BG, CZ, **ES,** FR, HU, IT, **PL,** PT, **RO,** SK

Note: acronyms in bold indicate the countries from which regions were ultimately selected.

Notably, attention was given to the inclusion of 'capital regions' within the selected ten, since the particular role they play in research, science and technology concentration (i.e. share of researchers on total employment, human resources in science and technology on total population, employees in high-tech sectors on total population) (Eurostat, 2015) is considered valuable for the analysis. Furthermore, the selection process was not influenced by considerations on the challenging task of analysing regions with innovation governance at different administrative levels than that of the NUTS2. This is the case for the UK (i.e. UKJ1, where the leading policies for innovation are at NUTS3 level) and Germany (i.e. DE11, where the leading policies for innovation are at NUTS1 level). Table 8 lists the ten selected regions.

Table 8. Selected regions[8]

Innovator type	Country	NUTS2 code and name	QH innovation index
ADV	UK	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	0.703
ADV	SE	SE11 – *Stockholm*	0.693
ADV	CZ	CZ01 – *Praha*	0.672
ADV	NL	NL31 – *Utrecht*	0.672
MED	DE	DE11 – *Stuttgart*	0.641
MED	FI	FI19 – *Länsi-Suomi*	0.551
MED	IT	ITI4 – *Lazio*	0.452

[8] Seven out of the ten selected regions classified with the QHII match the innovation performance groups of the RIS (EC, 2014) if the following correspondence is considered: RIS Innovation Leaders = Advanced innovators; RIS Innovation followers and Moderate innovators = Medium innovators, and RIS Modest Innovators = Modest innovators. In this study, *Länsi-Suomi* and *Stuttgart* (*Baden-Wuttemberg*) are classified as Medium innovators while they are labelled as Innovation Leader in the RIS. On the contrary, *Praha* is Moderate in the RIS and Advanced according to the QHII.

Innovator type	Country	NUTS2 code and name	QH innovation index
MOD	ES	ES43 – *Extremadura*	0.280
MOD	PL	PL43 – *Lubuskie*	0.191
MOD	RO	RO22 – *Sud-Est*	0.141

2.2 Comparison of the ten selected regions: index and sub-indices

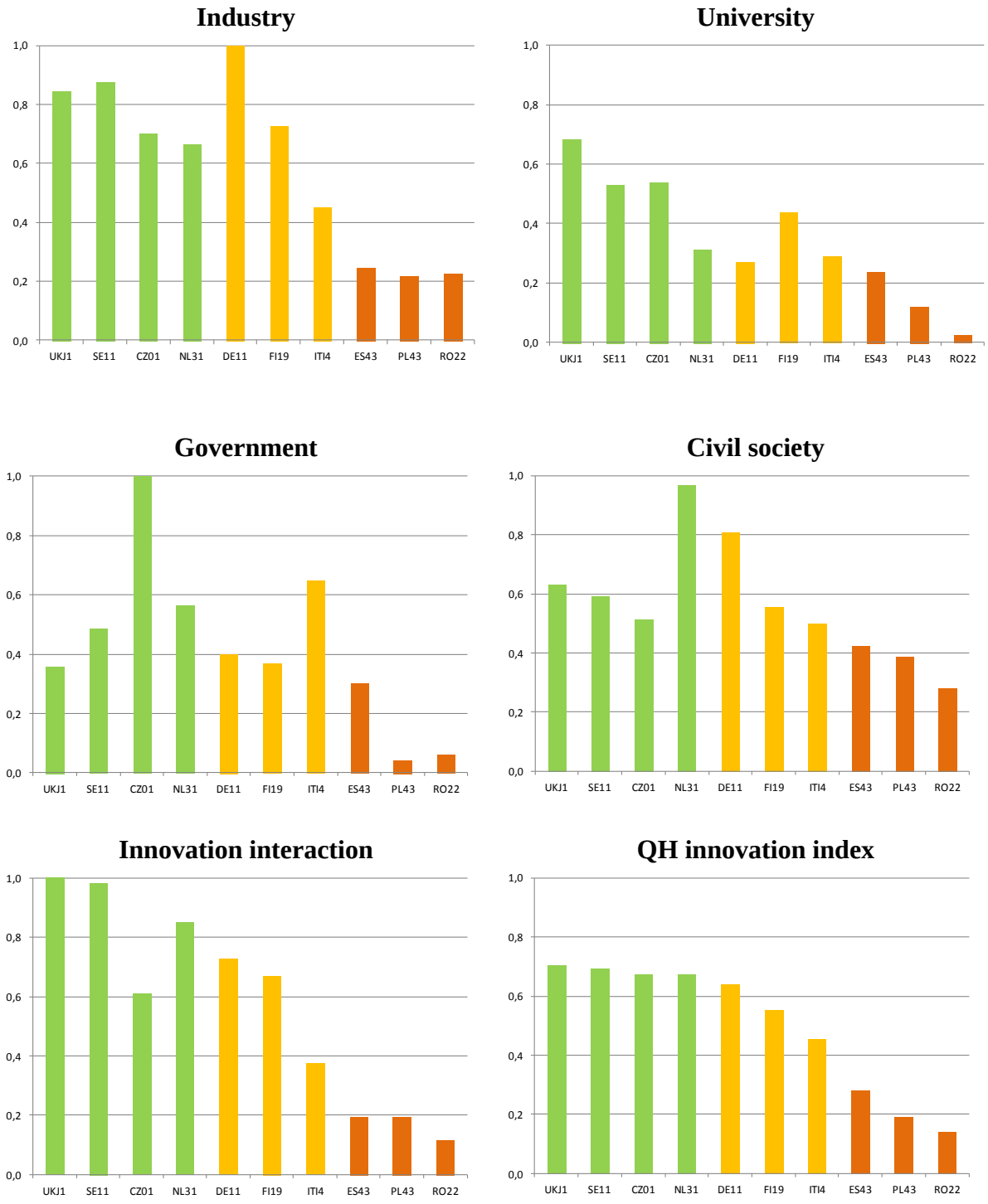
The comparative analysis of the QHII and of the sub-indices for the ten selected regions confirms the structural evidence which was already identified while analysing the population of 247 regions. On average, advanced innovators (ADV) perform better than medium innovators (MED), which in turn perform better than modest innovators (MOD) (Figure 4). It is only within the IND and CIV spheres that the difference between ADV and MED is less evident.

The good correspondence between the innovator types and the values of the sub-indices confirms the idea of innovation as an interactive process which has positive side effects on all the considered spheres regardless of which regional 'regime' generates it[9]. Although these results are in line with the hypotheses behind the TH/QH, some caution and additional considerations should be made in interpreting the values of the five sub-indexes.

Concerning **Industry,** the five considered indicators (*Business R&D expenditure, R&D personnel employed in BES sector, non R&D innovation expenditures (SMEs), Product of process innovators, Employment in technology and knowledge intensive sectors)* clearly fit with the purpose of measuring the business innovation performance. Within the selected ten regions the best IND performer (DE11 *Stuttgart*, IND = 1) is included.

[9] As described in Part 1, Ranga and Etzkowitz (2012) define three types of application of the TH model: the 'statist regime' where government leads by driving the innovative capacity of academia and industry in a predefined policy framework; the '*laissez faire*' regime where industry is leading the innovative capacity in a framework ruled by government and with knowledge support provided by the university; and the 'balanced' regime where university and other knowledge production institutions become more and more relevant and promote joint initiatives and partnerships with industry and government.

Figure 4. Comparison of the QH index and sub-indices of the ten regions



On the contrary, indicators related to **Government** (*R&D expenditure in public sector, R&D personnel in GOV sectors*) and **University** *(HEI R&D expenditure, R&D Personnel in HEI sector)* have an evident limited capacity to be a proxy for the actual contribution of the institutional framework and of research to innovation, as these two spheres indeed play a larger role. Within the selected ten regions the best GOV performer (CZ01 *Praha*, GOV = 1) is included.

For **Civil society,** the five considered indicators provide an interesting insight into certain aspects of civil participation in the bottom-up process contributing to innovation, namely 'non-traditional' R&D (i.e. *Private non-profit R&D expenditures, R&D personnel in Private non-profit sector*), civil society high skills (i.e. *Population aged 30-34 with tertiary education*), digital accessibility to participation mechanisms (i.e. *Households with broadband access*), and digital social engagement (i.e. *Individuals who used internet for social media*)[10].

The **interaction among the different actors in the four spheres**, which is necessary to create innovation, has been assessed through a relatively appropriate number of indicators, namely *EPO patent applications, Innovative SMEs collaborating with others, Employed scientists and engineers,* and *Scientific publications.* However, this aspect is further analysed within the regional profiles by looking at more qualitative information such as the existence of structural collaborations (i.e. hybrid organisations) which provides insights into the role of knowledge sharing among the helices. Notably, within the selected ten regions the best INT performer (UKJ1 - Berkshire, Buckinghamshire and Oxfordshire, INT = 1) is included.

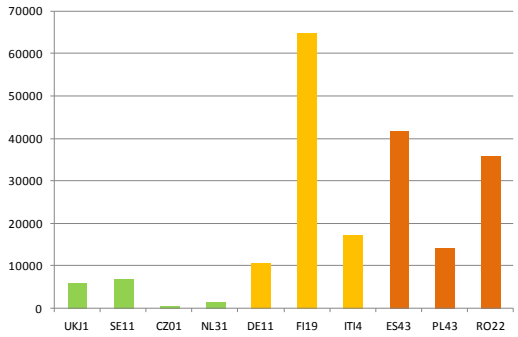
2.3 Comparison of the ten selected regions: structural and socio-economic conditions

Regardless of the approach adopted to assess the regional innovation performance, an analysis of structural and socio-economic conditions is needed to gain an understanding of the framing conditions for innovation within each region. By considering a few **structural variables** (e.g. area, population and GDP), it is evident that on average, advanced (ADV) and modest (MOD) innovators have opposite conditions (e.g. large vs. small geographical area, high vs. low population density), while medium innovators (MED) are usually characterised by a high variability of the same condition within the group (Figure 5).

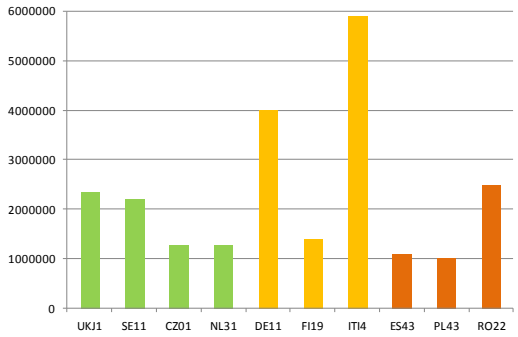
[10] As confirmed by literature review and indicated in the QH working definition proposed in Part 1, *Democracy/social inclusion* and *Pervasiveness of ICT* are contextual hypotheses for achieving innovation through a QH approach. Lack of proper proxies at the regional level which allow comparison of such contextual elements across Europe has led to the use of indicators which combine both the 'inclusive' and the 'digital' aspects. Since social engagement for innovation is essentially based on the exchange of ideas and knowledge, it is not bound to the physical presence of citizens, thus the time- and space-related requirements are relaxed. According to this, ICT is the essential enabling factor for civil society involvement in the innovation process. 'Households with broadband access' is used as a proxy of digital accessibility to participation mechanisms, and 'Individuals who used internet for social media' is used as a proxy of digital social engagement.

Figure 5. Comparison of the structural conditions of the ten regions

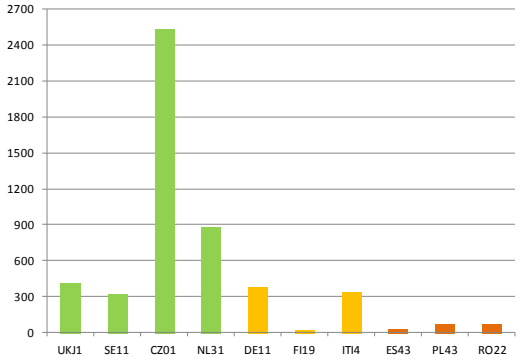
Area (2015)
(km^2, Eurostat)



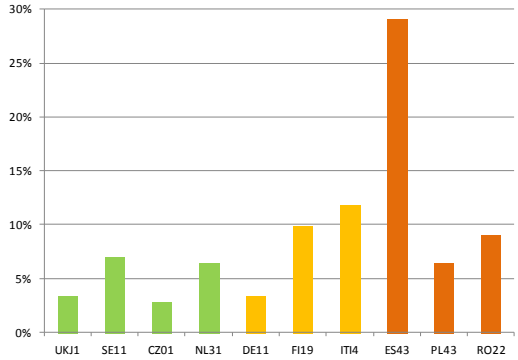
Population (2015)
(inhabitants, Eurostat)



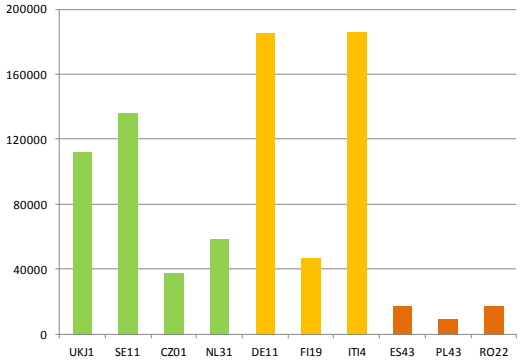
Population density(2015)
(inhabitants/km^2, Eurostat)



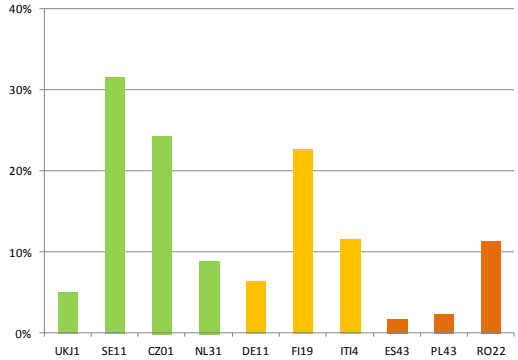
Unemployment (2015)
(% of the population over 15 years, Eurostat)



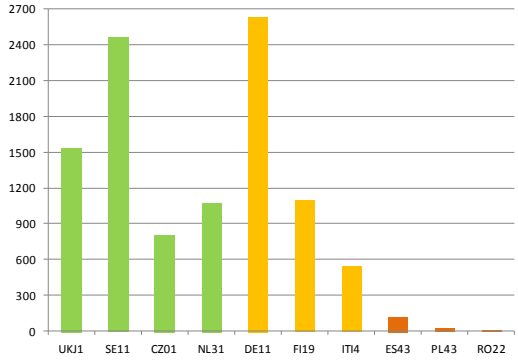
Regional GDP (2014)
(million euro, Eurostat)



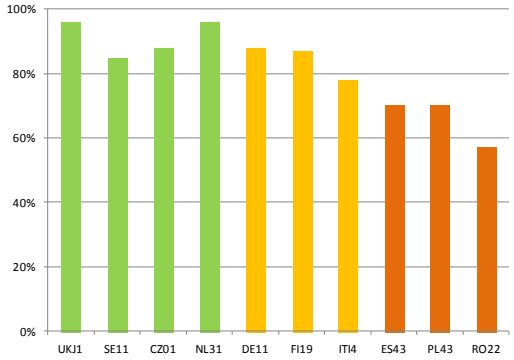
Share of national GDP (2015)
(percentage, Eurostat)



GERD (2013)
(euro per inhabitant, Eurostat)



Broadband access (2015)
(% households, Eurostat)



With regard to the **geographical area**, ADV have a limited extension (less than 6,800 km^2) while MOD have a large one. On average, the three MOD regions have a territory which is eight times larger than the ADV. For example, *Praha* (CZ01) has an area of 496 km^2, while *Extremadura*'s (ES43) area is over 41,000 km^2. Among the MED, *Stuttgart* (DE11) reaches 10,000 km^2 while *Länsi-Suomi* has the largest territory in the sample with some 65,000 km^2. In terms of **population**, on average ADV have more inhabitants than MOD but the highest population (almost 5,9 million inhabitants) is found in *Lazio* (ITI4) and *Stuttgart*, both classified as MED. Based on the combination of data between area and inhabitants, **population density** in ADV is on average almost 20 times higher than in MOD. Among the ADV, *Stockholm* (SE11) has the lowest value in the group with 324 inhabitants per km^2; among the MOD the highest value in the group is found in *Lubuskie* (PL43) with 72 inhabitants per km^2. The MED group again shows a high variability. Having a **critical mass in terms of population** seems to be a necessary condition within a territory for a significant innovation performance.

Considering the structural conditions from the socio-economic perspective, **unemployment** is higher in MOD (on average, about 15%) than in ADV (on average, about 5%). For example, in *Praha* (CZ01) the unemployment level is 3% while in *Extremadura* (ES43) it is 29%. In the MED group the situation is very heterogeneous with the unemployment level ranging from 3% in *Stuttgart* (DE11) to 12% in *Lazio* (ITI4). Data on **regional GDP** also underline a socio-economic gap between the ADV and MOD groups. Within the ADV, regional GDP ranges from EUR 37,673 million in *Praha* (CZ01) to EUR 135,631 million in *Stockholm* (SE11). In the MOD group, the highest value is found in *Sud-Est* (RO22) with EUR 16,935 million. *Lazio* and *Stuttgart* are exceptions within the MED group, with both having a regional GDP of some EUR 185,000 million.

Within the selected sample, it seems that having **a critical mass in terms of economic activity** is a necessary condition for a territory's positive innovation performance. Looking at the contribution of each selected region to the

prosperity of its country, the ranking in terms of **share of national GDP** is led by the ADV *Stockholm* (SE11) (31.5%). On average, regions included in the MOD contribute almost three times less than MED and almost four times less than ADV to the growth of their country.

Among the structural conditions which enable innovation, a regular gradient of the **GERD** from ADV and MED to MOD regions is evident, with ADV and MED spending on average 30 times the amount spent by MOD. *Stockholm* (SE11) and *Stuttgart* (DE11) spend between EUR 2,400-2,600 per inhabitant in R&D, while *Sud-Est* (RO22) spends less than EUR 5 per inhabitant. The difference between ADV and MOD is also evident for broadband access by households: the average of ADV is over 91% while for MOD it is about 66%.

2.4 Regional profiles and innovator types comparison

In the following sections, the ten selected regions (NUTS2 level) are described by type: Advanced (4 regions), Medium (3 regions), Modest (3 regions). For each region, a 3-page profile is developed, including:

- **Facts & Figures** mainly sourced from Eurostat.
- A short description of the **innovation boosting factors** and of the **potential challenges** affecting regional innovation performance.
- The innovation positioning of the region according to **RIS (2014)** and to the **QH innovation index**.
- A **radar chart** showing the positioning of the region according to the five QH sub-indexes (IND, GOV, UNI, CIV, and INT). For comparative purposes, the chart also reports the minimum value of the sub-indexes within the dataset.
- **A narrative overview** of innovation policies and governance.
- **Strengths** [+] **and weaknesses** [–] towards the operationalization of the TH/QH approaches for the IND and UNI helices.
- Outlining of **hybrid organisations and structural interactions** involving more than one type of actor/sphere.
- Brief references to **bottom-up civic participation initiatives contributing to innovation outputs**.

The profiles structure our regional innovation performance analysis in a TH/QH perspective where both **publicly available quantitative data** and **qualitative aspects** are considered. These aspects are fairly comparable when publicly available quantitative data are used. This is not always the case for the analysis of qualitative aspects, as these may vary across regions and the same aspect may

be discussed with a different emphasis, depending on the region, or using different sources of available information.

The research method is based on desk review of documents and literature. Considered statistics are gathered from both European (e.g. Eurostat) and national sources. **Phone interviews** were carried out with representatives of the regional authorities of *Stockholm*, *Länsi-Suomi*, *Lazio* and *Extremadura* to fill information gaps (see the interview structure and the main findings in Appendix IV).

For each type of innovator, a **characterisation of the type** precedes the description of the profiles. The characterisation is grounded on the assessment of the quantitative (sub-indexes values) and qualitative (narrative) information gathered. The qualitative information is interpreted against the presence/absence in each concerned region of specific conditions related to governance, business and academic environments, interaction levels, and civic engagement.

2.4.1 Advanced innovators

Figure 6. Topological representations of the leading spheres of the innovation space in ADV innovators, in the sample (4 regions) and in Europe (13 regions)

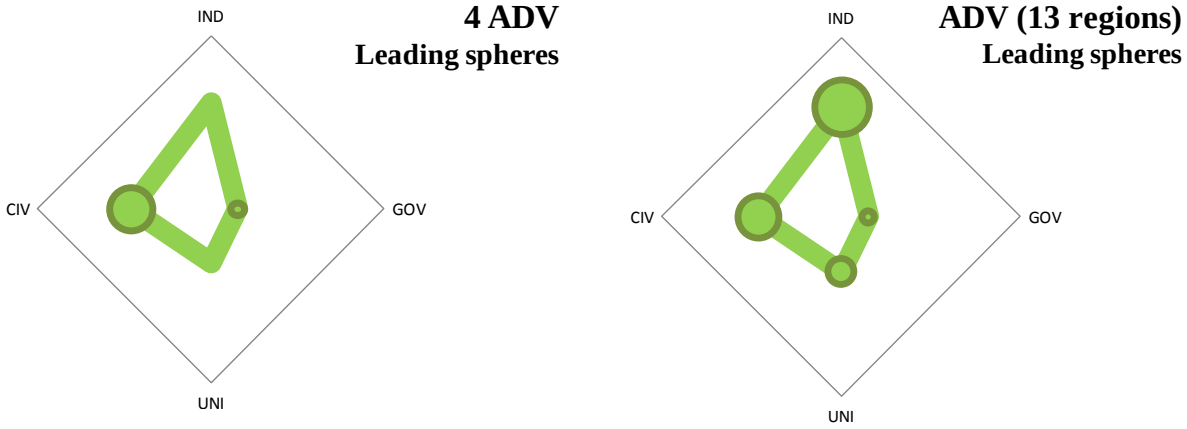
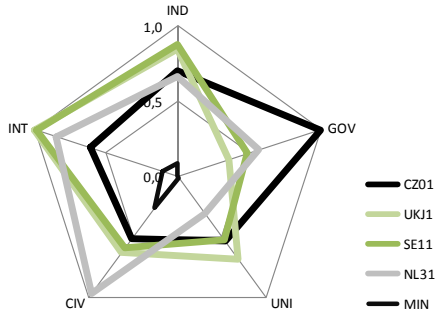


Figure 6 shows that the CIV sphere has a leading role in the four selected advanced regions. This is in line with the fact that, in general, the QH approach is more matured in this innovator type with respect to the other types. Each of the selected ADV is a leader in at least one sphere (CIV, GOV and/or INT). Their QH shapes are characterised by some marked peaks and by a low contribution to the

Figure 7. Overlapping of the radar charts of the 4 ADV innovators in the sample



innovation performance of one of the four helices (Figure 7). This last feature makes the shape of the selected ADV's radar chart resemble a quadrangle more than a pentagram.

Within the sample, a strong similarity in the shape (i.e. QHII performance) is noted between *Stockholm* (SE11) and Berkshire, Buckinghamshire and Oxfordshire (UKJ1) on one side (green lines in Figure 7), and between *Utrecht* (NL31) and *Praha* (CZ01) on the other side (grey lines in Figure 7). In the Swedish and British regions, there is a well-structured process of knowledge exchange and transfer of know-how among the actors of the helix models (innovation interaction), a marked industrial relevance, and a good civil society engagement. On the other hand, the Czech and Dutch regions have the same value of the QHII (0.672) but a generation process based on opposite spheres. *Praha* has its best performance in GOV with CIV being the 'flattening' sphere. *Utrecht* has the worst performance in GOV and the best in CIV, a condition which may be linked to the regime of the helix model in force in the region. In fact, **advanced innovators' charts clearly show the existence of a prevailing regime as they have clearly marked peaks**, a fact which points to a 'pulling' effect of one or more of the spheres. A more advanced performance in terms of innovation is pulled by at least two of the helices (the peaks of CIV and INT in NL31, for example, or of IND and INT in SE11).

In addition to the quantitative assessment, the four regional profiles described hereinafter provide some qualitative information. By assessing this qualitative information in a structured manner, inclusion in the 'advanced' group seems to be characterised by several or all of the following prevailing conditions:

- presence of governance conducive to innovation;
- science and knowledge excellence and/or assets;
- business concentration;
- hosting on the territory of world-leading businesses/companies;
- high reliance of the economy on technology and/or knowledge intensive industries;
- relevant ICT-based industry;
- and the presence of hybrid organisations which allow a structural interaction among the various helices.

Qualitative data confirm the emphasis given in *Stockholm* (SE11) and *Utrecht* (NL31) to civil society participation in the helix model, which supports the

assumption derived from the interpretation of the shapes that these two regions are moving from a TH model towards a QH approach.

- Berkshire, Buckinghamshire and Oxfordshire (UKJ1–ADV)

Facts & Figures

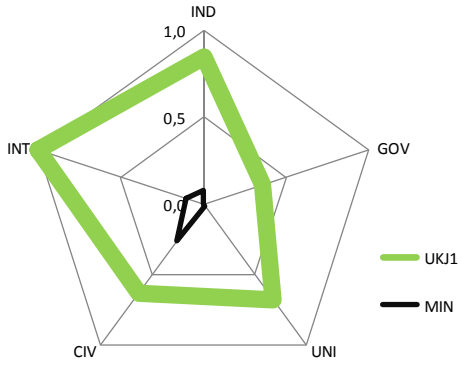
Size: 5,743.4 km^2 (2015)
Population: 2,349,644 (4 % of national) (2015)
Regional GDP (% of national GDP): 5.0 (2014)
Unemployment (%): 3.4 (2015)
Regional GERD (euro/inhabitant): 1,536 (2013)
Broadband access (% households): 96 (2015)

Innovation boosting factors: Thames Valley Berkshire (TVB): strong tech-based economy significantly characterised by internationalisation and the role of corporates. Buckinghamshire Thames Valley (BTV): key industrial sectors, strong knowledge economy. Oxfordshire (Ox): science and knowledge excellence and high-technology economy.

Potential challenges affecting regional innovation performance: TVB: underdeveloped business to business networks and 'soft networks' due to the lack of 'aggregating' urban centres; congested transport and communications infrastructures. BTV: infrastructures deficiencies (including broadband), skills loss (brain drain), limited skilled workforce, lack of public sector research infrastructure, and weak business growth. Ox: limited business growth, limited skilled workforce, constrained digital connectivity especially in the rural areas, limited physical space for business development, lack of affordable housing, limited support given to business.

Innovation positioning

RIS (2014): (South East - NUTS1 - Leader)
QH innovation profile: advanced
QH innovation index value: 0.703
Leading sphere: INT



Sources: Eurostat, S3 Platform, the Strategic Economic Plans of OxLEP, BTVLEP and TVBLEP.

Strengths and weaknesses vs. the operationalization of the TH/QH, by helix

► ***Government***

In England, there is a single S3 (UK Department for Business Innovation and Skills, 2015) applicable at the regional level and developed on the basis of a TH model (government, businesses, research institutions). The strategy sets out the

main priorities for investment in innovation, lists other policies and programmes that support business innovation, helps Local Enterprise Partnerships (LEPs) and their partners to identify opportunities and collaborate across England and beyond, and helps to align the activities funded through the ESIF with other research and innovation programmes. The LEPs are voluntary local collaborations established in 2011 which bring together local authorities, businesses and other stakeholders to promote economic growth in their territories. LEPs were asked to contribute to the strategy through the preparation of Strategic Economic Plans (SEPs) which were inclusive of **proposals to support innovation.** There are currently 39 LEPs across England, three of which refer to Berkshire, Buckinghamshire and Oxfordshire (UKJ1). These are the **Oxfordshire LEP** (OxLEP), a partnership between businesses, academia and the public sector which is driving economic development across the county; the **Buckinghamshire Thames Valley LEP** (BTVLEP), a business-led 'partnership of equals' between the local government and the private sector, building the conditions for sustainable economic growth in the county; and the **Thames Valley Berkshire LEP** (TVBLEP), another business-led partnership. The SEP of OxLEP is strongly grounded on the collaboration between the TH actors and centred on innovation-led growth which relies on the "*University research and development capacity, business collaboration and supply chain potential*" (OxLEP, 2014). Namely, the approach to growth is based on four objectives: 'innovative enterprise', 'innovative people', 'innovative place' and innovative connectivity'. The SEP of BTVLEP was developed on the basis of "*a process of open innovation, seeking out the best ideas from the public, private, third and academic sectors to deliver projects which offer the greatest growth impact*" (BTVLEP, 2014). It prioritises, among other targets, the acceleration of innovation in key industrial companies. Also the SEP of TVBLEP was based on the dialogue between authorities, businesses and other stakeholders. As part of the 'Enterprise, Innovation and Business Growth Programme', the targets are to strengthen soft networks with a view to facilitate innovation and "*to ensure that knowledge is effectively commercialised and grown in TVB, noting that we have never had a science park and that our network of business incubators and co-working space merits further development*" (TVBLEP, 2014).

► ***Industry***

[+] The economic success of the region is fuelled by a combination of scientific and cultural assets, entrepreneurial spirit, and leadership in some of the eight 'great technologies' of the future which were outlined in 2013 by the UK Government to support national science and business growth.

[+] R&D expenditure in the industry (business) sector was 2.14% of GDP in 2013 and on a growing trend since 2009 (1.95%) (Eurostat data).

[+] Oxfordshire shows "*strengths across a broad base of knowledge-intensive sectors: satellite and data tracking; biomedical engineering; pharmaceuticals and advanced manufacturing, as well as medical software for managing healthcare technology and service*" (OxLEP, 2014). The biotech sector in particular is exploiting a development strategy based on the TH model (Lawton Smith and Bagchi-Sen, 2010). Additionally, Oxfordshire is part of "*UK's 'Golden Triangle' of innovation intensive economic potential with Cambridge and London*"[11] and represents one of the "*top 5 technology innovation ecosystems in the world*" (OxLEP *et al.*, 2014).

[+] The UK Competitiveness Index 2013 considers the TVBLEP as "*the most competitive LEP area in England*" (TVBLEP, 2014, quoting Huggins & Thompson). The UK headquarters of global industrial players such as Microsoft, Oracle, Verizon, Vodafone, Telefonica, Fujitsu, Mars, Johnson & Johnson and Honda are located in Berkshire (TVBLEP website).

[+] Buckinghamshire defines itself as "*the Entrepreneurial Heart of Britain*", with an over-representation in Construction, Space, Creative Industries, HighTech Manufacturing, Aerospace, Life Sciences, Education, Information Economy and Business Services (BTVLEP, 2014). It is also home to the Silverstone circuit, a leading cluster of high-performance technology.

► ***University***

[+] In the three counties there are a number of strategically important assets, including the University of Oxford (ranked 2nd nationally and 5th globally), the Oxford Brookes, the Reading University, the University of Surrey, the University of Buckinghamshire, the New Bucks University and their associated research infrastructures.

[+] The University of Oxford has the world's biggest biomedical research centre which is classified globally as number one in terms of clinical, pre-clinical and health sciences. Its strength in this research sector is highlighted by having 23 Nobel Prize Winners in medicine and chemistry (OxLEP, 2014).
[+] R&D expenditure in the higher education sector increased from 0.70% of GDP in 2005 to 0.95% in 2013 (Eurostat data).

► ***Hybrid organisations and structural interactions***

The **Science Vale** [UNI-IND] in Oxfordshire, "*has the largest concentration of research and development activity in Western Europe*" (OxLEP, 2014) with the

[11] See: http://www.oxfordshirelep.org.uk/content/key-sectors

Harwell Campus being home to the UK's space industry and to an innovation centre (the Harwell Innovation Hub) whose focus is to promote open innovation. The **Oxford BioEscalator** [UNI-IND] "*is an incubator space designed nurture small spin-off companies in the life science sector with the capacity to grow into mid-sized companies*" (OxLEP *et al.*, 2014). The **Begbroke Innovation Accelerator** [UNI-IND], located at Begbroke Science Park, focuses on advanced engineering sectors (e.g. robotics, nano-medicine, supercomputing) through the successful integration of the academic and business communities. The **ECO Bicester LivingLab** [UNI-IND-GOV-CIV] is a partnership between the Oxford Institute for Sustainable Development and Bioregional (a charity and social enterprise) which collaborates mainly with the Cherwell District Council (local authority) and a private housing company (A2Dominion). The LivingLab is experimenting with new ways of organising communities for the promotion of a 'sustainable town' concept.

Bottom-up civic participation contributing to innovation output

UK counties authorities usually run very user-friendly websites where 'Have your say' and 'Consultation' sections are included to allow the direct participation of citizens on a number of topics, including policymaking. At the time of writing, for example, the Buckinghamshire County Council is running five consultations.

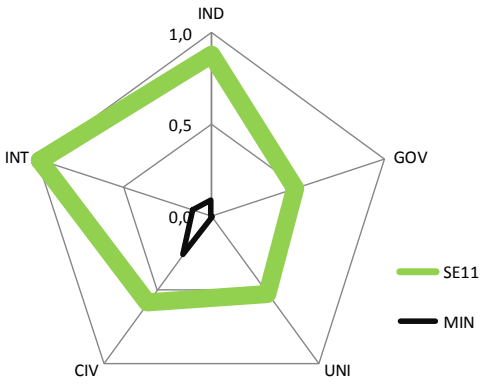
- *Stockholm* (SE11–ADV)

Facts & Figures

Size: 6,779.0 km^2 (2015)
Population: 2,198,044 (23% of national) (2015)
Regional GDP (% of national GDP): 31.5 (2014)
Unemployment (%): 7.0 (2015)
Regional GERD (euro/inhabitant): 2,466 (2013)
Broadband access (% households): 85 (2015)

Innovation positioning

RIS (2014): Leader
QH innovation profile: advanced
QH innovation index value: 0.693
Leading sphere: INT



Innovation boosting factor: competitiveness on a global level. As a Capital Region, Stockholm is host to main businesses and universities. It has educated workforce and modern infrastructure. It is a

wealthy and productive economy, with important technology-intensive industries. Trade is a major driver of growth.

Potential challenges affecting regional innovation performance: an ageing population, implying possible future shortcomings in workforce supply; limited availability of housing with respect to demand; innovative potential of SMEs not fully exploited.

Sources: Eurostat, S3 Platform, The Brookings Institution (2015).

Strengths and weaknesses vs. the operationalization of the TH/QH, by helix

► *Government*

According to the 2011 Regional Innovation Report, *Stockholm* has a strong innovation structure which is mainly based on academic and scientific research focusing on ICT and life science (Lindqvist and Baltzopoulos, 2011). In 2011, the county's authorities, with the co-funding of the Swedish National Agency for Innovation Systems 'Vinnova', started the project 'Innovation Power Sthlm' aimed at addressing the lack of regional coordination for innovation development and at preparing a regional innovation strategy. The '2025 *Stockholm*' strategy (2012), developed through the involvement of main stakeholders, policy-makers and university representatives, was launched in 2012 together with an Action Programme. The strategy's focus is on: i) further investing in research and innovation infrastructure in order to enable proof of concepts in the most realistic environments as possible; ii) expanding innovation procurement, as a tool to drive innovation, especially among SMEs; iii) expanding the supply of capital, in particular in the early stages of new innovation businesses; iv) encouraging a cross-sector approach; and v) globally promoting the attractiveness of the region. Both the strategy and the programme reflect the QH approach, especially in the envisaged cross-sector exchanges of knowledge and ideas. These exchanges are aimed at boosting collaboration among universities, businesses, public actors and citizens through, for example, incentives for people to work together, or for establishing bottom-up collaborations.

► ***Industry***

[+] R&D expenditure in the industry (business) sector was well above the EU28 average of 1.29% in 2013 (2.84% of GDP) and on a growing trend since 2009 (2.59%) (Eurostat data).

[–] Employment in technology and knowledge intensive sectors decreased from 8.5% of total employment in 2010 to 7.9% in 2014 (Eurostat data). R&D personnel in the business sector also decreased in the last decade, from 2.24% of total employment in 2005 to 1.82% in 2013.

[+] The region's main business strengths are in niche areas of relatively high-tech sectors such as ICT, Knowledge Intensive Business Services, CleanTech & Professional Services, and Research Expertise (Karlsson *et al.*, 2015).

[+] The region enjoys innovation benefits from some research-intensive companies located in Stockholm, such as Ericsson, IBM Svenska and Telia-Sonora in the ICT sector; and AstraZenec and Pfizer in the life science sector (Lindqvist and Baltzopoulos, 2011).

► ***University***

[+] The region accounts for a total of 19 HEIs including a number of strong research institutions and internationally competitive clusters.[12]

[+] *Stockholm* hosts three globally important universities: *Karolinska Institutet* (ranked 1st nationally and 71st globally), KTH – The Royal Institute of Technology (ranked 4th nationally and 126th globally) and the *Stockholm* University (SU) (ranked 5th nationally and 168th globally).[13] They were the major beneficiaries of the Seventh Framework Programme (FP7) funds absorbed by the region and equalling 40% of the budget granted to Swedish participants (Karlsson *et al.*, 2015).

[+] R&D expenditure in the higher education sector increased from 0.74% of GDP in 2005 to 0.87% in 2013 (Eurostat data).
[+] *Stockholm* Academic Forum is a co-operative organisation allowing for co-operation among the 19 HEIs on information and awareness, marketing, analysis, and networking (Lindqvist and Baltzopoulos, 2011). The City of *Stockholm* is also involved in the forum as a partner.

[12] See Innovation Stockholm factsheet
[13] For world universities' ranking at the global and national level, the reference throughout the report is to the Center for World University Rankings available at http://cwur.org

► ***Hybrid organisations and structural interactions***

There are several cases of hybridization/interaction in the region, including:

- ***Stockholm* Business Region (SBR)** [IND-GOV] is a company owned by the City of Stockholm which has the aim of promoting clusters and a TH approach in the region (OECD, 2013).

- **SU Innovation** [UNI-IND], funded by *Stockholm* University and other public and private partners, offers services to researchers and graduate students to develop entrepreneurial skills and establish businesses and start-ups. It also promotes social innovation and acts as an incubator.

- ***Stockholm* Innovation and Growth (STING)** [UNI-IND-GOV], established in 2002, is a business incubator focusing on start-ups which operate for the most in ICT, internet and media, cleantech and life science.[14]

- **KISTA collaboration platform and ICT cluster** [UNI-IND-GOV] is a TH co-operation which has been in operation for some 30 years, so that the TH model is often referred to as the 'Kista model'. Notwithstanding the continuous growth of the Kista Science City, a critical review of the cluster pointed to the fact that "*KSC had not invested enough in networking, cross-pollination and peer learning between companies*". This shortcoming was successfully addressed through an ERDF co-funded project which established a network among Chief Executive Officers of SMEs, a "*peer learning network for specialists*", and a project-based cross-pollination between ICT and audio-visual industries.[15]

- **Stockholm Living Lab** [UNI-IND-GOV] is based on a TH approach and implements projects based on user involvement and user innovation (with a focus on homecare and elderly care). Its activities range from the commercialisation of the research results of the partnering institutes, to marketing and business support in terms of provision of test-beds and proof of concept tools.[16]

Bottom-up civic participation contributing to innovation output

The *Utveckla din stad* ('Develop your city') platform has been established within OPENLAB, i.e. "*a creative centre that provides opportunities for finding solutions to challenges in society*". The platform invites citizens to contribute to

[14] See: http://www.stockholminnovation.com/
[15] See: http://ec.europa.eu/regional_policy/en/projects/best-practices/sweden/2689
[16] See: http://www.openlivinglabs.eu/livinglab/stockholm-living-lab

the identification of societal challenges (e.g. ageing, healthcare, sustainable urban development) and to look for and/or create solutions through the interdisciplinary collaboration of different actors (students, researchers, professionals, end-users). Openlab is founded by the City of *Stockholm*, *Stockholm* County Council, *Stockholm* County Administrative Board, *Karolinska Institutet*, *Stockholm* University, KTH Royal Institute of Technology and *Södertörn* University.

- *Praha* (CZ01–ADV)

Facts & Figures

Size: 496.0 km^2 (2015)
Population: 1,259,079 (2015) (12% of national)
Regional GDP (% of national GDP): 24.3 (2014)
Unemployment (%): 2.8 (2015)
Regional GERD (euro/inhabitant): 804 (2013)
Broadband access (% households): 88 (2015)

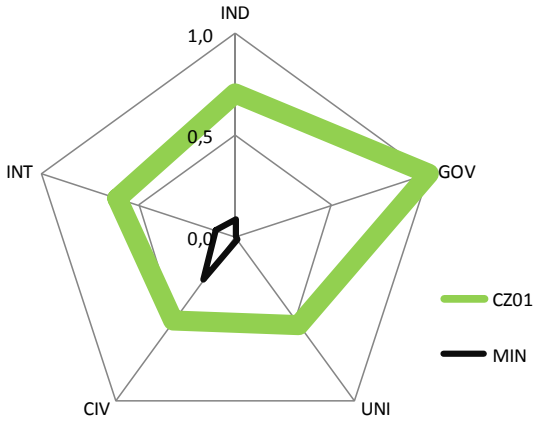
Innovation boosting factor: *Praha* as a Capital Region. *Praha* generates almost a fourth of the national GDP essentially from the service sector. Because of a high concentration of knowledge, the region has shown economic growth dynamics which are significantly higher than the national average. Additionally, the city of Prague, the only urban area of the *Praha* region (CZ01), hosts the main authorities of the state administration as well as the most important financial institutions and foreign enterprises.

Potential challenges affecting regional innovation performance: The structural lack of co-operation and mutual awareness among innovation actors hampers the exploitation of R&D results and of concentration of knowledge, which is then reflected in a decreasing number of EPO patent applications.

Sources: Eurostat, S3 Platform.

Innovation positioning

RIS (2014): Moderate
QH innovation profile: medium
QH innovation index value:0.672
Leading sphere: GOV



Strengths and weaknesses vs. the operationalization of the TH/QH, by helix

► ***Government***

The Prague Innovation Strategy (Prague RIS3), elaborated by the Prague Institute of Planning and Development (Prague IPD) and released in September 2014, manifests a concrete awareness towards the need and potential benefits of improving the collaboration among the key players of the Triple Helix (universities, enterprises and government). Nevertheless, no explicit reference is made to a structural involvement of civil society in the production of knowledge and innovation. The strategy outlines the strategic sectors for regional innovation according to the analysis of the key actors and of the structural features of the region. One of the important considerations made points to a scarce and poorly planned public expenditure in R&D. Initiatives undertaken by the city of Prague to explicitly support innovation are limited and small-scaled (e.g. an innovation voucher project in 2013). Additionally, the Prague RIS3 underlines that the EU structural funds also had too broad of a focus and that funded projects typically lacked sustainability. According to the S3 Platform, selected priority areas for the smart specialization of the region are: 1) Pharmaceutical & clinical research, bio-materials & molecular biology, 2) Digital media, mobile applications, visualisation and design, production & distribution of media products; 3) Internet & IT-based services; 4) Smart energy; 5) Business consultancy; 6) Aerospace; and 7) Research consultancy, technology services, qualified human resources and creative services. Strategic challenges and lines of actions identified in the Prague RIS3 are: a) creating an "*Environment stimulating innovation and functioning partnerships*"; b) boosting initiatives regarding the "*Simplified creation and development of knowledge-intensive companies*"; c) fostering a "*More intensive development of local human resources for the needs of the knowledge economy*"; and d) "*Increasing intensity of internationalization in research and innovation*". The Prague IPD has been created to effectively support regional strategic planning and foster co-operation among different actors. The institute is funded by the city hall and has the main tasks of preparing conceptual documents and strategic planning and supporting the implementation of selected projects of the innovation strategy. Within the Prague IPD, the Communication and Presentation office aims at establishing open communication and active co-operation with citizens and other stakeholders.

► ***Industry***

[+] The regional economy is characterised by a high share of services, in particular knowledge-intensive ones; companies located in Prague generate almost 40% of the national business revenue.

[-] R&D expenditure in the industry (business) sector was 0.95% of GDP in 2013 (Eurostat data). This share is well below the EU28 average of 1.29% in the same year.

[+] In the city of Prague there are several knowledge intensive and highly specialised companies working in particular in the fields of chemical and pharmaceutical industry (e.g. Zentiva, Sanofi-aventis sro, PRO.MED.CS Praha a.s., Interpharma a.s.), manufacturing of specialised electrical and optical equipment (e.g. Siemens), manufacturing of transport equipment (e.g. Stadler Praha sro) - in particular related to aviation technologies -, and ICT technologies (e.g. T-mobile Czech Republic). In the city, large enterprises rather than SMEs have to be considered key actors of the innovation systems as they are the major investors in private R&D.

[+] The city of Prague has a very high share of skilled workforce, with 84% of its population having a university degree or full secondary education.

[–] In 2013, the region of Praha hosted 239,861 active enterprises (excluding insurance activities) (Eurostat data) out of which only 6.93% had been operating for more than three years.

► ***University***

[+] *Praha* hosts about one fourth of the national R&D employees (27%, corresponding to 22,164 full-time equivalents) with a clear focus on science (Prague IPD, 2014).

[+] R&D expenditure in the higher education sector increased from 0.42% of GDP in 2005 to 0.59% in 2013 (Eurostat data).

[+] Praha region hosts 8 public universities, 40 institutes of the national Academy of Sciences, and 50 other research bodies.

[+] There are 32 public and private universities in the region, enrolling 100,000 and 30,000 students, respectively (RIS3 peer review, 2013). Among other major universities, the city of Prague hosts the best nationally ranked university (270th globally), Univerzita Karlova v Praze.

► Hybrid organisations and structural interactions Inovacentrum [UNI-IND] was founded in 2010 by the merging of two companies, the Technological and Innovation Centre and the Business Co-operation Centre. It is run cooperatively by several entities including the Czech Technical University, the Technology

Centre ASCR (providing technology transfer services), the science and technology parks IBC IEM ASCR and STP VZLÚ Prague, a business incubator for entities in aerospace, automotive, transportation and military industries (Prague IPD, 2014). Inovacentrum also hosts the Enterprise Europe Network Center of Czech Republic.

Bottom-up civic participation contributing to innovation output

There is a perceived lack of co-operation among the key players of the TH, which is even more evident in the case of interactions and involvement of the civil society. To foster civil society participation some initiatives are currently being drafted by the Prague IPD, in particular in the field of public spaces conceptual design (e.g. Vinohradská Street reconstruction).

- *Utrecht* (NL31–ADV)

Facts & Figures

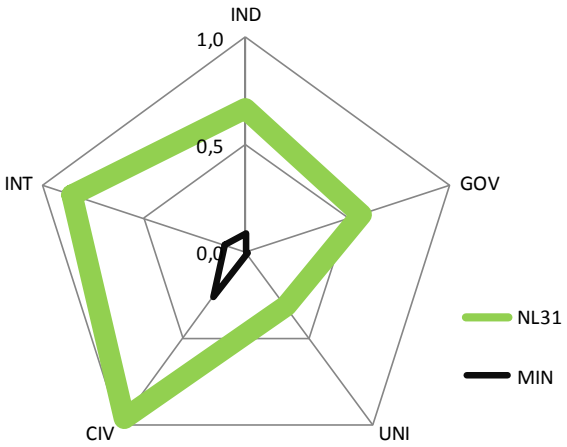
Size: 1,449.0 km^2 (2015)
Population: 1,263,572 (7% of national) (2015)
Regional GDP (% of national GDP): 8.8 (2014)
Unemployment (%): 6.4 (2015)
Regional GERD (euro/inhabitant): 1,074 (2013)
Broadband access (% households): 96 (2015)

Innovation boosting factor: sustainable system innovations. *Utrecht* has extensive sustainability expertise, robust knowledge assets, and strong capabilities for the development of ICT-based information systems and integrated system innovations. It is an ideal test-bed for sustainable innovations in urban environments.

Potential challenges affecting regional innovation performance: the provincial government has limited resources for innovation policy development; the province relies mostly on the service industry which may not boost the full potential of technological innovation. The

Innovation positioning

RIS (2014): Leader
QH innovation profile: advanced
QH innovation index value: 0.672



province's small size implies a limited internal market for services while national and international exports are dependent on economic trends; the connection of the service economy with the academic sector is not optimised.

Sources: Eurostat, S3 Platform, Government of the Netherlands' website, RIM + (2014a).

Strengths and weaknesses vs. the operationalization of the TH/QH, by helix

► ***Government***

According to the Regional Innovation Report, the province of *Utrecht* has a very limited budget and mandate for innovation policy. Despite this, its 2012 strategy for smart specialisation gained a broad consensus around the three identified priorities of Life Sciences, Creative Industry and Sustainability (RIM+, 2014a). At the national level, innovation policy development has been based on a TH model of exchange between those businesses, research institutes and governments which were actively involved in the innovation process and were invited to form 'Top Consortia for Knowledge and Innovation'. At the provincial level, since 2012, the task of implementing *Utrecht*'s innovation policy has been given to the Economic Board *Utrecht* (EBU). The board reflects the TH model adopted at the national level as it includes representatives from local governments (i.e. province and main cities), academia, and industrial sectors with a joint *"main goal to create a green, healthy and smart region"* (EBU, 2013).

► ***Industry***

[+] Utrecht is a wealthy, business-oriented province. It has a well-developed service sector with a strong focus on sustainability, life sciences and health, and on the creative industry (RIM+, 2014a).

[+] Its economy is characterised by highly educated workforce and by considerable high-productivity business networks.

[–] Employment in technology and knowledge intensive sectors decreased from 5.5% of total employment in 2010 to 5.0% in 2014 (Eurostat data).

[+] R&D personnel in the business sector significantly increased in the last decade, from 0.85% of total employment in 2005 to 1.69% in 2013.

[+] Its ICT (software and services in particular) sector is one of the most promising. The province is home to world-leading ICT companies such as Oracle, Capgemini, CSC, Asus and Fujitsu.

[+] The game development sector is strategic for *Utrecht*. Nintendo, Ubisoft, Vlambeer, Ronimo Games, and Game Oven have located offices in the province, making it the capital of creative game development in the Netherlands.

► ***University***

[+] *Utrecht* hosts several research-based organisations, including the Netherlands' biggest university (the University of Applied Sciences Utrecht, ranked 2nd nationally and 87th globally), the academic *Utrecht* Medical Centre, the National Institute for Public Health and the Environment (RIVM), and the Royal Meteorological Institute (KNMI) (RIM +, 2014a).

► ***Hybrid organisations and structural interactions***

The **knowledge infrastructure** is well developed and multi-disciplinary. It includes "*extensive expertise in accelerating the implementation of system innovations in society*" (*Utrecht* Region, 2012). In order to increase economic growth, added value was identified in cross-sectoral co-operation and connection (EBU, 2013).

Various innovation facilitators are found in the province (RIM+, 2014a), such as:

- The **Utrecht Science Park (USP)** [UNI-IND], funded in 2011 by *Utrecht* University, *Utrecht* University of Applied Sciences, the province of *Utrecht* and the municipality of Utrecht, is currently sustained financially with the contributions of the private sector. Its core mission is to develop an eco-system for innovation in the *Utrecht* University's campus which also houses different types of enterprises from start-ups to multinationals (i.e. Danone).

- **Utrecht Inc.** [UNI-IND-GOV] is an autonomous incubator hosted in the *Utrecht* University's campus, created by the municipality of *Utrecht*, the University of *Utrecht* and the University of Applied Sciences, and merges a set of initiatives aimed at facilitating innovation. *Utrecht* Inc. provides housing and facilities to academic and innovative start-ups and also offers services to support fund-raising and licensing. Furthermore, it hosts ICT-related organisations such as the national professional association 'ICT Nederland' and the network organisation 'SkillCity'.

- **Utrecht Life Sciences (ULS)** [UNI-IND] connects research organisations and enterprises operating in veterinary, public health, urban healthy living and food. ULS acts as facilitator between scientists and entrepreneurs but also supports researchers in starting their own enterprises, and in disseminating medical and public health knowledge to the general public.

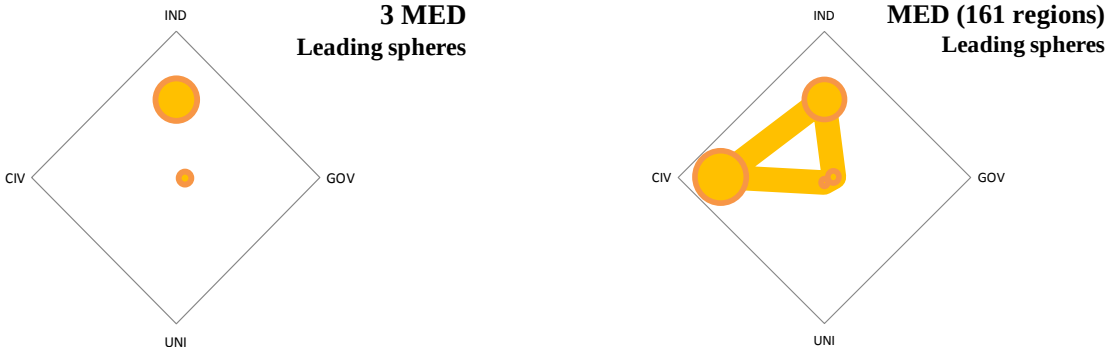
- The **Utrecht Sustainability Institute (USI)** [UNI-IND-GOV] has the mission of developing a commercial cluster on sustainability in the province, which focuses on urban environments, climate change and energy savings. As a multi-stakeholder network, it aims at connecting the Utrecht universities, governmental research institutions (i.e. RIVM, KNMI, and TNO), business partners, and the planning bureau for the urban environment.

Bottom-up civic participation contributing to innovation output

The *Utrecht* Development Board (UDB) promotes the development of the city of Utrecht by connecting businesses, civil society organisations and local authorities. Several actions are implemented to allow interactions and contributions of civil society such as: i) city labs for continuous education ii) initiatives for developing corporate social responsibility and social entrepreneurship with the support of the University of *Utrecht*, the Young Leaders League, the Kenniscentrum MVO Nederland, and the Stichting Move; iii) initiatives aimed at connecting culture and creative industries (i.e. the Dutch Game Garden, the incubator StartNU); iv) initiatives aimed at periodically bringing together private and public stakeholders in order to have pro-active positions in the national debate and to have opportunities for networking (i.e. Administrative Jazz Café); v) growing up of Young UDB to recruit young talents with a view to use creative ideas in addressing concrete issues experienced by the city.

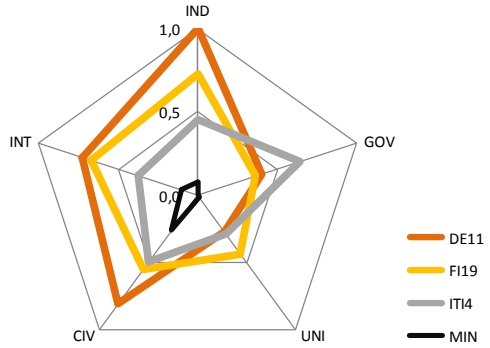
2.4.2 Medium innovators

Figure 8. Topological representations of leading spheres of the innovation space in MED innovators, in the sample (3 regions) and in Europe (161 regions)



The three selected medium innovators are led by IND and, to a lesser extent, GOV (Figure 8). The shapes of the three regions suggest that *Stuttgart* and *Länsi-Suomi* have an innovation model which relies on the same leading spheres while *Lazio* is GOV-oriented (Figure 9). More than for the advanced innovators, the shape of the medium innovators resembles a quadrangle rather than a pentagram, with the UNI as a common 'flattening' sphere.

Figure 9. Overlapping of radar charts of the 3 MED innovators in the sample



Stuttgart (DE11) and *Länsi-Suomi* (FI19) base their innovation performance on IND, CIV, and INT while *Lazio* relies more on GOV and CIV, with less satisfactory results. The knot of the QH where the four regions converge most is UNI. Even though the very modest values of this sub-index may be affected by the limited number of indicators available to assess the innovation performance of the academic sphere, the University sphere appears as the weak link of the innovation performance in this type, with the strongest role apparently being played by the business community. This is in line with traditional models where innovation is a prerogative of the IND sphere.

According to the qualitative information gathered in the regional profiles, the medium innovators show fewer commonalities than the advanced. Nevertheless, their characterising feature is the presence of business concentration; business networking, co-operation, and/or connection; and the presence of hybrid organisations.

- *Stuttgart* (DE11–MED)

Facts & Figures

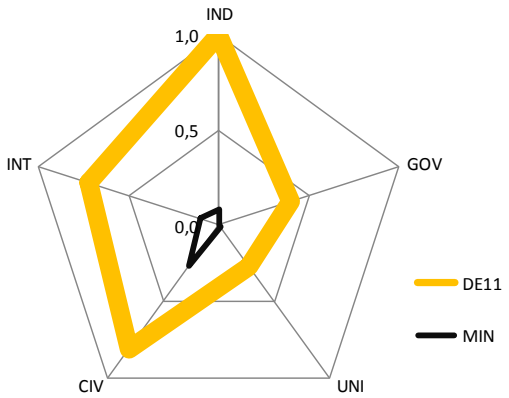
Size: 10,557.0 km^2 (2015)
Population: 4,008,288 (2015)(5% of national)
Regional GDP (% of national GDP): 6.3 (2014)
Unemployment (%): 3.3 (2015)
Regional GERD (euro/inhabitant): 2,632 (2013)

Innovation positioning

RIS (2014): (Baden-Württemberg - NUTS1 - Leader)
QH innovation profile: advanced
QH innovation index value: 0.641
Leading sphere: IND

Broadband access (/% households): 88 (2015 – NUTS1)

Innovation boosting factor: the industrial sector. Since the 1970s, *Regierungsbezirk Stuttgart* has been home to world-known industrial sectors (i.e. automotive) and to globally important companies. On a sub-regional level, the '*Verband-Region*' *Stuttgart*, is the most innovative area within the region, as well as in Europe and in the world, especially from a business perspective.



Potential challenges affecting regional innovation performance: in the near future it will be challenging for the region to keep pace with its past performance. According to a study of the McKinsey Institute (2010), innovation and economic growth are performing at an average level within the whole *Land Badenwürttemberg* and new measures and initiatives will be needed to make innovation and economic growth dynamics permanent.

Note: within the *Stuttgart* region (DE11 - *Stuttgart Regierungsbezirk*) there are three sub-regional entities or 'confederations': '*Region Stuttgart*', '*Region Heilbronn-Franken*' and '*Region Ostwürttemberg*'. '*Stuttgart*' in the text below is used to indicate *Stuttgart Regierungsbezirk.*

Sources: Eurostat, S3 Platform, Region Stuttgart (Verband-Region) website, *Ministerium für Finanzen und Wirtschaft Baden Württemberg* (2013).

Strengths and weaknesses vs. the operationalization of the TH/QH, by helix

► *Government*

There is no innovation strategy at the regional level since the strategy has been defined at the level of *Bundesland Badenwürttemberg* (NUTS1) and is based on the dialogue between the government, representatives from the industry, HEIs, and civil society. In particular, the strategy foresees the use of dialogue-oriented politics to dynamically develop the territory through the involvement of different actors from industry, university and research centres, networks and clusters, and labour and other organisations (*Ministerium für Finanzen und Wirtschaft Baden Württemberg*, 2013). Key priorities for the innovation development of the *Land* are sustainable mobility; environmental technologies, renewable energies and resource efficiency; health and health care; ICT, green IT, and intelligent products.

► ***Industry***

[+] R&D expenditure in the industry (business) sector was significantly above the EU28 average of 1.29% in 2013 (5.51% of GDP) and on a slight growing trend since 2009 (5.46%) (Eurostat data). Each day, companies from *Stuttgart* invest more than EUR 13 million in R&D.[17]

[+] *Stuttgart* hosts the headquarters of large-sized innovative and globally active companies such as Sony, Samsung, IBM as well as Mercedes, Daimler, Porsche, and Bosch, but also of well-established medium-sized companies such as Kärcher, Märklin, Stiehl and Trumpf. In particular, in the confederation of *Stuttgart*, key sectoral businesses relate to vehicle- and mechanical-engineering, IT, and creative services and industries such as architecture, games and software industry, film and music industry.

[+] In the confederation of *Ostwürttemberg*, the industry focuses on innovative future-technologies (photonics and optical technologies), surface engineering and automotive industry. Additionally, specialised textile enterprises like Triumph and SUSA produce for the global marketplace. Different business and technological centres as well as a number of clusters demonstrate the high innovation potential of the confederation.

[+] The confederation of *Heilbronn-Franken* has the highest density (in relation to the number of citizens) of global market leader businesses in Germany. The focus is on machine and automobile construction and electronic technology, with innovation being a leading driver of businesses development. Important research and development centres are, for instance, those of Bosch and Getrag.

[+] The Business Angels Region *Stuttgart* and the HiTURS project (for high-technology businesses) are examples of initiatives to increase the number of successful business created. Start-ups are mainly established in the field of knowledge-intensive businesses.

[+] The confederations of *Stuttgart* and *Ostwürttemberg* have the highest patent density in Germany (Eurostat data). The Innovation platform Ingenia in the confederation of *Ostwürttemberg* was established *ad hoc* to support talents and the development of patents.
[–] Employment in technology and knowledge intensive sectors decreased from 4.7% of total employment in 2010 to 4.5% in 2014 (Eurostat).

[17] See: http://campus.region-stuttgart.de/chapters/view/2/newsflash:608

► ***University***

[+] There are 33 HEIs and 8 research centres in *Stuttgart*, distributed as follows: 4 HEIs, 2 distance-learning universities, 3 research institutes and 20 knowledge-transfer centres affiliated with the Steinbeis Foundation (confederation of *Ostwürttemberg*); 3 HEIs (confederation of *Heilbronn-Franken*); 26 HEIs and 13 research centres/institutions (4 Fraunhofer, 2 Max-Plank Institutes and 6 DLR Institutes (German Aerospace Centre) (confederation of *Stuttgart*). In the three confederations, the number of graduates in engineering disciplines is very high.

[+] The HEIs of the three confederations allow students to combine theoretical learning with practical experience. This is possible due to the high number of companies located in the region and the fruitful co-operation between these companies and the universities.

[–] R&D expenditure in the higher education sector is below the EU28 average of 0.48% of GDP and only increased slightly from 0.22% of GDP in 2005 to 0.24% in 2013 (Eurostat).

► ***Hybrid organisations and structural interactions***

The *Stuttgart* Region Economic Development Corporation [UNI-GOV] is a publicly funded organisation cooperating intensely with businesses, universities and other stakeholders. It is the main contact for investors and companies in the confederation of *Stuttgart*. The same type of economic development co-operation has been established in the other two confederations. In the ***Stuttgart Verband Region* PUSH!** [UNI-GOV], a network of universities, research centres, industry, financial institutions and other actors supports technological- and knowledge-intensive start-ups from the region's academic environment. The network is coordinated and supported by the Wirtschaftsförderung Region Stuttgart GmbH. Within the confederation of *Stuttgart*, innovation through a TH approach has been achieved through the Competence and Innovation Centre Initiative. The competence centres are meant to be instruments for economic development through the facilitation of network creation and collaboration between industry, university and public authorities (EURIS project, 2012). There are 11 **Competence Centres** (*Kompetenzzentren Stuttgart*) [UNI-IND-GOV] located across the region, covering four thematic fields (plant construction and engineering, information and communication systems, logistics/mobility). There are also several innovation initiatives driven by public authorities, such as the ***Pakt Zukunft*** [UNI-IND] in the confederation of *Heilbronn-Franken*. Established in 2007 as an association between the municipalities and industry, the *Pakt* supports and finances projects and

initiatives related to innovation, education, infrastructures, and assistance to the elderly (website). Strong interaction between university and industry is achieved through initiatives such as the **association of HEIs and the Stuttgart Economic Region** (Verein Hochschul-und Wissenschaftsregion Stuttgart e.V.) [UNI-IND-GOV]. This initiative was launched in 2011 to enhance co-operation between universities, research centres and private R&D institutes (e.g. Sony, Samsung, Mercedes, IBM, Porsche, Stiehl, and Kärcher).

Bottom-up civic participation contributing to innovation output

The '*Beteiligungsportal*' is a platform which exists on different administrative levels (NUTS1, NUTS2, and district level) and allows for citizen information and participation in public initiatives.

- *Länsi-Suomi* (FI19–MED)

Facts & Figures

Size: 64,763.0 km^2 (2015)
Population: 1,377,281 (25% of national)(2015)
Regional GDP (% of national GDP): 22.6 (2014)
Unemployment (%): 9.8 (2015)
Regional GERD (euro/inhabitant): 1,092 (2013)
Broadband access (% households): 87 (2015)

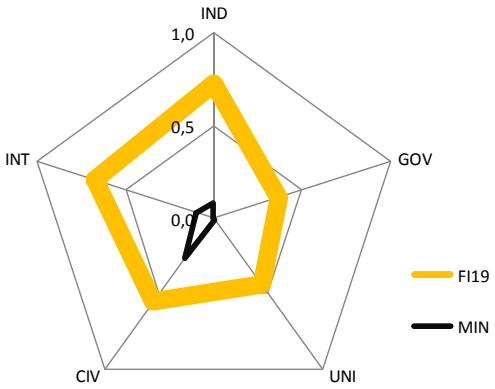
Innovation boosting factors: a robust industrial sector. Second best performer in the country in economic terms, and the most industrialised. Centrality of the large municipalities creates a critical mass for innovation. High broadband access guarantees effective social and economic interactions.

Potential challenges affecting regional innovation performance: unemployment and an overall decreasing trend in industrial production; increasing of ageing population.

Sources: Eurostat, S3 Platform, RIM+ (2014b).

Innovation positioning

RIS (2014): Leader
QH innovation profile: medium
QH innovation index value: 0.551
Leading sphere: IND



Strengths and weaknesses vs. the operationalization of the TH/QH, by helix

► ***Government***

Governance of innovation is managed at both national and regional/local level. The central level defines the general guidelines while regional councils and municipalities have the role of preparing regional development programmes. From 1994 to 2013, the main national instrument for regional innovation policy in Finland was the **Centre of Expertise programme (OSKE)**. New innovations, products and services to support specialisation and international competitiveness in the regions were the key actions of the programme. OSKE covered topics such as: digital business, energy technology, food development, forest industry, health-bio, health and wellbeing, intelligent machines, maritime, nanotechnology, tourism and experience management, and ubiquitous computing. In 2014, OSKE was replaced by the **Innovative Cities programme 2014-2020 (INKA)**. INKA aims at generating internationally attractive innovation clusters at the local and regional level which are "*able to create brand-new products and services for the international market"* (Tekes, the Finnish Agency for Technology and Innovation website); and at fostering co-operation of science/education, business and the government in a Triple Helix approach (Ministry of Employment and of Economy website). In the programme, five national themes are defined: bio-economy; sustainable energy solutions; future health care; smart cities and industrial regeneration; and cyber security. Each of these themes is developed by one urban region with the support of the others. *Länsi-Suomi* leads the theme 'Sustainable energy solutions' with *Vaasa*, 'Smart cities and industrial regeneration' with *Tampere*, and 'Cybersecurity' with *Jyväskylä*. *Länsi-Suomi* has not produced a smart specialisation document although one of its sub-regions, *Ostrobothnia*, provided an important contribution to the modelling of smart specialisation with the development - in the framework of a project carried out from 2012 to 2014 - of a method for measuring Quadruple Helix connectivity and relationships (Virkkala *et al.*, 2014).

► ***Industry***

[+] *Länsi-Suomi* is the second best performing region in Finland in economic terms and the most industrialised one. Machinery, pulp and paper, shipbuilding and energy are the key sectors (RIM +, 2014b).

[+] R&D expenditure in the industry (business) sector was well above the EU28 average of 1.29% in 2013 (2.40% of GDP) although on a decreasing trend since 2009 (2.97%) (Eurostat data).

[+] The share of SMEs which are technological innovators (more than 70%) is higher than in Finland (about 62%) and well above the EU27 average of 40% (RIM +, 2014b).

► ***University***

[+] There are four main universities in the region, all ranking below the 440th position globally: Tampere University of Technology, University of *Jyväskylä*, University of Tampere, and University of Vaasa. In addition, several minor universities and public sector institutes are located in the region (RIM +, 2014b).

[+] R&D expenditure in the higher education sector is above the EU28 average of 0.48% of GDP and slightly increased from 0.60% of GDP in 2005 to 0.68% in 2013 (Eurostat data).

[+] In *Ostrobothnia*, a shared regional technology platform between universities and companies allows for continuous co-operation and interaction (Virkkala *et al.*, 2014).

► ***Hybrid organisations and structural interactions***

The **Business out of Innovations - Pirkanmaa** project [GOV-IND] promoted by the Tampere Region Economic Development Agency Tredea and carried out from 2011 to 2013, aimed at supporting small and medium-size businesses in technology fields in bringing their innovation ideas to the market. The main source of ideas was determined by the needs of users. The initiative sustained SMEs with a 50% share of the development cost.

Demola [UNI-IND] is a network which has outgrown the national boundaries and today has an international and interdisciplinary dimension. The network allows for co-operation and co-creation among universities, researchers, students, companies and agencies. Demola aims at building ecosystems where innovation is the result of a mixing of ideas, skills and perspectives. The change towards open innovation is guided by the development and application of co-creation methods. The Demola Tampere initiative was launched in 2008 and is physically located at the New Factory Innovation Center. On average, Demola Tampere carries out 100 projects yearly; partner companies usually license some 80% of the project outputs and employ about 15% of the students who were involved in the projects (Demola Tampere website).

Protomo [IND-CIV] is an environment created for developing business through a community of companies and professional experts. Protomo provides facilities free of charge to local communities to set the conditions for developing new

services and products. Protomo in *Länsi-Suomi* is in Tampere. The other two locations are in *Helsinki* and *Lathi*. So far, the overall initiative has created employment for 767 people, 288 start-ups (since 2009) and 151 active teams.

Bottom-up civic participation contributing to innovation output

Some initiatives aimed at **engaging citizens in innovation** were carried out within the framework of the CLIQ (Creating Local Innovation in a Quadruple Helix) Project (2008-2012), funded under the Interreg IVC Programme. Besides undertaking a deep investigation of the theoretical and applied aspects of the QH approach, the project, for example, implemented a pilot in the former paper mill area 'Kangas', in *Jyväskylä*, aimed at including civil society in city planning. Also, the JAMK University of Applied Sciences transformed a small residential area of *Jyväskylä* (i.e. *Lutakko*) into an environment where, through the Living Lab methodology, users can exchange knowledge and develop innovation. Another initiative started by the City of *Tampere* in 2012 and due to continue through 2018 is the **Open *Tampere*** programme. The programme aims at creating mini clusters of enterprises where diverse stakeholders, including citizens of *Tampere* as well as businesses and researchers, may interact to create innovative products and also to define their commercialisation strategy. Over the period 2012-2015, Open *Tampere* created 129 businesses and 898 jobs. Creation of new products and services is also possible in the **Suuntaamo** community. With an open approach citizens can participate in the innovative initiatives led by industry actors. The participants of Suuntaamo are invited to brainstorm innovative ideas, validate prototypes, and improve existing products and services. At the end of March 2016, 2,193 individuals participated in 94 projects conducted for 46 organisations (mainly private companies).

- Lazio (ITI4–MED)

Facts & Figures

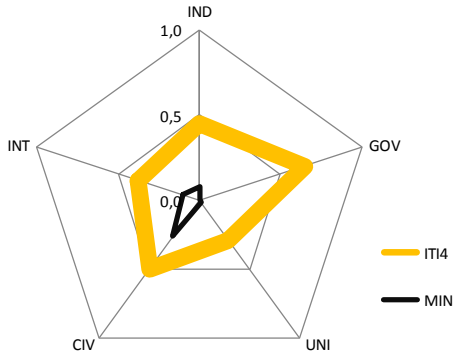
Size: 17,232.0 km^2 (2015)
Population: 5,892,425 (10% of national) (2015)
Regional GDP (% of national GDP): 11.5 (2014)
Unemployment (%): 11.8 (2015)
Regional GERD (euro/inhabitant): 539 (2013)
Broadband access (% households): 78 (2015)

Innovation positioning

RIS (2014): Moderate
QH innovation profile: medium
QH innovation index value: 0.452
Leading sphere: GOV

Innovation boosting factor: the aggregating role of Rome as a capital city. Rome has a high concentration of businesses, government offices, and universities.

Potential challenges affecting regional innovation performance: limited business R&D (given the high number of SMEs); reduced collaboration between business and public R&D; limited competences in technology transfer; reduced matching between demand and supply of innovation; scarce attention for IPR; limited financial instruments for innovation (i.e. risk capital).



Sources: Eurostat, S3 Platform, Regione Lazio (2014), RIM + (2011).

Strengths and weaknesses vs. the operationalization of the TH/QH, by helix

► ***Government***

Regional innovation policy and related optimisation of the allocation of Structural Funds for the period 2014-2020 are led by the regional Smart Specialisation Strategy (S3) published in 2014. The strategy was developed through a participative process involving some 200 main regional stakeholders, with thematic focus groups being organised among enterprises, associations, public and private universities, and research centres[18]. The strategy considers the active collaboration among key actors of the TH (namely, national and regional authorities, institutions, the industrial system, universities and research centres) as an essential condition for the creation of a regional innovation ecosystem (Regione Lazio, 2014). For the generation of innovation, the S3 prioritises the following sectors: Creative Industries, Green Economy, Life Sciences, Aerospace, Safety & Security (ranging from citizens security, to agro-food security and air-traffic security), Agri-Food (as a cross-cutting sector touching upon high-tech, biotechnology, low-tech industries, and tourism), Cultural Heritage and Technologies for Culture (Regione Lazio, 2014). The main policy actions implemented to foster creation of knowledge are: i) enforcing the regional Technological Districts (TDs)[19] and the national Technological

[18] See: Regione Lazio website

[19] TDs have the main objective of grouping actors producing and actors using knowledge around the same domain. This specific aggregation role is evident also in the institutional framework of the TDs: they aggregate small, medium and large enterprises in specific areas according to the indications on prevailing economic sectors given by regional authorities. The TDs proposed by the regional authorities are then evaluated by the Italian Ministry for Education, University and Research which is responsible for their establishment (Regione Lazio, 2014).

Clusters; ii) increasing international partnerships inside and outside Europe which engage different types of stakeholders (i.e. municipalities, regions, networks); and iii) fostering the achievement of the main objectives of the DAE in line with the national agenda. 'Lazio Innova' is the in-house company of the Regional Authority in charge of connecting the actors on its behalf.

► ***Industry***

[+] *Lazio* had more than 628,000 companies in 2014, over 10% of the national total. Almost half of *Lazio*'s companies (46.3%) operate in the services sector (Chamber of Commerce of Rome, territorial statistic database, year 2014).

[+] The urban area of Rome has the highest number of registered active businesses in Italy (355,894).

[+] In 2013, considered the lowest point of the economic crisis which began in 2008, *Lazio*'s economy showed some entrepreneurial dynamism: the trend rate of growth of enterprises was 1% against the average negative national value (-0.5%) and against the equally negative performance of other major Italian regions (Lazio Region, 2014).

[+] In 2014 and 2015, *Lazio* has been investing EUR 18.5 million in enterprise creation funding, with 183 start-ups being established. There are 497 innovative start-ups in the region, accounting for 9.8% of the national total.

[–] R&D expenditure in the industry (business) sector was 0.5% of GDP in 2013 (Eurostat data), well below the EU28 average of 1.3% in the same year.

► ***University***

[+] There are various private and public research bodies in the region, including: 12 universities, 4 university centres of excellence, 48 institutions and research institutes, and 218 research laboratories. Out of the 12 public and private universities located in the region, 10 have their headquarters in Rome (Regione Lazio, 2014).

[+] Among the six public universities, La Sapienza University of Rome is the number one in Europe for number of students (i.e. about 115,000 students, and a total of 250 graduate programs and 200 masters). It is followed by RomaTre University (36,000 students) and Tor Vergata University (34,000 students). La Sapienza is ranked 1st nationally and 112th globally.

[–] The National Agency for the Evaluation of the University and Research ranked Lazio's quality of the university system as second in Italy, with a score of 6.4 over 10 (Regione Lazio, 2014).

[+] Graduates in science and technology tripled over the past decade (from 6.3 units per 1,000 inhabitants in the 20-29 years class in 2000, to 19 units in 2013). The percentage of science graduates in *Lazio* is well above the national average (17.9% against 13.2%), a figure that has increased sharply in recent years (from 6.3% in 2000 to 17.9% in 2012) (Lazio Innova, 2015).

[+] R&D expenditure in the higher education sector is close to the EU28 average of 0.48% of GDP and increased from 0.35% of GDP in 2005 to 0.46% in 2013 (Eurostat data).

[+] Public RTDI expenditure in *Lazio* is extremely high (65% of the total RTDI expenditure in the region). This is due to the presence in the region of the most important Italian research institutes: the National Council for Research (CNR), the National Agency for Energy and Environment (ENEA), the National Institute for Nuclear Physics (INFN), the Institute for Health (ISS) and the Council for Agricultural Research (CRA). For the same reason the public sector employs over 4/5 of the total regional R&D staff (RIM +, 2011).

► *Hybrid organisations and structural interactions*

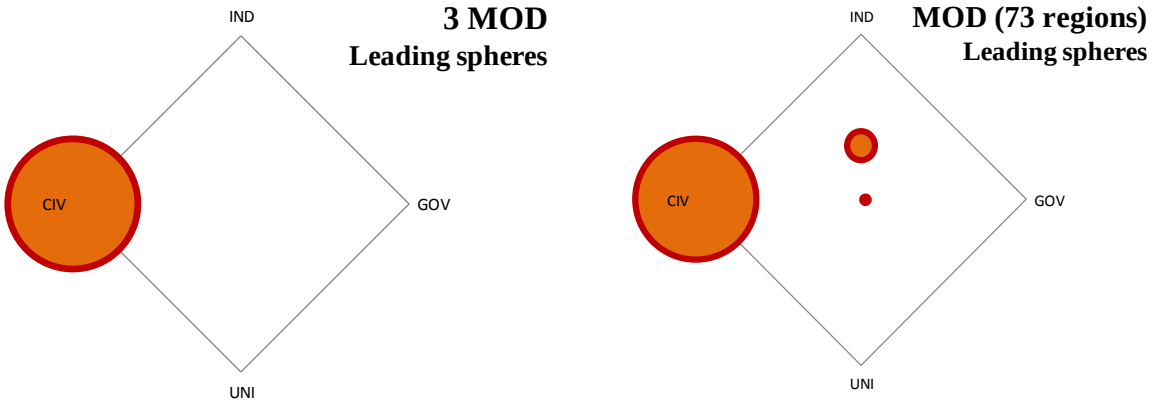
Hybrid organisations such as **private accelerators and incubators** [UNI-IND] aimed at supporting the start-up phase of new businesses are common in the region. Among them are Luiss Enlabs, Startalia, The Hub Roma as well as other initiatives of large companies such as Working Capital Telecom Italy, Wind Business Factor of Wind, EnelLab ENEL and Ego of Ericsson. Among the university-based initiatives are InnovactionLab, Sapienza Innovation, SpinOver, and I.Luiss (Lazio Region, 2014). *Lazio* hosts four **scientific and technology parks** [UNI-IND]: PST di Tor Vergata, PST Palmer-Basso Lazio, Parco Scientifico Biomedico San Raffaele, PST di Castel Romano-CSM. The **Technological Districts** [UNI-IND-GOV] are hybrid organisations and territorial aggregations at the regional level which are aimed at fostering interaction among enterprises, universities, research centres, science parks and professional associations. *Lazio* has TDs on aerospace, bioscience, and new technologies for cultural heritage maintenance. They are meant to develop strategic programmes for research, technology development and innovation in line with European priorities (i.e. H2020); to improve regional competitiveness; to enforce synergies among regional, national and European policies and instruments; to facilitate the internationalisation process of enterprises; and to attract foreign (financial and human) capital (Regione Lazio, 2014).

Bottom-up civic participation contributing to innovation output

The regional S3 envisages civil society's active involvement in specific innovative initiatives for the exchange of knowledge, information and needs. An example in this sense is *Spazio Attivo* ('Active Space'), a regional project under the Smart Communities Programme which was formally launched in July 2015 and aims at creating a regional network for social innovation where local authorities, Regione Lazio, industry (i.e. SMEs, large enterprises, aggregation of enterprises, start-ups), universities and citizens can interact in physical locations which are spread over the five provinces of the region.

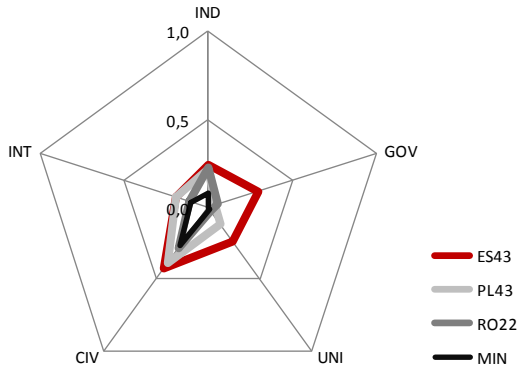
2.4.3 Modest innovators

Figure 10. Topological representations of leading spheres of the innovation space in MOD innovators, in the sample (3 regions) and in Europe (73 regions)



The three selected modest innovators confirm the lack of a defined geometry and of a prevalence of the CIV sphere (Figure 10) in this group. As a consequence, the regions are mainly comparable not in terms of overall shape but in terms of peaks (Figure 11). The highest values are scored in CIV. In *Extremadura* the innovation potential of civil society is, to a certain extent, matched by the innovation capacity of GOV and UNI.

Figure 11 Overlapping of the radar charts of the 3 MOD innovators in the sample



The role of the CIV should be interpreted carefully. Modest innovators perform poorly in terms of QHII (i.e. less than 0.333). A strong presence of civil society is a potential boosting factor of innovation if both structural/socio-economic

conditions and TH model spheres/interaction have not already reached a critical mass for activating a dynamic self-feeding innovation process. However, this potential is not sufficient to lead the innovation process by itself. *Lubuskie* and *Sud-Est*, notwithstanding the maturity of the fourth helix (CIV), have very limited innovation capacity in the three other helices (UNI, IND and GOV) and as such are not expected to experience improvements unless at least one of these three helices starts playing a pulling role.

Interestingly, the shape of *Extremadura* resembles an upside down quadrangle compared to the medium type, where the pulling role is played by GOV and UNI instead of that by IND and INT, which is nothing more than one of the phases of the technological paradigm. The Spanish region, in fact, has a fair innovation performance, approaching the one the MED type (*Extremadura* QHII is 0.280 and the threshold defined in this study for being medium innovators is 0.333).

The knots of the QH where the three regions seem to converge most are IND and INT but given the very modest values of these two sub-indexes the knot should be simply interpreted as a shared weak point.

The three selected modest innovators do not show commonalities according to the qualitative information gathered in the regional profiles. The existence of very heterogeneous conditions also provides the indication that the scarce QH innovation performance of these territories is the result of a lack of a structured strategic approach (e.g. by helices) for transferring research and innovation results to regional growth.

- *Extremadura* (ES43–MOD)

Facts & Figures

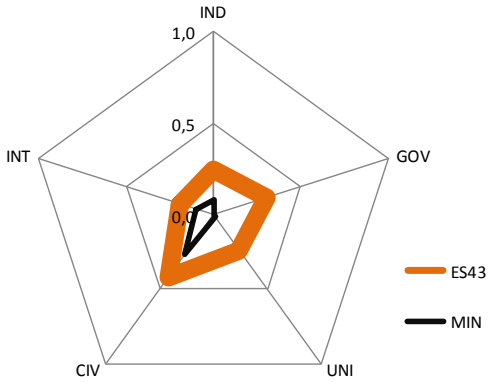
Size: 41,611.0 km^2 (2015)
Population: 1,091,623(2015) (2% national)
Regional GDP (% of national GDP): 1.6 (2014)
Unemployment (%): 29.1(2015)
Regional GERD (euro/inhabitant): 118 (2013)
Broadband access (% households): 70 (2015)

Innovation positioning

RIS (2014): Modest
QH innovation profile: Modest
QH innovation index value: 0.280
Leading sphere: CIV

Innovation boosting factor: political will. The region has a marked rural propensity and requires products and processes innovation to valorise this specific endowment. It is acknowledged as one of the best regions nationally for the quality of agricultural products, the quality of living, and as an important wildlife area.

Potential challenges affecting regional innovation performance: limited investment in R&D by the private sector, limited use of created knowledge, and lack of co-operation among key players of the innovation system, within the region and between the region and other regions/countries.



Sources: Eurostat, S3 Platform, Gobierno de Extremadura (2014).

Strengths and weaknesses vs. the operationalization of the TH/QH, by helix

► ***Government***

The innovation policy of Extremadura has been formalised within the RIS3 strategy (*Estrategia RIS3 Extremadura* 2014-2020) published in 2014. The RIS strategy, as part of the Regional Strategy **ONE - *Organizando una Nueva Extremadura*** ('Organising a New Extremadura'), is indented as an integrated agenda aimed at fostering the transformation of the regional economy by means of a more efficient use of public funds, higher private funding, and more focused resources on key sectors. Based on the analysis of the key socio-economic conditions of the region and of the typical connotation of the region which is traditionally associated with wellbeing, sustainable use of natural resources and excellence of agricultural products, the priority areas identified in the S3 are agroindustry, tourism, ICT, renewable energy, and health (Gobierno de Extremadura, 2014). To effectively support these priority areas, five investigation lines have been identified as being of primary importance to guarantee products and processes innovation: Eco design and New materials; Chemistry, Biochemistry and Biotechnologies; Software Engineering, Electronics and Automation; and Agronomy, Biology and Ecology. The QH approach is explicitly referenced in the regional strategy as a structural component of the innovation governance, where the different actors are classified according to their role in the innovation process, namely 'Knowledge generators' (public, private and mixed research centres), 'Innovation public promoters', and 'Knowledge receptors' (entrepreneurs implementing

innovation). The RIS3 strategy has been elaborated with the intention of maximising the participation of all important actors, including civil society, and through a participatory approach aimed at enhancing ownership and building consensus around priority challenges and related measures to improve the regional innovation ecosystem. These are: i) creation of a society with attitude to change, through actions aimed at improving the interest of society towards science and technology, at developing a culture of innovation and entrepreneurship, and at opening the local society to external relations; ii) consolidation of a knowledge society based on people's talent, through actions aimed at attracting, developing and supporting talents, and at improving the human capital involved in innovation and development activities; iii) development of an internationalised entrepreneurial environment, through actions aimed at supporting highly competitive entrepreneurs, at improving the number of innovative and competitive regional firms, and at fostering regional companies' internationalisation; and iv) adaptation of infrastructures to the development needs of the region, through actions aimed at creating an open and innovative public administration, at improving the competitiveness of the scientific and technological infrastructures, and at creating and reinforcing basic infrastructures. Operative instruments already implemented by Extremadura include a significant public contribution to investment in R&D (in 2012, public funding covered 80% of regional investment in R&D); and the establishment in 2010 of *Extremadura Avante*, a public company aimed at increasing competitiveness, supporting business projects, boosting internationalisation, and supporting co-operation between different actors.

► ***Industry***

[–] The regional economy relies highly on the primary sector. The industrialisation level is very low and the region has the second lowest number of enterprises across the country (higher only than those of the Spanish islands). Enterprises belong to the medium-higher technological level (152 enterprises, including, among others sectors, pharmaceutical, communication, optical electronics and aeronautics) and experience a negative annual growth rate (Instituto de Estadistica de Extremadura, 2014).

[–] In 2013, the industry expenditure in R&D was quite limited and amounted to 0.16% of the regional GDP (the national average is 0.67% of the GDP). The private R&D investment is only 20% of the regional total R&D investment versus the national average share of 53% (Gobierno de Extremadura, 2014).

[+] In 2012, the new enterprises creation regional rate of 2.95% exceeded the national average of 2.11% (GEM, 2012). In particular, the regional

entrepreneurship is exploring new market opportunities, mainly in the tourism industry, commerce and food sector.

[+] Because of favourable weather and climate conditions the renewable energy industry of *Extremadura* is near the top of the national ranking, occupying second place in terms of installed thermo-solar power and third place in terms of installed photovoltaic power (Gobierno de Extremadura, 2014).

► ***University***

[–] The regional employment rate in R&D is among Spain's lowest, corresponding to 1% of the total national R&D employees (only *La Rioja* and *Baleares* regions perform worse) (Gobierno de Extremadura, 2014).

[+] R&D expenditure in the higher education sector is slightly below the EU28 average of 0.48% of GDP but above the national average of 0.35% and increased from 0.37% of GDP in 2005 to 0.44% in 2013 (Eurostat data).

[–] The University of Extremadura is only ranked 33th nationally and 872th globally.

[+] Up to 2014, the University of Extremadura had generated ten spin-offs, four in the agri-food sector, three in ICT and communication equipment, and the others in health and lighting sectors (Gobierno de Extremadura, 2014).

[+] *Extremadura* benefits from highly specialised publicly funded research centers in the sectors of ICT (CénitS - *Centro Extremeno de Investigación, Innovación Tecnologica y Supercomputación¸ Centro de Investigación Cientifica de Extremadura*), Health (*Centro de Cirurgia de Minima Invasión Jésus Uson,* el Anillo - *Centro Internacional de Innovación Deportiva en el Medio Natural*), and Agriculture (*Centro de Acuicultura "Las Vegas del Guardiana", Centro de Seleccion y Reproducción Animal de Exremadura*).

► ***Hybrid organisations and structural interactions***

***Fundación* FUNDECYT-PCTEX** ('Foundation for the Development of Science and Technology in Extremadura') [UNI-IND-GOV]. The regional Government aims at supporting the socio-economic exploitation of research and innovation results through this foundation. The foundation manages the *Parque Científico y Tecnológico de Extremadura* ('Science and Technological Park of Extremadura') with its two locations, in *Badajoz* and in *Cáceres*.

Bottom-up civic participation contributing to innovation output

Innovation culture is not considered to be completely mature in Extremadura, and, consequently, awareness building is among the key priorities of the RIS3 strategy (Gobierno de Extremadura, 2014). Civil society was already involved during the elaboration phase of the strategy, and engagement is planned to continue via online consultation tools and the realization of public events for awareness raising.

- *Lubuskie* (PL43–MOD)

Facts & Figures

Size: 13,988.0 km^2 (2015)
Population: 1,007,442 (10% of national)(2015)
Regional GDP (% of national GDP): 2.2 (2014)
Unemployment (%): 6.4 (2015)
Regional GERD (euro/inhabitant): 22 (2013)
Broadband access (% households): 70 (2015 – NUTS1)

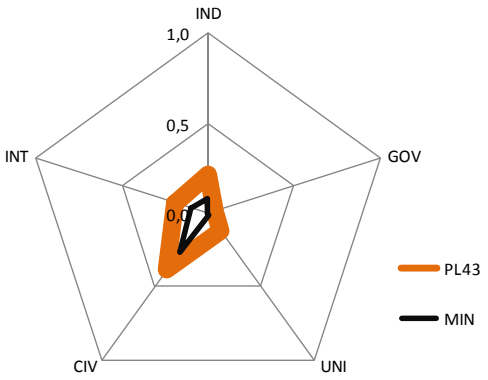
Innovation boosting factors: strategic location. The region may benefit from opportunities given by its centrality with respect to the European corridors and by its proximity to Germany and in particular to the Brandenburg region. Other positive features include a high number of companies per inhabitant, a large number of companies with foreign capital, high employment in industry and construction, strong industries (e.g. automotive, chemical, construction materials, information technology, wood), and the possibility of exploiting fossil energy (i.e. lignite).

Potential challenges affecting regional innovation performance: the region is one of the smallest in the country, with almost half of its area covered by forests and with only two main urban centres, *Gorzow Wielkopolski* and *Zielona Gora*. Hence, it lacks the opportunity of reaching sufficient critical mass (social, economic). Both transport (i.e. air, rail, and water) and communication infrastructures (i.e. broadband) require improvements.

Sources: Eurostat, S3 Platform

Innovation positioning

RIS (2014): Modest
QH innovation profile: Modest
QH innovation index value: 0.191
Leading sphere: CIV



Strengths and weaknesses vs. the operationalization of the TH/QH, by helix

► ***Government***

The implementation of the regional innovation strategy of *Lubuskie* was assigned in 2011 to the *Lubuskie* Innovation Council[20]. The Council is an advisory body of the regional government including representatives of LRAs, enterprises, universities and research centres, and NGOs. A Regional Steering Committee is in charge of monitoring the implementation of the *Lubuskie* Regional Innovation Strategy. According to the priorities outlined on the S3 platform, *Lubuskie* is promoting interaction among regional stakeholders in seven areas: i) pharmaceutical & clinical research, bio-materials & molecular biology; ii) digital media, mobile applications, visualisation and design, production & distribution of media products; iii) internet & IT-based services; iv) smart energy; v) business consultancy; vi) aerospace; and vii) research consultancy, technology services, qualified human resources & creative services.

► ***Industry***

[–] R&D expenditure in the industry (business) sector was 0.07% of GDP in 2012 (Eurostat data). This share is negligible and well below the national (0.38% of GDP in 2013) and the EU28 average (1.29% of GDP in 2013).

[+] In both large and medium-sized companies the region recorded the highest innovation sales (6.29% and 4.57% respectively) in the country. Small enterprises (10-49 employees) recorded 3.45% (RIM+ *Lubuskie* profile).

[+] In *Lubuskie*, 14.2% of all investments in the manufacturing sector are allocated for R&D activities (RIM+ *Lubuskie* profile).

[–] The manufacturing sector recorded a decline in innovation investments of some 14% over the period 2013-2014 (RIM+ *Lubuskie* profile).

[+] The Kostrzyn-Slubice Special Economic Zone is an attractive industrial hub in the region for national and foreign business given the fiscal advantages guaranteed by the Polish government and by the local authorities. Entrepreneurs (up to 50 employees) may benefit from income tax exemption on their initial investment costs or on the employment costs incurred over two years. Exemption varies according to the size of the enterprises (ranging from 35% for large enterprises to 55% for SMEs). In the region, the number of companies

[20] See: http://innowacje.lubuskie.pl/wsparcie-innowacji,item10175,11186.html

with foreign capital reaches 38% of the total vs. a national average of 24% (Innovacje Lubuskie website).

► ***University***

[–] There are 16 HEIs (*Innovacje Lubuskie* website) of limited size in the region. The biggest one is the University of *Zielona Gora*, formally established in 2001 but with an academic tradition that dates back to 1965. In 2013, the University of *Zielona Gora* had 15,500 students enrolled. Using the H-index[21], the university is nationally ranked at only the 36th position; the ranking improves (i.e. 29th) if considering the so-called modified Hirsch index that also accounts for the size of the university (i.e. larger universities generate more publications)[22].

[–] Latest available data on R&D expenditure in the higher education sector dates back to 2011 and equals 0.11% of GDP, a share which is well below the national (0.25% of GDP) and the EU28 average (0.48% of GDP).

► ***Hybrid organisations and structural interactions***

The region hosts some scientific and industrial parks where units promoting innovation are located [UNI-IND-GOV]. These include the Lubuskie Industrial and Technology Park, the Park Naukowo-Technologiczny Uniwersytetu Zielonogórskiego, the Science and Technology Park of the *Zielona Góra* University, the Technology and Industry Logistic Park „Interior" in Nowa Sól, the Laboratory low-energy ecologic hall for energetics and renewable energy sources in Sulechów, and the Lubuski region Centre of innovation and agrotechnical implementation in *Kalsk*.

In Lubuskie, innovation, competitiveness, and knowledge transfer is mainly achieved through **clusters** [IND-GOV]. The number of clusters was 10 in 2006 and 8 in 2012. The cluster approach has been clearly indicated as **an implementation of the triple helix model** (Skawińska *et al.*, 2013). The cluster policy's efficiency is assessed by the Polish Agency for Enterprise Development on the basis of six aspects: i) support for networking and co-operation (e.g. through cluster coordinators, development of intelligent specialisations, granting public means for projects regarding co-operation and partnership); ii) combination of grass-roots (e.g. in the form of initiatives) and top-down (e.g. for creating favourable conditions and incentives) approaches in supporting clusters development; iii) creation of an effective ecosystem of institutions supportive of

[21] The Hirsch h-index is a method used to assess the academic activity of universities and it refers to the most frequently quoted papers published in prestigious ISI classified periodicals.
[22] See: http://www.uz.zgora.pl/index.php?academic-research-at-the-university-of-zielona-gora

the clusters; iv) concentration of support on clusters having the biggest potential for developing intelligent specialisations; v) coordination of public instruments and policies around the key clusters; vi) private co-financing of clusters development. In particular, the success of the *Lubuskie* Metal Cluster (LCM)[23] has been recognised as an effective application of the Triple Helix model with a predominant role played by the government and the research actors, notably by the University of *Zielona Góra*.

Bottom-up civic participation contributing to innovation output

The Forest Promotional Complexes (LKPs) of 'Lubusz Forest' are *"a kind of experimental and testing ground serving the implementation of changes in important elements of forest works"*. Since 1994, LKPs are large forest areas and compact forest complexes created for ecological promotion. They aim at reconciling *"business purposes with active ecosystem protection purposes, propagate environmentally friendly technologies, and promote scientific researches"*. In practice, their aim is to enhance the impact of the forest on the social and economic development of the region and to facilitate co-operation of all stakeholders with natural environment protection organisations. The Social and Economic Council governing the initiative includes representatives of the local government, local media and academia. Involvement of civil society is done essentially through knowledge sharing initiatives such as events (i.e. the International Day of Forests, the Earth Day, the Tree Day) and a series of initiatives organised together with the educational institutions of the area (lessons, art competitions, and playing contests such as 'Forest in prose and poetry').

- *Sud-Est* (RO22–MOD)

Facts & Figures

Size: 35,761.7 km^2 (2015)
Population: 2,492,352 (13% of national) (2015)
Regional GDP (% of national GDP): 11.3 (2014)
Unemployment (%): 9.0 (2015)
Regional GERD (euro/inhabitant): 4 (2013)
Broadband access (% households): 57 (2015)

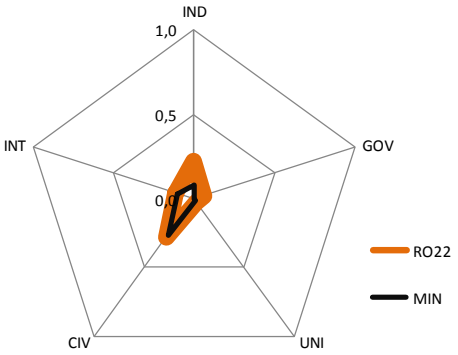
Innovation positioning

RIS (2014): Modest
QH innovation profile: Modest
QH innovation index value: 0.141
Leading sphere: CIV

[23] http://www.lubuskiklaster.pl/

Innovation boosting factor: access to the Black Sea. Sud-Est is the only region of Romania with access to the sea, with a coastline of 256 km. This provides the region with unique touristic, work-related, commercial, and cross-border co-operation opportunities.

Potential challenges affecting regional innovation performance: very low spending in R&D, inability to generate a critical mass of R&D and consequently, economic development.



Sources: Eurostat; EUNETMAR (2014); Dachin and Postoiu (2015).

Strengths and weaknesses vs. the operationalization of the TH/QH, by helix

► ***Government***

The South-East NUTS2 has no administrative or legal status. This condition applies to all the NUTS2 of the country. Coordination of regional development policies is implemented by the South-East Regional Development Council and the South-East Regional Development Agency (ADRSE). ADRSE in particular works to identify regional challenges and opportunities and is responsible for regional planning as well as for the allocation of Structural Funds, especially in the fields of transport infrastructures, tourism, business support infrastructures and services, social services, and urban development. Although there is no smart specialization strategy for South-East, the 2014-2020 Regional Development Plan (Agenția pentru Dezvoltare Regională Sud-Est, 2014) includes two priorities, out of the 10 identified, which specifically refer to smart specialisation: Priority 3 "*Improving the quality of regional economy, in the context of promoting economic specialization smart*", and Priority 9 "*Improving human resources at regional level in the context of smart specialization*".[24] These priorities are associated with specific objectives which are: i) under priority 3, 3.1 "*Develop infrastructures of R&D and synergies between enterprises and research centres by using innovative processes and products*" (whose interventions are expected to be oriented towards the improvement of technology transfer, social innovation, creation of clusters and promotion of smart and specialized economy); and 3.2 "*Supporting the development of*

[24] In addition to the regional development plan, coherent local development strategies focusing on local development needs are elaborated at the municipal level in *Brăila*, *Buzău*, *Constanța*, *Galați*, *Tulcea* and *Vrancea*.

regional companies in order to increase competitiveness and create new jobs" (whose related actions will be oriented towards the improvement of the productive capacity and the services for companies); ii) under priority 9, 9.1 "*Improve performance of human resources through investments infrastructures*" and 9.2 "*Improve public services, promote partnerships at regional and local levels and create a modern, flexible and inclusive regional labour market in order to meet market needs*".

► ***Industry***

[–] The regional workforce is highly concentrated in the agricultural sector (28%, RIM + profile) and the region is considered the second major producer of cereals and wheat of the country with competitive potential at the European level (Voicilas, 2014).

[+] In the light of its unique geographical position (the only region with a coastline on the Black Sea), the maritime economy provides both employment and development opportunities. The most promising sectors are water-related projects (e.g. dredging actions on the Danube, port developments, etc.), shipbuilding & ship repair (with a long tradition, well-developed infrastructures, and an on-going greening of the technologies to cope with competiveness and to continue attracting foreign investments), coastal tourism, offshore oil and gas (by reason of the identification of new reserves in the Black Sea), short-sea shipping, and inland waterway transport (EUNETMAR, 2014).

[+] The industrial base is very heterogeneous and includes petrochemical, metallurgical, nuclear energy, machinery, naval, construction materials, textiles and clothing enterprises. The regional workforce employed in the industrial sector is 22.1% of the total (Regional Innovation Monitor Plus). The steel processing industry (*Galați* hosts one of the world's biggest steel producers, namely the Mittal Steel) represents one of the economic pillars of the region.
[–] R&D expenditure in the industry (business) sector was negligible in 2013 (0.01% of GDP) (Eurostat data) and well below the national (0.12% of GDP) and the EU28 average (1.29% of GDP) in the same year.

► ***University***

[–] The region is characterised by an evident weakness in R&D capacity. R&D expenditure in the higher education sector was 0.02% of GDP in 2013, a share which is well below the national average of 0.08% of GDP and far from the EU28 average of 0.48% of GDP.

[+] The region hosts seven public and private universities, mostly concentrated in the areas of *Constanţa* and *Galaţi*. The University of *Constanţa*, founded in 1961, hosts 16 faculties and offers full degrees in English, attracting a considerable number of foreign students; the University of *Galaţi*, founded in 1974, hosts 14 faculties and some specialised courses such as Naval Engineering and Fishery.

[+] There are other research organisations operating in the region, including the National Sea R&D Institute 'Grigore Antipa' in *Constanţa*, the National R&D Institute 'Delta Dunarii' and the Eco-museal Research Institute in *Tulcea*.

► ***Hybrid organisations and structural interactions***

Romanian Maritime Cluster [UNI-IND-GOV]: established in 2011, the cluster is a collaborative initiative that involves 38 organisations including firms, business associations, educational and research institutions in the maritime sector as well as maritime authorities, catalysts and other actors[25]. The cluster, among other activities, promotes the co-operation among multiple sectorial stakeholders via joint activities and knowledge sharing. It also provides assistance to companies on environmental requirements, innovation and entrepreneurship as well as funds and subsidies access.

The region hosts three industrial parks [UNI-IND-GOV] in *Galaţi*, *Navodari* and *Constanţa*. The Galaţi industrial park, whose extension is about 22 hectares, is particularly active, has a clear sectorial focus (mechatronics and robotics, commerce and transport) and is based on a close co-operation and interaction with two of the major universities of the region, 'Dunarea de Jos' and 'Danubius'.

Bottom-up civic participation contributing to innovation output

ADRSE has a key role in the mobilisation and involvement of local and regional stakeholders in the evaluation of the regional context and in the design of regional strategies. Indeed, for the elaboration of the 2014-2020 Regional Development Plan (RDP) an extensive public consultation process was implemented in order to gather continuous feedback from working groups' members, regional partners, and other selected stakeholders. Workshops were used to collect feedback. Examples of participants include regional institutions, county councils, city hall representatives and prefectures of major cities, county school inspectorates, social assistance directorates, representatives from agencies for employment, academics, NGOs, and major utility providers. The

[25] See: http://clustero.eu/romanian-maritime-cluster/ for the complete list of involved partners.

outputs of the workshops were used to complete the SWOT analysis of the RDP and identify major priorities. Similarly, during May 2014, ADRSE hosted 24 workshops on the *ex ante* assessment of the 2014-2020 RDP for the South-East which were also meant to increase visibility with, and participation of, regional representative actors and other local stakeholders.

2.5 Main trends and challenges

From the comparative analysis across the three regional innovation types (ADV, MED, MOD) and from the investigation of the ten selected regions, main trends related to UNI, IND, and CIV and common challenges (CH) faced by GOV (i.e. regional authorities) are outlined below:

- **CH1. Awareness on the TH/QH models**

  Addressing this challenge serves to reinforce the operationalization of the working definition of the QH of this study.

The analysis of the regional innovation strategies confirms that, with no exception, involved regional authorities are aware of the strategic role of the Industry sphere, of the relevance of the University sphere, and of their structured interaction (e.g. in scientific parks). Less explicitly mentioned are policies and strategies applying the TH/QH models and involving civil society. Where structured, policy indications are addressed mainly to the Industry sphere and often require the participation of the actors from the other spheres (e.g. for the allocation of EU Structural Funds within Regional Operational Programmes).

A *CIV-related trend*, applying to all innovator types, points to an increasing awareness by LRAs of the importance of an explicit formalisation of a QH approach while defining strategies and policies towards innovation. This implies an enabling role of LRAs in promoting spheres' interaction, with higher attention given to involving civil society. The *challenge* for GOV, especially in MED and MOD regions, is the explicit consideration of strategies and policies ruled by the TH/QH application and envisaging mechanisms for the active involvement of civil society in the innovation-generating process (e.g. Open Tampere in *Länsi-Suomi*).

- **CH2. Application of the TH/QH in S3**

  Addressing this challenge serves to reinforce the operationalization of the working definition of the QH of this study.

There is evidence of the benefits derived from the application of TH/QH, however the pursuit of TH/QH by LRAs (i.e. the government sphere) requires resources and cannot cover all the strategic sectoral domains of a region. Through the S3, regional authorities may identify where to concentrate their TH/QH efforts (e.g. the Metal Cluster in *Lubuskie*).

An *IND-related trend* points to an increasing (formal or informal) application of the TH and QH in one/more specific sectoral domain(s). The *challenge* for GOV, especially in MOD regions, is the strategic application of the TH and QH towards the reinforcing of some spheres so as to maximise the benefits outside the selected sectoral domain(s) by means of spill-overs and side-effects.

- **CH3. Civil society and creativity valorisation to overcome structural limits which hamper regional innovation and growth**

  Addressing this challenge serves to reinforce the contextual hypotheses of the working definition of the QH, i.e. democracy and social inclusion.

Regions may lack assets or have a weak industrial sector or perform research which is scarcely applicable. Investment in creativity (e.g. *Utrecht*) may open new innovation opportunities beyond the TH. In fact, QH shall not be interpreted as a linear evolution of TH but as a new perspective for the building of innovative processes where creativity may also boost innovation by interacting with only one quite robust innovation sphere. This new perspective may lead to the consideration of traditionally low-profitable sectors such as forests in *Lubuskie*, Poland, or tourism in *Sud-Est*, Romania, in the innovative process.

An *IND&CIV-related trend* points to an increasing contribution of creativity and of human factor into the innovation process at a macro level. The *challenge* for GOV, especially in MED and MOD regions, is to identify new sectoral domains to be exploited for innovation and new ways to exploit the traditionally less-profitable sectors/domains through creativity and the involvement of civil society.

- **CH4. Exploitation of participation tools for a concrete and effective application of QH**

  Addressing this challenge serves to reinforce the contextual hypotheses of the working definition of the QH, i.e. pervasiveness of ICT.

The active participation of the society in the innovation process needs tools to potentially allow all citizens to contribute. Technologies in general and

broadband diffusion in particular are driving the participation of civil society in the sharing of knowledge and in the creation of innovation. Internet accessibility in terms of availability of broadband and preparedness of citizens are necessary conditions for an effective adoption of the QH (e.g. Open Lab in *Stockholm*).

A *CIV-related trend* relates to the increasing of the digitalization level and literacy of the territory. The *challenge* for GOV, especially in MED and MOD regions, is to provide civil society with a sufficient number of 'contribution channels', including digital ones, and with the capacity to exploit them.

Part 3: Thematic analysis of the QH approach and good practices

This section deepens the analysis of each sphere of the QH against some specific themes driving innovation. In particular, UNI is discussed with respect to its changing role and engagement with industry and society at large. Within the GOV sphere the emphasis is on eGovernment as a driver of innovation in the public sector which in turn is leading to enhanced information sharing and engagement of end-users. At the IND level, the focus is on the interactive innovation processes implied by entrepreneurial discovery. Finally, CIV is mostly discussed as one source of social innovation and experimentation with respect to some specific challenges. The thematic analysis is supported by the identification of good practices (GP) which are discussed in terms of the four helices of the QH approach, with the ultimate aim of highlighting those success factors which led to the manifestation of the QH in the concerned territories. These practices are sourced from different types of regions. The considered regions also include those which remain unclassified according to our QHII ranking because of lack of data. This further demonstrates that existing data and indicators are still unable to fully capture the innovation performance of regions.

3.1 The changing role of universities

While contribution to innovation has only recently become one of the main missions of the University sphere, creation of knowledge has always been a fundamental goal of the Higher Education Institutions (HEIs). The **centrality of university** in **knowledge production** (educational function and technology transfer function) was formalised by Gibbons *et al.* (1994). With knowledge having gained a crucial role in social dynamics over the last 20 years, university has increased its influence in the economic growth processes, influence that was previously exclusive to the entrepreneurial domain. Universities were asked to climb down from the 'ivory tower' (i.e. *"an atmosphere where intellectuals engage in teaching and research activities that are disconnected from the practical concerns of everyday life and society"*, E3M project, 2011) and become *"key actors of economic and cultural growth, transforming themselves into engaged institutions with industry and society at large"* (E3M project, 2011).

Among the various proposed definitions, 'third mission' (TM) or 'stream' are **relationships** (intended as knowledge exchanges and productive interactions) **of the university with non-academic stakeholders** and, in particular, with those

stakeholders belonging to industry, public authority and society (Schoen *et al.* 2007). For Molas-Gallart *et al.* (2002) *"teaching, research and the communication of research results"* should be considered *"core university activities. When these are developed with the participation of non-academic actors and/or pursuing mainly non-academic goals, the performance of such activities constitutes in itself an instance of Third Stream activity."* Going beyond the simple relationships, Ranga and Etzkowitz (2012) and Etzkowitz *et al.* (2008) already introduced in the TH model the concept of a more pragmatic **Entrepreneurial University** based on the need for functional substitution, especially with the Industry sphere.

TM actions of University can be categorised into three types (E3M project, 2011; Molas-Gallart *et al.*, 2002):

- **Technology transfer and innovation (TM1).** The research function (carried out internally or with external actors) produces knowledge inside the university which is then transferred to a non-academic sphere. Examples are external research contracts, collaborative research (e.g. through participation in research activities within consortia, establishment of technology transfer offices), transfer of qualified personnel, IPR exploitation (e.g. through the creation of spin-offs or start-ups). These activities usually generate more economic returns, rather than social and reputational returns, to the university.

- **Continuing Education (TM2).** The teaching and training functions of the university contribute to wide-scope educational purposes such as education of students through contacts with non-academic users and beneficiaries (i.e. students' placement), courses not oriented to an academic degree (e.g. vocational education for communities), or programmes defined in collaboration with stakeholders outside of academia (e.g. alignment of curricula with the local industrial needs). These activities usually generate social and reputational as well as economic returns to the university.

- **Social (or public) Engagement (TM3).** The knowledge production role, especially in its institutional function, allows universities to contribute to understanding and proposing solutions which address societal challenges. Initiatives for social engagement range from public dissemination or communication of research outcomes (both through informal exchanges and through traditional and social media) to active involvement in promoting creative actions such as enriching societal learning opportunities or contributing to culture as public good. These activities usually generate social and reputational returns to the university.

The three types of TM actions require UNI's strong interaction with both the IND and the CIV sphere settings, along with proper GOV policies, i.e. a favourable theoretical environment for the operationalization of the QH approach. Although the debate introduced by Clark (1998) on the capacity of a teaching/research university to become an entrepreneurial actor is still open, the author identifies five essential organisational elements that, together, make universities (especially if European) entrepreneurial: i) a **strengthened steering core** focusing on managerial values; ii) an **expanded developmental periphery** formalising, beyond the traditional functions, structural interactions with external stakeholders (i.e. offices for knowledge transfer, industrial contacts, intellectual property management, and fundraising); iii) a **diversified funding base** relying, apart from the institutional governmental support, on other funds such as those from competitive research contracts and grants; consultancy services for industrial firms, local governments and non-profit organisations; royalties from intellectual property; student fees; or alumni fundraising; iv) a **stimulated academic heartland** based on the initiative of faculties, departments and researchers which become entrepreneurial units; v) an **integrated entrepreneurial culture** blending existing traditions with new values in order to create a specific identity and distinctive reputation. An example from the author's work is reported in Box 5.

Box 5. The case of a Dutch entrepreneurial university

The University of *Twente*, established in *Enschede* (NL21 – *Overijssel*, classified as **medium innovator** in our QHII ranking (QHII=0.556) in the mid-sixties, started to become an entrepreneurial university in the nineties. A strengthened steering core was needed to overcome the marginal and weak institutional position of the university. This was realised through a change in the governance's perspective. The expansion of the developmental periphery was achieved by opening to national needs (industry, regional government and community groups) and, at the international level, by co-operating, with the creation of a Temporary Entrepreneurial Placement Program, the activation of technology transfer, and the initiation of international co-operation on research. Additionally, a privatised business school was established. The funding structure was reshaped, with incentives being based on performance and public funding being reduced to 75% of the total budget (the remaining 4% coming from the exploitation of research and 21% from teaching activities). The stimulation of the academic heartland happened by reviewing and diversifying teaching programs (first including horizontal aspects such as communication and management, and then including more vertical elements such as medical technologies and management of medical facilities). The integrated entrepreneurial culture was stimulated by the introduction of a risk-taking approach following the idea that doing business also means making money.

Source: Clark (1998).

Conflicting operational issues and governance challenges may arise from the hybridization between the university and industrial spheres. Academic culture is based on knowledge production, scientific excellence and free dissemination of results. Hence, it is essentially based on production of public goods. Business culture is based on economic value production, profits and appropriation of results (De Maret, 2014). Government strategy may also affect the evolution of the entrepreneurial university model by creating conditions that foster the academic transition and, in turn, have positive side effects on economic growth. The UK case (Box 6) is considered an effective public intervention towards the creation of successful entrepreneurial universities (e.g. Cambridge University), an intervention which was also strengthened through the relevant instalment made available by the Higher Education Funding Council England (HEFCE) for promoting relationships between universities and external stakeholders (i.e. about GBP 4 million per year, over the period 2013/2014-2015/2016).

Box 6. The UK case: the attempt to create entrepreneurial universities by law

In 1985, a top-down political decision forced UK universities to become entrepreneurial by definition. The right and the responsibility to exploit university intellectual property rights (IPR) derived by publicly funded research were assigned to the same universities. To support and reinforce this decision, the traditional national reward system for universities was changed by increasing the competiveness component implicit in an entrepreneurial model. In addition to publications in outstanding journals (i.e. conventional output of the research process), the UK Higher Education Funding Council also started considering patents held by academics as evidence of 'quality research' in the national Research Assessment Exercise. In some cases, successful effects were achieved by this approach, such as traditional researchers' profile shift towards an academic entrepreneur role, awareness/application of IPR as a requirement for the commercialisation of research results, and/or creation of institutional functions/offices supporting the entrepreneurial activities (e.g. industrial liaison offices, incubators). However, in most of the UK universities, the process of adapting to the new entrepreneurial role required time, caused confusion of roles among researchers, and created organisational issues within academic institutions. Academic spin-offs happened to be the less complex and most widely adopted response in the country to the need for commercialising research.

Source: Etzkowitz *et al.* (2000).

In 2003, at the European level, as part of the debate on the policy influence towards the creation of entrepreneurial universities, the EC published the Communication on 'The role of the universities in the Europe of knowledge' (COM(2003)58 final) where knowledge production and interaction among the actors belonging to the different spheres were directly linked to regional and local development. In the last two decades, increasing financial resources for universities have been made available at the EU level. These funds are to be

accessed on a competitive basis and are intended for the implementation of activities involving external actors.

Among the current funding for **technology transfer and innovation (TM1)**, Horizon 2020 has an overall budget of almost EUR 80 billion for research and innovation over the period 2014-2020, potentially supporting university co-operation with industry and LRAs. Collaborative projects among the different spheres at the international level are defined in bi-annual work programmes with specific objective-oriented instruments: co-operative and support actions for knowledge interaction and know-how exchange, research and innovation actions to advance the research frontier on specific topics, and innovation actions to bring applied research results directly to the market. For promoting **Continuing Education (TM2)**, the Erasmus+ programme and its dedicated EUR 14.7 billion budget over the period 2014-2020 provides the opportunity for 'Learning mobility of individuals', 'Co-operation for innovation and the exchange of good practices' and 'Support for policy reform'. **Social (or public) Engagement (TM3)** is expected to be achieved with the direct involvement of civil society representatives in the design of projects, in particular by having end-users engaged in the projects' research and learning activities. Since social engagement is mostly characterised by a focused geographical dimension, the European Structural and Investment Funds (ESIF) are particularly suited to support universities in carrying out joint initiatives where research and innovation also envisage the involvement of civil society.

With a focus on the local dimension, universities are also recognised as crucial players within Smart Specialisation Strategies (S3), with the potential role of *"shaping and supporting regional institutions, supporting the creation of networks and other capacity building activities"…"particularly in 'institutionally thin' regions"* (Kempton *et al.*, 2013). Although universities may have a strategic role in supporting the GOV sphere for the design and implementation of research and innovation policies, **technology transfer** remains the most common activity implemented by the academic (becoming entrepreneurial) institutions in Europe. The aim is to commercialise the knowledge developed within the research activities. The subject of the technology transfer can be **knowledge** that, with the involvement of the proper actors of the other spheres (i.e. enterprises, local authorities, citizens) becomes innovation; or, more directly, **innovative products/services** addressed to specific end-users. The approach for technology transfer (TM1) suggested by the Knowledge Management Center (KMC) of the Széchenyi István University (GP 1) is based on: i) the collection and rationalization of the knowledge produced within the academic sphere, and ii) its transfer to the business world. Interaction with IND also allows the KMC to perceive the specific demand of

innovation and then to incentivise research activities within the University towards demand.

GP 1. The Knowledge Management Center of Széchenyi István University, Hungary

Implementation period: 2009-2011
Involved authorities: Széchenyi István University
Involved stakeholders: UNI (with a leading role), IND
Financing: EU and national: 85% from the Social Renewal Operative Programme. University: 15%, own resources.
Innovator type: The university is located in *Gyor*, in the Western Transdanubia region (HU22 *Nyugat-Dunántúl).* The region is classified as **modest innovator** in our QHII ranking (QHII= 0.301).

1 Description

The Knowledge Management Center (KMC) was launched in 2009 by the innovation office of Széchenyi István University. Structured as a horizontal service, the centre is responsible for the university's knowledge management and for creating new collaboration opportunities with the entrepreneurial world, especially in those sectors closer to the technical specialisations of the university (i.e. automotive engineering, mechanical engineering, electrical engineering, informatics, architecture, civil engineering, and transport services). In particular, KMC activities are focused on the exploration and exploitation of best opportunities for technology transfer, and on the promotion of the university as a 'regional knowledge center'. To this end, the KMC fosters the knowledge transfer processes (e.g. through information services) and the involvement of private and institutional partners. Among its activities are analysis of the innovation demand of the Industry sphere, assessment of the opportunities for technology transfer and spin-off, management of the IPR portfolio of the university, and organisation of innovation management courses. Additionally, the centre promoted dissemination of knowledge through public events (e.g. in 2010, 'Science in *Győr* for everybody') and scientific publications.

2 Relevant contextual conditions

Western Transdanubia, a moderate R&D-intensive region according to the RIS (EC, 2014), is highly industrialised and oriented towards foreign markets. In 2012, the region accounted for 16% of the national industrial output, with 84% of the total industrial sales being for export (the national average being 64%). The automotive industry, whose growth has been spurred by foreign direct

investments (FDI) after the change of the regime, has become a strategic sector and plays a role both in the regional S3 and in the R&D competence of the territory. Two Operational Programmes of the New Széchenyi Plan (the Science and Innovation Programme and the Enterprise Development Programme) facilitated collaborations between corporate research departments in this industry and research centres of excellence. In 2012, research centres were 239 (+27% compared to 2005) and researchers 1085 (+61% compared to 2005). HEIs are strategic actors in the automotive sector and participate in innovation collaboration projects with industrial partners. Among them, Széchenyi University in *Gyor* is a key stakeholder.

3 Impact

Although the original project was completed in 2011, the KMC continues providing innovation and business development services. Among the most effective initiatives are the *Széchenyi* Duo Creator Call where teams of at least one student and one professor create innovative products (including prototypes), a mentoring programme, and training in competence assessment and project management. Additionally, KMC contributed to the Open Innovation System of the region by mapping knowledge and research results of the university, implementing dissemination activities targeted at the general public, promoting co-operation among researchers and private organisations, and supporting technology transfer and the launch of spin-offs.

4 Transfer of research knowledge and innovation results

Transfer of research knowledge is the mission of the KMC.

5 Success factors

The acknowledged key features of the KMC are its transparency in the provision of services, its **market-orientation** and its proactive approach in the management of third-party collaborations. The KMC is recognised as a best practice within the European collaborative and regional open innovation strategies (EURIS).

References: EURIS project (2012), Embracing open innovation in Europe – a best practice guide on open innovation policies; Dőry T. (2011), Activities of the Knowledge Management Centre @ Széchenyi István University; Regional Innovation Monitor Plus (2014), Regional Innovation Report West Transdanubia, September 2014.

Transfer of knowledge and innovation, or services combining them, represents one of the main activities of the entrepreneurial university. While transfer of

products generally encompasses the results of the innovation developed according the technology-push approach, transfer of services allows the inclusion of a demand-pull component of innovation that takes into account the needs of the users. The transfer of services (TM1) promoted by the University of Maastricht with the Service Science Factory is strongly oriented towards the needs of the Industry sphere (GP 2).

GP 2. Maastricht University Service Science Factory, the Netherlands

Implementation period: 2011- on-going
Involved authorities: Maastricht University
Involved stakeholders: UNI (with a leading role), IND
Financing: EUR 850,000 spread over a period of 4 years. Sources: SBE, FHML, Maastricht University and the Dutch government. The remaining budget is covered with the revenue from projects and education.
Innovator type: *Maastricht* is located in the province of *Limburg* (NL42). *Limburg* is classified as **medium innovator** in our QHII ranking (QHII= 0.545).

1 Description

The Service Science Factory (SSF) is an initiative of the Maastricht University School of Business and Economics and is conceived as an 'academic workshop' where university and business representatives collaborate to develop new and value-added service concepts. The SFF is a specialised centre which combines expertise and competences in different sectorial domains and elaborates services delivered by SSF as a unique selling point. The main aim of SSF is to tailor innovative services which are based on the specific needs of businesses and which are aimed at increasing their effectiveness, innovation and competitiveness. The SSF team is composed of project leaders and PhD candidates from Maastricht University. It is managed by a board of advisors that includes both professors and associated partners. The SSF is acknowledged as a best practice at the European level in the field of competitiveness improvement and is part of the *European Service Innovation Centre (ESIC)* and of the *Limburg Makers program*.

2 Relevant contextual conditions

In the Limburg region, public contributions to R&D are lower than the Dutch average (0.47% vs. 0.7%). R&D investments are mainly driven by the private sector and in recent years the region has rapidly developed services sectors and has been recognised at the EU level as a large-scale demonstrator for service innovation. Although the region has no public research institutes, it is home to Maastricht University which is ranked among the best performing universities in the world, has more than 16,000 students, and about 215 full professors (RIM+).

3 Impact

To date, the SSF has completed more than 50 projects related to service innovation in the fields of energy, healthcare, hospitality, manufacturing, public sector and telecommunications. For example, in the telecommunication sector, SIEMENS requested that SSF develop a customer-centric mindset going beyond its traditionally engineering-based approach. Based on the analysis of the company needs and on the results of interviews with customers and employees, SSF developed an interactive game to develop a consumer-centric and service-oriented culture for SIEMENS employees. Employees were asked to take a specific role in the game and through this technique they became more aware of problems related to communication, about the SIEMENS process cycle, and about the need for cross-department interactions. The final output of the project was a general increase in the company's performance and an increase in each employee's customer experience. In December 2013, SSF had achieved 25 projects involving more than 150 students, academics and professionals; 10 Service Science Cafés as thematic events to disseminate the projects' outcomes (with more than 1.000 participants from academia and industry); a summer school on service design and innovation; an Executive Master in Business Services; an International PhD seminar and an International Academic Art and Science of Services Conference.

4 Transfer of research knowledge and innovation results

Each service/project realised by SSF developed tailored solutions for users to whom innovative methodologies were transferred.

5 Success factors

In general, the close relation with Maastricht University allows SSF to benefit from its **scientific reputation in the business sphere as well** and to offer innovative services thanks to the frontier research carried out by the PhD students and professors of the university. Among specific success factors are a

team entirely dedicated to the valorisation of SSF, with full-time project leaders **managing relations with clients according to a consulting approach**; and the professional recruitment of the project team (students are evaluated on the basis of their curriculum, cover letter, presentation, and their participation in an assessment meeting with clients).

References: Service Science Factory website; Entrepreneurial universities website – Case studies; Service Science Factory, Maastricht University: How to integrate the valorisation initiative into university research and education – UIIN Good practice series.

A successful outcome of the role of the entrepreneurial university in directly transferring applied research (TM1) to Industry and in generating economic growth is described by the experience of the Polish Region Cluster on BioEnergy (GP 3). Over the course of ten years, the collaboration proposed by the University sphere became a structured relationship between the industrial actors of the region (i.e. the cluster).

GP 3. The BioEnergy for the Region (BforR) Cluster, Poland

Implementation period: 2007-on-going
Involved authorities: *Lodz* Region
Involved stakeholders: UNI and IND (both with a leading role), GOV (local level), and CIV (NGOs)
Financing: ERDF and the State budget, European Funds for development of the region of *Lodz*, and economic contribution of the partners of the initiative
Innovator type: *Lodz* is located in the voivodeship of *Łódzkie* (PL11). *Łódzkie* is classified as **modest innovator** in our QHII ranking (QHII=0.267).

1 Description

The Bioenergy for the Region (BforR) Cluster is a bottom-up initiative launched in 2007 to implement projects in sustainable bioenergy, integrated energy solutions, and mitigation of climate change effects. The BforR, launched and promoted by the University of Lodz and the Technical University of Lodz, aimed to involve companies, farmers, R&D institutions, local administrations and organisations in supporting business in the region. The final goal of the cluster is to create synergies, set collaborations, and open innovation opportunities between R&D organisations and national and European public and private stakeholders dealing with renewable energies. Activities carried out in BforR are focused on information exchange, education, integration of multiple stakeholders' needs, and provision of support on relevant regulation and legal frameworks related to the biomass market in Central Poland.

2 Relevant contextual conditions

The region is characterised by important industries. It is a centre for electric power production and is considered highly attractive for foreign investments. According to the RIS, the region is a modest innovator, in part because of the low level of business expenditures in R&D (RIM+).

3 Impact

The University of Lodz and the Technical University of Lodz proposed the establishment of the BforR essentially relying on the support of public funding. Currently, the cluster is organisationally and financially independent from the academic structures. The BforR project website reports that over 9 years of activities the cluster has been able to implement 45 projects with the involvement of 7 local government units and 45 enterprises. Additionally, the cluster has become a tool for improving the visibility of projects carried out at the local level or by young scientists.

4 Transfer of research knowledge and innovation results

All initiatives and projects realised within the BforR cluster are focused on the transfer of knowledge among the involved partners. The cluster dimension also allows each initiative or project to generate positive information externalities in the bio-energy domain for all the other participants to BforR.

5 Success factors

The collaboration promoted by the UNI sphere is in a field (bio-energy) that perfectly matches **the need for renewing and innovating the industrial specialisation** of the area (which is already focused on energy production).

References: EURIS project (2012), Embracing open innovation in Europe – a best practice guide on open innovation policies; BforR website.

With regard to the Continuing Education (TM2) that an entrepreneurial university can provide, special synergies can be reached if the training targets are actors of the IND sphere (i.e. industrial players). An example of education for entrepreneurs is given by the experience of the Autonomous University of Madrid (GP 4).

GP 4. Industry-sponsored chairs at the Autonomous University of Madrid, Spain

Implementation period: 2003-on-going
Involved authorities: Universidad Autonoma de Madrid
Involved stakeholders: UNI (with a leading role), IND
Financing: Involved companies and Autonomous University of Madrid
Innovator type: The Autonomous Community of Madrid (ES30) is classified as **medium innovator** in our QHII ranking (QHII=0.455).

1 Description

The Autonomous University of Madrid (UAM) holds a leading position in the field of industry-sponsored chairs, both per number of chairs managed each year and per types of involved sponsors. Sponsored chairs (*Catedras de Patrocinio*) are tools used to establish a formal co-operation between the University and one or more enterprises (Industry sphere) for a temporary period. The collaboration takes the form of a private contract which is valid for a minimum period of 3 years. During this time, the enterprise provides financial support (EUR 50,000 per year, on average) to the sponsored chair and commits itself to supporting the chair activities. *Catedras de Patrocinio* are agreed on a specific field and include activities such as teaching, R&D, support for the innovation process (within the UNI sphere), awareness raising and dissemination activities (widening the scope to include civil society). For the UAM, the industry-sponsored chairs are a consolidated and vastly exploited approach to foster academic and industrial co-operation, to improve innovation capacities in specific fields that are in line with the actual needs of the business environment, and to train highly qualified human resources. The entire process for the establishment of sponsored chairs (from the identification of the field and selection of sponsors up to the signature of the contract) is managed by the Foundation of the Autonomous University of Madrid (*Fundacion de la Universidad de Madrid*) on behalf of the UAM.

2 Relevant contextual conditions

The Autonomous Community of Madrid has a higher level of investment in R&D than the national average (1.99% of the regional GDP versus 1.33% of the national average – RIM+). The fields for which the majority of sponsored chairs have been implemented by UAM generally match the priorities outlined in the S3.

3 Impact

To date, 28 sponsored chairs have been assigned (including some which were renewed after the minimum period), mainly in the fields of Medicine, Pharmaceutics, Engineering and Economics and Management. In some cases, sponsored chairs have been the first step in further collaboration activities between the UAM and the involved industrial actors (EUA, 2014). Some specific examples are: 1) UAM Faculty of Medicine – Johnson & Johnson (since 2014), Chair in Sutures and Healing, under which PhD scholarships and practical courses were implemented; 2) UAM Faculty of Economics – Accenture (since 2009), Chair in Economics and Management of Innovation focusing on joint research activities on innovation and knowledge management in entrepreneurial environments and on the implementation of activities for the development of entrepreneurial attitude and awareness (including conferences, forums, awards and other *ad hoc* events to show off students, centers, and enterprises working in the field of innovation); 3) Chair UAM – Fujitsu (since 2014) on Scientific Computation and Big Data, aiming at sponsoring both joint teaching and research in the field of Information Technologies, as well as at promoting dissemination activities (including both scientific publications and *ad hoc* events).

4 Transfer of research knowledge and innovation results

Sponsored chairs represent a structured tool for transferring research knowledge and innovation results from University to Industry. Formally, relevant outcomes from this exchange are managed with a contractual arrangement on industrial and intellectual property.

5 Success factors

Effectiveness and continuity of this collaborative approach are guaranteed by the size, by the **consolidated research reputation** and by the mission of the UAM. Experience and support in the management of the sponsored chairs approach is another essential enabling factor of such collaborations.

References: *Fundación de la Universidad Autonóma de Madrid* website; OECD-EC (2012), A Guiding Framework for Entrepreneurial Universities; European University Association (2014), University-Business collaborative research: goals, outcomes and new assessment tools.

Social (or public) Engagement (TM3) is probably the most challenging activity for universities and is far from the entrepreneurial idea. While business models for technology transfer and continuing education have been largely explored, social engagement, since it has more reputational goals, should be steered by

clear ethical values which in turn affect the governance of the institution (i.e. steering core and integrated entrepreneurial culture according to Clark, 1998). Improvement of social justice and social inclusion are the values which have inspired the engagement of Bocconi University, in line with its institutional mission, and through the initiative '*Una scelta possibile*' ('A possible choice') (GP 5).

GP 5. 'Una scelta possibile', Bocconi University, Italy

Implementation period: 2013–on-going
Involved authorities: Bocconi University
Involved stakeholders: UNI, CIV
Financing: University budget for each full tuition waiver: about EUR 24,000. Awarded: 3 (2013/2014). Planned: 10 (2014/2015).
Innovator type: The university is located in *Milano*, *Lombardia* region. *Lombardia* is classified as **medium innovator** in our QHII ranking (QHII=0.380).

1 Description

Università Bocconi identifies an active social engagement as part of its institutional role. The Community and Social Engagement project, run in collaboration with local organisations and civil society, was launched as an initiative encompassing different actions contributing to the development of the Bocconi community inside and outside the university. Among these actions, '*Una scelta possibile'* aims at supporting the enrolment of successful high-school students in a HEI, regardless of their economic condition. Students of any nationality coming from a high school located in the *Lombardia* Region who have an excellent academic record but face socio-economic barriers in accessing higher education, are given the possibility of attending a 5-year bachelor program at the Bocconi University. Together with a full tuition waiver (annual fees range from EUR 5,000 to EUR 11,000), students may also receive free accommodation at the University residence, free meals within the campus, and a scholarship of some EUR 4,000-5,000.

2 Relevant contextual conditions

In Italy, the cost of attending university is often a burden for the student's family, a situation which has been worsened by the recent economic crisis. The crisis is also impacting the allocation of the national budget towards the financing of scholarships. If in 2009, 84% of the students were eligible for funding, in 2011, this share dropped to 75%.

3 Impact

The initiative informed the community of the ethical values of solidarity and social justice which are built into the mission of the Bocconi University. Full tuition waiver and access to other services represent the benefits achieved by selected students. However, improved employment chances for highly educated new generations are expected to positively impact both the concerned families and the community at large in the short and medium term.

4 Transfer of research knowledge and innovation results

High level technical/scientific knowledge is directly transferred to a part of civil society. The University, in its institutional role, transfers information to the community regarding social justice values and opportunities of a larger social inclusion.

5 Success factors

Bocconi is a private, top-ranking university, especially in the fields of law and economics. It has a **strong orientation as entrepreneurial university**, a high reputation, and the economic capacity to support initiatives such as '*Una scelta possibile'*. The university spends about EUR 22 million yearly in supporting students' fees and other services.

References: Community and Social Engagement project website; Il sole 24 ore, press release dated 26/09/2013 '*Se la Bocconi è gratis. Borse da 70mila euro per i talenti disagiati*'.

3.2 Public sector innovation initiatives of eGovernment

Innovation in the public sector is defined as the **generation and implementation of new ideas which create value for society** (EC, 2013). Public sector's innovation is through policies, strategies and initiatives, especially in eGovernment, leading to improved access to information by users (e.g. through data opening), more targeted and efficient services to citizens and businesses (e.g. through the implementation of the 'once only' principle), and increased participation of citizens in the decision making process (e.g. through public consultations). A 'modern' public sector is envisioned in the new eGovernment Action Plan 2016-2020 (COM(2016) 179 final), according to which, by 2020, public administrations are expected to be "*open, efficient and inclusive, providing borderless, personalised, user-friendly, end-to-end digital public services to all citizens and businesses*"; furthermore, they will use

innovative approaches "*to design and deliver better services in line with the needs and demands of citizens and businesses*" and will "*use the opportunities offered by the new digital environment to facilitate their interactions with stakeholders and with each other*" (EC, 2016).

If ICT, overall, is at the basis of this transformation, acceleration towards modernisation requires the presence of at least three elements: interoperability, broadband access, and open governance. **Interoperable applications** are essential for eGovernment from the legal, organisational, semantic and technical points of view. **Broadband access,** largely recognised as one of the key enablers of "*Europe's full e-potential*" (EC, 2014), reflects the existence of appropriate ICT infrastructure and is positively correlated to the level of regional innovation[26]. Digitalisation drives innovation as it allows the opening of assets, services, and engagement. In the context of a helix approach, it creates knowledge and empowerment of the other elements of the ecosystem; enables co-creation of goods and services; and develops demand and tools for participation. Finally, **open governance** "*reaches across many parts and levels of the public sector as well to other appropriate actors outside government*" (Millard, 2013) and by implying change of roles, relationships, methodologies and forms of co-operation, is wholly congruent with the helix concepts (Boelman *et al.*, 2014).

This section reports on some good practices of eGovernment which outline the operationalisation of the helix models and the ways concerned public administrations have overcome common barriers to modernisation. The first case of the *Helsinki* Region Infoshare (HRI), awarded the European Prize for Innovation in Public Administration in 2013, is an example of **assets opening innovation** (GP 6). According to Millard (2013) "*Many governments, especially at regional and local level, are still struggling to come to terms with the meaning and value of opening their data, let alone how best to do so*." The author guards against the danger of what he refers to as an 'impeding data tsunami' but considers open data as a key element of an open government, and open government as one of the pillars of ICT-enabled public sector innovation.

GP 6. The *Helsinki* Region Infoshare (HRI) Service, Finland

Implementation period: 2009–on-going
Involved authorities: cities of *Espoo*, *Helsinki*, *Vantaa* and *Kauniainen*
Involved stakeholders: GOV (with a leading role), CIV (citizens), IND (business) and UNI

[26] In EC (2014), a positive and significant correlation is found between the Regional Innovation Index and the share of households having broadband access. This implies that regions where access by households to broadband is higher are more innovative.

(R&D society)
Financing: local (involved cities), national (the Finnish Innovation Fund SITRA and the Ministry of Finance through the inter-municipal co-operation funds)
Innovator type: *Helsinki-Uusimaa* (FI1B) is among the non-classified regions due to the lack of data related to the sub-indexes.

1 Description

In 2009, the *Helsinki* Region Infoshare (HRI) project was proposed within the '*Helsingin seudun seututietovisio 2020*' ('Helsinki Region data vision 2020'). Approved in 2010, the HRI web service was officially launched in March 2011. Since then, there has been an intensification of opened, produced, shared and utilised data. After the example of the US experience, the opening process was accelerated by the yearly running of a contest (the 'Apps4Finland') which rewards the best mobile and computer applications developed using Finnish open data. Today, the HRI feeds a wide range of applications across various sectors. Data are free, and may serve whatever purposes, from enhancing the citizens' understanding of their living environment, to supporting decision-making and R&D initiatives, as well as doing business.

2 Relevant contextual conditions

The *Helsinki-Uusimaa* regional strategy on smart specialisation covering the period 2014-2020 was approved in December 2014 and is a forward looking document in terms of the envisaged RIS3 operating model which is explicitly based on the "*Quadruple Helix thinking*". The strategy works towards the region's long-term goals of becoming the most competitive region in the Baltic Sea and one of the most important innovation clusters. This dynamism apparently enhances the region's capacity to turn challenges into opportunities. For example, an evident consequence of the recent financial and debt crisis was an increase in immigration to the Helsinki region, especially from Estonia. However, this seems to have had a positive impact on the regional economy as a driver of new demand (e.g. housing, services) and supply of labour.

3 Impact

A specific target of the HRI was increasing citizens' knowledge, participation and interaction. Although HRI is considered a successful initiative, the project's impact has never been quantified. Svahn (2015), on the basis of an investigation conducted in 2014 at the city level, identifies the following types of impact: efficiency improvements, which may add value in social and commercial terms; enhanced transparency, leading to information, participation, engagement, and commitment as well as better government administration and efficiency; new

possibilities for the creative use and visualisation of data, as well as for crowdsourcing; new opportunities for partnership and co-operation, as well as business, research and development activities.

4 Transfer of research knowledge and innovation results

A study commissioned by the HRI and published in 2014, highlighted the need to further build upon the achieved success and to accelerate the process of cultural change. In particular, participation by, and involvement of, actors in and around the *Helsinki* open data ecosystem (i.e. the ecosystem transfer capacity) was found to be insufficient. The study suggests the need to engage more frequently and more successfully with users, as well as the need to strengthen the network of interest groups, within and outside the country.

5 Success factors

The main driver of the initiative is the decision made by the local authorities to adopt **a new policy** in terms of open data. This decision was **influenced by earlier open data experiences from forerunners** such as the USA and the UK (the US government launched its data.gov data catalogue in May 2009, while the UK government's data.gov.uk followed shortly afterwards). In turn, this local policy influenced the open data movement at the national level (a national Open Knowledge Programme was launched in 2013), creating a mutual institutional strengthening of the opening innovation process. Other success factors relate to the effort put forth by participating institutions in clearing property rights aspects related to the publishing and use of their data. Attention was also paid to **relying on appropriate IT competences** for the development of the HRI as well as to the **involvement and training** of the municipal staff of the *Helsinki* Metropolitan Area.

References: HRI (2013), '2 years of open public data: providing stimuli for unlocking data' report; HRI website; Helsinki-Uusimaa Regional Council website and RIS3 document; Laakso S. and Kostiainen E. (2013), 'Divergent regional economies in Europe - Helsinki and Baltic Sea metropolises in the network of European regions'; Svahn S. (2015), 'Harnessing the uncovered opportunities of open data'; ECGT (2014), 'How to Accelerate the Open Data Revolution through a Win-Win Relationship for Both Producers and Consumers: The Case of Helsinki Region Infoshare'.

HRI has the potential of leading to concrete manifestations of the QH approach but much of this potential is still unexplored. The 2014 ECGT study clearly highlighted that the cultural change process is still on-going and that interaction, engagement (e.g. crowdsourcing from citizens and businesses), and participation in and around the data ecosystem are still insufficient and are affecting the transfer capacity.

Interaction, participation and engagement shape an open governance framework where, ideally, open engagement and open participation are legitimated by the concerned public authority as long as they facilitate the creation of public value (Millard, 2013). A successful example in this sense (crowdsourced law-making) is reported in Box 6, while Box 7 illustrates an example of a bottom-up initiative where the role of public authorities is equalled by those of the other participants.

Box 6. City of Hamburg: open engagement for a transparency law

The Hamburg transparency law was prepared on the initiative of three civil society groups. These groups combined their expertise and managed to go through the three steps required by law for legislative change: initiative, a request for vote, and a referendum. The text of a transparency law was drafted online, in a public wiki. It ended up being a high quality piece in part due to the free legal advice received in its drafting by a former judge of the Supreme Court. The law was approved in the city parliament with the favourable vote of all parties. Hamburg (DE60) is classified as **medium innovator** in our QHII ranking (QHII =0.608).

Source: Humborg C., Transparency International 'Space for Transparency', 25/06/2012.

Box 7. Civocracy, the Netherlands

Civocracy is a web-based platform that allows people to have a say on policy and social issues. Discussions are structured and aimed at conclusions shared as much as possible by different actors, including citizens, businesses, public authorities, and other organisations. Civocracy provides background information on the topics under discussion and highlights relevant events that may be attended by those interested, hence mixing online and offline interaction. The initiative is financed by the Startup Bootcamp (i.e. the 'Accelerator for Global Startups') and includes the Saxion University of Applied Sciences (NL) and the Petities.nl foundation as partners. Amsterdam is located in the North Holland Province (NL32) classified as **medium innovator** in our QHII ranking (QHII = 0.605).

Sources: Amsterdam Smart City (ASC) project's description; Civocracy website.

There is a growing tendency to consider technology as an enabler and not as the main driver of innovation. Hence, technology-based solutions are increasingly tested first, and then implemented only if testing is successful. This testing is preferably conducted in real settings such as Living Labs (LLs) and test-beds. LLs provide opportunities for interactive and innovation development with end users. They reflect environments which are shared by the actors of the quadruple helix. The most commonly adopted definition of LL within the European Network of Living Lab (ENoLL) reads "*Living Labs are user-driven innovation environments where users and producers co-create innovation in a trusted, open*

ecosystem that enables business and societal innovation" (Eskelinen *et al.* (Eds), 2015). A relevant example of LL based on a QH approach is reported in Box 8.

Box 8. Krakow Living Lab

The *Krakow* Living Lab, created by the initiative of the city authority, was officially recognised as such in August 2015 and is considered a pioneer in developing new approaches to product and service development in the region. The LL is described as being based on a QH model where the four helices contribute to innovation co-creation through a user-driven approach and the testing of solutions in real life environments. The LL deals with projects and activities related to the city's ICT environment and infrastructure, people's daily lives and citizen empowerment (e.g. Apps4Krk, CivilHub), eGovernment (e.g. open data and transparency), mobility, and environment. It is meant to contribute to economic growth and to the enhancement of companies' competitiveness. *Krakow* is located in *Małopolskie* (PL21), classified as **modest innovator** in our QHII ranking (QHII = 0.321).

Source: García Robles *et al.* (Eds.), 2015.

Another instrument leading to the co-development of products and services is the test-bed. This instrument is particularly suited for eHealth solutions as innovation in this sector is increasingly led by users' needs rather than by technology development only. This type of approach is shown in the *Norrbotten* example (GP 7).

GP 7. Prioritising ICT solutions in healthcare, *Norrbotten*, Sweden

Implementation period: since 1995 – on-going
Involved authorities: County Council and municipalities of *Norrbotten*
Involved stakeholders: GOV, IND, UNI, CIV
Financing: local, EU
Innovator type: *Norrbotten* is located in the *Övre Norrland* region (SE33). *Övre Norrland* is classified as an **advanced innovator** in our QHII ranking (QHII=0.695).

1 Description

The county is responsible for healthcare provision through 5 hospitals, 33 health centres and 34 dental clinics. Notwithstanding the absence of a specific strategy for eHealth, remote delivery of healthcare and services has been prioritised at the county level since the early nineties in an organic approach to territorial growth. A growing ageing population and the geographical challenges of the territory were the main two reasons to look for eHealth solutions that are able to ensure equal access and quality of services to citizens. The approach has

benefitted from the active contribution of *Luleå* University of Technology with its know-how on distance bridging technology. The university hosts the E-Health and Innovation Centre and it is within this centre that projects are run on the basis of triple helix collaborations. The private sector contributed to eHealth development with tailored ICT solutions such as the 'real presence' platform, allowing some forms of remote patient care and physical therapy through the use of high-resolution video communication. In 2010, the County established the Innovation gateway *Innovationssluss Norr*, with the aim of transforming new ideas into concrete healthcare products and services while increasing the number of start-ups and supporting regional growth. In general, the gateway supports the 'carriers of ideas' working in the health sector, such as citizens, patients, patients' relatives, small or medium sized businesses. One of the instruments used is the test-bed, which allows the testing of new or different ways of working, collaborating and developing products and services. The test-bed for person-centred stroke, dementia and palliative care is a needs-driven project which is based on the collaboration of businesses, academia, health care structures staff, users, and society. The ICT services developed within the county are reported to "*have won several prestigious prizes*" (Nordic Innovation).

2 Relevant contextual conditions

Norrbotten is a sparsely populated area, with low population density and vast distances to be covered. Other important challenges include demographic trends (e.g. depopulation, ageing), supply of labour force, and workforce's skills and competence level. The last two aspects are crucial in meeting the demand of both the public and the private sector from a growth perspective. The county is considered a forerunner in terms of the number of computers and the ICT knowledge of its citizens. Its governance structure is based on a formal collaboration between public authorities at all levels and organisations such as the *Luleå* University of Technology, the *Norrbotten* Chamber of Commerce, the Confederation of Professional Associations (SACO), and the Entrepreneurs *Norrbotten*. In 2013, the county published its 2013-2020 innovation strategy, which refers only briefly to eHealth but is meant to "*strengthen cooperation between university, research, business, society and the non-profit sectors*" (RIM+ webpage).

3 Impact

No quantification of the impact of eHealth development in the county is available even though *Norrbotten* is frequently quoted as a successful example of improved health care service delivery, better organisation of health structures, and cost savings. Interoperability, accessibility, increased interaction

opportunities and development of ICT solutions are at the basis of the regular investments decisions made towards eHealth research and innovation initiatives and projects.

4 Transfer of research knowledge and innovation results

The internationalisation attitude of the *Norrbotten* County Council and its ability to be involved in a multi-level system at the local, regional, national and international levels (e.g. the Assembly of European Regions e-Health Network) implies that its efforts in terms of innovation results and knowledge development are readily available for transfer. A simple example relates to its healthcare administration data system, one of the most efficient at the country level, and one that has been transferred to other county councils throughout Sweden.

5 Success factors

Performing ICT broadband infrastructure at the regional level was pursued by a strong political will in order to foster regional and social development and to overcome unfavourable geographic conditions. **International perspective** and **trans-border collaboration**, appropriate and competitive R&D capacities within the county's university and research facilities, as well as **knowledge of innovation methods such as test-beds** are amongst the main success factors.

References: Lindberg A. and Sjaunja K. (2014), 'E-Health in Norrbotten', in 'Developing regions for regional development – Towards a new Swedish model', Reglab Publisher; Customer story, Polycom (2012), 'Regional Healthcare Agency, County Council and Municipalities of Norrbotten', Sweden, deliver quality healthcare and services via Polycom® RealPresence® Platform; '51 examples of Nordic testbeds and innovation gateways' by Nordic Innovation.

In the *Norrbotten* case, the public authority functioned as an open collaboration platform supported by ICT for the creation of public value in the healthcare sector for which it holds primary responsibility: "*the public sector does not have a monopoly on public value creation, but it does have in most situations the prime role in ensuring that public value is created. Existing and new ICT is transforming the ability of government to act in these ways*" (Millard, 2013). This ability is amplified when directly cooperating with other actors. The *Norrbotten* experience, even if not guided by a defined strategy for eHealth, is clearly articulated around the four helices with the deployment of performing ICT infrastructures and the establishment of the innovation gateway by the local authorities; the inputting of technology and knowledge by territorial research and development facilities, as well as by the private sector; and the

implementation of test-beds involving the end-users. The conclusion is that challenges in this case were successfully turned into opportunities.
GP 8 is an example of public service reform through digitalisation and a non-linear, interactive approach focusing on users' needs centricity which is also referred to as 'design thinking' or design-led innovation. Hence, it is about **the opening of services and of engagement**.

GP 8. 'Shift' Surrey, UK

Implementation period: 2013 – on-going
Involved authorities: Surrey County Council
Involved stakeholders: GOV, CIV
Financing: local
Innovator type: Surrey is located in the Surrey, East and West Sussex region (UKJ2). The region is classified as **medium innovator** in our QHII ranking (QHII=0.486).

1 Description

'Shift' was initiated by the County Council in February 2013. It is an approach to change the way public services are developed and delivered to citizens. Following a six-month proof of concept (pilot), the initiative was then structured into a 3-year project based on the partnership between the Council and FutureGov, a company focusing on digital technology and co-design and co-ownership of products for the public services. The Shift approach is based on a few principles, including user-centred and collaborative approaches, and a 5Ds innovation process based on Discovery, Design, Development, Decision and Delivery. Within the framework of Shift, open events around innovation and discovery sessions have been organised and five projects have been initiated. These include: Patchwork (connecting public officers around clients, so that clients, for example, do not have to give the same information several times to several officers – it has been put in practice through the Surrey Family Support Programme); Lantern (an online tool co-designed with the residents, improving public response to the social care needs of individuals); Letterbox (enabling communication and interaction among people living in the same neighbourhood); Pathway Planning (improving the interaction between young people in care and social workers); and Election Dashboard ("*to help people understand what they're voting for*"). Shift is not only an approach, but has also developed into a physical space for interaction and creative collaboration.

2 Relevant contextual conditions

Within the new smart specialisation strategy for England submitted on April 2015, Surrey is one of the 15 designated Academic Health Science Networks (i.e. entry points for the industry-led innovation into healthcare). The South East is among the regions with the highest level of overall R&D investments (2010) and with a concentration of productive economic activity and knowledge intensive industries. Together with the East of England, the two regions employ 41% of the full-time equivalent research-related jobs in the country.

3 Impact

No quantification of the impact is available so far.

4 Transfer of research knowledge and innovation results

In 2013, Surrey was amongst the councils selected at the national level for the implementation of the 'Public Service Transformation Network'. The network is a "*'whole place', multi-agency approach to public service reform*". Its goal is to develop services which are designed around people's needs and then transfer the successful solutions that have been tested in the selected councils to other councils across the country.

5 Success factors

Originated as an **initiative of a few people** within the Council, the project has been structurally supported through the allocation of a **dedicated team of change professionals and service designers**, the latter charged with the task of turning ideas into practice. The project's success is probably also due to the fact that the initiative was run parallel to, and within, **a larger network public transformation programme** which was coherent and complementary in scope (e.g. focus on citizens, co-production, collaborative leadership, use of best evidence and of innovative tools/ideas).

References: Surrey Council website; Public Service Transformation Network website; FutureGov website; Beresford M. (2014), 'Smart people, smart places – Realising Digital Local Government', New Local Government Network; UK Department for Business Innovation and Skills (2015), Smart Specialisation in England.

'Shift' is an example of technology-led public policy experimentation associated with the need for changing the working practices and mindset of both the public staff and the services' users. The design thinking approach implies the understanding of the whole 'architecture' of the problem and requires people empowerment. The on-going 'WeLive' project (Box 9) shows how approaches

like ‘Shift’ are still pioneers for European public administrations and how the development of open technological frameworks is expected to enable the involvement of different actors in the innovation process.

Box 9. ‘WeLive’ pilot cities for ICT-enabled open government

‘WeLive’ is a Horizon 2020 funded project. It runs from January 2015 to December 2017 and has been granted a total budget of EUR 2,973,582. The project goal is “*to bridge the gap between innovation and adoption of open government services*” through the development of a technology-based framework which involves and empowers citizens, public administrations and businesses in four pilots: *Helsinki* Region (FI), *Trento* (IT), *Bilbao* (ES) and *Novi Sad* (Serbia). The project fosters an Open Government model based on the collaboration of the QH actors and on the Open Data, Open Services and Open Innovation principles. This is expected to promote the co-creation and delivery of urban services based on mobile apps.

Sources: CORDIS project description; WeLive website.

GP 9 is a qualitative undertaking by a city public authority to address future challenges related to rapid and massive urban development, keeping in mind the centricity of people and society. That is why the emphasis is not on being a ‘smart city’ but on being a ‘smart society’.

GP 9. The smart society philosophy of *Almere*, the Netherlands

Implementation period: 2012 – on-going
Involved authorities: *Almere* Economic Development Board
Involved stakeholders: GOV, IND, CIV
Financing: *not available*
Innovator type: *Almere* is located in the province of *Flevoland* (NL23). The province is classified as **medium innovator** in our QHII ranking (QHII = 0.541).

1 Description

Almere was founded some 40 years ago on reclaimed land. Located in the Amsterdam Metropolitan Area, it is one of the fastest growing cities in Europe. Its growth is expected to continue substantially in order to relieve the densely populated areas of the north-west of the country. The *Almere* 2.0 strategic vision is the development strategy at the basis of the agreement made by the city with provincial and federal authorities for a further expansion of the urban area. In the attempt to sustainably handle this rapid growth which is also meant to serve a national scope, the city has made a qualitative undertaking which is at the basis of its strategic vision. The basic principles expected to inspire its future

developments (and developers) include cultivating the city's diversity, fostering connectivity, combining urban and natural elements, anticipating change, innovating, designing healthy systems, and empowering people. The last principle is explained as "*Acknowledging citizens to be the driving force in creating, keeping and sustaining the city, we facilitate them in pursuing their unique potential*". The smart society philosophy of *Almere* further maintains and develops this emphasis on the 'society' element. In May 2012, a consortium including the municipal authority and the companies Alliander, Cisco, IBM, Philips and Living PlanIT, was established to create the '*Almere* Smart Society'. The latter is described as a movement of businesses, citizens and institutions working together towards the smart deployment of ICT (open infrastructure, platforms and data) in order for the city to achieve better urban management and cost savings, economic growth, social cohesion, and sustainable development. The focus is on intelligent use, involvement and co-creation rather than on technology.

2 Relevant contextual conditions

The city of *Almere* is considered a strategic location because of its proximity to major transport hubs (two international airports and the port of Amsterdam) and because it has ample space available to accommodate new residents and new businesses. Another characteristic of *Almere* is its cultural diversity. People living in *Almere* belong to 181 different ethnicities and 153 nationalities.

3 Impact

Future impact is unknown. In terms of expansion, about 60,000 new houses are expected to be built along with the creation of some 100,000 new jobs and related facilities by 2030. The city has been asked by provincial and federal authorities to expand its population to 350,000 inhabitants in 2030 (in 1977, the city was designed to accommodate a maximum of 250,000 inhabitants; in 2009, it had a population of 190,000 persons) to alleviate the pressure on the Amsterdam metropolitan area and *Noordvleugel Utrecht*.

4 Transfer of research knowledge and innovation results

The city's development is part of the regional collaboration programme RRAAM (*Rijksregioprogramma Amsterdam-Almere-Markermeer*) where a broad development strategy is defined at the federal and regional level. *Almere* is active in participating in national and European networking structures: it has been a promoter of the European New Town Platform (ENTP); it is an associated partner of Eurocities; and it is a partner of the national platform allowing co-operation among the Dutch cities.

5 Success factors

The strategic thinking is based on a **forward looking vision**, on putting people first, and on the **pursuit of innovative forms of administration and of collaboration** among the different actors.

References: Amsterdam Smart City Programme website; Mayor Annemarie Jorritsma's presentation at the Smart Cities Canada Summit, January 23 to 24, 2013 held in Toronto, Canada, 23-24/01/2013; Draft Strategic Vision Almere 2.0.

Almere is a rather new settlement. In this specific case, not having a past becomes a very good opportunity for focusing on the future.

3.3 The process of entrepreneurial discovery

Within the TH model proposed by Etzkowitz and Leydesdorff in 1995, the University, according to its *second mission* focused on research, represents the source of 'new knowledge', while Industry is in charge of bringing the knowledge to the market through an actor belonging to the same sphere, typically an entrepreneur. Perspectives change within the QH approach, where civil society, in an open innovation context, contributes with the other actors to innovation and may represent a privileged source of knowledge, with new ideas deriving from societal needs. *"By collaborating with external players, organizations have improved access to detail about information on needs and an expansion in the sources of solution information. In this way, the knowledge and creativity of external players that was previously unavailable is integrated into the process. This represents a departure from the traditional idea of the innovation process as being located largely within the company, which can be described as a closed innovation model"* (Ernst&Young, 2012).[27] Integration of knowledge from external players necessitates an '**absorptive capacity'** of the Industry sphere which is defined by Ernst&Young (2012) as *"the sum of organizational routines and strategic processes by means of which companies can acquire, assimilate, transform and exploit knowledge"*.

The combination of an active contribution by civil society in terms of knowledge and creativity with the absorptive capacity expressed by the Industry sphere is behind the *"more and more accurate and complete mutual knowledge of potential demand and supply attitudes"* of market participants which is referred to by Kirzner (1997) as **Entrepreneurial Discovery** (ED). Although

[27] The contribution of knowledge and creativity from civil society shall not be considered a substitute for the scientific/technical knowledge which comes from IND (intra-mural R&D) and from UNI (extra-mural R&D). Open innovation suggests an inclusive approach where all sources of knowledge are integrated.

the entrepreneur and innovation process at the firm level has a central role in the ED approach, the contribution of Kirzner goes beyond the microeconomics perspective: *"The Entrepreneurial Discovery approach offers a theoretical framework for understanding how market works. This framework has important practical implications for applied economics and for economic policy" (*Kirzner, 1997).[28] The ED approach may help LRAs to define not only inclusive policies but also innovation strategies which are aligned with the QH approach. According to Sobel (2015) "*Every state and nation has large numbers of people who are innovative and entrepreneurial. However, the proportion of those individuals who choose to actually pursue a life as a for-profit market entrepreneur is influenced by the existing institutions"*, for example "*through the rewards and incentive structures they create for entrepreneurial individuals"*. Moving from a microeconomics perspective to a macroeconomics one, the Government sphere has a precise role alongside civil society in the ED approach. In fact, Governments are called to actively participate as knowledge sources in the inclusive and interactive process aimed at generating new ideas, as well as to facilitate innovating actors (i.e. Industry sphere) in the application, implementation and exploitation of the novelty of ideas, and hence to properly select territorial specialization and priorities for an efficient allocation of resources. In particular, the ED process has been interpreted as a 'conceptual pillar' of smart specialisation (Capello, 2014), where future regional priorities and specialisation domains are defined by governments on the basis of the indications derived from inclusive and interactive processes among the different actors. The quality of the ED may be affected by (OECD, 2013a; Hausmann and Rodrik, 2003): **lack of information** (Government and Industry sphere) conditioning the perception of the innovation paths to be followed, **limited co-ordination incentives** (Industry sphere) conditioning the opportunities to collect new ideas from the market, **incomplete appropriability** (Industry sphere) of knowledge exploitation leading to a gap between the private and the social return[29], and **regulatory failures** (Government sphere) impeding or limiting the activity of the Industry sphere (both in terms of existing entrepreneurs or new businesses).

Three classes of actors providing key contributions to the ED process within a territorial Smart Specialisation Strategy are identified by Rodriguez-Pose and Wilkie (2015):

[28] Kirzner (1997) identifies four examples of areas of application of the ED approach: a) antitrust policy; b) economic justice; c) welfare economics; d) workability of central planning under socialism.

[29] As reported on the S3 Platform webpage related to the entrepreneurial discovery process (EDP), *"The discovery of pertinent specialisation domains may have a high social marginal return (development of the region's economy), but the entrepreneur who makes this initial discovery will only be able to capture a very limited part of this social value because other entrepreneurs will swiftly move into the identified domain ("first-mover disadvantage")".*

1) **Entrepreneurial agents** (Coffano and Foray, 2014) (belonging to the Industry, University and Government sphere) as source of the 'entrepreneurial knowledge'. At micro-level, they act both as a source of knowledge and as innovating actors with the capacity to exploit the novelty of the idea into a potential product or service. Entrepreneurial agents may assume a number of forms such as Small and Medium Enterprises (SMEs), industrial groups, HEIs, or public research institutes.

2) **The remainder of society** (Civil society sphere). Active involvement of the society, which is the leading source of creative knowledge, enlarges the scope of knowledge gathering and reinforces the local ownership of the ED process and of the related S3 strategies.

3) **Policymakers and those tasked with leading the smart specialisation efforts** (belonging to the Government sphere) as both integrators of entrepreneurial knowledge of the actors on the territory and facilitators of the bottom-up and decentralised nature of the ED process aimed at collecting information about potential S3 priorities. However, Mazzuccato (2014) moves further, proposing an **'entrepreneurial' role for the Government** which may also be an active source of knowledge and a facilitator of innovating actors.
The risk of a potential misalignment/approximation between the definition of priorities made by the Government and the actual specialisation of a territory (i.e. Industry sphere) is perceived as a threat for regional growth given the tight connection between the RIS3 and the thematic allocation of the Structural Funds (Sörvik and Kleibrink, 2015). In this case, the proper selection of actors for an effective ED process becomes essential. From the organisational and budgetary point of view, it is impossible, in practice, to involve all the representatives of the entrepreneurial potential of a territory in the process. Therefore, a selection approach based on efficiency, transparency and fairness is proposed by Martinez and Palazuelos-Martinez (2014).

Within any regional context in Europe, when reference to the Industry sphere is made in terms of economic growth and innovation and when entrepreneurial potential is under investigation, the main actors to be considered are essentially SMEs: "*Small and medium-sized enterprises (SMEs) are the backbone of Europe's economy. They represent 99% of all businesses in the EU. In the past five years, they have created around 85% of new jobs and provided two-thirds of the total private sector employment in the EU.*"[30] Having a small dimension by definition, SMEs are strongly related to the local dimension and their active partition in the ED process is crucial for their own sustainability: *"SMEs, and especially micro-enterprises, are heavily dependent on their regional*

[30] See: http://ec.europa.eu/growth/smes/

environment where proximity plays a key role for innovation, in particular regarding the spread and absorption of tacit knowledge. SMEs need policy support in tapping into the necessary outside resources, principally access to knowledge in the form of advice through innovation support services and tailored counselling, technology or qualified human capital, to face up to the new forms of competition that are developing in the global economy" (EC, 2012). In practice, the nature of SMEs and the way they aggregate at the territorial level influence their effective participation in the ED process. Since their role is essential in terms of source of knowledge and representativeness, governments are expected to facilitate their participation. This is a task which is increasingly enabled by the **adoption of ICT,** which opens new ways of interaction and engagement with stakeholders. Governments are also facing the challenge of stimulating digital innovation in all industrial sectors, and this will be facilitated by the development of Digital Innovation Hubs (DIH) aimed at *"spurring a wave of bottom-up innovations across sectors"* (EC, 2016a). Since ICT has been selected as a priority in the largest majority of the European regions (i.e. almost 90% according to EC, 2016a), local authorities (i.e. cities and regions), as well as universities and research centres, SMEs and large industries, accelerators and investors have been directly asked to support the definition of DIHs across Europe as participative actions for innovation on territories.

In the *Baden-Württemberg* region, awarded in 2011 with the European Committee of the Region's label of European Entrepreneurial Region (EER), stakeholders' participation is a central aspect in innovation policies. As a consequence, when the EU asked all Member States and their regions to develop S3, the main task for *Baden-Württemberg* consisted of making explicit existing processes of consultation and integrating existing elements into a coherent strategy (Kroll *et al.*, 2014). In fact, the *Baden-Württemberg* government decided to launch the RegioWIN contest as a strategic approach towards smart specialisation at the sub-regional level (GP 10). The contest is based on a competitive approach for best innovation projects proposed by cities and municipalities.

GP 10. RegioWIN, Germany

Implementation period: 2013 – on-going
Involved authorities: *Baden-Württemberg* Ministry of Finance and Economics, Ministry for Rural Areas and Consumer Protection, Ministry for Science Research and Arts
Involved stakeholders: GOV (regional level), IND, UNI
Financing: ERDF programming period 2014-2020 (EUR 68 million)
Innovator type: One out of the four regions of *Bundesland Baden-Württemberg* (DE12 –

Karlsruhe) is classified as **advanced innovator** in our QHII ranking (QHII = 0.713). The others (DE11 – *Stuttgart*, DE13 – *Freiburg*, and *DE14 – Tübingen)* are classified as **medium innovators** (with QHII = 0.641, QHII = 0.639 and QHII = 0.664, respectively).

1 Description

In 2013, *Bundesland Baden-Württemberg* launched the contest 'Regional competitiveness through innovation and sustainability RegioWIN' as part of the ERDF programming period 2014-2020. Recognising that co-operation among LRAs (i.e. cities and municipalities), Industry and University is necessary to create innovative projects and to develop regional strategies for growth, *Baden-Württemberg* sub-regions were asked to compete for the best approaches to local specialisation. Specific goals of RegioWIN are: i) improving the locational factors via smart specialisation within the regions; ii) promoting the elaboration of integrated, inclusive and sustainable concepts for regional development; iii) allowing the identification of relevant measures, flagships and key projects; iv) establishing governance structures for continuous improvement processes (RIM + RegioWIN webpage). The initiative is structured in two steps. The first step required the competing LRAs to elaborate regional strategies focusing on Competitiveness, Innovation and Sustainability[31]. Eleven sub-regions (called 'WINregions') entered the second step and were provided with funding for the elaboration of their inclusive regional strategies. Additionally, 21 innovative projects were accepted for funding through the ERDF and the Bundesland (RegioWIN website).

2 Relevant contextual conditions

Baden-Württemberg is a geographically large region located in the South-West of Germany and represents one of the most economically prosperous regions in Europe. It is classified as Innovation leader in the RIS (EC, 2014). Industry and its interaction with the University sphere can be considered the key driving factors of the region's innovation. GDP expenditure on R&D was 5.1% in 2011, with 80% of the total R&D expenditure coming from the private sector[32].

3 Impact

The overall impact of RegioWIN will include the definition of an integrated regional innovation and competitiveness strategy for the sub-regions and its implementation process. Even if it is too early to evaluate the impact of the initiative, *Baden-Württemberg* moved forward in implementing other similar initiatives. An example is the Integrated Territorial Investment (ITI) competition

[31] *Baden-Württemberg* Ministry of Finance and Economics press release 23.01.2015.
[32] See: http://www.s3vanguardinitiative.eu/partners/baden-wurttemberg

aimed at rewarding the best proposals for a smart specialisation strategy which takes into account ideas from the different types of stakeholders[33].

4 Transfer of research knowledge and innovation results

Most of the approved projects are meant to increase knowledge and technologies transfer among the involved stakeholders of the different spheres of the TH/QH. Some actions are focused on the physical establishment of hybrid organisations such as dedicated technology and innovation transfer centres, research-transfer centres, competence centres, and business development centres. Furthermore, the implementation of a virtual interactive centre, the *Mobilitätsplattform*, which allows the exchange of information in the *Verband Region Stuttgart*, should be emphasised.

5 Success factors

Structurally, the government follows a **dialogue-oriented economic policy** allowing policymakers, firms, associations, networks and clusters, academia and science, trade unions and other actors to interact. RegioWIN is a concrete initiative for transferring a regional helix collaboration practice to a sub-regional level for the elaboration of sub-regional development strategies.

References: Kroll *et al.*, 2014; *Ministerium für Finanzen und Wirtschaft* (2013), *Innovationsstrategie Baden-Württemberg*.

As the *Baden-Wuttemberg* case shows, the ED process can be applied to **any type of knowledge area. Entrepreneurial agents can belong to different sectoral domains** ranging from traditional industries to technological service providers. This is further demonstrated by the Basque Autonomous Community example (GP 11). The metal-mechanical and process industries are the strategic strength of the Basque country. Diversification and specialisation of competences have become a priority for allowing the generation of a qualitative change towards a more dynamic economic growth. Technological hybridisation with new business solutions was adopted as the way to innovate (Del Castillo Hermosa *et al.*, 2015).

[33] Ibidem

GP 11. *II Compite Bilgunea*: intersectoral processes for economic diversification, Spain

Implementation period: 2012
Involved authorities: Basque Government, Basque Business Development Agency (SPRI)
Involved stakeholders: IND (leading role), GOV (local and regional level)
Financing: Basque government (complemented by the financial support obtained through the Plan Resiste).
Innovator type: The *País Vasco* (ES21) is classified as **medium innovator** in our QHII ranking (QHII = 0.417).

1 Description

The '*II Compite Bilgunea*' (IIBC) was a pilot initiative aimed at fostering collaboration between metal-mechanical SMEs and healthcare companies in order to allow for technology transfer among them. The Basque Government and the Basque Business Development Agency (SPRI) offered resources and programs to enhance business competitiveness, according to the region's smart specialisation. Actors belonging to the two different productive domains were invited to participate in match-making events promoting technological hybridisation between industrial SMEs belonging to manufacturing sectors (i.e. automotive, electronics and electrical components, plastics, polymers manufacturers) and high tech companies for healthcare (i.e. high precision components).

2 Relevant contextual conditions

Industrial specialisation in niche areas is a key asset of the Basque country. Diversification strategies have led to policies focused on: i) for the Industry sphere: clusters' consolidation or promotion (through joint projects, internationalisation initiatives, spill-overs of entrepreneurship, best practices sharing, and boosting of co-operation among companies of different sectors); ii) for the University sphere: funding of Cooperative Research Centres (e.g. Ikerbasque, CICtourGUNE, CIC bioGUNE, CIC energigune) by the Department of Industry (and not by the Ministry of Education) in order to become key actors in conducting basic research, in place of the 'traditional' universities.

3 Impact

The target of the ED process realised through the IICB pilot was innovation through the combination of existing technical and scientific knowledge. IICB involved 28 participants (23 companies), generated 20 business contacts,

activated 4 hybridisation technology collaborations, and set up 1 project on specialised diversification.

4 Transfer of research knowledge and innovation results

The established ED process allowed knowledge exchange among vertically-structured domains. Such exchange permitted the actors who belonged to two different domains to identify, through co-operation, innovation opportunities in niche areas for industrial diversification. The renewed Industry sphere provided the Government with indications on how to design and implement effective policies for boosting the competitiveness of the region. Such indications include instruments which facilitate inter-sectoral collaboration of SMEs and promote technological hybridization.

5 Success factors

Each actor contributed with its **know-how**. Sectoral, technological and market knowledge were provided by the Industry sphere, while hybrid organisations in the region (i.e. development agencies such as Bilbao Ekintza, Inguralde, Goieki, DEBEGESA, Fomento de San Sebastián) provided knowledge of the territory's entrepreneurial potential as expressed in particular by SMEs.

References: Del Castillo Hermosa J., Paton Elorduy J. and Barroeta Eguía B. (2015), 'Smart specialization and entrepreneurial discovery: Theory and reality', Revista Portuguesa de Estudos Regionais, n. 39; Navarro Arancegui M., Aranguren Querejeta M. J., Magro Montero E. (2001), 'Smart Specialisation Strategies: The Case of the Basque Country', Orkestra Working Paper Series in Territorial Competitiveness Number 2011-R07 (ENG); COMPITE *iniciativas* website; Department of Industry, Innovation, Trade and Tourism of the Basque Government (2012), *The Basque Case Study*.

The ED process, which aims to encompass knowledge contributions from all the spheres for boosting a territory's innovation, is an evolving process. The experience of the NetPort.Karlshamn, which was renamed as 'NetPort Science Park' in 2013, shows how an interaction model based on TH evolved in an initiative which was inclusive of the needs of the territory, and which in recent years also encompassed civil society (GP 12).

GP 12. NetPort Science Park, Sweden

Implementation period: 2001–on-going
Involved authorities: *Karlshamn* Municipality, the *Blekinge* Institute of Technology
Involved stakeholders: GOV (local and regional level, with a leading role), UNI, IND
Financing: EUR 850,425 out of which EUR 362,530 from ERDF, EUR 362,921 from regional funds and EUR 124,974 from private contribution
Innovator type: *Karlshamn* is located in the *Sydsverige* region (SE22). The region is classified as **medium innovator** in our QHII ranking (QHII = 0.640).

1 Description

The NetPort Science Park, originally established as NetPort.Karlshamn in 2001, is a *"triple-helix organization that promotes partnerships between the business community, academia and the public sector"* (NetPort Science Park website). The organisation successfully evolved in the last decade with the widening of the scope of its activities. Today, NetPort is a non-profit organisation funded by the municipality (70%), the university (10%), local businesses (10%), and other *ad hoc* sources (Hennigsson, 2007). Its mission is "*to create conditions for companies in establishing their business within the premises, students and researchers to develop and grow, and for the municipality to attract more inhabitants"* (Samuel Henningsson, CEO of NetPort Science Park)[34]. NetPort provides a physical space where all actors have the possibility of co-operating in terms of transfer and exchange of new knowledge and discoveries, as well as in terms of set-up and implementation of new innovative projects. With regard to future developments, a cultural centre under the responsibility of the *Karlshamn* municipality has already been planned.

2 Relevant contextual conditions

Since the end of the nineties, a structural transformation of the *Karlshamn* area, located on the south coast of Sweden, was deemed necessary, in particular to respond to a decreasing population trend caused by a crisis of the local manufacturing industry. The focus was put on the two objectives of sustainable economic growth and community development at the local and regional level, while the transfer of knowledge and communication technologies were recognised as the key enablers of regional growth. Relying on the interactive approach envisaged in the TH model, the NetPort was established with the initial aim of encouraging and supporting new companies in the digital sector (i.e. moving away from industrial production towards innovation and business

[34] See: http://www.netport.se/en/2014/09/netport-science-park-is-expanding-2/

development), under the Objective 2 programme of the *Södra* region, which benefitted from EU funding over the period 2000-2006.

3 Impact

The NetPort initiative is well consolidated and expanding. An extension of its physical space was approved in 2014 and is expected to be implemented in the year 2017. The science park allows for the development and dissemination of skills, and for the identification of business opportunities, education and research activities. "*NetPort initiates and participates in research projects in collaboration with local, national and international partners, primarily in three focus areas: Digital Media, Energy and Intelligent Transportation Systems*". Its expected impact by 2020 is 750 fulltime students linked to the municipality, 1,100 new employment opportunities, 1,500 more residents in Karlshamn, and 100 researchers and 125 new companies in Net.Port's focus areas (NetPort Science Park website).

4 Transfer of research knowledge and innovation results.

One of the core objectives of Net.Port is to provide a physical place for the creation and exchange of knowledge among the territory's stakeholders. Entrepreneurship discovery is facilitated through a collaboration process which is based on a *"give and take"* principle, meaning each actor should concurrently contribute and benefit from the collaboration.

5 Success factors

The involvement and collaboration of the local actors allowed for the creation of a **territorial-shared goal towards the region's sustainability and prosperity**. Additionally, the creation of a **physical innovation environment** facilitated the effective interaction of all partners. ERDF funding successfully functioned as 'seed money'.

References: NetPort Science Park website; Henningsson S. (2007), 'NetPort.Karlshamn: a 'triple helix' organisation fostering new sources of local development', Södra, Sweden; InfoRegio project fact-sheet.

Aiming at sustaining the challenge faced by entrepreneurial agents of combining competitiveness at the global level with sustainable development at the local level, the Lazio Regional Authority is proposing the implementation of a new model of industrial areas integrated with green development (GP 13). The ED approach is leading the design and the implementation process of the model that will be regulated and managed directly by the regional actors (mainly belonging

to the Industry and Government spheres). In this case, the GOV is acting as the integrator of the territorial actors' entrepreneurial knowledge; as facilitator of the bottom-up and decentralised nature of the ED process through the collection of information about potential entrepreneurial priorities; and as institutional entrepreneur (especially in the case of local authorities) directly entering into the partnerships.

GP 13. The APEA model, Italy

Implementation period: 2016–on-going
Involved authorities: Lazio Regional Authority
Involved stakeholders: GOV, IND, CIV
Financing: EUR 30 million from the regional budget (Regional Operational Programme, ERDF 2014-2020, Thematic objectives: Competiveness (OT3.1.2) and Transition towards a low-emission economy (OT4.1.2)).[35]
Innovator type: *Lazio* region is classified as **medium innovator** in our QHII ranking (QHII = 0.452).

1 Description

The *Aree Produttive Ecologicamente Attrezzate* (APEA) ('Productive and ecologically equipped areas') model aims at converting industrial areas into areas where production is integrated within a green economy and within a social perspective which enables participants to share the management of infrastructures, assets, services and resources. The main objectives of the new APEA model are: i) increasing synergies between industrial development and environmental sustainability; ii) fostering the competitiveness of the target area's entrepreneurial excellences, with a special focus on SMEs; iii) improving the effectiveness of the circular economy; and iv) reducing pollution and waste of resources along the productive process. The model defines four categories of actors to be involved: i) private and public organisations potentially generating pollution (e.g. of water, air, or soil) in their entrepreneurial activity or waste of resources (i.e. energy)(Industry sphere); ii) infrastructure or network operators providing services in line with the objectives of the APEA; iii) private or public organisations which, having formalised a partnership agreement, develop research, good practices, products and services targeted to the eco-innovation achievement (i.e. all the TH spheres); iv) municipalities or public consortia of the target APEA area (Government sphere). All the participating actors must comply with an *ad hoc* regulation for the APEA which also defines its governance and management system.

[35] See: http://www.lazioinnova.it/programma-di-reindustrializzazione-del-territorio/

2 Relevant contextual conditions

The legal framework related to the APEA model was established at the national level in 1998[36]; administrative competences on APEA were delegated to Italian regions in 1999. A top-down and centralized approach aimed at minimising the different regional views failed and caused a relevant delay in the operationalization of the model at the territorial level. In 2015, the *Lazio* Region set up the guidelines for the operational implementation of the new APEA model (DGR 41/2015 dated 10.02.2015) to be implemented as a bottom-up initiative with the direct contribution of the regional actors in the development and approval of its *ad hoc* regulation.

3 Impact

Given the fact that the APEA model has not been implemented yet, it is too early to evaluate the impact of the initiative. Nevertheless, expected impact has been defined in terms of the following criteria: establishment of a closed circular economy; reduction, especially for the SMEs of the administrative burden related to environmental certifications; and improvement of the efficiency (e.g. reduction of costs for the entrepreneurial systems through the sharing of resources, infrastructures, assets and services).

4 Transfer of research knowledge and innovation results

Apart from its main operational objectives, APEA aims at: i) identifying new entrepreneurial opportunities within a green economy perspective; ii) suggesting governance improvements to LRAs which are aimed at facilitating a sustainable entrepreneurship; iii) proposing changes/modifications of the APEA regulation to the Lazio Regional Authority; and iv) fostering international co-operation on industrial areas.

5 Success factors

The main phases of the new APEA model initiative rely on an ED process and on bottom-up contributions of the entrepreneurial agents. Namely, these include the on-going development and approval of an *ad hoc* regulation for the APEA, based on a consultation with strategic regional stakeholders; and the establishment of each APEA partnership, which will be based on a dedicated web portal where actors will be asked to register.

References: Interview with representatives of the *Lazio* Regional Authority; lanotiziah24.com press release dated 17.06.2015; *Regione Lazio* project fact-sheet.

[36] Art.26 "Aree industriali e aree ecologicamente attrezzate" of the Legislative Decree n.112 of 31 March 1998.

3.4 Social innovation and experimentation for demographic challenges

Boelman *et al*. (2014) define social innovation as "*new approaches to addressing social needs. They* [these approaches] *are social in their means and in their ends. They engage and mobilise the beneficiaries and help to transform social relations by improving beneficiaries' access to power and resources*". The requirements of being a novelty and of being put into practice replicate those highlighted when discussing the public sector innovation and the entrepreneurial discovery concepts (see sections 3.2 and 3.3). The authors' definition is similar to the definition given by the EC in its 2013 Guide to Social Innovation. Still, instead of approaches, the EC definition refers to 'ideas' intended as "*products, services and models*" and specifies that these ideas "*rely on the inventiveness of citizens, civil society organisations, local communities, businesses and public servants and services*" (EC, 2013).

Digitalisation and research outputs are both enablers of social innovation. Digital technologies may empower social innovators, support engagement and mobilisation (hence, the interaction of the actors of the QH), directly address the meeting of social needs through specific tools (e.g. apps), or may help in developing other technologies supportive of social innovation (Boelman *et al*., 2014). In fact, digital technology may also facilitate experimental processes. Social experimentation implies that a policy intervention is first designed and then experimented on a small scale before being scaled up (Europe, 2011). Experimentation underlines the need **to have readily available and usable research outputs** which provide policymakers with evidence to guide their decisions. Towards this end, some policymakers have decided to arrange the testing and research of social innovations in innovation labs working on a small scale. Even if the scale of these tests is small, the solutions tested in these labs are tailored to the challenges particular to an area or locality and hence are more indicative than those derived from generalised studies (Boelman *et al*., 2014).

Social innovation is expected to help address societal challenges which affect a very diverse range of areas, including environment, poverty, and well-being. **Demographic challenges** such as those related to population ageing, overcrowding of some urban centres or, conversely, depopulation (e.g. caused by the declining industrial structure of a territory), as well as the current refugee crisis and migration waves may all be addressed through social innovation initiatives. These initiatives may have a specific goal or tackle broader development objectives. The Swedish Center for Public Entrepreneurship (CPE) is an example of a support structure for social innovation which has the aim of contributing to territorial development through civic participation but which

does not have a specific societal challenge as a focus. According to Lufrbj (2015), the centre is one of the few examples which support social innovation processes on the basis of a quintuple-helix model where the fifth helix is the group of 'social entrepreneurs' (Box 10).

Box 10. Centre for Public Entrepreneurship (CPE), Sweden

CPE is a regional development project initiated by the third sector but funded for the most part by the *Skåne* County. The Centre aims at increasing participation in social and territorial (local and regional) development by individuals and organisations and by means of social entrepreneurship initiatives. Since 2009, more than 220 initiatives have been supported by the centre. One example of an initiative aimed at the integration of immigrants is the 'Meeting Place Maggan', in *Norra Fäladen*, a city district of *Lund*. Established in 2012, the Maggan place is first a gathering place for people living in *Norra Fäladen*, and second a source of help and information for starting one's own business. The initiative sees the participation and contribution of *Folkuniversitetet*, the Swedish Public Employment Service, the *Lund* municipality, local associations, property companies, local enterprise organisations and the '*Social inkubator som samverkansaktörer*' project. The *Skåne* County is located in South Sweden (SE22 - *Sydsverige*), and is classified as **medium innovator** in our QHII ranking (QHII = 0.640).

Sources: Lufrbj A. (2015)*;* CPE (2012), 'The Art of Inviting Participation'; CPE website.

The examples of **social innovation initiatives multiply if a quadruple helix model is considered within the context of Living Labs**. Social innovation is thus found, for instance, to be one of the core activities of the following members of the European Network of Living Labs (ENoLL): Coventry Living Lab (UK), focusing on user driven innovation in a smart city context; Laurea Living Lab (FI), focusing on both social and business innovation in the fields of health and wellbeing; and i2Cat Living Lab (ES), focusing on the application of the QH model in the areas of eHealth, smart cities & smart regions, advanced manufacturing, and culture & creativity.

Living Labs are one of the instruments used to implement **direct democracy**. When considering the public or users according to a collectivist approach (i.e. where the users are involved directly or indirectly in the definition and/or delivery approach of the service), Arnkil *et al.* (2010) refer to the idea of Hoggett and Hambleton (1987) for which the decision-making process can benefit from the bottom-up perspective through either representative or direct democracy. While representative democracy requires counsellors as advocates, direct democracy can be implemented using three types of approaches: resourcing non-statutory organisations, community development, and the involvement of user groups, for example through living labs.

Interestingly, some of the social innovation initiatives which are now labelled as 'living labs' started as TH or QH collaborations institutionalised under different frameworks (centres, associations, formal partnerships, etc.). These structures were usually not labelled as 'living labs' until a later stage, in order to **enhance their visibility and networking opportunities**. This is the case, for instance, of the two Spanish examples of Citylab (Box 11) and of Guadalinfo (GP 14). The Guadalinfo case has been selected due to its focus on **rural areas** and its outstanding impact. In this initiative, the use of digital technologies is emphasised in terms of inclusion, political participation, and meeting of the expectations and/or needs of the users.

Box 11. Citylab, Spain

Citylab is a foundation for social and digital innovation in *Cornella de Llobregat*, Barcelona. It is based on a partnership among the City of *Cornella*, local companies and multinationals, the *Universitat Politècnica de Catalunya* (UPC), and citizens' representatives. Initiated in 1997, it became a foundation in 2003 and a member of ENoLL in 2008. Citilab focuses on citizens and on the internet as the way to achieve citizens' integration and collaboration in the innovation process. Applied working methods include design-thinking and user-centred creation. Any new comer to Citylab is asked what he or she wants to do and is then invited to create his or her own project. For example, within the LaborLab initiative, the invitation is to invent jobs using ICT. Several other initiatives which have been implemented are: Senior Lab (introducing the elderly to ICT), Edutec (working with primary and secondary schools), Social Media Lab, and Smart Citizens. Citylab is considered to have introduced the citizen-driven methodology in the city of Barcelona (in 2014, the city of Barcelona was awarded the European Capital of Innovation prize). Barcelona is located in *Cataluña* (ES51), and is classified as a **medium innovator** in our QHII ranking (QHII = 0.393).

Sources: Citylab website; Eskelinen *et al.* (Eds.) (2015).

GP 14. Guadalinfo, the *Consorcio 'Fernando de los Ríos'* Living Lab, Spain

Implementation period: 2003- on-going
Involved authorities: regional and local authorities of Andalusia
Involved stakeholders: CIV, UNI, IND
Financing: local, regional, EU (ERDF)
Innovator type: *Andalucía* (ES61) is classified as **modest innovator** in our QHII ranking (QHII = 0.305).

1 Description

'Guadalinfo' is the flagship project of the *Consorcio 'Fernando de los Ríos'* Living Lab. The consortium is a public entity including the Ministry of Economy, Innovation and Science of the Government of Andalusia and the eight provincial councils. Originally, it was established to encourage ICT literacy and uptake by citizens, with the aim of enhancing inclusion of those living in disadvantaged areas, enabling general public access to services, and facilitating citizens' participation in public and policy life. Today, it is officially labelled as a 'Living Lab' and relies on a myriad of rural and urban labs (840) involving some 750,000 users belonging to very diverse categories, from children and teenagers to elderly people or people with disabilities. The consortium "*tries to offer efficient public services and a better use of the ICT (Future Internet) to users, through piloting projects and testing products and services and to promote entrepreneurship in the different centres*". In these labs, citizens are actively involved in projects generated from their own ideas or from ideas generated by other stakeholders (e.g. service/product providers). Projects relate to areas such as ICT inclusion and political participation. Guadalinfo started as a pilot in 2003 and was then implemented regionally over the period 2004-2009. In fact, over time Guadalinfo evolved into a sort of community. A recent example (2016) relates to the participation of hundreds of 'Guadalinfo' users in *Granada*, *Jaén* and *Málaga* in a project run by the University of Granada for the development of a virtual platform to recognise and prevent cognitive decline of the elderly. Guadalinfo includes, among other figures, 757 centres with public access to the internet, more than 1,000 on-going social innovation projects, 163 telecentres associates, more than 767,000 users, 293,280 activities with the user participation in the centres, 900,389 pages viewed in the portal each month, 88,000 mentions in social media, 1,173 virtual communities, and more than 264,000 video results on Google (32,000 on YouTube).

2 Relevant contextual conditions

The RIS of *Andalucía* was published in 2015 and covers the period 2014-2015. Under the ICT and digital economy priority, its emphasis is on further ICT development, eGovernment, and digital content innovation. Andalusia has been hit hard by the economic crisis. According to 2015 statistics, the region has the highest unemployment level across the EU28 (34.8%), with the rate of unemployment of the youth (aged 15-24) being almost double (61.5%).

3 Impact & transfer potential

People who were involved in Guadalinfo had higher (5%) chances of finding employment and their ICT skills were 17% higher than those of the general

public. The economic impact of Guadalinfo includes an increased regional GVA by EUR 24.2 million, equivalent to a 6.68% increase over the period 2007-2010; creation of 1,500 direct and indirect jobs; and increased internet access in municipalities with fewer than 10,000 inhabitants (i.e. 18.46% vs. a regional average of 16.7%). The initiative proved to be highly sustainable and transferable both nationally and internationally, with several expressions of interest received by the Ministry of Economy, Innovation and Science.

4 Success factors

Among the success factors are **full compliance with and mainstreaming of ICT regional policies**, a clear vision of the benefits that could be brought about by promoting ICT literacy, provision of **innovative approaches to users' involvement and to training**, use of innovative content and tools for customers, and use of a monitoring and evaluation system which has allowed for the quantitative and qualitative analysis of the project's achievements.

References: Eurostat statistics explained on 'Unemployment statistics at regional level'; RIS Andalusia 2014-2020; METIS (2009), Mini-Case Study: *Guadalinfo*, Spain.

Among the demographic problems is the ageing societal challenge which may, in fact, turn out to be an opportunity for regional growth, as it fuels the so called **silver economy**. Silver economy relates "*to a broad range of economic activities, from health and care products and services, to mobility and ambient assisted living, thus touching upon not only social market segments but also wellness, fitness, leisure, travel, culture, communication, entertainment and, consequently, ICT*" (COR, 2011). Such an economy is driven by major factual evidence, including a relevant spending capacity of Europeans aged over 65 (estimated in some EUR 3,000 billion), the structural change of the population (*"by 2060 one in three Europeans will be over 65*"), and the fact that retirees of the baby boomer generation will be wealthier than their predecessors and likely to demand higher quality products and services (COR, 2011; the EC European Silver Economy Strategy website). The silver economy is therefore strictly linked to innovation processes, to the need for developing new approaches for products and services design and development, and to the necessity of having the public sector involved in the light of the ever increasingly costs for care from public budgets.

According to the Business Opportunities for Health Ageing (Biz4Age) cluster project funded by the Interreg IVA 2 Seas Cross-border Co-operation Programme, **TH/QH approaches are necessary to transform the ageing challenge into a business opportunity** at the regional level along with "*mechanisms to catalyse and sustain regional networks involving the many*

different kinds of stakeholders; ways of building trust for open innovation; user-led innovation through living laboratories that place the needs and dignity of citizens at the centre of social and technological change" (Biz4Age website). An example in this sense is illustrated with GP 15.

GP 15. Open Innovation for health related services in the silver market, Germany

Implementation period: 2012
Involved authorities: State Government
Involved stakeholders: CIV (German Senior League), UNI (RWTH Aachen University), IND (MedCom international ltd.)
Financing: funded by the Ministry of Economic Affairs and Energy of the State of North-Rhine Westphalia through EU structural funds (ERDF 2007-2013)
Innovator type: The German Senior League and the RWTH Aachen University are located in *Regierungsbezirk Köln* (DEA2). *Köln* is classified as **medium innovator** in our QHII ranking (QHII = 0.617).

1 Description

The Open ISA project aimed to actively involve the elderly in the design and development of products and services reflecting their requirements. The project established a web-based interdisciplinary open innovation platform allowing interaction as well as co-design and co-development. The initiative goes a step forward with respect to those approaches where the designers simulate problems or observe behaviours of the target clients. Furthermore, it shifts the focus from the latest technically possible features (which would otherwise be prioritised by designers in product development) to the concrete needs of the users. In 2012, this co-creation approach used within the context of the Open ISA project (but developed within the framework of another initiative) received the Co-Creation Award in the 'non-profit innovation' category.

2 Relevant contextual conditions

Germany, as one of the 'oldest' countries in the EU, is particularly sensitive to the demographic change driven by population ageing. However, it is also a forerunner in looking for solutions which facilitate 'active ageing' and in considering the opportunities created by the silver economy.

3 Impact & transfer potential

Within the OpenISA partnership, RWTH Aachen University plays a key role in the transfer of research knowledge and innovation results. The university manages a website 'WiPro – *Innovativ mit Methode*' which provides examples of innovation methods. These examples are complemented by detailed descriptions and an advice service provided by 'method experts'. The initiative is funded by the State of North-Rhine Westphalia.

4 Success factors

An ideal blending of expertise and roles is behind the success of this project. RWTH "*develops theories, concepts and tools to explain and design interactions and the division of work in the innovation process. Therefore RWTH became the "method" experts on crowdsourcing (seniors*)". The German Senior Citizens League is a charitable non-profit organisation which since 1994 has been voicing the interests and the needs of the elderly. It was the 'perfect customer', bringing in, through the organisation of focus groups, experience, knowledge, and a 'high motivation and pragmatic intelligence'. The private company MedCom was in charge of project management and product development.

References: Changemakers website; German Senior Citizens League website; RWTH website.

Living & Care Lab, in Belgium, is a practical demonstration of the capacity of a QH approach to successfully follow up R&D activities in two specific sectors. In fact, the lab has the explicit aim of improving the transferability of R&D results into a real life context, hence enhancing the effectiveness of investments and improving the compliance of products and services with the expectations and needs of end-users (Box 12).

Box 12. LiCalab – Living & Care Lab, Belgium

In 2009, the City of Turnhout, Belgium, started the development of a community living lab named LiCalab after the two focus areas of the lab: living and care. LiCalab is both a system and an environment resembling real life conditions where new products and services are developed using a user-centric approach. Within the innovation chain, the lab places itself between the prototyping and commercialisation phase of the product/service. It has the double aim of having a faster placement of the product/service on the market and a better response of the product/service with respect to the user's needs. These goals are achieved by involving the users through co-creation methods at a very early stage of product/service development. The living lab works with a group of 650 end-users but there are plans to expand this group to 1,000 persons by mid-2016. The lab is grounded on the claim that "*60 to 70% of all innovations do not reach the market. Many private and public R&D-investments fail to produce real and sustaining value for the society, due to the fact that they are initiated and executed in a closed and artificial laboratory environment. In this situation there is limited interaction with, and understanding of, the real user-needs, the care givers needs, the potential implementation problems, especially regarding economic valorisation and the required support of an eco-system of stakeholders*". Within the initiative Welzijnszorg Kempen (an association of local governments dealing with local affairs), K.H.Kempen University College, research and industrial partners (commercial and non-commercial), and health institutions are also involved. *Turnhout* is located in the Province of *Antwerpen* (BE21), and is classified as a **medium innovator** in our QHII ranking (QHII = 0.502).

Source: Health4Growth project (2013), 'Good practices in Europe' brochure, funded through the Interreg IVC programme.

Urban regeneration is also another demographic challenge faced by local authorities. Regeneration capacity has indeed been negatively affected by the economic and financial crisis and is a direct consequence of an average (EU28) decreasing public expenditure by LRAs over the period 2009-2013 compared to the pre-crisis period 2000-2009 (EC-DG REGIO, 2014). **Social innovation has proved to offer several solutions for undertaking interventions within urban environments which require low investments**. These solutions are usually based on the mobilisation of a large group of actors at the community level (including, for example, local authorities, NGOs, companies, and citizens) but do not seem to rely significantly on the use of new technologies and do not refer explicitly to the implementation of TH/QH approaches, although envisaged collaborations could theoretically fit into such models. Examples include initiatives on: 1) the temporary use of buildings. In Bremen, Germany, such initiatives were started at the community level and then picked up by the city authorities, who ran a pilot and finally rolled out the approach through a temporary use agency; 2) the adoption of more flexible standards and regulations allowing the implementation of new approaches driven by bottom-up initiatives. An example of this is found in Amsterdam, where the northern waterfront, a polluted ex-industrial area owned by the municipality, has been

revitalised by ideas put in practice by civil society initiatives[37]; 3) a growing active role of citizens, residents and/or movements. The *Kerameikos-Metaxourgeio* area in Athens, for example, has been the target of collective efforts by artists and developers to turn it into a cultural district (Tosics, 2015).

Social innovation approaches may also be adopted in order to tackle global challenges which have a local impact and therefore need local solutions. The refugee crisis has triggered a series of social needs which are not fully met by current policies and institutional initiatives and which have determined a wide range of social innovation responses aimed at welcoming immigrants and/or at supporting their integration at the community level. Some of these responses rely heavily on the networking capacity of ICT to rapidly spread across local, regional and national borders. 'Refugees Welcome' is a very recent initiative, but already in 2015 it was considered by the Social Tech Guide[38] as one of the 100 most inspiring social tech innovations from across the world (GP 16). The second example, which originated in France but then was networked across the whole of Europe, was awarded a Prize for Civic Engagement in 2012 (GP 17).

GP 16. Refugees Welcome, Germany

Implementation period: November 2014 – on-going
Involved authorities: public authorities at any level
Involved stakeholders: CIV, GOV
Financing: public and private (donations, crowdfunding)
Innovator type: not applicable

1 Description

Back in November 2014, when the 'Refugees Welcome' project started, the basic idea of the German non-profit initiator was to match those refugees who had been granted asylum but did not have a place to live, with people having spare rooms in their houses. Matching between householders interested in renting one room in their flat and refugees looking for a way out of the camps is done through the organisation's website and staff. The rent paid to householders is sourced through different ways: small donations by friends and colleagues (from a few EUR to a maximum of EUR 50 per month), use of crowdfunding through the crowdfunding.de platform, or public funds. In Germany, funds from the federal states may be available to facilitate and financially support the move of refugees from camps to residential accommodations. However, public

[37] See: 'Post-Crisis Urban Planning: Innovative Local Solutions to Fight Environmental Degradation'
[38] See: http://socialtech.org.uk/

financial support is regulated differently in each federal state of Germany, and in each Member State where the 'Refugees Welcome' project was replicated.

2 Relevant contextual conditions

According to ECHO website, "*By end of February 2016, over 1.1 million people – refugees, displaced persons and other migrants – have made their way to the European Union, either escaping conflict in their country and in search of better economic prospects.*"

3 Impact & transfer potential

In April 2015, after a few months from its start, the project reported having accommodated 26 persons and having 780 registrations offering accommodation. House-owners were aged between 21 and 65 and included families as well as single households. One third of the rents were contributed by public structures (the Job Centre or the Social Welfare Office), the others were contributed through donations and private contributions. One year later, in March 2016, the 'Refugees Welcome' homepage reported a total of 570 refugees accommodated in private homes, including 281 through Refugees Welcome Germany, 269 through Refugees Welcome Austria, 5 each through Refugees Welcome Poland and Refugees Welcome Greece, 2 through Refugees Welcome Spain, and 1 each through Refugees Welcome Netherlands and Refugees Welcome Portugal. In fact, the project approach rapidly spread across Europe, creating a network of nine nationally-based and registered structures (e.g. the one in Italy was established by three individuals and registered as a non-profit 'association'). With the exception of the Austrian group which started in January 2015, all the other networked 'groups' were created between October and November 2015.

4 Success factors

The project gained visibility through a series of press releases. It aims at creating a win-win situation with benefits for both the householders and the refugees. **Different funding sources** are envisaged, including channels (e.g. crowdfunding) which make it easy for a high number of individuals to participate and contribute. The initiative seeks compliance with institutional channels and regulations which already exist to face the current humanitarian crisis.

References: Social Tech Guide description of the initiative; Refugees Welcome website; Refugees Welcome press release 1/2015 dated 27.04.2015.

GP 17. Asylos, France

Implementation period: 2010 – on-going
Involved authorities: judicial system authorities
Involved stakeholders: CIV (NGOs, volunteers), GOV (humanitarian organisations at EU and UN level)
Financing: private, charities
Innovator type: not applicable

1 Description

Founded in Paris in 2010 by a few individuals, the goal of Asylos "*is to help people facing persecution in their home countries to exercise their right to asylum. We believe in the importance of this fundamental human right and we take concrete actions to protect it.*" The work of this association relies as much as possible on digital tools to gather evidence that fill in the information gaps of the official Country of Origin Information reports released by UN and EU agencies, or international NGOs. This additional information provides a great help to both lawyers and judges who are dealing with asylum seekers' applications and is often fundamental in making the asylum seekers' cause successful. Asylos is registered as a charitable incorporated organisation with the Charity Commission of England and Wales and as an *Association Loi 1901* in France. Mentioned supporters include the Sigrid Rausing Trust, the Open Society Foundations, and the Danish Refugee Council.

2 Relevant contextual conditions

In the EU, the asylum system gives the right to any migrant having claimed asylum or refugee status to have this claim reviewed by the judicial system and not to be expelled while the claim is examined. Almost all Member States provide refugees with legal assistance paid for by taxpayer money. The recent humanitarian crisis has put a lot of pressure on this system.

3 Impact & transfer potential

Nowadays Asylos is a wide network organised into six regional teams (Balkans, Afghanistan, Middle East and Mediterranean area, Africa, Asia, Russia/CIS). It relies on the contribution of more than 80 volunteers spread across Europe and encompasses the knowledge of more than 30 languages. To date these volunteers have responded to more than 400 information requests.

4 Success factors

The system is based on **online connection and networking** thus relying on a limited number of support staff. The bulk of the work is done on a volunteer basis, with a limited workload required (two hours per week) per person. The initiative is particularly suited to the needs of society considering the existing humanitarian crisis and adds value to the work carried out by international organisations and national judicial systems.

References: Project's description on Asylum Corner's website; Asylos' website; Sciences Po Paris, June 2012 newsletter.

Another example of a bottom-up initiative, started by two individuals and then taken up and supported by broader organisations and large companies is reported in Box 13.

Box 13. REFUNITE: a tech-based service for refugees

One of the problems of asylum seekers is to reconnect with friends and family who were left behind. Started in 2010 by two Danish brothers, the project has been helping thousands of people get in contact with their families. According to the type and quantity of information that the refugee is willing to disclose, REFUNITE allows the use of multiple mobile-based systems to attempt to find relatives. The service has been improved over the years with the collaboration of the organisations working with refugees and of mobile technology companies.

Source: Asylum Corner 'Social innovation for refugees: a successful story'.

The social innovation examples related to the refugee crisis reflect a type of social innovation which is very much focused on immediate needs and is unlikely to fit into a medium- or long-term regional development perspective or vis-à-vis the current needs of LRAs. Common characteristics of the two proposed good practices are the **reliance on new technologies to communicate and engage as well as to spread rapidly**; and their **legitimation** within existing institutional frameworks which are determined at the national or supra-national level. Another characteristic shared by these refugee-related initiatives is that they were **initiated by a few individuals only**, with their launch not tied to reaching a 'critical mass'. As 'good ideas' they were rapidly taken up by many others and resulted in creating Europe-wide networks.

Part 4: Conclusions and recommendations

This section provides conclusions and recommendations on the applicability and possible use of the QH approach by LRAs, taking into account the evidence gathered over Parts 1, 2 and 3. Recommendations (*R*) are in italics.

4.1 The theory of the helix models versus their operationalization

Evidence from the literature review (Part 1), the comparative analysis of regional innovation performance (Part 2) and the gathered experiences by LRAs (Part 3) indicates that innovation policies commonly target the spheres of the helix models. However, this is often done on a discrete basis, while the integrated approach envisaged within both the TH and the QH is, in most cases, not explicitly used as the theoretical reference to frame innovation policymaking and even less so in the implementation of strategies. In fact, helix models are hardly referred to in S3. Co-existence of several concepts in literature have somewhat detached theory from practice and an insufficient emphasis still seems to be given to the operationalization of the models.

- ***R1.*** *The fostering of both the TH and QH needs to be tackled through the* ***identification and sharing of successful evidence across territorial authorities,*** *rather than in an academic or theoretical manner. Examples of such evidence include best practices, well-functioning mechanisms for effective interaction, and blooming of attitude-change approaches. If possible, the positive territorial impact derived from the application of the helix models should also be highlighted.*

Two main theoretical streams dominate in literature: 1) the evolved version of the TH model originally developed by Etzkowitz and Leydesdorff (1995) in which the three pillars of the innovation process (UNI, IND, GOV) interact to exchange knowledge and in which their components/actors interact up to the point that they absorb some of the functions of the others (i.e. entrepreneurial universities) or become hybrid actors; 2) the QH approach proposed by Yawson (2009), which still relies on interaction but introduces a new source of knowledge, external to the institutional spheres. Although a number of options have been theorized in literature, Civil society (CIV) is the candidate for this fourth helix. Regardless of the type of application of the TH model at the territorial level (i.e. statist regime, *laissez faire* regime, balanced regime) CIV 'properly combined' with the other helices may create sufficient conditions to

stimulate their development and effective involvement in an innovation-generation process.

- ***R2. Civil society engagement*** *has to be intended* ***as an innovation boosting factor*** *if properly integrated in a helix-based strategy. The innovative potential of civil society is widespread across sectors, does not require long-term investments and is ready-to-use. This change of perspective may favour those regions, especially MED, where joint-development of helices is not mature enough**.** Also in MOD, where the technological paradigm is still not applicable, the inclusion of civil society in the innovation process impacts favourably by promoting consensus in policymaking.*

Evidence calls for the need to facilitate the understanding and operationalization of the helix models with easy-to-use instruments (Parts 1 and 2). Availability of better data and indicators may expand the scope of the regional comparison and increase the robustness and significance of the proposed QHII (or, more in general, of composite indexes). Tools allowing an easy interpretation of data and indicators may support the prioritization of helices' maturity, provide indications on the development of interaction mechanisms over time, and represent a monitoring tool for the fine-tuning of territorial strategies.

- ***R3.*** *Further research work on synthetic indexes on QH innovation maturity should be conducted for developing* ***effective tools to be used by decision makers for the measurement and monitoring of the TH/QH maturity*** *and related interactions. This is grounded in the conviction that making the helix approach a success requires situational awareness.*

- ***R4.*** *The* ***clustering of data and their analysis by helix****, as developed in this study through the outlining of the sub-indexes, is further recommended as an operational method to understand strengths and weaknesses as well as opportunities and threats of a territory with respect to the helix approaches.*

The computation of the QHII has highlighted important gaps in data availability for existing indicators aimed at measuring research and innovation performance at the regional level (NUTS2). Within this study, only 21 regions out of 268 (i.e. about 8%) could not be classified and were excluded from the QHII analysis but this was a result of using NUTS1 and NUTS0 level data in several cases as proxies for NUTS2 level missing data. Data constraints are also clearly identified in the RIS 2014 *"Attempts to monitor RSIs and region's innovation performance are severely hindered by a lack of regional innovation data"* (EC, 2014). The problem is twofold: existing indicators for measuring knowledge and

innovation are only partially suitable and may lead to an inaccurate representation of reality and to policy actions with limited effectiveness; and data for existing indicators do not have an adequate geographical coverage at the territorial level.

- ***R5.*** *Additional effort should be put on the* ***identification of new indicators and on the improvement of the quality of existing ones****. The academic world may have a key role in defining these new indicators for measuring knowledge and innovation.*

The proposed QHII may be improved both in terms of significance (i.e. more indicators are added in the sphere-related sub-indexes) and robustness (i.e. it is computed using updated and completed data at the regional level).

- ***R6.*** *Improvements in terms of availability and quality of data and indicators may allow the further fine-tuning of indexes representing the innovation performance of a territory (e.g. of the proposed QHII)* ***by assigning different weights to the spheres*** *reflected by the sub-indexes.*

4.2 On the characterisation of the three innovator types

Preferred innovation 'pullers' vary according to the type of innovator region (Part 2). The analysis of the computed sub-indices of the QHII across the whole population (247 regions) leads to the conclusion that IND and INT are by far the most 'effective' and structural pullers across ADV and MED regions. This is confirmed by the analysis of the 'puller capacity' of the spheres in the sample of the ten selected regions. Innovation interaction (INT), intended as both existence of active hybrid institutions/organisations and informal exchange of knowledge and sharing of know-how among actors, is a necessary condition for setting an innovation dynamic path. Looking at the experience of the ADV, it seems to also become a **sufficient** condition in presence of at least one mature sphere (mostly, IND).

- ***R7****. Policy investments in reinforcing the IND sphere, combined with actions to foster* ***interaction (INT) with other spheres, are recommended*** *for moving regions from the MED type to the ADV type.*

Notably, the importance of UNI as a leading sphere seems to be limited in both ADV and MED and dramatically decreasing in relevance from ADV to MOD. This disappointing finding may be due on one side to the poor representativeness of the indicators used to calculate the UNI sub-index. However, it is a fact that a few regions, on the basis of the same indicators, show

a satisfactory (or even leading) performance of the UNI sphere. Also in the small sample, UNI rarely leads innovation-generation, driving the conclusion that there is space for better tailoring the contribution of this sphere to innovation from a QH perspective.

- ***R8.*** *The innovation performance of UNI may be improved by fostering its entrepreneurial role as: i)* ***technology transfer actor****: this implies a strengthening of the capacity to reach the market; ii)* ***knowledge transfer actor*** *to the other institutional spheres (i.e. GOV and IND). Incentivizing universities to increase their reliance on competitive funds rather than on institutional ones may leverage the entrepreneurial attitude of UNI implying also a reinforcement of INT.*

GOV also shows a very limited weight in innovation performance across the three types of regions. As for the UNI sphere, this may be due to the poor representativeness of the indicators in the sub-index. However data highlight that GOV leadership in innovation performance occurs in the population of regions only in seven cases. Among these are capital regions (e.g. *Praha*, *Bucharest*), regions hosting capitals (e.g. *Lazio*) and relatively autonomous regions (e.g. *Corse*, *Provincia Autonoma di Trento*). In these cases, the active contribution of GOV to innovation in a helix perspective seems to be correlated to the relevance that the public sector has in governing the socio-economic dynamics of a territory. However, this evidence is not enough to conclude that devolution/federalisation outperforms in terms of helix approaches.

Finally, MOD are characterised by having very limited evidence of the implementation of the QH approach (as indicated by the low values of the QHII) and of the performance of each helix. Among the 73 regions belonging to the MOD type, none of them has INT as the leading element. CIV emerges as the leading sphere as a consequence of the lack of performance of the other spheres. This structural fragmentation is also evidenced by the qualitative analysis conducted on the small sample of selected modest regions.

- ***R9****. Less innovating regions suffer from a lack of helix maturity for an effective implementation of the QH approach. Limited capacity for economic investments for innovation may be partially overcome by focusing on* ***regional specialisation*** *(in line with the S3 and sustained through EU structural funds) and on* ***the boosting of the innovative potential of CIV*** *by adopting, with limited cost, a new perspective favouring bottom-up initiatives and social inclusion (see R2).*

Through the comparative analysis of the ten selected regions' structural conditions, the following seem to be positively correlated to a good innovation

performance: small physical size of the territory, high population density, high regional GDP and GERD, and high levels of broadband access. In addition, the qualitative analysis shows that ADV innovators host world-leading businesses/companies on their territories, and/or rely on technology and/or knowledge intensive industries, and/or have an important ICT-based industry. It may thus be concluded that among the important boosting factors of innovation performance at the territorial level is the actualization of a critical mass in terms of human resources (population) and economic activities.

- ***R10.*** *Since* ***concentration of assets has a leading role in fostering innovation*** *and soft assets such as science/technology-based knowledge and creative knowledge grow through interaction, policy actions should be focused on improving the connectivity of actors (i.e. social inclusion). Critical mass in knowledge can also be achieved outside of the physical dimension through the fostering of broadband penetration.*

4.3 On experiences and good practices in specific themes of the QH

Universities in the last decade have enlarged the scope of their activities either by explicitly defining a new mission (i.e. the third mission) or by reshaping teaching and research according to market requirements or societal needs. In both cases universities assume an 'entrepreneurial role' contributing to innovation with both science/technology-based knowledge and creativity-based knowledge. Apart from the theoretical categorisation of the third mission actions (Technology transfer and innovation, Continuing Education, Social (or public) Engagement), the identified cases (Part 3) highlight the relevant role of **universities (UNI) in interacting (INT) with industry (IND) and civil society (CIV)** through **the provision of valuable knowledge** to be exploited by these helices for innovation purposes. Collection and rationalization of the knowledge produced within the academic sphere and its transfer to the business world are the core activities of the Knowledge Management Center (KMC) of the Széchenyi István University. Explicit interaction to develop marketable knowledge is the essential feature of the Service Science Factory (SSF) of the Maastricht University School of Business and Economics.

When universities are leading the innovation process, the 'last mile' is with players of the IND sphere. For example, although the Bioenergy for the Region (BforR) Cluster was launched and promoted as a bottom-up initiative by the University of Lodz and by the Technical University of Lodz, the cluster then became organisationally and financially independent from the academic

structures with the main aim of transferring knowledge to the industrial partners belonging to the bio-energy domain. The back-end role of the UNI sphere with respect to the IND sphere is confirmed by the experience of the *Catedras de Patrocinio*, sponsored by enterprises for directly addressing knowledge gaps in innovation capacities of IND actors. The relevance of this interaction between UNI and IND is typical of the QH approach as well as of the TH model.

Moving to the societal dimension and looking at the contribution of the UNI sphere to the CIV sphere, the initiative *'Una scelta possibile'* of the Bocconi University aims at enlarging the opportunity of society to generate knowledge for innovation by providing successful high-school students with financial support to continue academic careers.

- ***R11.*** *Rather than fostering direct contribution of universities towards innovation, an effective implementation of the TH and QH approaches needs improvement of interaction opportunities (INT) where* ***high value knowledge produced by universities*** *(already innovation-oriented) can be properly* ***transferred and exploited*** *by the IND and CIV spheres.*

There is evidence (Part 3) that **innovation in the public sector** supports the establishment of governance conducive to innovation. According to the examples and practices gathered in the thematic analysis of eGovernment, it may be concluded that success factors leading to enhanced access, services, transparency, accountability and engagement include availability of the (broadband) infrastructure and technology as enablers; presence of innovation culture, driven by models, examples, or by the vision of a few; existence of one or more important pulling force(s) embedded in the territory (e.g. a geographical challenge to be overcome, a legislation or programme to comply with); availability of knowledge hubs; management capacity of change and/or set up of 'innovation teams', if necessary relying on the input of change professionals; and enabling framework conditions (e.g. political support at higher administrative levels, empowered users). Evidence also shows that the co-operation and interaction among the helices of the theoretical models is commonly implemented in public sector innovation-oriented initiatives. In particular, the public sector is evidently giving a growing emphasis to the role of users (i.e. users' needs and users' perspectives) through participation and engagement, which is a precondition for moving away from the traditional (and institutional) top-down approach.

The proposed good practices outline some of the factors which are able to overcome commonly recognised barriers to public sector innovation. The *Helsinki* Region Infoshare case shows the importance for public administrators to have an **inspiring** model or vision (e.g. *Almere* smart society) **which**

nurtures the necessary leadership in the public authority to trigger innovation. This is important if we consider that some innovative solutions implying the change of both working practices and mindset are evidently initiated by a few individuals and are only institutionalised' at a later stage by the adopting public administration (i.e. the case of Shift in Surrey, UK). Another recurrent feature in the proposed cases is the **knowledge of innovative processes and methods**. Innovation needs competence in order to turn ideas into value for society. Appropriate IT competence was used in the data opening of Helsinki; knowledge of innovation methods such as test-beds is at the core of the success of *Norrbotten* healthcare approach; and 'change professionals' were hired to support the Shift project in Surrey. Finally, performing ICT capabilities (reflecting the existence of appropriate infrastructure, access and digital skills) are confirmed by all examples to be a *sine qua non* condition for driving innovation.

- ***R12.*** *The operationalisation of the helix models may greatly benefit from an* ***enhanced innovation cultural level of the public administrators.*** *This may be fostered through an effective sharing among administrations of concrete and successful experiences (good practices) and evidence, or by the involvement of organisational innovation professionals of 'change' in the modernisation process of public administrations.*

Multiple, interdisciplinary and unstructured sources of knowledge and know-how are the key elements behind **the process of entrepreneurial discovery**. One of the main success factors to exploit these sources is the existence of an environment which allows industry players and government stakeholders to benefit from idea contributions from all possible sources (not only from CIV). The pilot initiative of 'II Compite Bilgunea' (IIBC) was aimed at fostering collaboration between metal-mechanical SMEs and healthcare companies based on technological hybridisation. Match-making events organised by hybrid organisations provided the opportunity to exchange know-how between the two involved industrial sectors. The 'NetPort Science Park' is another case of a physical interaction model based on TH that evolved into an initiative based on the QH approach for creating innovation according to the needs of civil society (i.e. through a creation of a cultural centre) in addition to the needs of businesses. The RegioWIN contest launched in *Baden-Württemberg* is an example of bottom-up contribution to innovation from all the spheres co-operating in a QH approach where the design and implementation of hybrid organisations (as places of entrepreneurial discovery) was set up in parallel to the implementation of a virtual interactive centre for the information in the *Verband Region Stuttgart*. The new APEA model, aimed at managing industrial production and societal needs (including environmental sustainability), is put forward by the *Lazio* Regional Authority as a bottom-up initiative where all the

spheres have the opportunity to interact in the design and implementation of productive and ecologically equipped areas. On a consultation basis, strategic regional stakeholders are asked to make proposals on an *ad hoc* regulation for APEA and to establish partnerships interacting on a dedicated web portal. The *Lazio* case shows that ICT infrastructure is, along with physical locations, a strategic enabler of information sharing that allows industry players and government stakeholders (e.g. through public consultations) to benefit from idea contribution from all possible sources (not only from CIV).

- ***R13.*** *Information sharing among spheres both in terms of provision of ideas or expression of know-how requires a structured environment that should ideally be set up by GOV. Such an* ***environment*** *should be* ***spatially tailored*** *(i.e. physical or virtual)* ***on the basis of the type of information to be shared and the type of stakeholders to be involved****.*

Regarding **social innovation and experimentation**, proposed examples show how technology-led initiatives may be commenced independently by civil society (individuals or communities or civic organisations) or may be solicited and facilitated by public authorities (e.g. *Guadalinfo, Almere*). Evidence also suggests that if on the one hand GOV acts as supporter (e.g. CityLab) or catalyst (e.g. *Guadalinfo*), then on the other hand ICT clearly acts as accelerator and multiplier of bottom-up initiatives. Even if initiatives are started by only a few individuals and in one specific location (e.g. Refugees Welcome), they may roll out across borders in a relatively brief lapse of time (e.g. months) and become unbounded with respect to the territory they originated from (i.e. the not necessarily 'spatially specific' contribution of the fourth helix to the innovation process). Evidence also shows that not all contributions of civil society to the innovation process explicitly fit into a regional development perspective of growth. This is a reasonable finding since social innovation deals with responses to changing conditions which do not follow a market dynamic. These responses look for 'intangible' benefits rather than for an economic return which is readily transferable into regional growth. Furthermore, there is ample evidence that **living labs**, and in particular those that are **public-sector-centred**, provide several successful examples of inclusion in the innovation process of the broader community, or users. This has the potential to not only consider the democracy perspective in the innovation process but also to increase the chances for R&D efforts to reach the market and produce real value for society. Interestingly, some of the social innovation initiatives which are now labelled as 'living labs' started as TH or QH collaborations institutionalised under different frameworks (centres, associations, formal partnerships, etc.).

Among the most evident success factors of the proposed social innovation and experimentation initiatives are availability of the infrastructure and technology

as enablers and accelerators; presence of one idea, which may originate also from a single person, implying that a critical mass for social innovation is not necessary in the very beginning of the innovation process; fitting of the initiative within existing institutional frameworks, though maintaining its independent nature; and reliance on more than one funding source, where sources are often leveraged through crowd-based mechanisms. From the point of view of public authorities, flexibility in changing attitudes, rules and regulations to fit innovative initiatives is as important as the setting up of monitoring mechanisms which may provide a quantitative and qualitative assessment of the impact of the initiatives. This last aspect is related to the innovation awareness of the public sector as one of the main challenges public authorities face towards modernisation and change.

- ***R14.*** *The unstructured, flexible and autonomous nature of social innovation makes it less connected to the structural conditions and strategic assets of a territory. Social innovation offers* ***opportunities for cross-border co-operation and networks creation to boost exchange of ideas*** *and should be considered by less innovative regions as a way out of path-dependencies and lock-in conditions in socio-economic growth.*

Several of the initiatives reviewed in the report rely on local, regional and/or national funding. European funding is also frequent and mostly sourced through Structural Funds, in particular the European Rural Development Fund. None of the experiences refer to EU instruments such as Innovation Partnerships, awards or labels, with the exception of the RegioWIN initiative of *Baden-Württemberg*, which received the European Committee of the Region's label of European Entrepreneurial Region (EER).

- ***R15.*** *There seems to be* ***ample room for turning existing EU instruments related to co-operation for research and innovation*** *(e.g. Innovation partnerships) into effective ways for boosting QH approaches on territories.*

For example, the European Innovation Partnerships (EIPs) were recently reviewed (EC-DG Research, 2014) and found to necessitate several adjustments, including at the governance and engagement level. With regard to engagement in particular, the under representation of the industry and of SMEs was noted, a circumstance which is hampering the possibility of giving a QH perspective to the partnership tool.

- ***R16.*** *EU funds aimed at increasing research and innovation through cross-border co-operation (e.g. H2020) may be further* ***exploited for the***

empowerment of individual helices at the territorial level and for improving local capacities of interaction.

Looking at the tight collaboration and at the functional substitution among spheres achieved in some of the good practices presented in the thematic analysis (Part 3), it is evident that **opportunities for interaction** have a key role and generate a **multiplier effect of the innovation outcomes**. EU-funded programmes allowing interaction aimed at directly creating innovation through research exploitation (e.g. H2020) or at reinforcing the innovation potential through best practice transferability (e.g. Interreg programme) represent suitable opportunities for enlarging the scope of interventions in terms of both type and number of activities implemented and actors involved.

Appendix I – Indicators for the QH index

Indicator category	Source	Name	Year
Industry (IND)	RIS (2014)	Business R&D expenditure	2014
Industry (IND)	EUROSTAT (t_reg)	R&D personnel employed in BES sector	2013
Industry (IND)	RIS (2014)	Non R&D innovation expenditures (SMEs)	2014
Industry (IND)	RIS (2014)	Product or process innovators	2014
Industry (IND)	EUROSTAT (t_reg)	Employment in technology and knowledge intensive sectors	2014
Government (GOV)	RIS (2014)	R&D expenditure in public sector	2014
Government (GOV)	EUROSTAT (t_reg)	R&D personnel in GOV sector	2013
University (UNI)	EUROSTAT (t_reg)	HEI R&D expenditure	2013
University (UNI)	EUROSTAT (t_reg)	R&D Personnel in HEI sector	2013
Civil society (CIV)	EUROSTAT (t_reg)	Private non-profit R&D expenditures	2013
Civil society (CIV)	EUROSTAT (t_reg)	R&D personnel in Private non-profit sector	2013
Civil society (CIV)	RIS (2014)	Population aged 30-34 with tertiary education	2014
Civil society (CIV)	EUROSTAT (t_reg)	Households with broadband access	2015
Civil society (CIV)	EUROSTAT (t_reg)	Individual who used internet for social media	2015
Innovation interaction (INT)	RIS (2014)	EPO patent applications	2014
Innovation interaction (INT)	RIS (2014)	Innovative SMEs collaborating with others	2014
Innovation interaction (INT)	EUROSTAT	Employed scientists and engineers	2014
Innovation interaction (INT)	RCI (2013)	Scientific publications	(average 2008-2010)

(*) RIS = Regional Innovation Scoreboard (2014); EUROSTAT = Eurostat Regional statistics (t_reg); RCI = Regional Competitiveness Index (2013).

Appendix II – Classification of regions versus the QHII

ADVANCED INNOVATORS: QHII ≥ 0.666

GEO		QHII
DK	DK01 - Hovedstaden	0,761
DE	DE30 - Berlin	0,744
SE	SE12 - Östra Mellansverige	0,717
DE	DE12 - Karlsruhe	0,713
UK	UKH1 - East Anglia	0,712
UK	UKJ1 - Berkshire, Buckinghamshire and Oxfordshire	0,703
AT	AT13 - Wien	0,698
SE	SE33 - Övre Norrland	0,695
SE	SE11 - Stockholm	0,693
DE	DE91 - Braunschweig	0,679
DE	DE21 - Oberbayern	0,676
CZ	CZ01 - Praha	0,672
NL	NL31 - Utrecht	0,672

MEDIUM INNOVATORS (contd.) 0.333 ≤ QHII < 0.666

FR	FR71 - Rhône-Alpes	0,487
UK	UKJ2 - Surrey, East and West Sussex	0,486
FR	FR62 - Midi-Pyrénées	0,486
UK	UKM3 - South Western Scotland	0,482
DE	DEB1 - Koblenz	0,478
DE	DEE0 - Sachsen-Anhalt	0,477
BE	BE22 - Prov. Limburg (BE)	0,475
UK	UKD6 - Cheshire	0,472
UK	UKK4 - Devon	0,468
CZ	CZ06 - Jihovýchod	0,467
BE	BE25 - Prov. West-Vlaanderen	0,463
UK	UKD3 - Greater Manchester	0,463
DK	DK02 - Sjælland	0,462
UK	UKI2 - Outer London (NUTS 2010)	0,461
ES	ES30 - Comunidad de Madrid	0,455
UK	UKD7 - Merseyside	0,454
UK	UKF2 - Leicestershire, Rutland and Northamptonshire	0,453
IT	ITI4 - Lazio	0,452
BE	BE35 - Prov. Namur	0,452
AT	AT12 - Niederösterreich	0,451
NL	NL13 - Drenthe	0,451
IT	ITH2 - Provincia Autonoma di Trento	0,451
UK	UKF1 - Derbyshire and Nottinghamshire	0,450
UK	UKL2 - East Wales	0,450
IE	IE01 - Border, Midland and Western	0,449
UK	UKE3 - South Yorkshire	0,448
UK	UKJ4 - Kent	0,446
BE	BE33 - Prov. Liège	0,446
FR	FR42 - Alsace	0,438
AT	AT32 - Salzburg	0,437
FR	FR61 - Aquitaine	0,437
NL	NL12 - Friesland (NL)	0,435
DK	DK03 - Syddanmark	0,435
BE	BE32 - Prov. Hainaut	0,435
FR	FR82 - Provence-Alpes-Côte d'Azur	0,433
NL	NL34 - Zeeland	0,433
BE	BE34 - Prov. Luxembourg (BE)	0,431
UK	UKE2 - North Yorkshire	0,431
UK	UKC2 - Northumberland and Tyne and Wear	0,430
AT	AT21 - Kärnten	0,428
UK	UKE4 - West Yorkshire	0,427
FR	FR81 - Languedoc-Roussillon	0,423
UK	UKC1 - Tees Valley and Durham	0,422
UK	UKD4 - Lancashire	0,422
FR	FR72 - Auvergne	0,422
IT	ITH4 - Friuli-Venezia Giulia	0,422
FR	FR43 - Franche-Comté	0,421
ES	ES21 - País Vasco	0,417
UK	UKM6 - Highlands and Islands	0,415
UK	UKG3 - West Midlands	0,414
AT	AT31 - Oberösterreich	0,413
FR	FR41 - Lorraine	0,409
FR	FR63 - Limousin	0,409
UK	UKN0 - Northern Ireland (UK)	0,408
ES	ES22 - Comunidad Foral de Navarra	0,402
FR	FR52 - Bretagne	0,400
IT	ITH5 - Emilia-Romagna	0,396
ES	ES51 - Cataluña	0,393
AT	AT11 - Burgenland (AT)	0,389
UK	UKK2 - Dorset and Somerset	0,387
UK	UKL1 - West Wales and The Valleys	0,386
PT	PT16 - Centro (PT)	0,385
SE	SE31 - Norra Mellansverige	0,385
IT	ITC1 - Piemonte	0,385
SE	SE32 - Mellersta Norrland	0,384
SE	SE21 - Småland med öarna	0,382
FR	FR51 - Pays de la Loire	0,381
FI	FI20 - Åland	0,381
IT	ITI1 - Toscana	0,380
PL	PL12 - Mazowieckie	0,380
UK	UKD1 - Cumbria	0,380
IT	ITC4 - Lombardia	0,380
RO	RO32 - Bucuresti - Ilfov	0,375
UK	UKE1 - East Yorkshire and Northern Lincolnshire	0,374
AT	AT34 - Vorarlberg	0,373
UK	UKG1 - Herefordshire, Worcestershire and Warwickshire	0,370
PT	PT11 - Norte	0,368
UK	UKF3 - Lincolnshire	0,363
ES	ES13 - Cantabria	0,360
UK	UKK3 - Cornwall and Isles of Scilly	0,359
FR	FR83 - Corse	0,358
FR	FR53 - Poitou-Charentes	0,357
CZ	CZ02 - Strední Cechy	0,355
IT	ITC3 - Liguria	0,352
FR	FR30 - Nord - Pas-de-Calais	0,348
FR	FR24 - Centre (FR)	0,347
UK	UKG2 - Shropshire and Staffordshire	0,347
ES	ES23 - La Rioja	0,346
ES	ES24 - Aragón	0,344
HU	HU33 - Dél-Alföld	0,343
FR	FR23 - Haute-Normandie	0,342
FR	FR25 - Basse-Normandie	0,339
FR	FR26 - Bourgogne	0,338
ES	ES12 - Principado de Asturias	0,333

MEDIUM INNOVATORS 0.333

GEO		QHII
DE	DE14 - Tübingen	0,664
DE	DE50 - Bremen	0,659
DE	DE11 - Stuttgart	0,641
SE	SE22 - Sydsverige	0,640
DE	DE13 - Freiburg	0,639
DE	DED5 - Leipzig	0,628
UK	UKI1 - Inner London (NUTS 2010)	0,619
DE	DEA2 - Köln	0,617
NL	NL11 - Groningen	0,613
DE	DED4 - Chemnitz	0,611
DE	DED2 - Dresden	0,610
DE	DE60 - Hamburg	0,608
DE	DE25 - Mittelfranken	0,607
NL	NL32 - Noord-Holland	0,605
UK	UKH2 - Bedfordshire and Hertfordshire	0,602
NL	NL33 - Zuid-Holland	0,596
NL	NL41 - Noord-Brabant	0,593
FI	FI1D - Pohjois- ja Itä-Suomi	0,592
BE	BE10 - Région de Bruxelles-Capitale / Brussels Hoofdstedelijk Gewest	0,588
SE	SE23 - Västsverige	0,586
DE	DE72 - Gießen	0,586
UK	UKM2 - Eastern Scotland	0,586
NL	NL22 - Gelderland	0,584
DE	DE23 - Oberpfalz	0,579
DE	DE71 - Darmstadt	0,576
DE	DE26 - Unterfranken	0,572
AT	AT22 - Steiermark	0,569
DE	DEB3 - Rheinhessen-Pfalz	0,564
FI	FI1C - Etelä-Suomi	0,564
DE	DE92 - Hannover	0,558
NL	NL21 - Overijssel	0,556
UK	UKM5 - North Eastern Scotland	0,555
DE	DEG0 - Thüringen	0,553
FI	FI19 - Länsi-Suomi	0,551
DK	DK04 - Midtjylland	0,547
DE	DE24 - Oberfranken	0,546
BE	BE24 - Prov. Vlaams-Brabant	0,546
NL	NL42 - Limburg (NL)	0,545
IE	IE02 - Southern and Eastern	0,541
NL	NL23 - Flevoland	0,541
UK	UKJ3 - Hampshire and Isle of Wight	0,537
FR	FR10 - Île de France	0,535
DE	DEC0 - Saarland	0,532
PT	PT17 - Área Metropolitana de Lisboa	0,526
SI	SI02 - Zahodna Slovenija	0,526
DE	DE27 - Schwaben	0,526
DE	DE22 - Niederbayern	0,526
BE	BE31 - Prov. Brabant Wallon	0,523
SK	SK01 - Bratislavský kraj	0,521
DE	DEA5 - Arnsberg	0,518
AT	AT33 - Tirol	0,517
UK	UKH3 - Essex	0,517
DE	DEA4 - Detmold	0,517
DE	DEA1 - Düsseldorf	0,515
DE	DE80 - Mecklenburg-Vorpommern	0,514
DE	DE73 - Kassel	0,511
DK	DK05 - Nordjylland	0,509
BE	BE23 - Prov. Oost-Vlaanderen	0,509
DE	DE40 - Brandenburg	0,506
DE	DEA3 - Münster	0,505
BE	BE21 - Prov. Antwerpen	0,502
DE	DE94 - Weser-Ems	0,500
UK	UKK1 - Gloucestershire, Wiltshire and Bristol/Bath area	0,496
HU	HU10 - Közép-Magyarország	0,496
DE	DEF0 - Schleswig-Holstein	0,491
DE	DEB2 - Trier	0,491
DE	DE93 - Lüneburg	0,491

≤ QHII < 0.666

MODEST INNOVATORS: QHII < 0.333

GEO		QHII
CZ	CZ07 - Střední Morava	0,333
CZ	CZ03 - Jihozápad	0,333
CZ	CZ05 - Severovýchod	0,332
IT	ITF1 - Abruzzo	0,326
ES	ES52 - Comunidad Valenciana	0,325
IT	ITF3 - Campania	0,325
FR	FR21 - Champagne-Ardenne	0,324
FR	FR22 - Picardie	0,323
ES	ES11 - Galicia	0,323
IT	ITH3 - Veneto	0,323
IT	ITI2 - Umbria	0,322
PL	PL21 - Malopolskie	0,321
ES	ES41 - Castilla y León	0,314
BG	BG41 - Yugozapaden	0,313
SI	SI01 - Vzhodna Slovenija	0,310
HU	HU32 - Észak-Alföld	0,308
ES	ES61 - Andalucía	0,305
HU	HU22 - Nyugat-Dunántúl	0,301
HU	HU23 - Dél-Dunántúl	0,300
SK	SK02 - Západné Slovensko	0,300
ES	ES62 - Región de Murcia	0,298
IT	ITG2 - Sardegna	0,292
HU	HU21 - Közép-Dunántúl	0,291
IT	ITC2 - Valle d'Aosta/Vallée d'Aoste	0,289
CZ	CZ08 - Moravskoslezsko	0,288
IT	ITI3 - Marche	0,287
IT	ITG1 - Sicilia	0,283
ES	ES43 - Extremadura	0,280
IT	ITH1 - Provincia Autonoma di Bolzano/Bozen	0,278
PL	PL51 - Dolnoslaskie	0,276
PL	PL63 - Pomorskie	0,275
HU	HU31 - Észak-Magyarország	0,271
PL	PL11 - Lódzkie	0,267
IT	ITF4 - Puglia	0,266
PL	PL31 - Lubelskie	0,265
PT	PT20 - Região Autónoma dos Açores (PT)	0,265
PL	PL41 - Wielkopolskie	0,264
SK	SK03 - Stredné Slovensko	0,263
IT	ITF5 - Basilicata	0,261
PT	PT15 - Algarve	0,259
IT	ITF6 - Calabria	0,259
IT	ITF2 - Molise	0,258
PT	PT18 - Alentejo	0,258
HR	HR03 - Jadranska Hrvatska	0,257
PL	PL32 - Podkarpackie	0,250
SK	SK04 - Východné Slovensko	0,249
PL	PL22 - Slaskie	0,249
ES	ES70 - Canarias (ES)	0,247
ES	ES42 - Castilla-la Mancha	0,241
ES	ES64 - Ciudad Autónoma de Melilla (ES)	0,240
PL	PL42 - Zachodniopomorskie	0,235
PT	PT30 - Região Autónoma da Madeira (PT)	0,235
PL	PL62 - Warminsko-Mazurskie	0,231
PL	PL61 - Kujawsko-Pomorskie	0,230
PL	PL34 - Podlaskie	0,230
ES	ES53 - Illes Balears	0,220
ES	ES63 - Ciudad Autónoma de Ceuta (ES)	0,220
PL	PL33 - Swietokrzyskie	0,211
CZ	CZ04 - Severozápad	0,206
PL	PL52 - Opolskie	0,200
BG	BG42 - Yuzhen tsentralen	0,194
PL	PL43 - Lubuskie	0,191
RO	RO42 - Vest	0,184
RO	RO11 - Nord-Vest	0,180
BG	BG33 - Severoiztochen	0,164
RO	RO21 - Nord-Est	0,159
BG	BG32 - Severen tsentralen	0,157
BG	BG34 - Yugoiztochen	0,155
BG	BG31 - Severozapaden	0,154
RO	RO12 - Centru	0,150
RO	RO22 - Sud-Est	0,141
RO	RO31 - Sud - Muntenia	0,131
RO	RO41 - Sud-Vest Oltenia	0,122

Appendix III – References

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Appendix IV – Information on interviews

In order to fill information gaps, **phone interviews** were carried out with the representatives of regional authorities of the following NUTS2: *Stockholm, Länsi-Suomi, Lazio* and *Extremadura.*

All interviews were based on the same structure (i.e. list of seven questions) and aimed at collecting useful references and material on the innovation performance of the regions according to a TH/QH perspective. Questions include:

1. Has your region a Smart Specialization Strategy (S3) or a comparable innovation strategic plan? If yes, is it (explicitly) based on the Triple or Quadruple Helix concepts?
2. Could you please briefly describe initiatives based on the TH model that your region has implemented or it is going to implement?
3. Could you please briefly describe their impacts/achievements?
4. Could you please briefly describe the success factors?
5. Could you please briefly describe initiatives that your region has implemented or it is going to implement with the aim to involve civil society in the innovation process?
6. Could you please briefly describe their impact/achievements?
7. Which lessons have you learnt from civil society involvement?

Main findings of interview – *Stockholm*

Interviewee: Representative of the County administrative board in *Stockholm* (*Enheten för näringslivsutveckling Länsstyrelsen i Stockholms län*).

- Smart Specialization Strategy (S3) based on the TH concept is under discussion.
- Main initiatives fostering the application of TH are: the Digital Agenda for Stockholm (where digitalization is implemented at different governmental levels) and the "OpenLab" Platform aimed at addressing societal challenges and involving also civil society.
- As regards the OpenLab platform, no detailed results can be reported giving the recent establishment of the initiative. Workshops aimed at facing societal challenges have been organized with civil society representatives.
- Interactive discussion during workshops is a success factor for all the challenges (e.g. climate change, elderly people) of the OpenLab platform.

Main findings of interview - *Länsi-Suomi*

Interviewee: Representative of the Regional Council of *Ostrobothnia* (the interviewee mainly refers to *Ostrobothnia* (NUTS 3 level) and part of *Länsi Suomi* (NUTS 2).

- Existence of a Smart Specialization Strategy (S3) based on the TH/QH concepts.
- Initiatives to make TH a reality are ERDF calls tailored to fill innovation system gaps, international co-operation projects for transnational learning, and research projects.
- Impacts/achievements depend on the objective of developers that can be slightly different from the policy willingness.
- Success factors include perception of regional development and mindset. It is important to identify regional gaps, communicate them and understand how to use regional resources in order to create innovation and development. Dialogue between stakeholders and bringing them together are crucial aspects.
- Involvement of civil society in the innovation process is part of the Quadruple Helix approach of the *Ostrobothnian* model. A gap analysis aimed at investigating innovation partnerships and experiences/expectations of participating stakeholders (mainly business sector) is followed, for each identified gap, by a focus group/seminar involving all relevant stakeholders in order to find solutions.
- Impacts are gradual and their assessment helps leading business to easily understand S3 concepts.
- Civil society involvement is difficult to achieve, making the entrepreneurial discovery process a challenging task. This difficulty in involving civil society strictly depends on the type of stakeholders needed to be involved and by the issue to be addressed. For example, collaboration between business and universities is easier due to their shared needs (i.e. research outcomes).

Main findings of interview - *Lazio*

Interviewee: Representatives of the Research, Innovation and Green Economy of the Lazio Region.

- The *Lazio* Smart Specialization Strategy (S3) is based on the TH concept. The S3 is going to be further improved giving more relevance to civil society engagement.

- ERDF tailored to address regional specialization priorities is one of the main instruments to operationalize TH. Specific sectors and productive areas are the main beneficiaries.
- The new APEA (*Aree Produttive Ecologicamente Attrezzate*) model is a best practice on the involvement of civil society (and for the QH approach). A bottom-up approach is going to be implemented with the main goal to convert industrial areas into areas where production is integrated within a green economy and social perspective, where participants may share the management of infrastructures, assets, services, and resources.

Main findings of interview - *Extremadura*
Interviewee: Representative of the *Desarrollo de Negocio Parque Científico Y Tecnológico De Extremadura.*

- *Extremadura* has a S3. A Fundecyt-Pctex (an initiative carried out by the University of *Extremadura* and by the Regional Government of *Extremadura* aiming at developing connections between science/technology and market/society) has coordinated its design and establishment process. *Extremadura* S3 is the result of a bottom-up process where university, government, industry and civil society have been consulted through thematic workshops (around 700 people involved). *Extremadura* development is based on a change of culture through innovation and entrepreneurship.
- All the regional programs are based on the Triple Helix concept. Main instruments are European projects or experimental public policies programs. Some examples are: the Extremadura office for innovation, the campaign for fostering Social Entrepreneurship, the Bellota Valley Start Up School, the contest University of Extremadura Answer (to be activated in 2016).
- The main impact is the methodological innovation in public policies, increasing efficiency and efficacy of such actions. This was achieved because *Extremadura* is a region with low population on a wide territory, low industrialization and important rural areas, in which traditional models of industrial poles are not applicable. A second relevant impact is measurable with the number of actively involved stakeholders: more than 300 organizations participating in training, mentoring and networking sessions. This close contact with the society allows the regional government to be aware of local needs and challenges and achieve higher impacts.
- Success factors of the implanted initiatives are: inclusion of beneficiaries in the design of public policies and actions, proactive attitude of the public sector, sharing of the ideas with different type of actors, co-

creation and co-responsibility. Initiatives have to consider the specific interests/roles of different actors: Government, budget allocation and regulation definition; University, knowledge and methodology development; Industry, market trends and risk; Civil Society, participation and expression of needs.

- Involvement of civil society generates for government better knowledge of reality, establishment of a participative process, improvement of flexibility, co-responsibility in decisions, co-creation of innovation (i.e. Quadruple Helix in action).