An Exploration of the Influence of Regional Level Institutional Frameworks in the Evolution of an Inter-regional Innovation System

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Under the supervision of Prof. Bill O'Gorman and Dr. Valerie Brett

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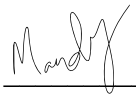
Dedication

To Curtis

Declaration

I hereby certify that this material is entirely my own work and has not been taken from the work of others and to the extent that such work has been cited and acknowledged within the text of my work.

Signed: 

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Abstract

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Collaboration across borders is often confined to a limited number of issues and it differs greatly in size, competences, finance and commitment (Klatt and Herrmann, 2011). While cross-border areas are believed to bring together firms, people and knowledge generation institutions that are in geographic proximity, albeit with an international border in between (OECD, 2013), Van den Broek and Smulders (2014) stated that the nation state border itself can act as a barrier to cross-border learning by hindering interaction between actors on both sides of the border. These barriers can also be expected at inter-regional collaboration, especially in the absence of geographical proximity. While the systematic interaction between knowledge producer and knowledge exploitation sub-systems in regional innovation systems stresses the advantage of geographical proximity, the perception of spatial proximity as a competitive advantage raises the question of the possibility of creating an inter-regional innovation system (iRIS) with non-contiguous regions. To address this question, this research studies collaboration among 15 triple helix institutions from four European regions with non-contiguous borders. It explores how inter-regional innovation systems are developed and establishes how institutions in regional institutional frameworks interact with each other at inter-regional level.

The research employed a multiphase mixed methods research design which entailed desk research (analysis of the four regions), a three time-point longitudinal survey (n=83), interviews with the collaborative group (CG) (n=17), and a detailed review of 573 emails. The findings indicate that the inter-regional CG was working from the beginning and continued to collaborate effectively, despite their differences, throughout the collaborative process.

The major contributions of this research are: (i) while literature suggests that geographical proximity is advantageous for research and innovation activities, the findings of this research suggest that the inter-regional CG established an interaction and collaboration that works effectively over a distance and across non-contiguous borders; (ii) the research identified the three non-spatial forms of proximity (social, cognitive and organisational) that are key determinants for developing a successful iRIS. Thereby, the research suggests that the substitution mechanism of geographical proximity is not with only one non-spatial form of proximity but with all three non-spatial forms of proximities. Another major contribution of this research is the uniqueness of the study's method, especially the longitudinal aspect, employed to determine changes in perceptions of CG members over time. And finally, as well as providing a deeper awareness of the institutional gaps, which did not hinder the collaboration process for non-contiguous regions and institutions, this study presents a novel and unique framework for inter-regional innovation collaboration, which can be applied to regions and institutions that want to collaborate from a distance and across non-contiguous borders.

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1 Introduction

The great recession of 2008 spread rapidly to Europe which led to a crisis leaving millions of people unemployed, called for Europe to develop strategies to enable an exit from the crisis (European Commission, 2010). Most member states faced more problems and fewer public resources as compared to a few member States, such as Germany and Poland, which have escaped the crisis relatively unharmed (European Commission, 2010). Therefore, the European Commission proposed to concentrate resources on important areas such as employment (particularly for young people), training and education, social inclusion, innovation and SMEs, energy efficiency and a low carbon economy and expand it to ICT infrastructures and digital growth measures. According to the European Commission (2010), all national, regional and local authorities should implement partnerships that will contribute to the expansion of national reform programmes as well as to their implementation. Therefore, by establishing permanent interactions between various levels of government, the priorities of the European Union are brought closer to citizens, strengthening the ownership required to deliver the Europe 2020 strategy.

In addition, the crisis has made it more difficult to reach the Europe 2020 goals of smart, sustainable and inclusive growth, due to the reduced employment rates and increasing poverty and social exclusion (European Commission, 2010). Only a stable and strong recovery can reduce the unemployment rates and a resilient economy requires a growth agenda that is supported by a balanced industrial mix, the development and adoption of new knowledge or technological platforms, and risk-taking in radical and incremental innovations, as well as in soft and hard innovations (Cooke and De Propris, 2011).

In order to tackle the aftermath of the crisis and to overcome short term plans, the European Union put forward three priorities to achieve a sustainable future, namely: smart, sustainable and inclusive growth. Cohesion policy and its structural funds are key delivery mechanisms to achieve these priorities of smart, sustainable and inclusive growth in member States and regions. The main implementation vehicle of Cohesion Policy is the European Structural and Investment Funds (ESIFs) within which European

Regional Development Fund (ERDF) funds are allocated towards regional development under different measures. The funds are built around three strands of cooperation: *cross-border* (Interreg A), *transnational* (Interreg B) and *interregional* (Interreg C). While encouragement and funding towards cross-border and transnational cooperation promotes collaboration among European regions, peripheral regions have been hugely overlooked. In order for these micro regions to become competitive and reduce the disparity between European regions, attention to the inter-regional collaboration among less developed regions is greatly needed. Therefore, this current research aims to contribute to the study and the awareness of less developed regions by exploring the development of an inter-regional collaboration where regions do not share borders.

In an inter-regional collaboration, the advantages that cross border regions have regarding geographical proximity are non-existent when it comes to collaborating from a distance. Geographical proximity has been regarded as advantageous for inter-organisational collaboration and innovation (Storper, 1997; Lawson and Lorenz, 1999; Howells, 2002) as the possibilities of face-to-face interactions decreases coordination costs and facilitates the transfer of tacit knowledge. However, in inter-regional collaboration, transfer of tacit knowledge is often considered not to be possible from a distance. The local character and the perception of region as a locus of innovation has been emphasised in the innovation processes perceiving spatial proximity as a competitive advantage. Accordingly, certain studies (Katz, 1994; Gertler, 2003; Storper and Venables, 2004; Pan, Kaski and Fortunato, 2012) have provided evidence of the advantages of being close to one another and that geographical distance can be an impediment to collaboration. However, these studies raise the question of the possibility of collaborating at a distance.

Nevertheless, collaboration across borders is often confined to a limited number of issues and it differs greatly in size, competences, finance and commitment (Klatt and Herrmann, 2011). While cross-border areas are believed to bring together firms, people and knowledge generation institutions that are in geographic proximity, albeit with an international border in between (OECD, 2013), Van den Broek and Smulders (2014) stated that the nation state border itself can act as a barrier to cross-border learning by hindering interaction between actors on both sides of the border. These barriers to cross-border collaboration can also be expected on an inter-regional collaboration, especially

with the absence of geographical proximity. In order to tackle this, the current research also looked at substituting geographical proximity to that of a non-spatial one. The institutional aspect is prominent in defining a regional innovation system as these institutional infrastructures support innovation within the region (Asheim and Gertler, 2005), therefore, the current research investigates the actors, specifically in triple helix institutions (government, academia and industry). Additionally, the possibility of substituting geographical proximity with other non-spatial forms of proximity in an inter-regional collaboration is explored.

The different institutional settings of academia versus industry versus government actors can be a hurdle for interactions (Etzkowitz and Leydesdorff, 2000), especially when regions collaborate with different institutions across borders. The relevant norms and beliefs alter as well as the rules and regulations under which they interact. While there is an inclination to assume that institutions facilitate interaction in regional innovation system (RIS), Van Den Broek and Smulders (2014) argued that in a cross-border RIS, institutions' influence on actors on both sides of the border could create institutional gaps hindering cross-border cooperation. Following this concept, this current research also conceptualises that institutional gaps occur in inter-regional innovation systems, which may influence the collaborative process between regions that are collaborating from a distance.

1.1 Research Question and Objectives

The general objective of the research is to investigate whether institutional frameworks at a regional level influence the collaboration at an inter-regional level for the evolution of an inter-regional innovation system. In other words, the aim is to examine if the interactions at an inter-regional level are effected by the dynamics of the regional environment. Therefore, the research question is:

How do regional level institutional frameworks influence the evolution of an inter-regional innovation system?

In order to address this research question, the objectives of the research are to:

1. Understand the construct of the institutional framework within regions
2. Understand the construct of an inter-regional institutional framework
3. Establish how stakeholders in an inter-regional institutional framework interact with each other at an inter-regional level.
4. Examine the extent of the effects of different types of proximity at an inter-regional level.
5. Investigate if regional institutional frameworks have an effect on the evolution of an inter-regional innovation system

Answers to these questions are sought using mixed methods, employing a pragmatism paradigm in order to provide for a rich understanding of the influence of institutional frameworks in an inter-regional innovation system in a real world setting. The research aims to understand how an inter-regional innovation system is developed without the existence of geographical proximity. In order to address this, four (4) European regions that collaborated at an inter-regional level were chosen as a medium to answer the research question. The regions are, Bucharest-Ilfov, Romania, Castilla La Mancha, Spain, Central Hungary, Hungary and South East Ireland, Ireland. The reason why these four particular regions were selected was because these regions collaborated in a European Commission funded project called *e*DIGIREGION (see section 1.3.1 for more details). The author's research scholarship provided her an important role on the *e*DIGIREGION research team resulting in maximum exposure and input into the *e*DIGIREGION transnational cooperation framework and its development. As a result of working on this project, the author had easy access to the regional and inter-regional stakeholders, who were selected as key informants for the current research.

Since the aims and objectives of the research are to understand how inter-regional innovation systems evolve, it was necessary to identify and work with an emerging or existing inter-regional innovation system. However, identifying, engaging with and being accepted by such an inter-regional innovation system are virtually impossible. Hence, this research employed a purposive sampling technique. Because, whereas it is relatively easy to identify inter-regional collaborative groups through EU funded platforms such as HORIZON 2020, INTERREG, and ERASMUS (to mention a few), it

is extremely difficult to get access to these collaborative groups and even more difficult to engage with such groups in an immersive longitudinal way. Therefore, because the researcher was a member of the eDIGIREGION project team, the focus of which was to develop an inter-regional innovation system, the eDIGIREGION project was used as a convenient sample to study the phenomenon of how regional level institutional frameworks influence the evolution of an inter-regional innovation system. The researcher realises that the *e*DIGIREGION collaborative partnership (group) may not be representative of all inter-regional collaborative partnerships and therefore that the findings are not generalisable. However, using the *e*DIGIREGION collaborative partnership does provide the researcher with the opportunity to understand the phenomenon expressed in the Research Questions and therefore contributes to the existing bodies of research on proximity, regional level institutional frameworks and the development of inter-regional innovation systems.

Whereas the *e*DIGIREGION project was used as a vehicle to answer the research question, it must be stressed that this research and thesis are not about the *e*DIGIREGION project. Rather the unit of analysis and observation were the collaborative partner organisations constituting the *e*DIGIREGION project. Accordingly, the research is not generalisable as it only looks at one inter-regional collaboration process (*e*DIGIREGION). However, the research still provides major contributions to theory and practice as regards the development of inter-regional innovation systems and the substitution of geographical proximity with non-spatial proximities.

In order to understand the phenomena at hand, a multi-phased mixed methods research process was employed (see Figure 1.1). Firstly, desk research was conducted to understand the regional environment and the institutions of the four regions that made up the regional innovation system studied (Phase 1). Secondly, a three time point longitudinal survey was administered using the triple helix partners in the four regions to understand the inter-regional dynamics of collaboration (Phase II) and lastly, the findings from the survey were followed up by conducting interviews with seventeen (17) key informants in order to have an in-depth understanding of the collaboration at an inter-regional level and the challenges it entails when geographical proximity does not exist (Phase III).

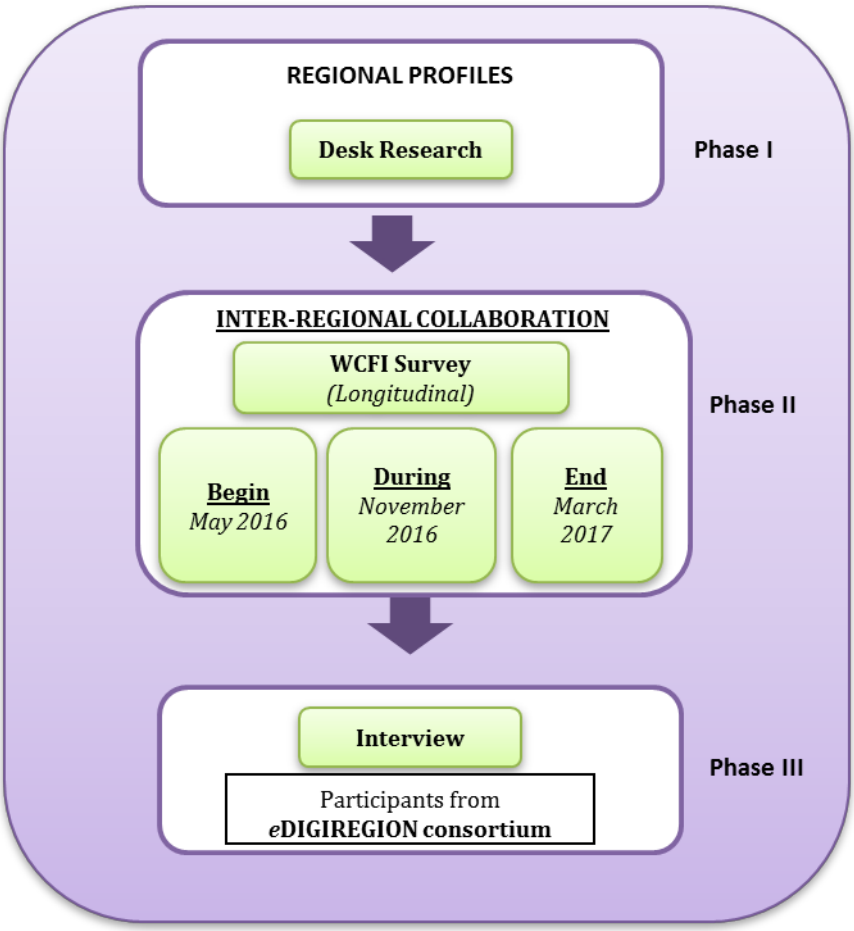


Figure 1.1: Research process including tools (*Source: Current Research*)

1.2 Regional profiles

The first phase of the research process is concentrated at the regional level. In order to have an understanding of the regions being studied, extensive desk research was conducted on each of the four regions. Each regional profile outlines the region's demographics as well as its economic activities and information regarding research, development and innovation. This regional profile also explores each region's governance structure to understand how policies are formulated and implemented thereby providing insights into the four regions differences and similarities.

1.3 Inter-regional interactions of institutions

The next phase of the research involves examining inter-regional collaboration, specifically regions collaborating from a distance. Each of the four regions (Bucharest-Ilfov, Romania, Castilla La Mancha, Spain, Central Hungary, Hungary and South East Ireland, Ireland), which were a part of the *e*DIGIREGION project, has an institutional framework consisting of academia, industry and government, which were collaborating towards developing an inter-regional innovation system. The aim of this phase is to understand the influence of different regional institutional frameworks on an inter-regional collaboration. The Wilder Collaboration Factors Inventory (WCFI) survey was administered to the collaborating inter-regional actors to understand the perceived collaboration dynamic among the actors. This longitudinal survey was administered at three (3) time points, which are:

1) At the beginning of the inter-regional collaboration

2) During the collaboration and

3) At the end of the collaboration.

The analyses of the longitudinal survey provided an overview of the inter-regional institutional interactions, allowing it to be used in the framing of the qualitative interview strand (Phase III), to achieve greater understanding of the collaboration at an inter-regional level and the challenges it entails when geographical proximity does not exist. This interview helps in interpreting the findings from the surveys and provides an insight into the perceptions of the actors about the changes (if) they occur over the course of their collaboration process.

1.3.1 Inter-regional Actors

The '*e*DIGIREGION: Realising The Digital Agenda Through Transnational Cooperation' project started in April 2014 and was funded as part of an FP7 Regions of Knowledge Programme specifically, 'Transnational cooperation between regional research-driven clusters'. *e*DIGIREGION was a unique collaborative project which involved fifteen (15) partners from four EU regions: Bucharest-Ilfov, Romania,

Castilla-La Mancha, Spain; Central Hungary and South East Ireland with triple helix partners in each region (research / academic, government agencies, and industry). The project focused on enhancing regions' sustainable competitiveness by exploiting their strengths and smart specialisations to realise the Digital Agenda within their regional domain. Through a planned process of inter and intra-regional mentoring, the *e*DIGIREGION project facilitated transnational and international collaboration leading to the creation of an inter-regional Joint Action Plan (iJAP). The project also designed a framework to successfully implement transnational cooperation for implementing a sustainable process of ongoing transnational interactions, collaboration and cooperation between stakeholders in different regions in Digital Agenda technologies.

The transnational cooperation was established through the six (6) iActions[1] which were developed from the iJAPs. As each consortium region worked together toward achieving iActions a survey was administered to understand the perceived collaboration dynamic among the collaborating actors. The Wilder Collaboration Factors Inventory (WCFI) Survey (Mattessich, Murray-Close and Monsey, 2001) was administered in order to understand the actors' perceptions of their collaboration process and the longitudinal data allows us to explore the changes in this perception. Through their extensive literature review, Mattessich et al. (2001) identified 20 factors that influence the success of organisational collaborations and developed the Wilder Collaboration Factors Inventory (WCFI) as an instrument to understand the perception of the actors about their collaboration process. The WCFI score helped in assessing the strengths and weaknesses of their collaborative activities. However, rather than taking steps to address the weaknesses in their collaborative activity at every time point, the researcher administered the survey without intervention in order to see the natural changes of each actor's perception. Consequently, the nature of the data collected allowed testing for changes of the different factors at different points of time.

[1] The iActions are: (i) Establishment of trans-regional industrial doctorate (iPhD), (ii) Bringing universities curricula to meet industry market needs, (iii) Create a transnational research network (TRN), (iv) Preparation of project proposals, (v) Establish thematic group of experts and (vi) Increase understanding about the Industry '4.0' approach.

1.4 The evolution of an inter-regional Innovation System

In addition to the survey, formal interviews with relevant participating actors were conducted to help better understand the behaviour of each institution and help in interpreting the results. The findings from the survey helped in the formulation of the qualitative strand of interviews. A total of seventeen (17) interviews were conducted in line with the structure of the *e*DIGIREGION project (see Figure 1.2 for *e*DIGIREGION structure) with the project coordinator (one), each regional lead (four) and representatives of each regional triple helix actors (twelve).

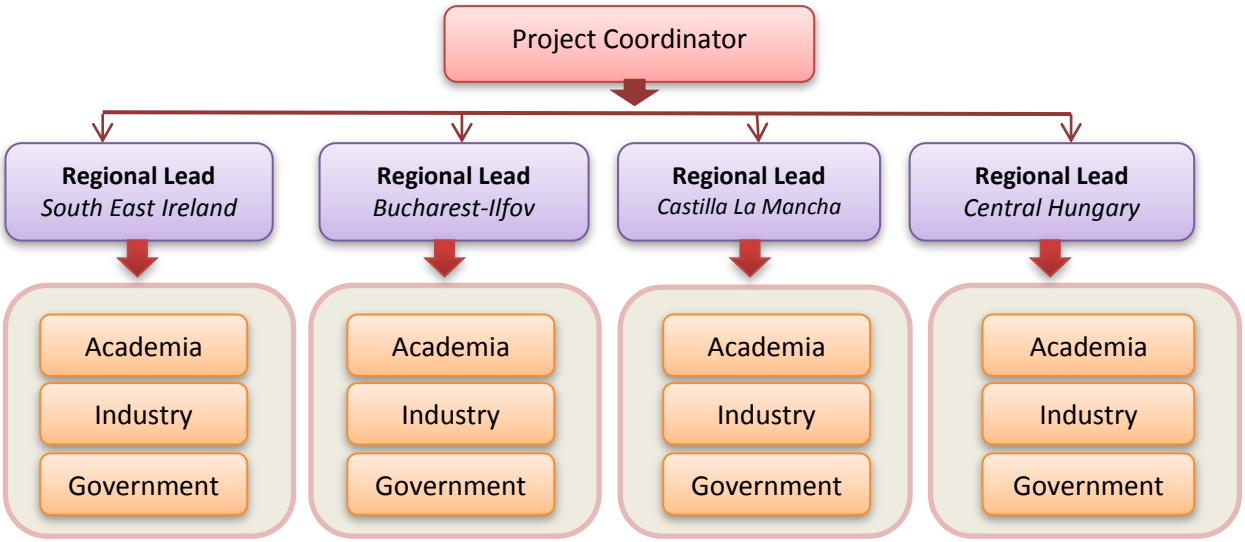


Figure 1.2: eDIGIREGION structure (*Source: Current Research*)

1.5 Conceptual Framework

The conceptual framework presented in Figure 1.3 depicts the regional institutional framework and how these institutions' relationships make up the regional innovation system. It further portrays how different regions at a distance form a collaborative partnership and the different institutional gaps that arise which may have an influence on the inter-regional innovation system.

Institutional (North, 1990) and triple helix (Etzkowitz and Leydesdroff, 2000) literature is drawn upon in order to examine the construct of a regional institutional framework in a knowledge based economy. Regional Innovation System (RIS) theory is drawn upon

as the system relies on the role of support institutions in knowledge production and innovation, focusing at a regional level. RIS is a social system in which innovation is the result of social interaction between economic actors, which interact with their environment (Edquist, 2001). Accordingly, the interaction of the triple helix actors at the regional level was explored in order to understand the regional institutional frameworks.

The current research explored regions that are collaborating from a distance; therefore, proximity dynamics (Boschma, 2005; Hansen, 2015) are also highlighted, as the spatial dimension of proximity does not exist at an inter-regional collaboration where regions do not share contiguous borders. Since the advantages that cross-border RIS has (for example, contiguous region, geographical proximity, transfer of tacit knowledge) is not existent at an inter-regional level, this study looks at the possibility of substituting geographical proximity with other forms of proximity for a successful inter-regional innovation system.

The current research aims to answer whether institutional frameworks at a regional level influence the development of an inter-regional innovation system. Accordingly, the current research also acknowledges that the main challenge of long distance collaboration is to overcome institutional differences (Gertler, 2003), therefore, this study conceptualises that institutional gaps (Van den Broek and Smulders, 2014) exist at an inter-regional collaboration level. In order to ascertain how these gaps influence the evolution of an inter-regional innovation system, the institutional gaps are categorised into three pillars; regulative, cultural-cognitive and normative gaps (Scott, 2008).

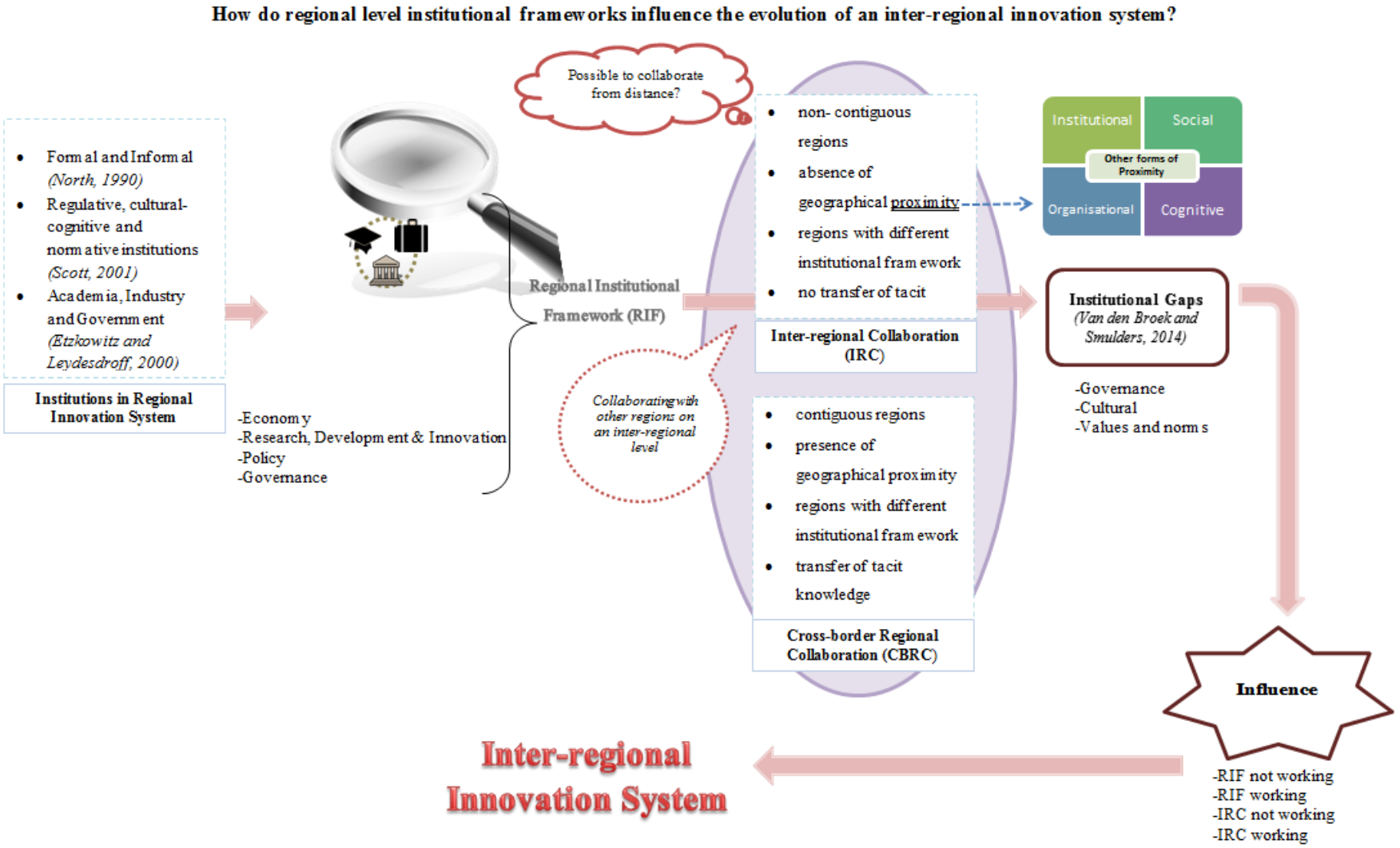


Figure 1.3: Conceptual framework (*Source: Current Research*)

1.6 Thesis Structure

This thesis consists of nine (9) chapters in total including introduction, the research context, theoretical framework, methodology, three chapters of findings of the research, discussion of the research and finally, research contributions, limitations and future research chapter. Figure 1.4 presents the breakdown of this thesis document chapter by chapter outlining what is addressed in each chapter.

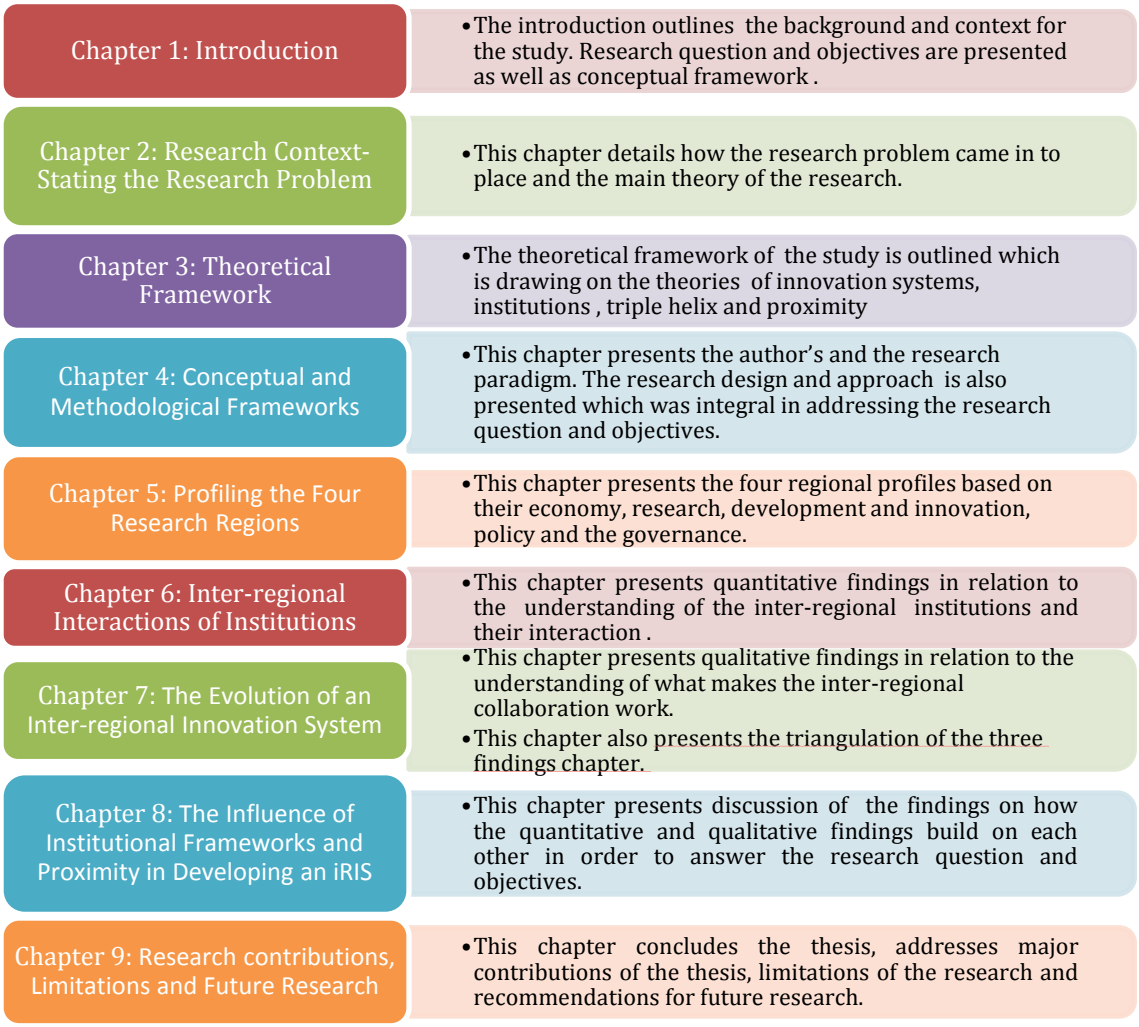


Figure 1.4: Outline of Thesis Chapters *(Source: Current Research)*

1.7 Chapter Summary

This thesis explores the influence of regional institutional frameworks on the development of an inter-regional innovation system. The research aims to enhance the existing research on the study of institutional frameworks, inter-institutional and inter-regional collaboration. With the growing need for collaboration with other regions of Europe and increasing funding allocated towards regional development, inter-regional collaboration is still hugely overlooked and understanding the effects of institutional gaps will have implications for regional and inter-regional policy makers and/or institutions which have an intention to collaborate across their 'traditional' borders. Thus, the major contributions of this research to both theory and practice are the uniqueness of the method employed especially the longitudinal aspect of the study, the generation of a deeper awareness of 'proximity' with regard to developing an inter-regional innovation collaboration and the development of a novel framework for inter-regional innovation collaboration, which can be applied to regions that want to collaborate from a distance.

The next chapter outlines the background and contextualisation of the current research.

2 Research Context- Stating the Research Problem

The purpose of this research is to investigate the influence of regional institutional frameworks on an inter-regional level collaboration for the evolution of an inter-regional innovation system (iRIS). This chapter provides a context for the research explaining why there is a need to develop an inter-regional innovation system.

2.1 The economic crisis of 2008 and its outcome

The economic crisis of 2008 wiped out the steady gains in economic growth and job creation observed before the crisis. Europe's GDP fell by 4% in 2009, industrial production dropped back to the levels of the 1990s (European Commission, 2010) and 21 million people were unemployed (as compared to 16 million in 2008[2]). The economic crisis also made the task of securing future economic growth much more difficult with public finances being severely affected, with deficits at 7% of GDP on average and debt levels at over 80% of GDP. In addition, the crisis made it more difficult to reach the Europe 2020 goals of smart, sustainable and inclusive growth, due to the reduced employment rates and increasing poverty and social exclusion (European Commission, 2010). A stable and strong recovery was required to reduce the unemployment rates; therefore, a resilient economy would require a growth agenda that is supported by a balanced industrial mix, the development and adoption of new knowledge or technological platforms, and risk-taking in radical and incremental innovations, as well as in soft and hard innovations (Cooke and De Propris, 2011). In 2010, the European Union put forward three priorities to achieve a sustainable future in order to move beyond short-termism they are:

(1) Smart growth: developing an economy based on knowledge and innovation;

(2) Sustainable growth: promoting a more resource efficient, greener and more competitive economy;

[2] Eurostat data [lfst_r_lfu3pers]

(3) Inclusive growth: fostering a high-employment economy delivering social and territorial cohesion.

Cohesion policy and its structural funds are key delivery mechanisms to achieve these priorities of smart, sustainable and inclusive growth in member States and regions. The main implementation vehicle of Cohesion Policy is the European Structural and Investment Funds (ESIFs). The ESIFs are used to fund some national, but mainly regional projects that fall within agreed priorities throughout a set funding period. One of the funds under ESIF is the European Regional Development Fund (ERDF). Within ERDF funds are allocated towards regional development under different measures. ERDF concentrates on key priority areas known as thematic concentration: innovation and research; digital agenda; support for small and medium-sized enterprises (SMEs); and low-carbon economy. ERDF finances the European Territorial Cooperation (ETC) objective which supports cross-border, transnational, and inter-regional cooperation programmes. ETC, better known as Interreg, provides a framework for the implementation of joint actions and policy exchanges between national, regional and local actors from different member States. Interreg is built around three strands of cooperation: *cross-border* (Interreg A), *transnational* (Interreg B) and *interregional* (Interreg C). Five programming periods of Interreg have succeeded each other since 1990, Interreg V (2014-2020) being the current programming period has a budget of €10.1 billion[3]. Out of the total budget for the current programming period, cross border Interreg VA has a budget of €6.6 billion whereas, transnational Interreg VB has a budget of €2.1 billion and inter-regional Interreg VC with a budget of only €0.5 billion with four cooperation programmes. While this funding existed, the inter-regional cooperation programme is still vastly overlooked compared to that of cross-border and transnational programmes. Therefore, this current research contributes to the study and the awareness of less developed regions and their inter-regional collaboration where they might not necessarily share borders.

[3] See http://ec.europa.eu/regional_policy/en/policy/cooperation/european-territorial/

2.2 Cohesion Policy -focus on less developed regions and territorial cooperation

From its inception, cohesion policy has had a focus on less developed regions and territorial cooperation. According to the European Commission (2010), all national, regional and local authorities should implement partnerships that will contribute to the expansion of national reform programmes as well as to their implementation. Therefore, by establishing permanent interaction between various levels of government, the priorities of the European Union are brought closer to citizens, strengthening the ownership required to deliver the Europe 2020 strategy of smart, sustainable and inclusive growth.

While encouragement and funding towards territorial cooperation between less developed regions promotes collaboration among European regions, peripheral regions have been hugely overlooked. In order for these micro regions to become competitive and reduce the disparity between European regions, attention to the inter-regional collaboration among less developed regions is greatly needed. While it is clear that cooperation between member States is imperative, a particular importance has been given to cross-border cooperation.

It has been argued that the contiguous cross-border areas are most relevant for developing joint, or at least co-ordinated, regional policies (OECD, 2013) as such regions have geographic proximity and may be a more favourable environment for the development of a shared vision, which in many cases may be supported by greater cultural proximity than in macro-regions that group many countries together. Consequently, cross-border regional innovation systems (CBRIS) have been heavily studied (see for example, Trippl, 2010; Nauwelaers, Maguire and Ajmone Marsan, 2013; Weidenfeld, 2013; Van den Broek and Smulders, 2014; Makkonen and Rohde, 2016). One CBRIS for example is the 'Oresund region', which is the most well-known example of European cross-border collaboration, building on the metropolitan area around Copenhagen and, across the sound, southern Sweden with the cities of Malmö, Lund and Helsingborg. Whilst cross border cooperation deals with regions which lie directly on the borders or adjacent to each other, transnational cooperation programmes concentrate on macro-regions' cooperation which aims to promote better cooperation

and regional development within the European Union by joint approaches to tackle common issues; the Danube region and the Baltic Sea region being two of the most well-known regions in transnational cooperation.

According to the Seventh report on economic, social and territorial cohesion (European Commission, 2017)[4], regional disparities are narrowing again since the economic crisis of 2008 with growth everywhere. Nevertheless, there still are regions that have GDP per capital and employment rates below pre-crisis level. The report also stated that future funding for cross-border cooperation should continue to focus on areas to resolve cross-border problems, such as gaps and missing links in different policy fields, including transport. However, the concentration is still heavily geared towards cross-border cooperation programmes and it is evident from the report that inter-regional collaboration is still overlooked.

2.3 Geographical proximity and its implications

The advantages that regions have regarding geographical proximity are non-existent when it comes to collaborating from a distance. Proximity has been argued as a very important factor for innovation (Knoben and Oerlemans, 2006; Hansen, 2015) highlighting that a certain form of proximity is required for successful knowledge interactions. While, geographical proximity can be advantageous for inter-organisational collaboration and innovation (Storper, 1997; Lawson and Lorenz, 1999; Howells, 2002), in inter-regional collaboration, transfer of tacit knowledge is often considered not to be possible from a distance. The possibility of face-to-face interactions decreases coordination costs and facilitates the transfer of tacit knowledge, thereby perceiving spatial proximity as a competitive advantage. Accordingly, certain studies (Katz, 1994; Gertler, 2003; Storper and Venables, 2004; Pan, Kaski and Fortunato, 2012) have provided evidence of the advantages of being close to one another and that geographical distance can be an impediment to collaboration. However, these studies raise the question of the possibility of collaborating without the existence of geographical proximity.

[4] https://ec.europa.eu/regional_policy/sources/docoffic/official/reports/cohesion7/7cr.pdf

While collaboration across borders is not without any limitations and issues, which may vary greatly in size, competences, finance and commitment (Klatt and Herrmann, 2011), cross-border areas are believed to bring together firms, people and knowledge generation institutions that are in geographic proximity, albeit with an international border in between (OECD, 2013). However, the nation state border itself can act as a barrier to cross-border learning by hindering interaction between actors on both sides of the border (Van den Broek and Smulders, 2014). These barriers to cross-border collaboration can also be expected in inter-regional collaboration, especially with the absence of geographical proximity. In order to overcome this, substituting geographical proximity to that of a non-spatial one is vital for inter-regional collaboration. Thereby, highlighting the need to explore other forms of proximity in order to substitute geographical proximity when collaborating at a distance.

2.4 Inter-regional Innovation System for regions at a distance

The concept of Regional Innovation Systems (RIS) has evolved into a widely used analytical framework (Ashiem and Isaksen, 2002; Ashiem, Isaksen, Nauwelaers and Totdling, 2003) to generate empirical foundations for innovation policy making (Doloreux and Parto, 2004). This according to Doloreux and Parto (2004) is driven by the increased intensity of international competition in the global economy, the apparent shortcomings of traditional regional development models and policies and the emergence of successful clusters of firms and industries in regions around the world (Enright, 2003). Consequently, Ashiem, Smith and Oughton (2011) concurred that it is driven partly by advances in theoretical analysis, the growing interest in innovation as a source of competitive advantage, and by the need for new policies to address regional inequalities and divergence. The development of the RIS literature (since Cooke, 1992) highlights the role of regional learning processes and institutions in an evolutionary framework (see for example, Cooke and Morgan, 1994a, 1994b; Oughton and Whittam, 1997; Asheim and Isaksen, 1997; Morgan, 1997; Baptista and Swann, 1998; Braczyk, Cooke and Heidenreich, 1998; Howells, 1999). The kernel of the argument is that close proximity between organisations strongly facilitates the creation, acquisition, accumulation and utilisation of knowledge rooted in inter-firm networking, inter-

personal relationships, and local learning processes and 'sticky' knowledge grounded in social interaction (Asheim and Isaksen, 2002). Additionally, there is increasing development of cross-border innovation system (CBRIS). According to Lundquist and Trippl (2013), CBRIS should be seen as the most advanced form of cross-border cooperation as the stages of integration system will pinpoint basic conditions by characterising each stage regarding the main RIS dimensions, that is, economic structure, science and knowledge bases, nature of linkages, institutional set-ups, and policy structures. Furthermore, they also added the dimension 'accessibility' to take into account the degree of physical proximity as exchange of knowledge (especially tacit knowledge) depends on face-to-face contacts and that physical distance can prohibit the actors from capitalising on the learning potential. Thus, the accessibility dimension is assumed to be very important, similar to that of RIS.

Nonetheless, not much research has been done on the inter-regional aspects of innovation systems as literature points towards the advantageous of geographical proximity as being close allows for exchange of tacit knowledge and low cost of coordination. Hence, in the opinion of the author of this thesis, research on developing an inter-regional innovation system (iRIS) is vital especially for regions that want to collaborate from a distance. Therefore, this research looks at how regional institutional frameworks may have influence on developing an inter-regional innovation system (iRIS).

2.5 Chapter Summary

This chapter presented the context to this research, providing the reader with an overview and reasoning behind why this research is undertaken. The background and context of this research were presented to outline the position from which this research was approached. Due to the economic crisis of 2008, Europe's public finances were severely affected which made securing future economic growth much more difficult. In order to tackle the crisis and to achieve long-term priority, the European Union put forward three priorities of smart, sustainable and inclusive growth. Through the Cohesion policy, ERDF funds were allocated for regional development which supports cooperation programmes for cross-border, transnational and inter-regional activities. However, these funds are unequally distributed and concentrated mostly on cross-border

and transnational cooperation programmes leaving little funds for inter-regional cooperation programmes. While there is encouragement and funding allocated for less developed regions to collaborate, inter-regional collaboration is still hugely overlooked. Extensive studies exist on cross-border innovation system, however little research has been done on inter-regional innovation systems where geographical proximity does not exist, and regions collaborate from a distance. Hence, this research focuses on the emergence and development of inter-regional innovation systems especially for regions that do not share contiguous borders. Therefore this research contributes to the existing small, but growing, body of research on inter-regional innovation systems. The next chapter provides the theoretical framework of this research

3 Theoretical Frame

The aim of this thesis is to research the underlying mechanisms of the influence of regional institutional frameworks on the evolution of an inter-regional innovation system, taking into account institutional variety in terms of types (i.e. regulative, normative and cultural-cognitive). It focuses on the relationships between regional institutions, mainly the triple helix actors when collaborating towards regional and inter-regional innovation systems. However, collaborations can be hindered when actors are embedded into an institutional architecture. Therefore, this research conceptualises that institutional gaps occur when different institutions collaborate and studies the influence of these institutional gaps rather than why collaboration happens. Accordingly, the relevant literature informed the theoretical frame of the current research on the systems of innovation and regional innovation systems with its institutions. First, the economic perspectives of innovation are reviewed which is followed by the review on innovation systems. Further, the regional innovation systems literature is reviewed with the focus on the institutions in regional innovation systems. Additionally, a discussion on institutions beyond the regional innovation systems approach is reviewed, and insight from several institutional perspectives is presented. This enables a fine-tuned conceptualisation of the institutions in regional innovation systems, which is applied in this thesis. It also reviews proximity and inter-regional collaboration and addresses the substitution mechanisms of spatial proximity. The chapter also highlights the different institutional gaps that are conceptualised in this research.

Table 3.1 shows the overview of the theoretical frame of research which will be addressed in the following sections.

Theory addressed	Description
Innovation-Economic perspective	The pioneering work on innovation stems from Joseph Schumpeter (1934) wherein he defined innovation as 'new combinations' of existing resources. **Product--Process—Technological Innovation**
Systems of Innovation *(Edquist ,1997; Nelson,1993; Lundvall,1992)*	Systems of innovation approach as a promising conceptual framework for advancing the understanding of the innovation process in the economy
Regional Innovation System *(Asheim et al, 2011; Uyarra, 2007; Doloreux and Parto, 2004; Iammarino, 2005; Cooke et al,1997)*	Importance of specific regional resources, interaction and learning processes, multiple institutional actors, localised capabilities, proximity, tacit knowledge, "embeddedness"
Institutions in Innovation systems (*Freeman ,1995;Lundvall ,1992)*	Definitions of Innovation System share institutional aspects, that it is embedded and/or encompasses institutions and/or the institutional set-up of the economy, which also highlights the importance of institutions in innovation systems.
Triple Helix *(Etzkowitz 2010; Etzkowitz and Leydesdorff, 1995)*	Interactions between university, industry and government are optimal conditions for innovation. Innovation is seen as a result of interactions within and between the triple helix actors.
Cross Border Regional Innovation System (CBRIS) *(Lundquist and Trippl, 2013; Trippl, 2010; Van den Broek and Smulders, 2014)*	A considerable flow of knowledge, expertise and skills across the border, high intensity of mobility of students and labour, innovation related networking among firms, academic collaborations and university-industry partnerships highlights a strongly integrated CBRIS.
Proximity (*Boschma, 2005; Hansen, 2015; Fitjar, Huber and Rodriguez-Pose, 2016).*	Argued to be an important factor for innovation, highlighting that a certain form of proximity is required for successful knowledge interactions. Substitution mechanism is explored to substitute geographical proximity with other forms of proximity for collaboration over a distance.

Table 3.1: Theoretical framework *(Source: Current Research)*

3.1 Innovation- Economic perspectives

The pioneering work on innovation stems from Joseph Schumpeter (1934) wherein he defined innovation as 'new combinations' of existing resources. Schumpeter also described a clear distinction between an invention and an innovation. He argued that inventions, when not carried out in practice, are irrelevant. Therefore, entrepreneurship is necessary to see the business opportunities and cope with the difficulties and resistance of introducing an invention to economic practice (Schumpeter, 1934; Schumpeter, 1947). Certainly, innovation attracts attention, as it becomes a powerful attribute that helps scholars explain differences across countries, their technological

progress and the success of their business organisations. It is broadly accepted that it constitutes a key element leading to economic development and competitiveness (OECD, 2007; Alberdi Pons, 2014; Dereli, 2015). Selling more competitive and attractive products and services in the global market helps advanced countries develop through the innovative capabilities of their organisations. These activities bring increased revenue streams which lead to better job opportunities and increased Gross Domestic Products (GDP) (European Commission, 1996), creating institutional dynamics (Lundvall and Borrás, 1997; Asheim and Coenen, 2006; Edquist, 2001 and 2011; Moodysson and Zukauskaite, 2014) which reinforce the tendency of these countries to rely on innovation as a source of international recognition, growth and welfare.

According to Fagerberg (2013), a significant contribution attributed to Joseph Schumpeter is the classification of innovations according to how radical they are. Continuous improvements are often characterised as "incremental" as opposed to "radical" innovations or "technological revolutions", which may have a very far-reaching impact across industries and economies (Schumpeter, 1934 and 1942). Radical innovation explores new technology and creates a dramatic change that transforms existing markets or industries, whereas incremental innovation is less ambitious in its scope by exploiting existing technology which improves competitiveness within current markets or industries while maintaining low potential for uncertainty. Nevertheless, due to its growing importance, scholars and key organisations have provided some extensive definitions of innovation (for example see Table 3.2).

Authors	Definitions
Zaltman, Duncan and Holbek, 1973, p.10	"*any idea, practice, or material artefact perceived to be new by the relevant unit of adoption"*
Dosi, 1988. p. 222	*"the search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes and new organisational set-ups."*
West and Farr, 1990, p. 9	*"the intentional introduction and application within a job, or organisation of ideas, processes, products or procedures which are new to that job, or organisation and which are designed to benefit the job, or the organisation.'*
Damanpour, 1991, p. 556	*"the generation, development, and adaption of novel ideas on the part of the firm"*
European Commission, 1995, p. 9	*"the successful production, assimilation and exploitation of novelty in the economic and social spheres"*
OECD, 2018, p.44	*"Innovation is more than a new idea or an invention. An innovation requires implementation, either by being put into active use or by being made available for use by other parties, firms, individuals or organisations. The economic and social impacts of inventions and ideas depend on the diffusion and uptake of related innovations. Furthermore, innovation is a dynamic and pervasive activity that occurs in all sectors of an economy; it is not the sole prerogative of the Business enterprise sector. Other types of organisations, as well as individuals, frequently make changes to products or processes"*
Edquist and Johnson, 1997, p.42	*"Technological innovations are here regarded as the introduction into the economy of new knowledge or new combinations of existing knowledge. This means that innovations are looked upon mainly as the result of interactive learning processes"*

Table 3.2: Definitions of Innovation *(Source: Current Research)*

Even though these definitions (Table 3.2) for innovation exist throughout literature, these definitions and the theory of innovation, however, have an identical basis in the

pioneering work on innovation by Joseph Schumpeter (Schumpeter 1934). Schumpeter's early definition of innovation is still very present in conceptualisations of innovation. He defined innovation as "new combinations" of existing resources and identified the following examples or categories:

- The introduction of a new good that is one with which consumers are not yet familiar, or of a new quality of a good.
- The introduction of new methods of production, which need by no means be founded upon a discovery scientifically new, and can also exist in a new way of handling a commodity commercially.
- The opening of a new market that is a market into which the particular branch of manufacture of the country in question has not previously entered, whether or not this market has existed before.
- The conquest of a new source of supply of raw materials or half-manufactured goods, again irrespective of whether this source already exists or whether it has first to be created.
- The carrying out of the new organisation of any industry, like the creation of a monopoly position or the breaking up of a monopoly position.

(Schumpeter, 1934, p.66)

Innovation is a complex mechanism of introducing a new product, method of production, new source of supply, opening of new market, implementation of new organisational method or the establishment of new business (Schumpeter, 1934). Consequently, other neo-Schumpeterian authors such as Dosi (1988) and Freeman (1988) also emphasised a more dynamic approach to the study of innovation. Dosi (1988) argued that innovation is about the development, search, imitation or adoption of new products, production processes or even new organisational methods. However, Freeman (1988) suggested that technological changes involved in the innovation process have the power to establish new strands for the transformation of the economy. These changes within the paradigm of innovation can be so significant that they can impact the economic performance of countries directly and even society as a whole. However, innovation can also be regarded as a cumulative process (Edquist and Johnson, 1997) as it is an empirically well-established fact that there is a strong cumulativeness in the form of innovation avenues (Sahal, 1985) in many areas of

technical change or technological trajectories (Dosi, 1982). These two characteristics of learning processes being interactive and cumulative also mean that the institutional set-up will affect innovation processes as institutions, by their nature, affect interactions between people and the norms, which somewhat comprise the cumulativeness of learning processes (Edquist and Johnson, 1997).

In economics, most of the focus has been devoted to product and process innovations (Fagerberg, 2013). Through product innovations, organisations can gain competitive edge by differentiating their output and significantly improving technical specifications, components and materials, software in the product, user friendliness or other functional characteristics, which allows them to increase the demand side and open up opportunities for growth. On the other hand, process innovations allow organisations to improve the quality of the products, or attain improvements in the efficiency of their production or delivery method. Thus, product innovations are mainly customer driven and are more focused on markets, whereas process innovations are primarily driven by efficiency (Utterback and Abernathy, 1975). The focus on products and processes could be explained by the excessive importance provided to technological change. In fact, technological supremacy has sometimes been claimed to spur global dominance (Fagerberg, 2013). Technological change implies changes in organisation, behaviour, and the way in which different agents in a system relate to each other which goes far beyond mere technical progress. However, information circulates in multiple directions in an interactive manner forming a variable perspective in system dynamics and is thus more holistic when understanding innovation from the systemic perspective. Innovation is also understood as institutional change (Pavitt and Patel, 1988; Dalum, Fagerberg, and Joergensen, 1988; Edquist and Jakobsson, 1988), which should not only occur in the world of production, but also in the field of consumption and society itself (Cooke, Uranga and Etxerbarria, 1997).

Edquist and Johnson (1997) viewed technological innovations as the introduction into the economy of new knowledge or new combinations of existing knowledge. This implies that innovations are regarded mainly as the result of interactive learning processes through which, different pieces of knowledge become combined in new ways or new knowledge is created which sometimes results in new processes and products. This interaction is not limited to taking place only with R&D but also in relation to

normal and everyday economic activities such as procurement, production, and marketing. Even though the interaction occurs within firms (between different individuals or departments), between firms and consumers, between different firms, or between firms and other organisations like public agencies, Edquist (2013) acknowledged that this does not mean individuals can never innovate alone i.e., without interacting or that all new knowledge is the result of new combinations of already existing knowledge. The author also noted that, looking at innovation as closely related to ordinary economic interactions also means that it is a 'normal' process which is integrated in the modern economy even though it is to some extent endogenous to the economic process. Hence, technological change is widely recognised as a primary engine for economic development (Fischer, 2000) and innovation being the core of technological change is essentially the innovation process that depends upon the accumulation and development of relevant knowledge of a wide variety. Indeed, individual firms play a crucial role in the development of specific innovations but the process that nurtures and disseminates technological change involves a complex web of interactions among a range of firms, organisations and institutions. While Innovation and technical progress are the result of a complex set of relationships among actors producing, distributing and applying knowledge, the innovative performance of a country depends on how these actors relate to each other as elements of a collective system of knowledge application and creation (OECD, 1997). Hence, considerable attention has been focused on the systems of innovation approach as a promising conceptual framework for advancing the understanding of the innovation process in the economy. Systems of Innovation emphasised the interaction between institutions which is similar to the triple helix approach that is grounded in the concept that innovation is the outcome of an interaction process involving different spheres of actors (Cavallini, Soldi, Friedl and Volpe, 2016), each of them playing a role according to its 'institutional' function in society. Each of these actors has a precise role in supporting economic growth through innovation and their contribution is foreseen in terms of sharing knowledge and transfer of know-how. Consequently, ideas and theories about actors leading the innovation process grew and changed over time. Accordingly, economic development is seen as a process of qualitative change driven by innovation (Fagerberg, 2003), which Schumpeter (1934) defined as new combinations of existing resources.

Innovation has been largely investigated and studied since the beginning of the nineteenth century mostly due to its crucial role in economic growth and competitiveness. In '*The theory of Economic Development'* (Schumpeter, 1911) Schumpeter, kept the focus on industry and considered the entrepreneur as the main protagonist of the innovation-generating process. However, according to Schumpeter (1942) research and development laboratories were intended as knowledge creators which were considered as an essential input for innovation while large enterprises are considered as the strategic stakeholders in the economic system. This change in the idea of innovation can be considered as one of the first explicit recognitions of knowledge reference (Cavallini, et al. 2016) wherein university plays a role of knowledge producer. The role of the university became more evident and knowledge production was formalised in two ways, 'Mode 1' and 'Mode 2' (Gibbons, Limoges, Nowotny, Schwartzman, Scott and Trow, 1994). 'Mode 1' refers to a knowledge production system led by universities performing basic research which are not necessarily focused on knowledge application whereas 'Mode 2' refers to a knowledge production system led by universities which is based on the principles that science is 'applied' and technology is 'transferred'(Gibbons et al., 1994). However, in 1995, Etzkowitz and Leydesdorff introduced the triple helix concept involving different spheres of actors, namely, university, government and industry, each contributing according to its 'institutional' function in society and named the three spheres as the triple helix model. In the triple helix model, the traditional actors in charge of creating innovation and knowledge interact with the government who provide the regulatory framework and the financial support for the definition and implementation of innovation strategies and policies, in order to create innovation that is directly transferred at the territorial level in terms of economic growth through a top-down approach (Cavallini et al. 2016). The different institutions that serve a variety of functions within an economy may be involved in knowledge production by research, while others may be involved in technological development. Hence, the territorial levels of innovation system such as the national and regional innovation systems become desirable as it underlines the interaction of the actors within an economy to efficiently respond to their region's societal and economic needs.

3.2 Systems of Innovation

The system of innovation approach is a conceptual framework and not a formal theory (Edquist, 1997). A system of innovation (SI) can be defined as "all important economic, social, political, organisational and other factors that influence the development, diffusion, and use of innovations" Edquist (1997, p.14). Systems of innovation may be supranational, national or sub national (regional, local). Despite the increasing processes of globalisation and regionalisation, writers such as Lundvall (1992) and Nelson (1993) stressed the continuing importance of national systems and Porter (1990, p.73) believed that "in a world of increasingly global competition, nations have become more, not less, important". While undoubtedly systems of innovation are transcending national borders, in general, nations have their own institutional structures (financial, education system and training), culture and unique production systems.

Definitions of innovation systems emphasise the role of institutions as they are of crucial importance for innovation processes. In other words, systems of innovation are normally defined in institutional terms. In all the definitions used, various economic, social and political institutions influencing innovations are central elements. For example:

- Freeman talked about 'the network of institutions' in his definition (Freeman, 1987 p.1)
- For Lundvall, 'The institutional set-up . . is the second important dimension of the system of innovation' (Lundvall, 1992 p.10).
- Nelson and Rosenberg (1993) stressed the importance of "the institutions and mechanisms supporting technical innovation" (p.1).
- Carlsson and Stankiewicz (1995) pointed to the "particular institutional infrastructure ….. involved in the generation, diffusion, and utilization of technology' (p.49).

These institutions are universities, R&D laboratories, schools, patent systems, labour market organisations, banking systems and various government agencies. There are also other kinds of institutions that may have important influences upon innovations and innovation systems such as the norms, habits, practices, and routines, even though this seems to be less emphasised in the literature. The importance of institutions in

innovation systems stemmed from the systems of innovation approach (Edquist, 1997, 2001, 2005), which argued that innovation should be seen as an evolutionary, non-linear and interactive process, requiring intensive communication and collaboration between different actors, both within companies as well as between firms and other organisations such as universities, innovation centres, educational institutions, financing institutions, standard setting bodies, industry associations and government agencies.

The concept of innovation system has initially been applied to the national level (Lundvall, 1992; Nelson, 1993; Niosi, Saviotti, Bellon and Crow, 1993; OECD, 1999). The national system of innovation (NSI) literature has revealed huge differences between countries in such attributes as economic structure, R&D base, institutional set-up and innovation performance (Edquist, 2001). Though the National System of Innovation (NSI) concept had its origins by the end of the 1980s and middle of the 1990s (Freeman 1987, 1988; Lundvall 1988, 1992; Nelson 1988, 1992, 1993; Pelikan 1988), the first person to use the expression 'national system of innovation' according to Freeman (1995) was Lundvall (1992). The NSI was developed with an aim to understand differences in technological development and profiles of technological specialisation among countries, which has been defined by different authors (see Table 3.3).

Authors	Definition
Freeman (1987, p. 1)	Over the last two centuries those scientific and technical activities which are intended to promote the flow of technical and organisational innovations and their diffusion have vastly increased in scale and have become highly specialised in a variety of institutions. At the same time national education and training systems, which may both encourage and disseminate advances in technology, have expanded largely to ensure that the labour force has the changing mix of skills needed to diffuse and operate these new techniques efficiently. The network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies may be described as 'the national system of innovation'.
Lundvall (1992, p. 12)	The narrow definition would include organisations and institutions involved in searching and exploring – such as R&D departments, technological institutes and universities. The broad definition […] includes all parts and aspects of the economic structure and the institutional set-up affecting learning as well as searching and exploring….
Nelson (1993, p. 4-5)	There is, first, the concept of a national system of innovation itself. […] Consider the term "innovation." In this study we interpret the term rather broadly, to encompass the process by which firms master and get into practice product designs and manufacturing processes that are new to them, if not to the universe or even to the nation. […] Then there is the term "system." […] Rather the concept is of a set of institutions whose interactions determine the innovative performance, in the sense above, of national firms. […] Rather, the "systems" concept is that of a set of institutional actors that, together, plays the major role in influencing innovative performance.

Table 3.3: Definitions of NSI (*Source: Vertova, 2014 p. 5*)

From the broad definitions in Table 3.3, it can be noted that all the definitions share institutional aspects, that the NSI is embedded and/or encompasses institutions and/or the institutional set-up of the economy, which also highlights the importance of institutions in an innovation system. However, Vertova (2014) argued that if institutions are everything, anything that impacts on "institutions" will also affect the NSI. The

author further argued that such broad definitions are rarely useful in identifying the NSI key elements and the features affecting them and that the NSI concept has become such a broad one that it can explain almost everything, and that means nothing. This argument is drawn from the "old" and "new" institutional economics that the evolutionary tradition uses a very broad concept of institutions, encompassing almost everything: "They encompass not only simply organisations - such as corporations, banks and universities - but also integrated and systematic social entities such as money, language and law" (Hodgson 1998, p. 179).

However, an analysis of the above definitions (Table 3.3) reveals several crucial themes in the manner in which the NSI is conceived and employed among scholars. These themes are crosscutting and originate from the definitions of the NSI in Table 3.3.

- *Variety of institutions:*

  The definitions of NSI indicate that it is composed of a range of institutions that serve a variety of functions within an economy. The institutions in the NSI may operate at different levels, they can be private or public and some may be competing firms within an economy. While some institutions may be involved in knowledge production by research (such as the universities and public research organisations), others may be involved in technological development and activities relating to the acquisition, adaptation, generation and diffusion of technology, this aspect underlines the importance of system governance and the rules of engagement that characterise the nature of interactions among the components of the NSI (Manzini, 2012).

- *Interactions:*

  The presence of interactions among the members of the NSI is a theme that cuts across all the given definitions of the NSI. This underlines the role of information and communication technologies in supporting knowledge systems, which cannot be over emphasised. However, the quality of these interactions is more important than their mere physical presence (Manzini, 2012). Therefore, in order to ideally respond to the needs of their economic environment, system components have to listen to efficiently respond to the social and economic needs of the society.

Although various researchers have embarked on research on the NSI or incorporated its ideas in policy and planning, in the 1990s other specifications of innovation systems emerged. Different authors (for example, Carlsson and Stankiewicz, 1991; Carlsson and Jacobsson, 1994; Carlsson and Jacobsson, 1997) analysed "technological systems" and argued that systemic interrelationships are unique to technology fields. While other authors emphasised the importance of a sectoral approach and examined how groups of firms develop and manufacture products of a specific sector and how they generate and utilise the technologies of that sector (see for example Breschi and Malerba, 1997; Mowery and Nelson, 1999; Malerba, 2002), a growing interest in regional innovation systems also emerged (Braczyk, Cooke and Heidenreich, 1998; Autio, 1998 ; Howells, 1999; Acs, 2000; Mytelka, 2000; Doloreux, 2002; Bathelt and Depner, 2003; Fornahl and Brenner, 2003). Though it is not denied that national, technological and sectoral factors are essential, it is argued convincingly that the regional dimension is of key importance as it was shown that knowledge spillovers, which play a key role in the innovation process, are often spatially bounded (Audretsch and Feldman, 1996; Anselin, Varga and Acs, 1997; Bottazzi and Peri, 2003). The RIS approach highlights the regional dimension of the production and the exploitation of new knowledge, thereby helping to explain regional differences in innovation capacity and economic strength.

3.3 Regional Innovation Systems (RIS)

Cooke (1992) is attributed as coining the term 'regional innovation system' in his Geoforum article "Regional Innovation Systems: Competitive Regulation in the New Europe". Since then, the concept of Regional Innovation Systems (RIS) has evolved into a widely used analytical framework (Ashiem and Isaksen, 2002; Ashiem, Isaksen, Nauwelaers and Totdling, 2003). This popularity, according to Doloreux and Parto (2004) is driven by the increased intensity of international competition in the global economy, the apparent shortcomings of traditional regional development models and policies and the emergence of successful clusters of firms and industries in regions around the world (Enright, 2003). Consequently, Ashiem, Smith and Oughton (2011) concurred that it is driven partly by advances in theoretical analysis, the growing interest in innovation as a source of competitive advantage, and by the need for new policies to address regional inequalities and divergence.

However, even with this growing interest, the concept of RIS has no commonly accepted definitions but is generally understood as a set of interactions between formal institutions and other organisations that function according to the arrangements and relationships which are favourable to the generation, use and dissemination of knowledge (Doloreux, 2003; Doloreux and Parto, 2004). Initial definitions of RIS mainly highlight the importance of interaction among different actors within the system such as the regional production structure or knowledge exploitation subsystem which consists mainly of firms, and the regional supportive infrastructure or knowledge generation subsystem which consists of public and private research laboratories, universities and colleges, technology transfer agencies, vocational training organisations (Cooke, Uranga and Etxebarria, 1998).

Cooke, Uranga and Etxebarria (1998) defined regional innovation systems as different sectors or even clusters interacting with regional governance and innovation support infrastructure as well as with the national and global levels. Asheim and Isaksen (1997) indicated that RIS denotes regional clusters surrounded by supporting organisations which interact with each other and are embedded in an institutional framework. The kernel of the argument is that close proximity between organisations strongly facilitates the creation, acquisition, accumulation and utilisation of knowledge rooted in inter-firm networking, inter-personal relationships, and local learning processes and 'sticky' knowledge grounded in social interaction (Asheim and Isaksen, 2002).

Cooke (2004) specified and enlarged the definition of RIS as "interacting knowledge generation and exploitation sub-systems linked to global, national and other regional systems for commercialising knowledge" (p.3) wherein knowledge generation subsystems consist of public and private research laboratories, universities and colleges, technology transfer agencies, and vocational training organisations; and knowledge exploitation subsystems are understood as the regional production structure (Cooke, 2004) such as firms.

The succeeding development of the RIS literature (since Cooke, 1992) highlighted the role of regional learning processes and institutions in an evolutionary framework (Cooke and Morgan, 1994a, 1994b; Oughton and Whittam, 1997; Asheim and Isaksen, 1997; Morgan, 1997; Baptista and Swann, 1998; Braczyk, Cooke and Heidenreich, 1998; Howells, 1999). However, the concept of institutions is often not clearly

elaborated upon in the RIS framework. The concept therefore, has turned out to be particularly challenging because different strands of research in economics and social sciences have defined and applied the notion of institutions in different ways (see for example Hollingsworth, 2000). North in his book *Institutions, Institutional Change, and Economic Performance* (1990 p.3) defined institutions as 'rules of the game in a society' or more formally, they are the humanly devised constraints that shape human interaction. These constraints can be formal such as rules that human beings devise or informal such as conventions or codes of behaviour. However, North's (1990) view of institutions is a more top down approach to institutions as it highlights the importance of a visible and fairly easily detectible 'rules of the game' which explicitly and implicitly emphasises institutions that regulate or in other ways normatively frame knowledge processes (Sotarauta, 2016), intellectual property right laws, governance structure, financial systems, R&D investment systems; and training and competence building system (see for example, Autio 1998; Braczyk, Cooke, and Heidenreich 1998; Howells 1999; Edquist 2005; Edquist 2008). While the top-down view uses pre-defined 'lists of institutions', the bottom-up view is more open as institutions are acknowledged in terms of how they interact with each other and how networks between them become established and function (Uyarra and Flanagan, 2013). Hence, focusing solely on the top down view of institutions would neglect the diversity of actors, which assumes all the actors are more or less the same, while it is the institutions that differ (Sotarauta, 2016).

The different interpretations of institution are abundant even in the much smaller field of innovation system studies (Edquist, 1997; Jacob, 2006). However, despite the efforts to arrive at a more straightforward concept and common understanding (see for example Edquist, 1997 and 2005), the analysis of institutions in innovation studies is still very heterogeneous and often conducted only implicitly (Rohracher, Truffer and Markard, 2008). Despite these bodies of literature illustrating the heterogeneity of approach to institutions, it ought to be studied as complex emergent phenomena (Sotarauta, 2016) that are always incomplete, provisional and unstable which co-evolve with many other complex phenomena (Jessop, 2001) and therefore highlights the multi-faceted phenomenon of institutions. As a result, the current research follows a dynamic and actor-centric concept of institutions, which emphasises change and heterogeneity rather than the rigidity, and independence of social structures. Generally, institutions are rules or norms, which regularise social behaviour whether in an enabling or in a restraining

sense. They provide stability necessary for the reproduction of society (Johnson, 1992) by reducing uncertainty, coordinating actor strategies, facilitating resolution of conflicts and so on (Rohracher et al., 2008). Nonetheless, this stability is never absolute, as institutions have to be constantly reconstructed and re-interpreted by individual and organisational actors (Giddens, 1984) underlining that institutions are not only dynamic but are also subjected to strategic interventions by actors involved in them.

3.3.1 Institutions in Regional Innovation Systems

Institutions may be created or evolved over time and specifying the institutions in play is one way of moving towards a concrete framework for studying the impact of regional policy on innovation (Moodysson and Zukauskaite, 2014). A set of institutions provides the institutional framework (Chavez, 2012) and the institutional framework fundamentally influences which organisations come into existence and how they evolve; at the same time, they influence the institutional framework from which they evolve. An institutional framework is generally understood as the system of formal laws, regulations, and procedures, and informal conventions, customs and norms that broaden, mould and restrain socio-economic activity and behaviour (Donnellan, Hanrahan and Hennessy, 2012). The institutional framework holds the formal and informal rules, the organisational set where certain actors interrelate in order to achieve specific goals, establish policies and procedures (UNEP, 2006).

Lauth (2004) differentiated formal and informal institutions. According to Lauth, informal institutions are institutions, which are not formally codified, in official documents (either in constitutions or laws). Formal institutions, however, are officially codified in written documents. Thus, they are regulated by rules, have the status of constitutional clauses and laws as well as standing orders and norms. Following this understanding, Lauth (2004) then stated that all private treaties or rules of associations, which are protected by the state, are formal institutions. While formal institutions are guaranteed by state agencies and their violation is sanctioned by the state, most of the informal institutions are based solely on their existence and effectiveness. The sanctioning possibilities that informal institutions imply are largely due to social mechanisms of exclusion or are based on the condition that its non-utilisation minimises the chances of gaining access to required goods and services. Even though informal

institutions are not codified in formal documents (Kusiluka, 2012); they are equally known and are publicly recognised.

Degree of Formality	Examples	Supportive Pillars
Formal Institutions	• Laws • Regulations • Rules	• Regulatory (Coercive)
Informal Institutions	• Norms • Culture • Ethics	• Normative • Cultural-Cognitive

Table 3.4: Dimensions of Institutions (*Source: Adapted from Peng, 2013, Scott, 2001 and North, 1990*)

While institutions can both be formal and informal, they can also be described according to their supportive pillars (See Table 3.4). Scott (1995) described institutions as;

> *"cognitive, normative, and regulatory structures and activities that provide stability and meaning to social behaviour. Institutions are transported by various carriers- cultures, structures, and routines- and they operate at multiple jurisdictions" (p.33)*

In 2001, Scott expounded his definition of institutions by including the cultural aspect onto the cognitive pillar and described that:

> *"institutions are comprised of cultural-cognitive, normative, and regulative elements that, together with associated activities and resources, provide stability and meaning to social life" (p.56)*

Nevertheless, it useful to distinguish between institutions that are formal and institutions that are informal because the balance between formal and informal institutions may differ. According to Edquist and Johnson (1997), formal institutions are more visible than informal ones as they are codified while informal ones must be indirectly observed through the behaviour of people and organisations. These differences must be taken into account when describing and comparing systems of innovation. While institutions by their nature regulate the relations between people and groups of people within, between

and outside the organisations, the pattern and the content of communication and interaction in the economy is affected by its institutional set-up. Subsequently, since innovation is regarded as resulting from interactive learning processes, institutions in turn affect innovation; a perspective that is not very common in institutionalist theory. The Scott (1995) framework divides between stages of emergence when it comes to institutional theory, where the focus regarding the implications of institutions vary from regulative, normative and cognitive issues while the distinction offered by North (1990) regarding the conscious distinction between institutions and organisations provides an additional guideline for distinguishing the different approaches. North (1990) defines institutions as:

> *"Humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights)" (p. 97)*

On the other hand,

> *"Organisations are created with purposive intent in consequence of the opportunity set resulting from the existing set of constraints (institutional ones as well as the traditional ones of economic theory) and in the course of attempts to accomplish their objectives are a major agent of institutional change" (North, 1990 p.5).*

Hence, organisations can be regarded as partly formed by the institutional frameworks and are at the same time the medium for their change. According to Edquist and Johnson (1997), organisations are strongly influenced, coloured, and shaped by institutions and that organisations are embedded in an institutional environment or set of rules while at the same time institutions are also embedded in organisations, which may be seen as concrete hosts for specific institutions. There is thus a complicated two-way relationship of mutual embeddedness between institutions and organisations which influences both the performance and change of systems of innovation. Following the embedded nature of institutions and organisations in systems of innovation pointed out by Edquist and Johnson (1997), the current research aims to understand the extent of institutional framework influence on the evolution of an inter-regional innovation system.

Cooke, Uranga and Etxerbarria (1997) defined three institutional forms, which are crucial for the capacity of regional innovation systems; they are: the financing, learning and productive cultures. In order for the regional innovation system to develop its capabilities, it needs good infrastructure and incentives for learning, cooperation and financial sources for innovation (Zukauskaite, 2013). In a later study (Cooke, 2001), the institutional dimension was redefined as co-operative culture, interactive learning and associative consensus, while financing is discussed as a separate (infrastructural) characteristic of the innovation system. However, learning, cooperation and consensus making are activities, not institutional per se and neither Cooke (2001) nor Cooke et al. (1997) further specify on how to measure institutions.

If actors within a region have a well-developed cooperation network – work on joint projects, have workshops for knowledge exchange and joint databases, they will have institutions supporting cooperation (Zukauskaite, 2013). However, the interactions between the actors in RIS have been insufficiently explored while the institutional context of these interactions has been by and large overlooked (Doloreux and Parto, 2004). Asheim and Gertler (2005) made the institutional aspect most prominent by defining RIS as an institutional infrastructure supporting innovation within the region. This clearly points out the interrelated nature of innovation processes and institutions but it does not contradict the perception of innovation as an outcome of systemic interaction. On the contrary, the institutional framework becomes relevant as it might hinder or facilitate interactions between the actors (Storper, 1997; Gertler, 2003), which in turn can influence the evolution of RIS.

The definition of RIS as an interacting knowledge generation subsystems (which consist of public and private research laboratories, universities and colleges, technology transfer agencies, vocational training organisations) and exploitation subsystems, understood as the regional production structure (Cooke, 2004) stems from Porter's work on how clusters, a geographically proximate group of interconnected firms in the same or adjacent industrial sectors, can produce competitive advantage based on the exploitation of unique resources and competencies, which have to be reproduced and developed through continuous innovation (Porter, 1990 and 2000) . This definition of RIS underlines the dynamic character of competitive advantage as a result of innovation, which represents the high road to economic development which is a more systematic approach to developing the endogenous capacity of firms and regions to innovate and

focuses on the role of knowledge creation, absorption and diffusion (Asheim, Lars, Moodysson and Jan, 2005). This puts stronger focus on the actors, agencies and governance forms relevant for constructing regional advantage in a triple helix model that builds on the idea of university–industry–government interactions and contributes to regional and national wealth creation through increased innovation and venture creation (Etzkowitz and Leyesdorff, 2000).

3.3.2 Triple Helix Concept and the Interactive Perspective

The triple helix (TH) concept has grown into an analytical framework (Ranga and Etzkowitz, 2013) for exploring the complex dynamics of the knowledge society and for informing policy-makers at national, regional and international level in the design of new innovation and development strategies. In this framework, innovation is seen as the result of interactions within and between University, Industry, Government institutional spheres, with University shifting from a secondary to a primary institutional sphere and an equal partner to Industry and Government, even taking a lead role in implementing innovation (Ranga, 2012).

The main thesis of the triple helix model (Etzkowitz and Leydesdorff, 1995, 1997) is that the interactions between university, industry and government are optimal conditions for innovation. The triple helix model posits these three spheres, overlapping and interacting freely, with each "taking the role of the other" (Etzkowitz 2008, p.9), producing hybrid organisations such as science parks, spin-offs, university-run enterprises and incubators from these interactions. Consequently, triple helix is increasingly being blended with a system of innovation approaches (Cai, Pugh and Liu, 2015), particularly in the regional dimension. Evidently, Ranga and Etzkowitz (2013) developed the concept of 'triple helix systems' as an analytical construct that synthesizes the key elements in innovation systems, with a particular focus on the triple helix interactions between university, industry and government. The triple helix approach (see Figure 3.1) of interaction is characterised by a key role of universities (as the main producers of knowledge), industry (as producing innovation through the improvement of organisational processes and the placement of products and services on the market) and the crucial role of government (in supporting the development of

science-based technologies and in formulating innovation-targeted policies) (Arnkil, Järvensivu, Koski and Piirainen, 2010).

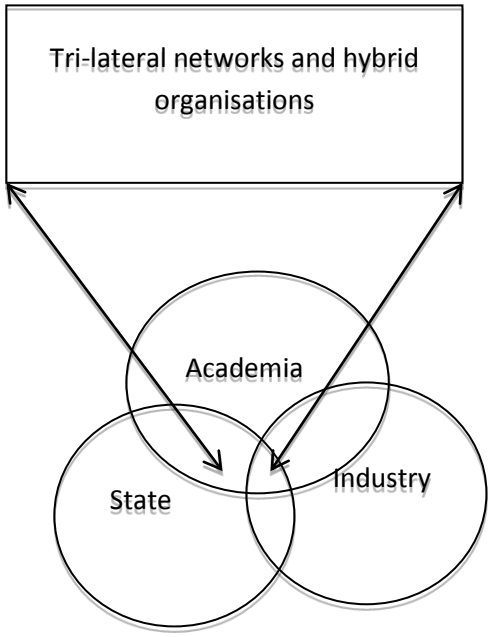


Figure 3.1: The triple helix model of university-government-industry relation *(Source: Etzkowitz and Leydesdroff, 2000 p.111)*

The triple helix (TH) model implies an increasing complexity in terms of key operational elements. Ranga and Etzkowitz (2013) defined these elements according to systems theory (Carlsson and Stankiewicz, 1991; Carlsson, Jacobsson, Holmé and Rickne, 2002; Edquist 2005; Bergek, Jacobsson, Carlsson, Lindmark, and Rickne, 2005) as a set of:

(i) components (the institutional spheres of university, industry and government, with a wide array of actors);
(ii) relationships between components (collaboration and conflict moderation, collaborative leadership, substitution and networking); and
(iii) functions, described as a set of activities specific to the "triple helix Spaces": the Knowledge, Innovation and Consensus Spaces which are the *"competencies of the system components that determine the system's performance"* (Ranga and Etzkowitz, 2013).

This hybrid theoretical approach of multiple-nature entities and synthesise features of University, Industry and Government provides a relevant base for innovation strategies

and addresses the key shortcomings in previous innovation systems approaches, such as diffuseness and conceptual heterogeneity, strong focus on institutions (especially firm-centrism and bias on R&D intensive, high tech industries) and low visibility of individual innovators, difficulty to draw system boundaries (Malerba, 2002; Edquist, 2005; Godin, 2007). The concept interprets the shift from a dominating industry-government dyad in the Industrial Society to a growing triadic relationship between university-industry-government in the knowledge society and provides a fine-grained view of innovation actors, relationships between the actors and knowledge flows within the system. This is mainly because knowledge has become an ever more important and crucial part of innovation (Marques, 2014), therefore, the role of university as an institution for the production and dissemination of scientific and technological knowledge has a more important role in industrial innovation; both as a provider of human capital, facilitating technology transfer and as an incubator of new ventures.

3.3.3 Triple Helix model in regional innovation system

The TH model offers policy makers an operational tool to set growth strategies and paths by providing an analytical framework to understand the role of key actors in a territorial system of innovation. At the regional level, the joint action of the triple helix actors (academia, government and industry) moved from the concept of institutional spheres to the concept of TH spaces: Knowledge, Innovation and Consensus Spaces (Cavallini et al., 2016). The fact that the triple helix systems accommodate both institutional and individual roles in innovation, and explain variations in the innovative performance in relation to the existence and development stage of the three triple helix spaces, highlights the strength of relationships between them and their capacity to integrate various regional development strategies. However, spatial aggregation in triple helix systems should not be overlooked, as it is predominantly important at the regional level (Ranga and Etzkowitz, 2013) for stimulating the creation and consolidation of the triple helix spaces (Knowledge, Innovation and Consensus Spaces) and their capacity to integrate various regional development strategies. The system boundaries in the ‘traditional’ approach to Innovation Systems are spatially defined by national or regional borders, or by industry structures that usually cross the geographic boundaries (Carlsson et al., 2002; Edquist, 2005), or by technologies that typically cross both geographic and sectoral boundaries (Hekkert, Suurs, Negro, Khulmann and Smits,

2007). However, in the triple helix systems, sectoral and technology boundaries are superseded by the boundary permeability among the institutional spheres that allows regional and local resources to be combined in order to realise joint objectives and new institutional formats in any of the Knowledge, Innovation and Consensus spaces. Consequently, this institutional format creates triple helix knowledge infrastructures in terms of overlapping institutional circles, each having the role of the other and with hybrid organisations emerging from the interfaces. Accordingly, Etzkowitz (2008) noted that the dynamics of the triple helix emerges at regional level from the interaction of the three triple helix spaces: "knowledge", "consensus" and "innovation" spaces.

Knowledge Space

Knowledge space provides the building blocks for regional growth in the form of a 'critical mass', a concentration of research resources on a particular topic, from which the technological ideas can be generated. The formation of this space is an essential step in the transition to a knowledge society and when these resources reach a certain level, they may play a role in regional development. The two dimensions, which can be used to operationalise this space are:

1. Mapping of regional R&D and non-R&D actors (e.g. public and private research labs, firms, universities, arts and cultural organisations), understanding their priority-setting and the design of their agendas, scope of operations (regional, national, international) and regional impact.

2. Developing policies and programmes on human resources for R&D in the sciences and arts at national/regional level, including labour market aspects for researchers, employment, education and training, immigration to attract world-class researchers, making research more attractive to various categories of the local population, especially women and minorities, reducing brain drain and improving brain gain at various stages of education and research career. (Etzkowotz and Ranga, 2010 p.14).

Consensus Space

A consensus space denotes the process of getting relevant actors to work together; brainstorming, analysing problems, and formulating plans. When these actors generate a strategy and bring together the resources to realise it, the regional development process

can be moved forward. It is a mix of top-down and bottom up processes to create leadership through collaboration rather than diktat. The collaboration is embedded in trust and is regulated by rules of the game negotiated and agreed by the participants. Actors in the consensus space are interdependent rather than seeing themselves as isolated entities (Ranga and Etzkowitz, 2013).

Innovation Space

An innovation space denotes an organisational invention or adaptation made to fill a gap in the regional development process (Etzkowitz, 2008). Activities in the Innovation Space include the aggregation of resources to create the new organisational format, induction of people into newly conceptualised roles and the creation of legitimating themes to justify the enterprise by linking it to both old and new societal goals making knowledge-based entrepreneurship the common characteristic in this space. According to Etzkowitz and Ranga (2010) two dimensions are suggested for developing and analysing the innovation space:

1. Technology transfer institutions (e.g. technology transfer offices in universities, in firms and in government research labs, industrial liaison offices), business support institutions (e.g. science parks, business/technology incubators) and financial support institutions for new technology-based firms (public and private venture capital firms, angel networks, seed capital funds, etc.).

2. Policies to promote the formation and activity of the institutions above.

With regions and countries trying to achieve some form of triple helix (Etzkowitz, 2008), the common goal is to build innovative and dynamic environments in their regions to create jobs and wealth. The result may consist of cultivating favourable conditions by creating:

1) academic spin-off companies (Carayannis, Rogers, Kurihara and Allbritton, 1998);
2) tri-lateral initiatives for economic development based on knowledge, as is the case of science and technology parks and business incubators (Marques, Caraca and Diz, 2006);
3) strategic alliances between firms (Tether, 2002);

4) hybrid institutions, with non-profit interface functions (Marques and Caraça, 1998); and,
5) R&D contracts with government laboratories and academic research groups (Benner and Sandström, 2000).

The varying combinations of relationships between university, industry and government produce a momentum that promotes and creates a balance between the different systems (Etzkowitz, 2008). Therefore, the current research highlights the interactions and relationships between these triple helix institutions in a region to better understand their regional innovation systems.

3.4 Cross Border Regional Innovation System (CBRIS)

The main driver of cross-border cooperation is the complementarities in the economic structure, socio-economic institutions and innovation capabilities between neighbouring regions. However, cooperation in cross-border regions is often confined to a limited number of issues and it differs greatly in size, competences, finance and commitment (Klatt and Herrmann, 2011). According to Peck and Mulvey (2016), the motivation to engage in cross-border collaboration also varies over time because of the institutional change which is combined with austerity. This can lead to significant disruption in building social networks across the border, reducing institutional capacity and creating greater institutional asymmetry. While Cross-border areas are believed to bring together firms, people and knowledge generation institutions that are in geographic proximity, albeit with an international border in between (OECD, 2013), Van den Broek and Smulders (2014) stressed that the nation state border itself can act as a barrier to cross-border learning by hindering interaction between actors on both sides of the border. There are economic, social and mental bordering processes that hinder cross-border interaction and network formation, which are required for cross-border institution building and the development of a cross-border regional innovation system (CBRIS). Cross-border regions have to focus more on their innovation performance to remain or become competitive (Lundquist and Trippl, 2013), and each actor[5] in their respective regions needs to address their action plans in order to start collaborating with other regions.

[5] The words actor and stakeholder are used interchangeably in this thesis.

Cross-border regions start with cooperating on a small number of issues (Van Den Broek and Smulders, 2014) but their cross-border economic strength in the long term is likely to rest upon their capacity to build an integrated innovation system (Lundquist and Trippl, 2013). In their conceptual study, Lundquist and Trippl (2013) identified different stages in the development of cross-border innovation systems and also highlighted the main characteristics and barriers in each phase. The authors argued that CBRIS should be seen as the most advanced form of cross-border cooperation and identified three stages in the evolution of CBRIS: weakly integrated systems (Stage I), semi-integrated systems (Stage II) and strongly integrated systems (Stage III) (see Figure 3.2).

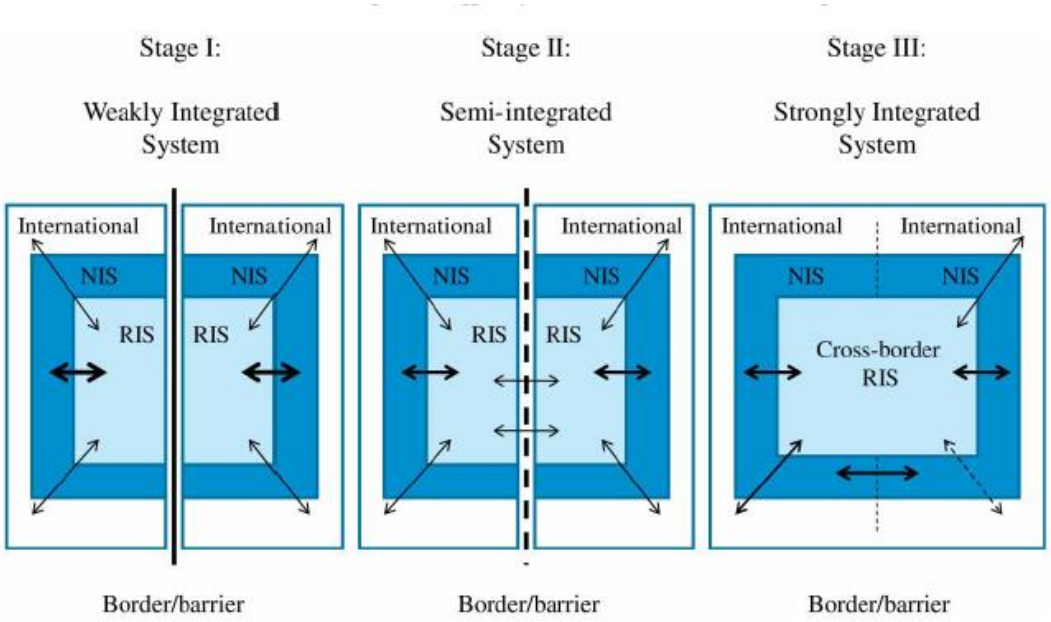


Figure 3.2: Different stages of Cross-border integration (*Source: Lundquist and Trippl, 2013, p.455)*

According to Lundquist and Trippl (2013), the stages of integration system will pinpoint basic conditions characterising each stage regarding the main RIS dimensions, that is, economic structure, science and knowledge bases, nature of linkages, institutional set-ups, and policy structures. Furthermore, they also added the dimension 'accessibility' to take into account the degree of physical proximity as exchange of knowledge (especially tacit knowledge) depends on face-to-face contacts and the physical distance can prohibit the actors from capitalising on the learning potential. Thus, the accessibility dimension could be assumed to be very important. As shown in Figure 3.2, the three stages represent ideal types of CBRIS. However, it is important to keep in mind that the

distinction between the three stages might not be as clear-cut in the real world as in the conceptual model (Lundquist and Trippl, 2013) and that cross-border areas might not necessarily move from one stage to the next one. While Stage I (weakly integrated systems) are characterised by low levels of cross-border economic relations in general and a lack of knowledge interactions and innovation linkages in particular, Stage II (semi-integrated systems) can be referred to as an emerging knowledge-driven system which features decreasing levels of asymmetry and provides opportunities for new and more mutual beneficial linkages on both sides of the border. However, Stage III (strongly integrated systems) is the most ideal CBRIS as it represents the most advanced form of innovation driven integration where RIS in the regions of the cross border areas become more and more amalgamated into a single one. This strongly integrated system is characterised by "a considerable flow of knowledge, expertise and skills across the border, brought about by a high intensity of mobility of students and labour, innovation related networking among firms, academic collaborations and university-industry partnerships" (Lundquist and Trippl, 2013, p.457). These integrated systems reflect the existence of substantial synergies which results from the co-existence of high levels of functional proximity and optimal levels of cognitive distance, at the same time offering favourable conditions which enable and support actors to make effective use of them.

Fundamentally, a strongly integrated CBRIS can emerge if the cross-border regions host an advanced scientific base and a well-developed innovation related infrastructure, industries on both sides of the border are innovative, existence of economic relations and processes of collective learning across the border, existence of certain levels of socio-cultural and institutional proximity in the border region and the absorptive capacity of the regions to make autonomous decisions to carry out policies (Trippl, 2010; Makkonen and Rohde, 2016). As well as these dimensions, CBRIS require a certain degree of geographical proximity (Lundquist and Trippl, 2013) which is non-existent in the case of inter-regional innovation systems. While a significant amount of research has been done in regards cross-border regional innovation system, there is little to none on inter-regional innovation system research. Therefore, this research explored the development of inter-regional innovation system and highlighted the need for developing an inter-regional innovation system especially for regions that do not share contiguous borders.

3.5 Proximity and Inter-regional Innovation Systems

The local character and the perception of region as a locus of innovation has been emphasised in the innovation processes perceiving spatial proximity as a competitive advantage which raises the question of the possibility of collaborating at a distance. However, there is also a tendency in assuming that proximity only means geographical distance (North, 1990; Scott, 2001; Gertler, 2003; Moodysson and Zukauskaite, 2014). Nevertheless, certain studies (see for example Knoben and Oerlemans, 2006; Broekel and Boschma, 2012; Hansen, 2015; Fitjar, Huber and Rodriguez-Pose, 2016; Garcia, Araujo, Mascarini, Santos and Costa, 2018) have stressed the importance of other non-spatial dimensions which are crucial for a successful innovative collaboration. Consequently, it has been broadly debated that geographical proximity can be advantageous for inter-organisational collaboration and innovation (Storper, 1997; Lawson and Lorenz, 1999; Howells, 2002) and that the possibilities of face-to-face interactions decreases coordination costs and facilitates the transfer of tacit knowledge.

Proximity, often characterised by the degree of similarity of actor characteristics, refers to the degree of closeness of actors (Fitjar, Huber and Rodriguez-Pose, 2015). Broadly, proximity has been argued to be an important factor for innovation (Knoben and Oerlemans, 2006; Broekel and Boschma, 2012; Fitjar, Huber and Rodriguez-Pose, 2015; Hansen, 2015; Garcia, Araujo, Mascarini, Santos and Costa, 2018) highlighting that a certain form of proximity is required for successful knowledge interactions. Boshma (2005) argued that proximity between organisations facilitates knowledge interactions via facilitating coordination and reducing uncertainty. However, too much proximity reduces the scope for novelty and can also hamper innovation (Fitjar, Huber and Rodriguez-Pose, 2015). The debate on proximity has emphasised the need to consider various types of proximity in addition to geographical proximity, including organisational, social, cognitive and institutional proximity (Gertler, 2003; Zeller, 2004; Lagendijk and Oinas, 2005; Torre and Rallet, 2005; Boshma, 2005; Knoben and Oerlemans, 2006; Lagendijk and Lorentzen, 2007; Boschma and Frenken, 2009; Mattes, 2012; Balland, 2012; Paci, Marrocu, Usai, 2014; Capello and Cargaliu, 2018).

Institutional proximity

Institutional proximity is understood as the economic actors sharing the same cultural habits and values (Boschma, 2005). Hence, institutional proximity can be regarded as an enabling factor for providing stable conditions for interactive learning to take place effectively (Boschma, 2005). Accordingly, institutional proximity is strongly linked with other forms of proximity. For example, Gertler (2003) suggested that when organisations are located in different institutional contexts, organisational and social proximity may not be enough to effectively engage in interactive learning and hence, institutional environment acts as a critical barrier to long distance collaborations. However, in long distance collaboration, geographical proximity does not exist. Certain studies (Hansen, 2015; Lander, 2015) have explored the substitution effect between institutional proximity and geographical proximity for long distance collaboration. For instance, Hansen (2015) in his study of collaborative innovation projects in the Danish clean-tech industry suggested that there is a substitution effect between institutional and geographical proximity, while highlighting that the essential intermediate for this substitution effect is the existence of social proximity. Additionally, based on the study conducted on Canadian infection and immunity research networks, Lander (2015) suggested that institutional proximity can compensate for a lack of geographical proximity to support collaboration.

Social Proximity

Social proximity refers to the strength of socially embedded relations between actors at the micro-level resulting from trust based on friendship, family relations or previous interactions (Boschma, 2005). Hence, the existence of common relationships (with friendship and trust) is supposed to diffuse informal knowledge and facilitates collaborations (Boschma and Frenken, 2009). Additionally, the reputation and trust effects created by the experience of past collaborations and repeated contacts between partners not only contributes to provide the diffusion of informal knowledge but also leads organisations with a common partner to be more likely to collaborate (Balland, 2012). Accordingly, in an empirical study, Hansen (2015) expressed that long-distance collaborations are significantly more likely between partners with established social relationships and hence highlighting the substitution effect between social and geographical proximity.

Cognitive Proximity

Cognitive proximity is commonly defined as the similarities in actors' perception, interpretation and evaluation of new ideas or the degree of overlap in actors' knowledge base (Knoben and Oerlemans, 2006). In order for actors to efficiently and effectively communicate and transfer knowledge, a similar frames of reference (such as organisational culture, customs, norms and routines) is required as it influence the way actors see and know the world (Knoben and Oerlemans, 2006). According to Boschma (2005), cognitive proximity in terms of a shared knowledge base is required for actors to communicate, understand, absorb and process new information successfully. While acknowledging in theory, that a combination of geographical proximity and some level of cognitive proximity is sufficient for interactive learning to happen, Boschma (2005) also highlighted that geographical proximity alone is unlikely to enhance interactive learning and innovation and suggested that cognitive proximity is a prerequisite for learning to happen. In an empirical study by Paci, Marrocu and Usai (2014), the authors analysed a sample of 276 European regions within the prevailing knowledge production function (KPF) framework for the complementary role of proximity dimensions in enhancing innovation diffusion and found that a common cognitive base is a crucial element for conveying knowledge across regions. Similarly, a study by Capello and Caragliu (2018) on interrelations between different forms of proximity found that when spatial distance increases, regions need to be cognitively and technologically close in order for collaboration to happen.

Organisational Proximity

Organisational proximity can be defined as the degree to which organisations have similar routines and incentive mechanisms (Metcalfe, 1994). Boschma (2005) defined organisational proximity "as the extent to which relations are shared in an organisational arrangement, either within or between organisations" (p. 65). Accordingly, organisational proximity can be defined as "the set of routines, explicit or implicit, which allows coordination without having to define beforehand how to do so" (Rallet and Tore, 1999 p. 375). The degree of hierarchy in intra or inter-organisational arrangements impacts the ability of the organisations to coordinate their economic activity and avoid uncertainty and opportunism (Hansen, 2015).

Even though all of these dimensions of the concept of proximity refer to 'being close to something measured on a certain dimension', they are certainly not identical. For instance, various dimensions of proximity have been defined in earlier literature (Hussler, 2004; Boschma, 2005; Knoben and Oerlemans, 2006) in terms of similarity of knowledge bases (cognitive proximity), shared cultural backgrounds such as language and religion (cultural proximity), similarity of formal rules and informal constraints (institutional proximity), similarity of organisational contexts (organisational proximity), personal trust-based relationships (social proximity) and shared technological experiences (technological proximity) while geographical proximity refers to the physical/spatial closeness. Hence, the literature on proximity recognises these different types of proximities, since just being geographically close does not automatically lead to intensive cooperation networks and high levels of innovative outputs (Koschatzky, 2000; Trippl, 2012).

Accordingly, Knoben and Oerlemans (2006) developed a dyadic level of dimensions of proximity highlighting this multi-level embeddedness, where cognitive, institutional, cultural and social proximity fall under organisational proximity (See Figure 3.3).

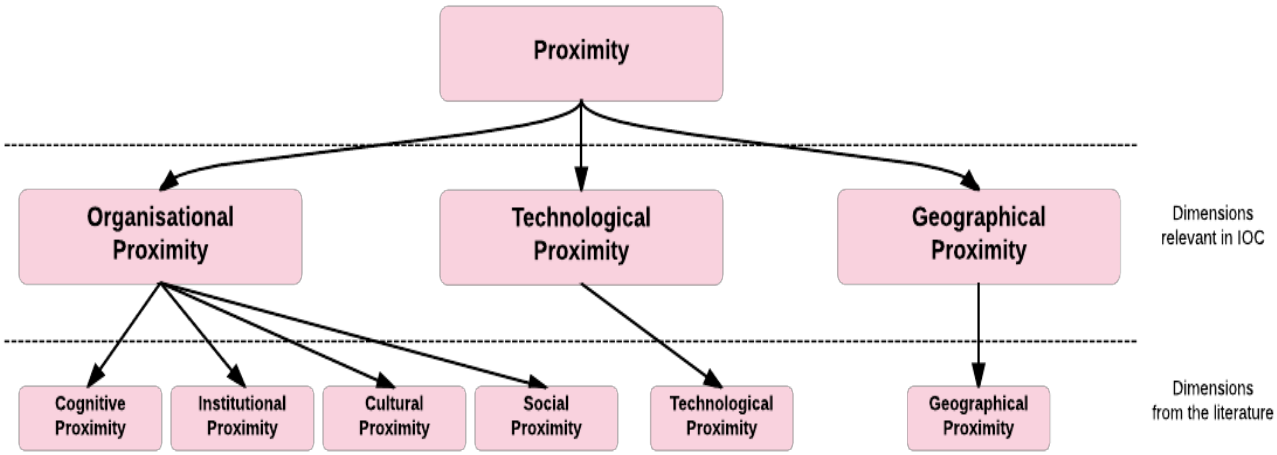


Figure 3.3: Dimensions of proximity at dyadic level *(Source: Knoben and Oerlemans, 2006, p. 80)*

Based on their study, Knoben and Oerlemans (2006) presented a systematic literature review in order to disentangle the dimensions of the proximity concept. Based on this

literature review of proximity and inter-organisational collaboration (IOC), the authors distinguished three dimensions of proximity that are relevant in inter-organisational collaboration (IOC): geographical, organisational and technological proximity. Figure 3.3 depicts the three dimensions of proximity at their dyadic level. Technological proximity is defined as 'the level of overlap of the knowledge bases of two collaborating actors' (Lane and Lubatkin, 1998). Geographically, proximity is defined as 'the extent to which two collaborating actors can have face-to-face relations, without prohibitive costs' (Capello, 1999). Finally, organisational proximity is defined as 'the set of routines-explicit or implicit- which allows coordination without having to define beforehand how to do so (Rallet and Torre, 1999). Knoben and Oerlemans (2006) stressed the importance of organisational proximity for inter-organisational collaboration (IOC). The reason behind stressing the importance of organisational proximity is that IOCs are more efficient and lead to better results when the organisational context of both interacting partners is similar due to the fact that this similarity facilitates mutual understanding. This form of proximity is thus seen as a prerequisite for dyadic and collective learning and in the joint creation of new resources and innovation (Kirat and Lung, 1999). As well as organisational proximity, other studies (Moulaert and Sekia, 2003; Hansen, 2015) have also debated the advantages of geographical proximity for inter-organisational collaboration and innovation as the possibilities of face-to-face interactions decreases coordination costs and facilitates the transfer of tacit knowledge (Storper, 1997; Lawson and Lorenz, 1999; Howells, 2002). However, in inter-regional collaboration, where regions are not contiguous, the transfer of tacit knowledge is not possible from a distance and geographical proximity is non-existent. Therefore, in the current research, the possibility of substituting spatial proximity with other non-spatial proximity is explored.

3.5.1 Substitution mechanism: non-spatial forms of proximity substitutes for geographical proximity

In his critical assessment of proximity and innovation, Boschma (2005) stressed the possibility of substituting non-spatial forms of proximity for geographical proximity while still acknowledging the indirect effect geography has through the facilitation of non-spatial forms of proximity and noted that "geographical proximity per se is neither a necessary nor a sufficient condition for learning to take place" (p.62). Consequently,

Malmberg and Maskell's (2006) essay on localised learning which looked at the existence of benefits of spatial proximity in processes of interactive learning, acknowledged that collaboration between actors does not necessarily require geographical proximity but it does have indirect impact on "developing a common institutional, social and cultural setting" (p.9).

The substitution mechanism of geographical proximity with non-spatial forms of proximity was analysed by Hansen (2015) in his empirical study on the relationships between geographical and non-spatial proximity dimension on innovative collaboration innovation projects. In this study, the author conducted structured interviews with representatives from Danish cleantech firms (n=50) where the main theme of the interviews was the firms' product development projects with external partners, which were most recently completed. While other forms of non-spatial forms of proximity indicate the substitution mechanism, Hansen (2015) found that there was no indication of substitution mechanism between geographical and institutional proximity (see Table 3.5). However, upon further analysing the data qualitatively, Hansen (2015) found that it is indeed possible to substitute institutional proximity for geographical proximity. The author further posed that while the substitution mechanism exists, it is of relatively low importance in the relationship between the geographical and institutional dimensions, which supports the suggestion of Gertler (2003) that the main challenge of long-distance collaborations is to overcome institutional differences.

	Substitute for geographical proximity	**Overlap with geographical Proximity**
Social Proximity	Yes	Yes
Institutional Proximity	No	Yes
Organisational Proximity	Yes	No
Cognitive Proximity	Yes	No

Table 3.5: Overview- Substitution and Overlap (*Source: Hansen, 2015 p.1680*)

While Boschma (2005) stressed the possibility of substituting non-spatial forms of proximity for geographical proximity, the author also stated that (in theory) geographical proximity combined with some level of cognitive proximity is sufficient for interactive learning. However, in the case of inter-regional collaboration where

geographical proximity does not exist, it is unclear from literature which forms of non-spatial proximity or/and combination of these are required for interactive learning and innovation. For instance, Davenport (2005) investigated the SME knowledge acquisition processes and critical interfaces of innovative SMEs in a study of 15 firms in New Zealand in order to determine if organisational or geographic proximity (or both) are the key to knowledge-acquisition. The study found that the key knowledge interfaces are with entities that are neither resident in the region, nor in New Zealand, therefore, organisational proximity dominates knowledge-acquisition activity over geographic proximity. On the other hand, a study of university-industry collaboration in Brazil, Garcia et al (2018) provided empirical evidence that cognitive proximity is a substitute for geographical proximity because shared capabilities and expertise between a university and a collaborating firm stimulates long distance collaboration. However, these studies have provided one non-spatial form of proximity (for example: cognitive proximity or organisational proximity) as a substitute for geographical proximity and no evidence of combining the different non-spatial proximities exists. The current research therefore looks at which non-spatial proximity or combination of these is required in order to develop an inter-regional innovation system.

The current research investigates the actors, specifically in triple helix institutions (government, academia and industry) therefore, the possibility of substituting geographical proximity with institutional proximity in an inter-regional collaboration will be explored. Institutional proximity will be associated with the institutional framework at the macro-level (Boschma, 2005) and refers to the extent to which the institutions' norms and values are similar. The level of similarity of formal or informal institutions (North, 1990) can influence inter-organisational relationships. For instance, the different institutional settings of university versus industry versus government actors can be a hurdle for interactions (Etzkowitz and Leydesdorff, 2000) especially when regions collaborate with different institutions across borders. The relevant norms and beliefs alter as well as the rules and regulations under which they interact. Therefore, this study conceptualises that institutional gaps (Van den Broek and Smulders, 2014) exist at an inter-regional level, which may influence the collaborative process.

3.5.2 Institutional Gaps in Inter-regional Innovation System

Institutions provide (temporary) stability by governing and conditioning social life by reducing uncertainty in everyday practice (North, 1990; Scott, 2001; Gertler, 2003). Institutions might consist of rules, routines, habits, conventions, customs or practices that are internalised by the majority of actors in a population (Gertler, 2003; Moodysson and Zukauskaite, 2012; Moodysson and Zukauskaite, 2012). When institutions collaborate, it may facilitate processes of collective learning and the build-up of economic relations by providing (temporary) stability (Van Den Broek and Smulders, 2014) but the multi-level collaboration can also impede this build-up of regularities and structure.

Although there is an inclination to assume that institutions facilitate interaction in RIS, Van Den Broek and Smulders (2014) argued that in a cross-border RIS, institutions' influence on actors on both sides of the border could create institutional gaps hindering cross-border cooperation. Following this concept, this current research conceptualises that institutional gaps occur in inter-regional innovation systems and further categorised the gaps into three pillars from Scott (2001): regulative, normative and cultural-cognitive. Regulative gaps refer to the barriers of cooperating among actors resulting from formal institutions such as rules and regulations. On the other hand, normative and cultural-cognitive gaps refer to the gaps that can occur due to the limited knowledge of the values, norms and cultures. These institutional gaps can arise in cross-border and inter-regional collaboration as stakeholders from different regions are embedded in different national and regional institutional structures which could hinder the evolution of inter-regional innovation systems. While institutions provide rules of the game, they do not provide actors with clear answers on how to act (Beckert, 1999), thus if the institutions conflict, actors may fall into institutional gaps (Van den Broek and Smulders, 2014).

These institutional gaps could influence the successful evolution of inter-regional innovation systems as different institutions are involved from each region and different norms and rules could hinder their collaboration. Therefore, acknowledging the

existence of and studying institutional gaps is essential, which is the basis of this research.

3.6 Chapter Summary

This current research required the review and amalgamation of literature from the fields of institution, innovation systems, triple helix and the theory of proximity. This research is concerned with understanding the influence of institutional frameworks on the development of an inter-regional innovation system. In order to address this research question, the regional institutional framework was explored, as the interaction among these regional institutions is crucial in understanding the environment of a regional innovation system. Keeping in mind the different characteristics of institutions at the regional level and the focus on regions as a locus of innovation due to its local characteristics, this research looks at the possibility of different institutional frameworks collaborating towards an inter-regional innovation system.

Throughout this chapter, the importance of interaction between institutions has been highlighted. There are significant studies on institutions interacting at a regional level, highlighting the importance of its spatial proximity as giving a competitive advantage. While there exists a cross-border regional innovation system (CBRIS), it requires a certain degree of geographical proximity (Lundquist and Trippl, 2013), which is non-existent in the case of an inter-regional innovation system. However, the difficulties in applying the concept of CBRIS in empirical literature are the fuzziness in the varying definitions of proximity (Makkonen and Rohde, 2016). While the dynamics of proximities are an important issue, they have not been sufficiently addressed (Balland, Boschma, and Frenken, 2015). Accordingly, the current research addresses the lack of the dynamics of proximity by highlighting the dynamic interplay and interdependence of non-spatial proximities when geographical proximity does not exist. Even though regional innovation systems and cross-border regional innovation systems have been extensively studied in literature, inter-regional innovation system is heavily overlooked. Therefore, there is a significant need for research to be conducted on the inter-regional level where regions collaborate without the existence of spatial proximity, which thereby gives access to knowledge that regions might not have access to otherwise. Although innovation is regarded as resulting from interactive learning processes,

different institutional frameworks can in turn affect the development of an innovation system. Accordingly, the research question for the current research is:

> How do regional institutional frameworks influence the evolution of an inter-regional innovation system (iRIS)?

Figure 3.4 is a diagrammatic representation of the conceptualisation of what might constitute an inter-regional innovation system (iRIS) which is the focus of this research. The diagram depicts the Triple Helix institutions (government representative, higher education institutes and industry) which make up the regional institutional framework located in four different countries denoted as countries A, B, C and D. These four countries, and hence the four regions, do not share border and are therefore situated at a distance. This diagram depicts the essence of what this research is about, it about understanding the inter-regional collaboration of these non-contiguous regions and the influence of each of their regional institutional framework on developing an iRIS.

The next chapter presents the methodological consideration and the approach employed for conducting the current research.

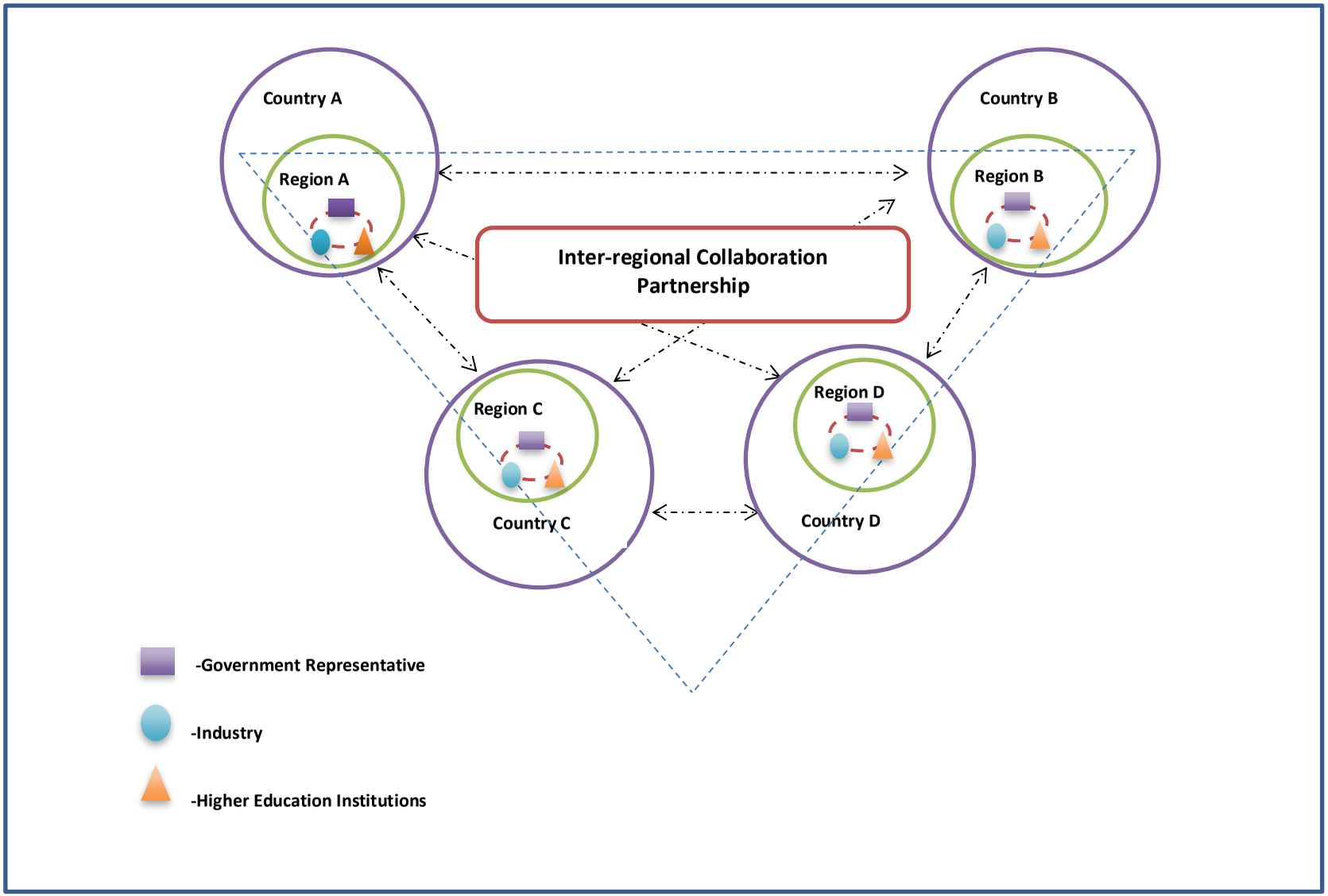


Figure 3.4: A conceptualisation of an inter-regional Innovation System *(Source: Current research)*

4 Conceptual and Methodological Frameworks

The previous chapter emphasised the main characteristics of networked-interactive regional innovation systems which are defined in terms of actors involved, type of research performed and collaboration patterns. Subsequently, the institutions involved in regional innovation systems (viz., higher education institutes, government organisations and industry) were defined. The interactivity among these institutions paves the way for a systematic approach in regional innovation system. The emphasis on the local character of region as a locus of innovation was addressed, as spatial proximity has been perceived as a competitive advantage. However, this perception of spatial proximity as having competitive advantage raises the question of whether institutions at a distance can have an equally successful collaboration with the absence of geographical proximity. Therefore, this research looks at all the detailed elements of what entails the evolution of an inter-regional innovation system.

4.1 Research Question and Objectives

This study is concerned with investigating the influence of regional institutional frameworks on an inter-regional level collaboration for the evolution of an inter-regional innovation system. Therefore, the research question posed is:

> 'How do regional level institutional frameworks influence the evolution of an inter-regional innovation system?'

In order to address this research question, the objectives of the research are to:

1. Understand the construct of the institutional framework within regions
2. Understand the construct of an inter-regional institutional framework
3. Establish how stakeholders in an inter-regional institutional framework interact with each other at an inter-regional level.

4. Examine the extent of effects of different types of proximity at an inter-regional level.

5. Investigate if regional institutional frameworks have an effect on the evolution of an inter-regional innovation system

The author believes that understanding inter-regional innovation systems requires an in depth understanding of the dynamics at a regional level. Therefore, the objectives of the research entail understanding the institutional frameworks at a regional level and the extent of these institutions' interactions in order to understand their regional innovation system. Consequently, understanding the institutions involved at an inter-regional level and how they interact with other institutions from different regions is equally important.

The research question and objectives are developed from the conceptual framework of this research, presented in Figure 4.1. The central point of this research is to understand regional institutional frameworks and their dynamics to examine their influence on an inter-regional collaboration. The conceptual framework outlines the key theoretical underpinnings for this research.

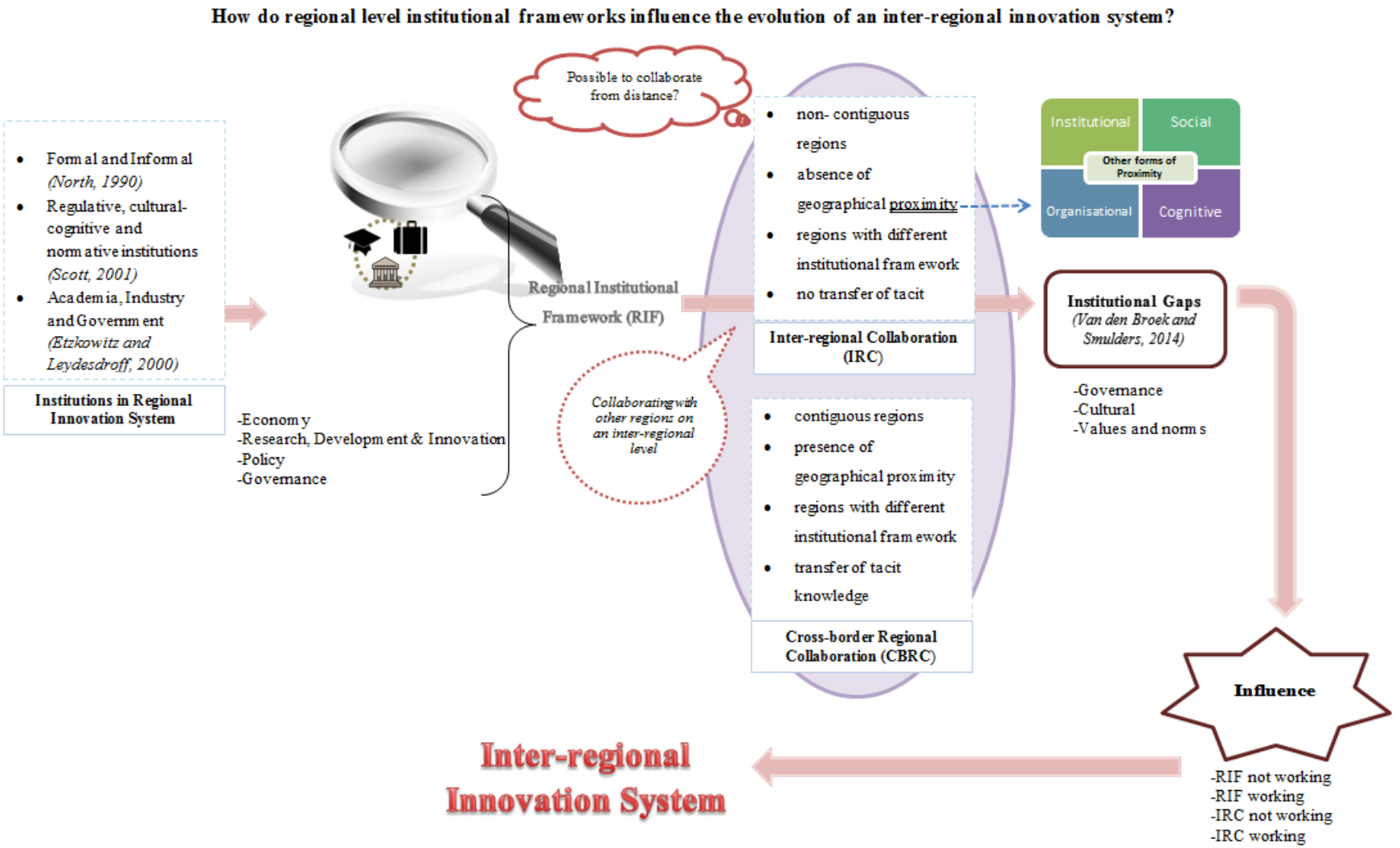


Figure 4.1: Conceptual Framework *(Source: Current Research)*

The purpose of this chapter is to firstly present the research question as it emerges from the conceptual framework. This chapter also discusses the philosophical assumptions and the design strategies underpinning this research study. The chapter is structured to reflect the research process the researcher followed. Section 4.2 addresses the research paradigm in order to provide an appreciation of the position from which this research was approached. The following sections outline the research methods, approach, and the design followed by data collection methods, sampling and analysis techniques employed.

4.2 Research Paradigm

A research paradigm is a philosophy underpinning how to gain knowledge on a certain subject. It is a belief about the way in which data around a phenomenon should be gathered, analysed and used. Therefore, every research is based upon certain assumptions about how the world is perceived and how it is that we can best understand it. This depends on the way the researcher thinks about the development of knowledge (Saunders, Lewis and Thornhill, 2012*)*.

4.2.1 Philosophical position of the researcher

Influenced by the functionalist paradigm, the author approaches knowledge from the objectivist point of view; from a standpoint which tends to be realist and positivist. However, in social science research, the knowledge of being is uncertain and in order to better understand a phenomenon, in depth investigation is essential. The author's pragmatic way of viewing the world view influenced the way this research was conducted: a systematic and complex way of understanding the role of institutions at the regional level and its influence on the inter-regional level to understand if it is possible for institutions to successfully collaborate from a distance. The author does not believe that one approach would justify the phenomena at hand and therefore believes that mixing two approaches is required. However, the initial positivistic belief of the researcher perked the interest to explore and refine the phenomenon for an in depth

study to have better interpretation of regional institutional frameworks' influence on inter-regional level collaboration.

4.2.2 Philosophical position of this research

In the case of the current research, the author is influenced by pragmatism based on abductive inference. Pragmatism has emerged as the dominant philosophical approach by mixed methods researchers wherein pragmatists recognise the many ways of interpreting and understanding the world and that no single point of view can give the entire picture, as there may be multiple realities (Saunders, Lewis, and Thornhill, 2009). Thus, for mixed methods researchers, pragmatism opens doors to multiple methods, different assumptions as well as different forms of data collection and analysis.

Morgan (2007) proposed pragmatism "as a new guiding paradigm in social sciences research methods" (p.48), integrating quantitative and qualitative methods. Morgan (2007) further posed the reflexivity of pragmatism that it puts more attention on the social character of the process of creating knowledge and also stressed that it moves beyond technical questions about mixing or combining methods which puts researchers in a position to argue for a properly integrated methodology for the social sciences. Consequently, this research bases the inquiry on the assumption that collecting both quantitative and qualitative data best provides a more complete understanding of how regional institutional frameworks influence the evolution of an inter-regional innovation system than either quantitative or qualitative data alone. Therefore, this process of collecting both quantitative and qualitative data, which is used to develop a deeper understanding of regional institutions on an inter-regional level, sits neatly within a pragmatic paradigm.

4.2.3 Research Philosophy

This section briefly explains the predominant philosophical stance driving the current study, considering the four main philosophical assumptions involved in a research (Creswell, 2014), which are post-positivism, constructivism, transformative, and

pragmatism. This section is not an argument about which philosophical paradigm is the most relevant in general, but rather to determine which is most suitable to answer the research question at hand.

The choice of philosophical stances forms the basis of all research, which leads to a practical implication for conducting and designing the research. Burrell and Morgan (1979) suggested that assumptions about the nature of science could be thought of in terms of what they called the subjective-objective dimension, and assumptions about the nature of the society in terms of regulation-radical change dimension. The authors believed that there are four sets of assumptions, which are relevant in understanding social science. The first one is the ontological nature of assumption, which is concerned with the very essence of the phenomena under investigation. Ontology summarised that social phenomenon is independent from other factors and is concerned with "what kind of world we are investigating, with the nature of existence, with the structure of reality as such" (Crotty in Ahmed, 2008, p.2). Guba and Lincoln (1989, p.83) stated that the ontological assumptions are those that respond to the question 'what is there that can be known?' or 'what is the nature of reality? The second assumption is about the epistemological nature of research, which are assumptions about the grounds of knowledge, about 'a way of understanding and explaining how we know what we know' (Crotty, 2003). Epistemology is also "concerned with providing a philosophical grounding for deciding what kinds of knowledge are possible and how we can ensure that they are both adequate and legitimate" (Maynard, 1994, p.10). The third set of assumptions is concerned with human nature, which is associated with the ontological and epistemological issues but conceptually separate from them. Burrell and Morgan (1979) believed that all social science must be predicted upon this type of assumption particularly, the relationship between human beings and their environment since human life is the object and subject of enquiry. Lastly, the fourth set of assumptions is concerned with methodological nature that aims to describe, evaluate and justify the use of particular methods (Wellington, 2000) which is the strategy, action plan, process or design lying behind the choice and use of particular methods and linking the choice and use of the methods to the desired outcomes (Crotty, 2003). Therefore, the last

assumption means that the three sets of assumptions highlighted above each have direct implications of a methodological nature and have important consequences for the way in which one attempts to investigate and obtain knowledge about the social world. Using these four sets of assumptions, Burrell and Morgan (1979) illustrated two broad perspectives, which they termed as the subjective-objective dimension (see Figure 4.2), which identify these four sets of assumptions that is relevant in understanding social science.

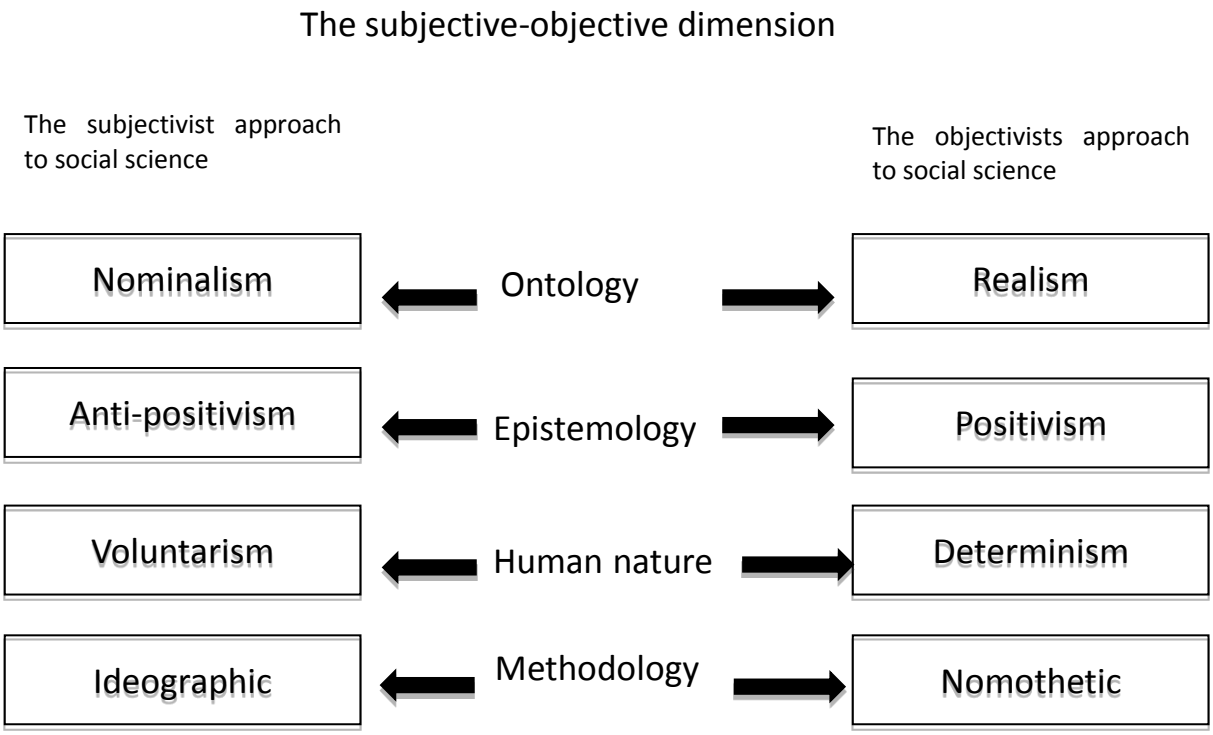


Figure 4.2: A scheme for analysing assumptions about the nature of social science *(Source: Burrell and Morgan, 1979 p. 3)*

In addition to the subjective-objective dimension (Figure 4.2) for assumptions about the nature of science, Burrell and Morgan (1979) suggested understanding assumptions about the nature of the society in terms of regulation-radical change dimension. The authors introduced the term 'sociology of regulation' and 'sociology of radical change' where the sociology of regulation is concerned with providing explanations of society by emphasising its unity and cohesiveness. It is a sociology, which is essentially concerned with the need for regulation in human affairs and attempts to explain why

society tends to hold together rather than fall apart. The sociology of regulation is concerned with status quo, social order, consensus, social integration and cohesion, solidarity, needs satisfaction and actuality. On the other hand, sociology of radical change is concerned with man's emancipation from the structure which limits and stunts his potential for development. It is concerned with finding explanations for radical change, deep-seated structural conflicts, modes of domination, structural contradiction, emancipation, deprivation and potentiality. These two key dimensions when taken together define four distinct sociological paradigms which can be used for the wide range of social theories (Burrell and Morgan, 1979). The relationships between these paradigms are illustrated in Figure 4.3.

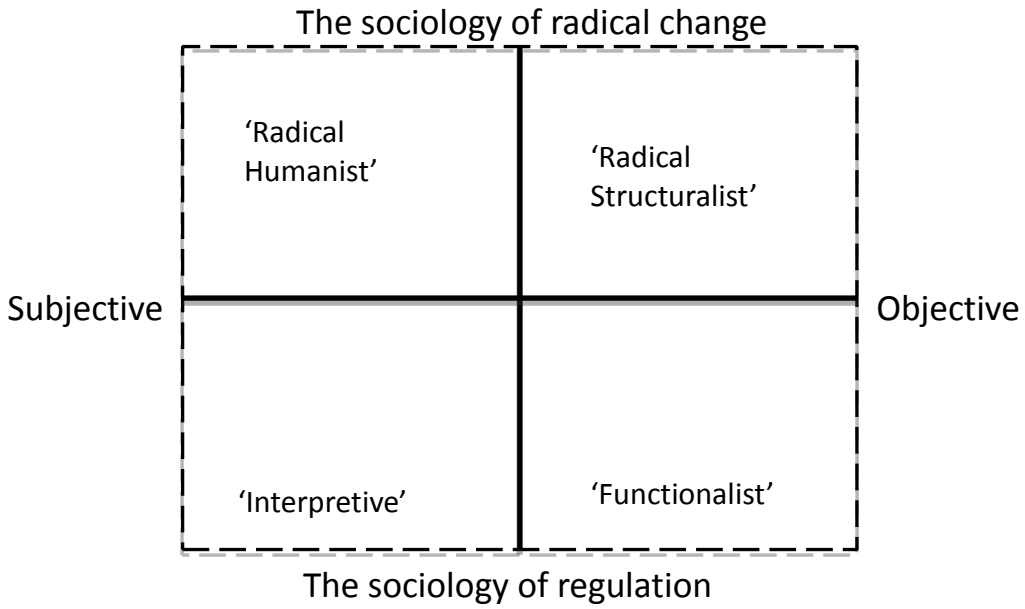


Figure 4.3: Four paradigms for the analysis of social theory *(Source: Burrell and Morgan, 1979 p.22)*

Within the sociology of regulation, there are two extreme paradigms: functionalists and interpretive. Functionalist paradigm approaches its subject matter from the objectivist point of view. It approaches general sociological concerns such as status quo, social order, consensus, social integration, solidarity, need satisfaction and actuality, from a standpoint which tends to be realist, positivist, determinist and nomothetic. Whereas, the interpretive paradigm approaches its subject matter from the subjectivist point of

view and is informed by a concern to understand the world at the level of subjective experience. It tends to be nominalist, anti-positivist, voluntarist and ideographic. Subsequently, within the sociology of radical change, there are two paradigms approaching from different standpoints. The radical humanist paradigm approaches are from the subjectivist standpoint, which has much in common with that of the interpretive paradigm that tends to be nominalist, anti-positivist, voluntarist and ideographic. However, the radical humanist places most emphasis on radical change, modes of domination, emancipation, deprivation and potentiality. On the other hand, the radical structuralist paradigm approach is from an objectivist standpoint which emphasises structural conflict, modes of determination, contradiction and deprivation. It approaches these concerns from a standpoint which tends to be realist, positivist, determinist and nomothetic.

It can be noted that the four paradigms in the analysis of social theory are defined by whether they come from the subjectivist or objectivist standpoint. One might argue that most of social science research could fit into the matrix (Figure 4.3), as it defines broad assumptions. However, other authors (see for example Morgan, 2007; Creswell, 2009) stressed that no single paradigm is completely fixed and researchers can be influenced by other paradigms and worldviews. Paradigms can be conceptualised as worldview (Creswell, 2014), epistemologies and ontologies (Crotty, 1998), or broadly conceived research methodologies (Neuman, 2009). Creswell (2009) emphasised his frustration with the concept of paradigms as absolute truths and debated the idea that it is impossible for a researcher's worldview to be influenced by more than one paradigm. For the purpose of this thesis, paradigm is understood as worldview as "a basic set of beliefs that guide action" (Guba, 1990, p.17). Creswell (2014) highlighted four widely discussed worldviews (Table 4.1), which is accommodating of multiple paradigms in research.

Post-positivism	Constructivism
• Determination • Reductionism • Empirical observation and measurement • Theory verification	• Understanding • Multiple participant meanings • Social and historical construction • Theory generation
Transformative	**Pragmatism**
• Political • Power and justice oriented • Collaborative • Change-oriented	• Consequences of actions • Problem-centred • Pluralistic • Real-world practice oriented

Table 4:1: Four worldviews (*Source: Creswell, 2014 p.36*)

4.2.4 Post-positivism worldview

The post-positivist assumptions hold true mainly for quantitative research than qualitative research. It is also called positivist/post-positivist research, empirical science, and post-positivism. The core argument of positivism is that "the social world exists externally to the researcher and that its properties can be measured directly through observation" (Gray, 2004 p. 18). However, post-positivism represents the thinking after positivism, defying the traditional notion of the absolute truth of knowledge (Phillips and Burbules, 2000) and recognising that when studying the behaviour and actions of humans, one cannot be positive about the claims of knowledge (Creswell, 2014).

4.2.5 Constructivism worldview

Constructivism is often combined with interpretivism and is primarily seen as an approach to qualitative research, which focuses on meaning and tries to understand what is happening through interpretation. According to Willis (1995) interpretivists are anti-foundationalists, who believe there is no single correct route or particular method to

knowledge. Walsham (1993) argued that in the interpretive tradition there are no 'correct' or 'incorrect' theories. Instead, they should be judged according to how 'interesting' they are to the researcher as well as those involved in the same areas. Therefore, the goal of the research is to rely as much as possible on the participants' views of the situation being studied (Creswell, 2014).

4.2.6 Transformative worldview

The transformative worldview places central importance on the study of lives and experiences of diverse groups that have been traditionally marginalised (Mertens, 2010). It is a meta-physical framework that "directly engages the complexity encountered by researchers and evaluators in culturally diverse communities when their work is focused on increasing social justice" (Mertens, 2009, p.10). It focuses on the tensions that arise when unequal power relationships suffuse a research context that addresses obstinate social problems (Greene, 2008). This worldview arose during the 1980s and 1990s from individuals who felt that structural laws and theories imposed by the post-positivist assumptions do not fit marginalised individuals in the society or issues of power and social justice, discrimination, and oppression that needed to be addressed (Creswell, 2014).

4.2.7 Pragmatism worldview

Pragmatism has gained considerable support as a stance for mixed methods researchers (Maxcy, 2003; Johnson and Onwuegbuzie, 2004; Morgan, 2007; Feilzer, 2010). It is oriented "toward solving practical problems in the 'real world'" (Feilzer, 2010, p. 8) rather than on assumptions about the nature of knowledge. It is derived from the work of Pierce, James, Mead and Dewey (Cherryholmes, 1992). According to Morgan (2007) and Creswell (2014), cited by Cherryholmes (1992), pragmatism provides a philosophical basis for research as:

- Pragmatism is not committed to any one system of philosophy and reality. This applies to mixed methods research in that inquirers draw liberally from both quantitative and qualitative assumptions when one engage in their research.

- Individual researchers have a freedom of choice. In this way, researchers are free to choose the methods, techniques, and procedures of research that best meet their needs and purposes. Pragmatists do not see the world as an absolute unity. In a similar way, mixed methods researchers look to many approaches for collecting and analysing data rather than subscribing to only one way (e.g., quantitative or qualitative).
- Truth is what works at the time. It is not based in a duality between reality independent of the mind or within the mind. Thus, in mixed methods research, investigators use both quantitative and qualitative data because they work to provide the best understanding of a research problem.
- The pragmatist researchers look to the 'what and how' to research based on the intended consequences. Mixed methods researchers need to establish a purpose for their mixing, a rationale for the reasons why quantitative and qualitative data need to be mixed in the first place.
- Pragmatists agree that research always occurs in social, historical, political, and other contexts. In this way, mixed methods studies may include a postmodern turn, a theoretical lens that is reflective of social justice and political aims.
- Pragmatists have believed in an external world independent of the mind as well as that lodged in the mind. (Creswell, 2014, p.11)

The core debate in social sciences about positivism versus interpretivism is the distinction between realism and anti-realism. This distinction is rejected by pragmatism, which is one of the most important features of pragmatism. For pragmatists, emphasis is stressed on actions and their consequences as there is indeed such a thing as reality, but it is ever changing, based on our actions. This emphasis on actions creates a gap between pragmatism and interpretivism by detaching the idea that we are free to interpret our experiences in whatever way we see fit. Instead, our actions have outcomes that are often quite predictable, and we build our lives around experiences that link actions and their outcomes (Morgan, 2014).

4.2.8 The worldview for the current research

The author appreciates the reflexivity of pragmatism, which puts more attention on the social character of the process of creating knowledge and the emphasis on actions and their consequences. Considering that the role of any researcher is not only to collect and measure data and facts but also to appreciate the different constructions and meanings that people place upon their experiences (Easterby-Smith, Thorpe and Lowe, 1994) and also considering the research question and objectives, the author positioned the current research within the pragmatism paradigm (Figure 4.4).

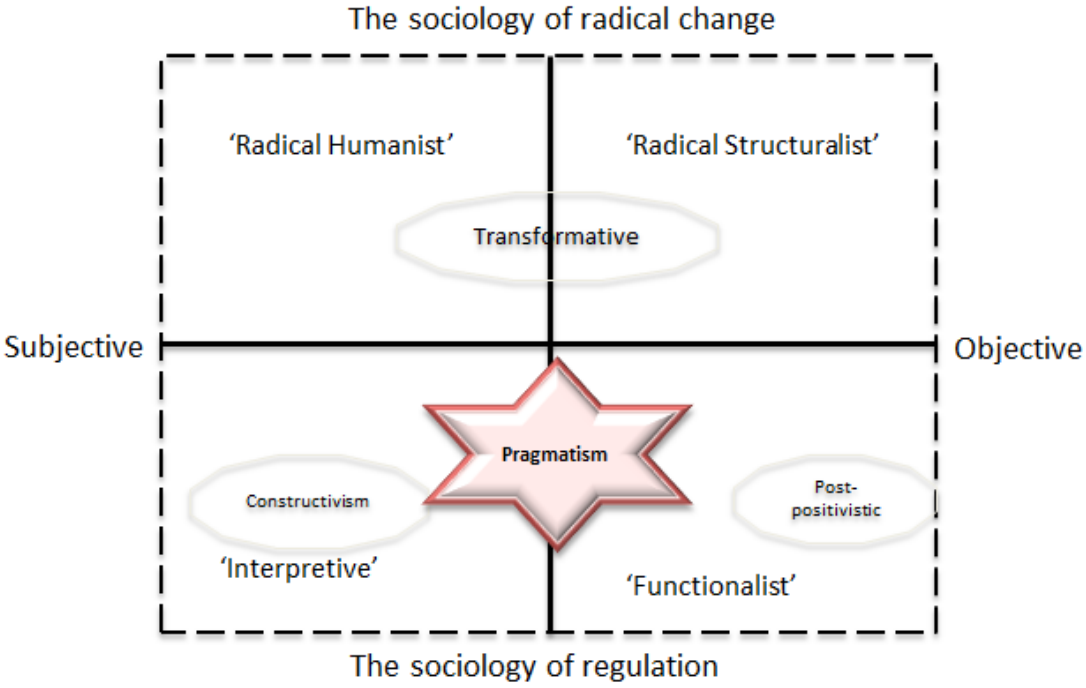


Figure 4.4: Research Worldview *(Source: Adapted from Burrell and Morgan, 1979 and Creswell, 2014)*

Figure 4.4 shows that the paradigms (according to Burrell and Morgan, 1979 and Creswell, 2014) are arranged to correspond to four conceptual dimensions: radical change and regulation and subjectivist and objectivist. In the bottom right corner of the quadrant is the functionalist and post-positivistic paradigm which is located on the

objectivist and regulatory dimensions. Objectivist in ontological position and regulatory in that it is more concerned with a rational explanation of why a particular problem is occurring (problem-oriented in approach) and provides practical solutions to practical problems.

In the bottom left corner of the quadrant is the interpretive and constructivism paradigm which is positioned on the subjectivist and regulatory dimension. The philosophical position to which the interpretivism and constructivism paradigm refers to is the way humans attempt to make sense of the world around them, where the concern is not to achieve change in the order of things but to understand and explain what is going on. In the top of the quadrant, the radical humanist paradigm is positioned within the subjectivist and radical change dimensions whereas radical structuralist is positioned within the objectivist and radical change dimensions. Radical humanist is concerned with changing the status quo which adopts the subjectivist dimension while the radical structuralist is concerned with approaching research with a view to achieving fundamental change.

While these paradigms could be arranged in either subjectivist or objectivist dimension in the matrix, two paradigms (transformative and pragmatism) cannot be put into just one quadrant. Therefore, transformative worldview is positioned in the upper quadrants of radical change dimension as a bridge between the subjective and objective dimensions as it is concerned with the complex approach to social justice that do not fit in just the objective dimension.

Similarly, pragmatism worldview is positioned in between the subjective and objective divide, in the lower quadrants of regulatory perspective. Instead of focusing on methods, pragmatist emphasise the research problem and use all approaches available to understand the problem (Rossman and Wilson, 1985). Therefore, pragmatism is not committed to any one system of philosophy and reality and applies to mixed methods research in that inquirers draw liberally from both quantitative and qualitative assumptions when they engage in their research.

Pragmatism helps to shed light on how research approaches can be mixed successfully (Hoshmand, 2003) and the outcome of that is that it offers the best opportunities for answering important research questions (Johnson and Onwuegbuzie, 2004). It offers an immediate and useful middle position philosophically and methodologically (by rejecting the distinction between positivism and interpretivism) as it offers a practical and outcome-oriented method of inquiry that is based on action and leads to further action and the elimination of doubt (Johnson and Onwuegbuzie, 2004). Morgan (2007) proposed a *Pragmatic Methodology* as an organising framework (see Table 4.2) for understanding what the pragmatic approach can offer social science methodology (p.70). In his framework, the author distinguished between three main approaches: quantitative, qualitative and pragmatic approaches based on its connection of theory and data, relationship to research process and inference from data.

	Qualitative Approach	**Quantitative Approach**	**Pragmatic Approach**
Connection to theory and data	Induction	Deduction	Abduction
Relationship to research process	Subjectivity	Objectivity	Intersubjectivity
Inference from data	Context	Generality	Transferability

Table 4:2: Pragmatic methodology in Morgan's conception (*Source: Morgan, 2007 p.71)*

According to Morgan (2007), the pragmatic approach is to rely on abductive reasoning by firstly converting observations into theories and then assessing theories through action. In other words, abductive reasoning moves back and forth between induction and deduction reasoning. Simply put, induction is discovery of patterns whereas deduction is testing of theories and patterns and lastly, abduction deals with uncovering and relying on the best set of explanations for understanding ones results (Johnson and Onwuegbuzie, 2004). Morgan (2007) further addressed the dichotomy between subjectivity and objectivity and highlighted the duality of pragmatism as it goes back

and forth between various frames of references. Intersubjectivity represents the pragmatic response to issues of incommensurability that treats it as an all or nothing barrier between mutual understandings by viewing issues of intersubjectivity as a key element of social life as pragmatic approach believes that there is a single 'real world' and that all individuals have their own unique interpretations of the world (p.72). The final comparison is based on the distinction between knowledge and transcends beyond either context dependent or generalised and highlights the pragmatic approach, which rejects the needs to choose between a pair of extremes. Morgan (2007) put forward that it is not possible for research results to be so unique that they have no implications or so generalised that it can be applied to every setting and posit that the pragmatic approach involves working back and forth between specific results and their more general implications. Transferability refers to the extent to which knowledge gained with one type of method in one specific setting can be applied and makes the most appropriate use of in other circumstances (Morgan, 2007). In other words, the pragmatic approach inquires how much of existing knowledge can be applied in a new set of circumstances rather than just abstract arguments about the possibility or impossibility of generalisability. Accordingly, Johnson and Onwuegbuzie (2004) stressed that relying on the pragmatic maxim allows for moving away from epistemology (including the logic of justification) dictating the shape of methodology (including data collection and analysis), thereby allowing the successful combination of qualitative and quantitative methods for scientific perspectives and research topics.

While the current research acknowledges the advantages of constructivism and post-positivistic worldview, pragmatism allows for moving back and forth between these two worldviews and integrating them to provide the best understanding of the current research question thereby exploiting both quantitative and qualitative methods. Thus, the pragmatist approach allows for understanding the complex actor-centric process of developing an inter-regional innovation system, and also provides flexibility to not have to choose a single method for understanding the phenomena at hand. Section 4.3 presents the research methods employed in the current research.

4.3 Research Methods

Research methods can be defined as the tools of data collecting and analysing (Blaxter, Hughes and Tight, 2001). In order to examine the influence of institutional frameworks on inter-regional innovation systems, a multi-phase mixed methods design was chosen. This design also allowed the quantitative and qualitative measures to illustrate the perception of the participants and enables the qualitative phase to further elaborate on the dynamics of the triple helix both at the regional and inter-regional level in the quantitative phase.

4.3.1 Research Approach

The research approach has a direct impact on the design and structure of the research. There are three approaches; inductive, deductive and abductive. What is most commonly used in mixed methods research is abduction. Abduction referred to as the third form of inference after induction and deduction which is considered to be "a type of reasoning that begins by examining data and after scrutiny of these data, entertains all possible explanations for the observed data, and then forms hypotheses to confirm or disconfirm until the researcher arrives at the most plausible interpretation of the observed data" (Charmaz, 2006, p.188). Abductive research starts with 'surprising facts' or 'puzzles' and the research process is devoted to their explanation (Bryman and Bell, 2015), whereas, the deductive approach tests the validity of assumptions (or theories/hypotheses) at hand, and the inductive approach contributes to the emergence of new theories and generalisations. Saunders et al. (2012) illustrated the major differences between deductive, inductive and abductive research in terms of logic, generalisability, use of data and theory (see Table 4.3).

	Deduction	Induction	Abduction
Logic	In deductive inference, when the premises are true, the conclusion must also be true	In an inductive inference, known premises are used to generate untested conclusions	In an abductive inference, known premises are used to generate testable conclusions
Generalisability	Generalising from the general to the specific	Generalising from the specific to the general	Generalising from the interactions between the specific and the general
Use of data	Data Collection is used to evaluate propositions or hypotheses related to an existing theory	Data Collection is used to explore a phenomenon, identify themes and patterns and create a conceptual framework	Data Collection is used to explore a phenomenon, identify themes and patterns, locate these in a conceptual framework and test this through subsequent data collection and forth
Theory	Theory falsification or verification	Theory generalisation and building	Theory generation or modification; incorporating existing theory where appropriate, to build new theory or modify existing theory

Table 4:3: Differences between deductive, inductive and abductive approaches (*Source: Saunders et al. 2012 p.145*)

Each of these approaches corresponds to a distinct logic of inquiry. While deductive is concerned with testing the prediction of data from theory, inductive is concerned with generating theory from data. However, the abductive approach is concerned with the explanatory relationship between theory and data, incorporating existing theory, to build new theory or modify existing theory where appropriate. Consequently, the current research employs the abductive approach as the logic of enquiry where different institutions from four European regions are studied in considerable depth and different theories are drawn upon to throw light on the extent to which regional institutions play a role in the evolution of an inter-regional innovation system. Although theory is a priori, abduction is different from the deduction approach as theory is not used to make predictions and it is different from that of the inductive approach as the theory does not

emerge from the data but exists a priori. However, it allows going back and forth between induction and deduction (Morgan, 2007) thereby allowing the current research to move from a more general approach to the more specific using deductive inference and following up with the interesting findings through the inductive approach. Since the current research does not aim to generalise whether inter-regional collaboration can work (or not) due to the existence or presence of certain factors and does not assume the findings to be the same for all inter-regional collaborations, applying just inductive or deductive approach will not justify the research objectives. Therefore, with the abductive approach, the current research aims to find the best possible explanation from the data collected by following up on the findings from the quantitative strand through the qualitative interview strands.

Since abduction is about finding the "best explanation" of the data (Hiles, 2012), both quantitative and qualitative data is used in this research to explain the research at hand. Mixed methods research has evolved into a set of procedures that can be used in planning a mixed methods study. It is an approach to inquiry involving collecting both quantitative and qualitative data, integrating the two forms of data, and using distinct designs that may involve philosophical assumptions and theoretical frameworks (Creswell, 2014). Mixed methods can be seen as a new methodology originating around the 1980s and early 1990s, which has gone through several periods of development including the formative stage, the philosophical debates, the procedural developments, and more recently reflective positions (noting controversies and debates) and expansion into different disciplines (Teddlie and Tashakkori, 2009; Creswell and Plano Clark, 2011).

The core assumption of this form of inquiry is that the combination of qualitative and quantitative approaches provides a more complete understanding of a research problem than either approach alone. Accordingly, this research employs mixed methods approach, as the richness of both qualitative and quantitative data will give a better understanding of the research being conducted. As the quantitative data gathers perception of the stratified sampled participants, the quantitative data alone will not justify the phenomenon of the influence the institutional frameworks have. Therefore, to

gain a deeper understanding of the interactions and influence of these institutions, qualitative data will also be employed to better explain the findings from the quantitative phase.

Mixed methods studies are defined as "an approach to research in the social, behavioural, and health sciences in which the investigator gathers both quantitative (close-ended) and qualitative (open-ended) data, integrates the two, and then draws interpretations based on the combined strengths of both sets of data to understand research problems" (Creswell, 2015 p.1). While the definition fits neatly in the current research, it is important to highlight the concepts of mixed methods and multi-methods study. Although some authors (see for example, Borkan, 2004; Stange, Crabtree and Miller, 2006; Burns, Bellows, Eigenseher, Jackson, Gallivan and Rees, 2014) make no distinction between the terms mixed methods and multi-methods, integration is an essential component of mixed methods from a methodological perspective (Teddie and Tashakkori, 2009; Bazeley, 2009; Fetters, Curry, Creswell, 2013) which is not required in multi-method studies (Plano Clark and Ivankova, 2016). Multi-method research can be defined as a 'combination of two or more methods, particularly in health sciences" (Plano Clark and Ivankova, 2016 p.59-60) whereas, mixed method research indicates "a process of research when researchers integrate quantitative methods of data collection and analysis and qualitative methods of data collection and analysis to understand a research problem" (p. 59).

Following this distinction, the current research follows a multiphase mixed method design where the emphasis is on qualitative data; and the quantitative analysis will provide for an overview, allowing it to be used in the framing of the qualitative strand and thereby integrating the findings of both qualitative and quantitative to answer the research question.

Even though the mixed methods approach provides for a deeper understanding, it is not without challenges. This approach entails extensive data collection; time-intensive nature of analysing both quantitative and qualitative data. As a result, the researcher needs to be familiar with both quantitative and qualitative forms of research. Therefore,

the complexity of the design calls for clear visual models to understand the details and the flow of research activities conducted through this design.

4.3.2 Research Design

There have been many designs within mixed methods research; with varying purposes, integration, priority, and timing of the research strands (Morgan, 2013) and diverse terms for the types of design have been used (Creswell and Plano Clark, 2011). However, the different mixed methods can be divided into three basic designs (Creswell, 2014):

- Convergent Parallel Mixed Methods Design

This design emerged from the historic concept of the multi-method, multi-trait idea from Campbell and Fiske (1959), who felt that a psychological trait could best be understood by gathering different forms of data. This design is the most familiar of the mixed methods strategies in which the researcher converges or merges quantitative and qualitative data in order to provide a comprehensive analysis of the research problem (Creswell, 2014). Both qualitative and quantitative data that are collected roughly at the same time and are then integrated to provide interpretation of the overall results. In this approach, the data collected from both quantitative and qualitative methods are analysed separately, and then the results are compared to see if the findings confirm or disconfirm each other.

- Explanatory Sequential Mixed Methods Design

The explanatory sequential mixed methods approach is a design in mixed methods that involves a two-phase project in which the researcher collects quantitative data in the first phase, analyses the results, and then uses the results to plan (or build on to) the second, qualitative phase (Creswell, 2014).

- Exploratory Sequential Mixed Methods Design

On the other hand, exploratory sequential mixed methods approach is the reverse of explanatory sequential mixed methods approach wherein the process starts with the

qualitative phase followed by quantitative phase. Here, the second database builds on the results of the initial database.

- Multiphase Mixed Methods Design

Multiphase mixed methods approach designs incorporate a series of qualitative and quantitative studies (three or more), comprising multiple sequential or concurrent designs. Typically, multiphase studies have a longer design arc than typical sequential or concurrent studies.

While there are many researchers using the different designs above, the multiphase mixed methods design was used in this study. The inferences made at the end of phase one (qualitative) aid in the design, focus and purpose of phase two (quantitative) which then informs phase three (qualitative). Phase three is grounded in the results from phase one and two. Once the three phases are complete, final interpretations are conducted using both quantitative and qualitative strands (see Figure 4.5 for research design). The purpose of conducting desk research in phase one is to set the scene and to have a better understanding of the regional institutional frameworks. While the purpose of collecting quantitative data at phase two is to explore the general perceptions of the institutions regarding their collaboration at an inter-regional level which also informed the qualitative interview strand at phase three. This is done in order to have better interpretation and a more in depth understanding by integrating the findings from both quantitative and qualitative strands.

Figure 4.5: Research design model (*Source: Adapted from Creswell, 2014*)

4.3.3 Data Collection Methods

The data collection in multiphase mixed methods design approach is conducted in three distinct phases with desk research conducted in the first phase, rigorous quantitative sampling in the second phase and with purposeful sampling in the third, qualitative phase. This approach has a challenge, which is to plan adequately what quantitative results to follow up on and what participants to gather qualitative data from in the third phase (Creswell, 2014), as the key idea is that the qualitative data collection builds directly on the quantitative results. In the current research, the qualitative sample is the same individuals from the quantitative sample as the intent of the design is to follow up on the quantitative results and explore the results in more depth to interpret and understand the quantitative analysis. The idea of explaining the mechanism 'how the variables interact' in more depth through the qualitative follow-up is a key strength of this design.

Since the current research employs a mixed methods approach, the data collection is conducted on a multi-step, multi-phased level wherein multiphase mixed methods approach is employed (see Figure 4.6). The regional level study is conducted in order to understand the dynamics of the regional triple helix institutions, which will help understand if regional institutional frameworks have an influence at the inter-regional level.

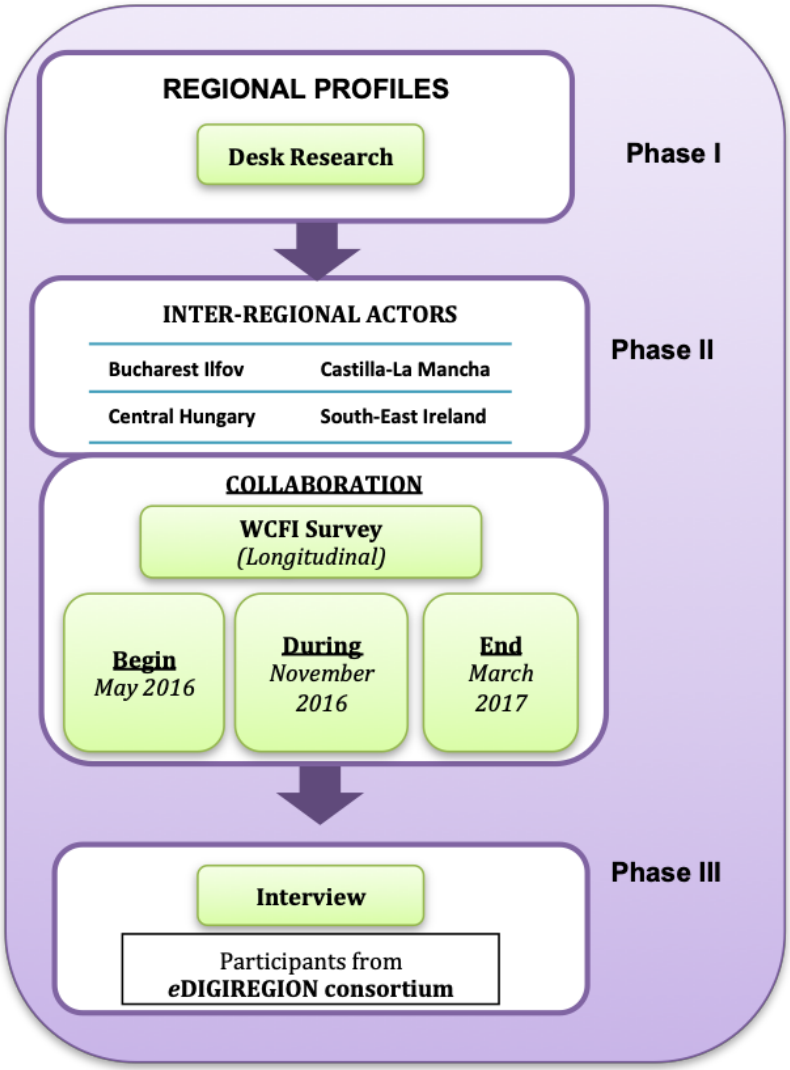


Figure 4.6: Data Collection Methods *(Source: Current Research)*

Figure 4.6 presents the data collection methods for the current research, highlighting the three phases of data collection. At the regional level (Phase I), a desk research on each of the four regions was conducted which helped in sampling the relevant regional actors engaged for the survey. The regions are, Bucharest-Ilfov, Romania, Castilla-La Mancha, Spain, Central Hungary, Hungary and South East Ireland, Ireland, with triple helix partners in each region (research / academic, government agencies, and industry). These four regions collaborated on a European Commission funded project called *e*DIGIREGION, which focused on enhancing regions' sustainable competitiveness by

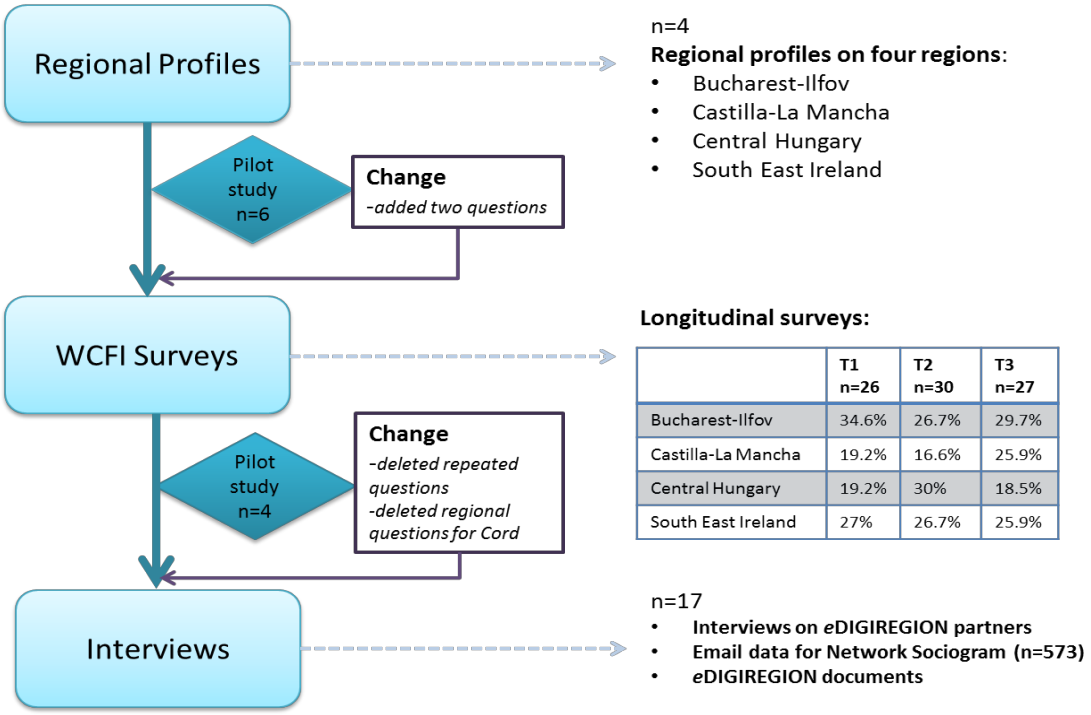
exploiting their strengths and smart specialisations to realise the Digital Agenda within their regional domain. The project also designed a framework to successfully implement transnational cooperation for implementing a sustainable process of ongoing transnational interactions, collaboration and cooperation between stakeholders in different regions in Digital Agenda technologies.

At the inter-regional level (Phase II), a three time points survey were conducted with the inter-regional actors, which are the triple helix partners from the *e*DIGIREGION project. The longitudinal data also allows for testing of change in the perception of the respondents over the period of their collaboration process. The analyses of the longitudinal survey provided an overview of the inter-regional institutional interactions, allowing it to be used in the framing of the qualitative interview strand (Phase III), for greater understanding of the collaboration at an inter-regional level and the challenges it entails when geographical proximity is not existing. This interview helps in interpreting the findings from the surveys and provides an insight into the perceptions of the actors about the changes (if) they occur over the course of their collaboration process.

4.3.4 Data Collection Process

As mentioned in Section 4.3.3, the current research employed a multi-phased mixed method approach wherein different methods were used to gather the data. While the regional profiles consisted of secondary data (such as CSO and Eurostat), the longitudinal survey and interviews were conducted with the *e*DIGIREGION partners. The *e*DIGIREGION project was a research-in-action and all four regions were involved in the inter-regional collaboration. The author's research scholarship provided her an important role on the *e*DIGIREGION research team resulting in maximum exposure to the transnational cooperation framework and its development. As a result of working on this project, the author had access to the regional and inter-regional stakeholders, thereby, allowing access to emails, documents and engagement process with key informants. The author acknowledges that by having direct involvement with the eDIGIREGION team exposes the research to the possibility of insider bias. However, being an 'insider' reduced the many problems associated with researching in the real

world such as gaining access (Kidd, 1992; Pugh, Mitchell and Brook, 2000), establishing rapport with subjects (Gerrish, 1997; Kennedy, 1999; Platzer and James, 1997) and not altering the flow of social interaction unnaturally (Adler and Adler, 1994; Kennedy, 1999). Nevertheless, the author's access to the CG allowed for collection of longitudinal data as well as seventeen interviews which might not have been possible otherwise. Nonetheless, the author acknowledges her role as an insider as one of the limitations of the research.



	T1 n=26	T2 n=30	T3 n=27
Bucharest-Ilfov	34.6%	26.7%	29.7%
Castilla-La Mancha	19.2%	16.6%	25.9%
Central Hungary	19.2%	30%	18.5%
South East Ireland	27%	26.7%	25.9%

Figure 4.7: Data Collection Flow Chart *(Source: Current Research)*

Figure 4.7 shows the data collection flow chart for this research. Firstly, desk research was conducted on the four regions providing an understanding of the regional institutional frameworks. Secondly, a three time point WCFI surveys were conducted with the *e*DIGIREGION partners. Finally, interviews were conducted with 17 *e*DIGIREGION partners, including the coordinator, four regional leaders and 12 triple helix representatives from each of the four regions. Access to the CG's Email communication data (n=573) was helpful in generating a Network Sociogram in order to show the communication links between the actors in the collaboration.

4.3.5 Sampling

A sample is a smaller collection of units from a population which is used to determine a representation of a population (Field, 2009). Sampling can be explained as a principle employed to select members of population to be included in the study (Dudovskiy, 2016). There are certain advantages of sampling (Brown, 2006):

a) Makes the research of any type and size manageable;

b) Significantly saves the costs of the research;

c) Results in more accurate research findings;

d) Provides an opportunity to process the information in a more efficient way;

e) Accelerates the speed of primary data collection.

A sample is used in the current research in order to determine characteristics of the entire population from a representative group of a given population. The process of sampling in primary data collection involves selecting a sampling method. This research employed a purposive sampling technique. Because, whereas it is relatively easy to identify inter-regional collaborative groups through EU funded platforms such as HORIZON 2020, INTERREG, and ERASMUS (to mentions a few), it is extremely difficult to get access to these collaborative groups and even more difficult to engage with such groups in an immersive longitudinal way. Therefore, because this researcher was working on the *e*DIGIREGION EU funded project, and, as a consequence, had easy and open access to four sets of regional stakeholders, 15 participating organisations and a larger number of individuals, the *e*DIGIREGION collaborative partnership (group) was chosen as the sample to study the phenomenon of how regional level institutional frameworks influence the evolution of an inter-regional innovation system. The researcher realises that the *e*DIGIREGION collaborative partnership (group) may not be representative of all inter-regional collaborative partnerships and therefore that the findings are not generalisable. This is another limitation of the research study. However, using the *e*DIGIREGION collaborative partnership does provide the researcher with the

opportunity to understand the phenomenon expressed in the Research Questions and therefore contributes to the existing bodies of research on proximity, regional level institutional frameworks and the development of inter-regional innovation systems.

4.3.6 Technique - Surveys

Survey research is a method of collecting information by asking questions. Zikmund (1997) defined a survey as "a research technique in which information is gathered from a sample of people by use of a questionnaire; a method of data collection based on communication with a representative sample of individuals" (p.202). This research employs surveys to gather information from triple helix institutions both at a regional level and inter-regional level.

On the inter-regional level, The Wilder Collaboration Factors Inventory (WCFI) questionnaire (see Appendix A) was used as the survey tool. WCFI was originally developed and validated by the Wilder Research Centre through three major stages. In the first stage, they identified and assessed research studies which included five steps, namely, formulation of a precise research question, collection of potentially relevant studies, development of acceptance criteria, initial screening of studies and critical assessment of studies. The second stage comprised of systematic codification of findings from each study, which included a further three steps, namely, development of methodology, identification of factors and validation of factors. Lastly, the third stage comprised of synthesising the findings from different individual studies. This phase involved determining the list of factors (based on forty valid and relevant studies), tallying the importance of factors and putting the factors into categories. After an extensive review of successful collaborations and the influential factors involved, Mattessich, Murray-Close and Monsey (2001) of the Wilder Research Centre identified 20 factors (see Table 4.4) that influence successful collaborations. These factors were categorised into six themes: environment, membership characteristics, process and structure, communication, purpose, and resource. All factors have been tested in

multiple studies and are deemed generalisable by the researchers (Mattessich, et al. 2001). After conducting the research, the Wilder Research Centre created a questionnaire designed to address the 20 factors, with 40 Likert-scale style questions that investigate the details of the organisations actions related to collaboration and partnership.

History of collaboration or cooperation in the community	Development of clear roles and policy guidelines
Collaborative group seen as a legitimate leader in the community	Adaptability
Favorable political and social climate	Appropriate pace of development
Mutual respect, understanding, and trust	Open and frequent communication
Appropriate cross section of members	Established informal relationships and communication links
Members see collaboration as in their self-interest	Concrete, attainable goals and objectives
Ability to compromise	Shared vision
Members share a stake in both process and outcome	Unique purpose
Multiple layers of participation	Sufficient funds, staff, materials, and time
Flexibility	Skilled leadership

Table 4:4: WCFI 20 factors (Source: Adapted from Mattessich, Murray-Close and Monsey, 2001)

As regards this current research, on the inter-regional level, the research aims to understand if collaboration can be successful over a distance. While the WCFI does not address proximity, the CG in the current research are located in four different European regions hence, collaborating from a distance. The WCFI helped in assessing strengths and weaknesses of the CG which facilitated the understanding of the collaboration process. Since, WCFI is already a tried, tested and validated instrument for collaboration, the current research employed WCFI in three different time-points in order to understand if the collaboration worked over a distance and to establish if there were changes in the collaboration over time. Thus WCFI survey was administered three times, at the beginning of the collaboration, during and at the end of the collaboration. This longitudinal approach provides for a better understanding of the collaborative

group (CG) as the collaboration progressed and also provided data for analysing the change of the respondents' perceptions from one time point to another. Upon completion of the data analysis, interview questions were formulated in order to have an in depth understanding of the respondents' perceptions of the inter-regional collaboration.

4.3.7 Technique – Interview

Upon completion of collecting and analysing the data from Phase-II, the current research adopted an interviewing strategy at the inter-regional level. The interview participants were selected from the survey respondents in Phase-II whereby the quantitative analysis provided for an overview, allowing it to be used in the framing of the qualitative interview strand, for greater understanding of the collaboration at an inter-regional level and the challenges it entails when geographical proximity is not existent. Thus based on the analysis of the quantitative findings, interview questions were formulated. In order to understand how regional level institutional frameworks influence collaboration on an inter-regional level, three different set of questions were framed to represent the three levels of partners in the project structure (see Figure 4.8 for structure). The questions for the Coordinator were based at the leadership and management level and include questions regarding the role and the challenges as the Coordinator of the collaborative group. Whereas, the Regional Lead questions include their respective regional focus and inter-regional focus as well as their role and challenges as a Regional Lead. The third sets of questions were formulated for the triple helix representatives in all the four regions which include questions regarding regional, inter-regional focus. All three levels of questions include sets of questions which were framed based on the analysis of the quantitative findings. Since the research looks at the possibility of collaborating without the existence of geographical proximity, different non-spatial forms of proximity such as, institutional, social, cognitive and organisational proximity were addressed in order to understand what makes the collaboration work.

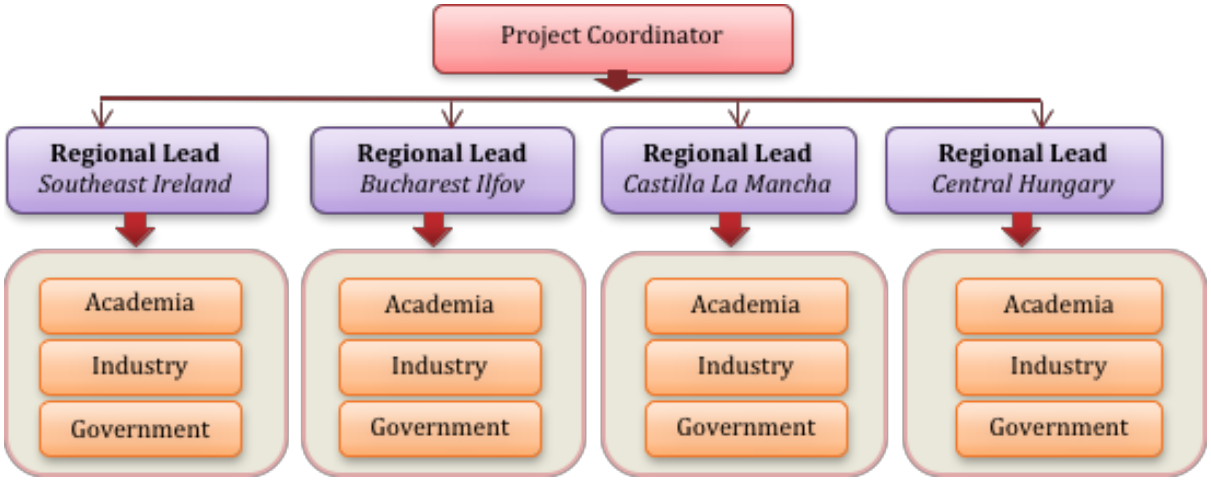


Figure 4.8: Representatives of the CG for interview process on the inter-regional level (*Source: Current research)*

Figure 4.8 shows the dyadic multi-level approach of the interview strand for the inter-regional level, which allowed the author to have an in-depth understanding of the CG from the perspectives of different levels of roles in the CG. On the inter-regional level, representatives from the collaborative group (CG) (n=17) were selected for the interview strands (see Table 4.5 for interviewee profiles).

Interviewee	Role in organisation
Coordinator (Coord)	Director of research centre
South East Ireland	
Regional Lead	Project Manager of EU funded projects
Academia	Researcher of Regional Innovation System
Industry	Manager of Irish Software Innovation Networks
Government	Assistant Director of SE Regional Authority
Bucharest-Ilfov	
Regional Lead	Head of Innovation Department
Academia	Assistant Professor of Computer Architecture
Industry	President and CEO
Government	Coordinator and Expert in the agency for regional development
Castilla-la Mancha	
Regional Lead (Spain)	Professor of Computer Architecture
Academia	Associate Professor of Computer Architecture
Industry	Project Manager of EU projects
Government	Director of Universities, Research and Innovation
Central Hungary	
Regional Lead	National Contact Point for EU projects
Academia	Head of Technology and Knowledge Transfer Office
Industry	Director of Hungarian Mobility and Multimedia Cluster's Management Office
Government	Manager of ICT Support Team

Table 4:5: Job roles/Title of interviewees (Source: Current Research)

4.3.8 Pilot Study

A pilot study is a smaller sized study, which helps in assisting the planning and modification of the main study (In, 2017). The main goal of pilot studies is to assess feasibility in order to prevent potentially disastrous consequences when conducting a large study (Thabane, Ma, Chu, Cheng, Ismaila, Rios, Robson, Thabane, Giangregorio, and Goldsmith, 2010). The current research conducted two pilot studies for the surveys and interview strands (see Section 4.3.4 Figure 4.7).

Firstly, a pilot study was conducted on the WCFI surveys in order to have the surveys tested, which resulted in adding two preliminary questions to the beginning of the survey to capture basic descriptive/demographic data. Secondly, prior to conducting the interviews, another pilot study was conducted to test the interview protocol. Upon completion of the pilot study, regional focus questions (see Appendix G) were removed for the Coordinator's questions as the focus for the Coordinator (Coord) was on the Coord's perception of the CG as well as follow up questions regarding the WCFI findings. As for the Regional Leads and triple helix representatives, repeated questions were removed from the inter-regional focus questions as the WCFI follow up questions (See Appendix F and G for the interview questions) already addressed these questions.

4.3.9 Reliability and Validity

Reliability refers to the "consistency and trustworthiness of research findings" while validity refers to "the truth, correctness and strength of a statement" (Kvale and Brinkmann, 2009, p. 245-246). While there are prominent differences between quantitative and qualitative research in relation to the concepts of validity and reliability (Kumar, 2011), it is more developed in quantitative research as compared to that of qualitative research as the concepts cannot be rigorously applied in the same way as they are in quantitative research. However, Robson (2002) while agreeing with the difficulty in establishing the concepts of reliability and validity in qualitative research, highlighted certain ways to increase the likelihood of validity in research such as: rigorous collection of data using multiple methods, utilising detailed methods, data collection, data analysis and reporting and writing up the research clearly to present the realities of the subjects' lives.

In the current research, Wilders Collaboration Factors Inventory (WCFI) was used at the inter-regional level study were developed by Mattessich, et al. (2001) which was validated and tested by the Wilder Research Centre, meaning that this instrument was guaranteed to generate reliable and valid data. Employing previously validated instruments increases the reliability of the current research. Additionally, the current research employed multiple methods of data collections such as desk research and

interviews in order to ensure it clearly presents the development of an inter-regional collaboration.

4.3.10 Validity

Validity refers to how well the collected data covers the actual area of investigation (Ghauri and Gronhaug, 2005). In other words, validity means to measure what is intended to be measured (Field, 2005). To ensure the validity of the data collected in the current research, pilot studies were conducted both for the surveys and interviews before they were administered to the intended respondents. Thus, the use of pilot studies allows the author to rectify if there are any problems with the instruments. In the current research, surveys were pilot tested by triple helix representatives in South East Ireland (n=6, 2 respondents from each triple helix organisation) and 4 participants took part in the interview pilot study. The current research is concerned with regional institutional frameworks' influence on the development of an inter-regional innovation system. Therefore, the *e*DIGIREGION project was used as the population for the current research. As mentioned in 4.3.5, the *e*DIGIREGION project was a unique collaboration involving 15 different triple helix partners from four different regions who were collaborating at the inter-regional level. Hence, the data collected both for the surveys and interviews cover the actual area of investigation, providing validity of the current research.

4.3.11 Data Analysis

The analysis of the data represented an immense undertaking. For the purpose of this research, there was a significant amount of data collected (see Figure 4.9). Before the analysis began, the data collection required a huge amount of time. Since the current research follows multiphase mixed methods, the quantitative data analysis was undertaken before the qualitative interview strand was developed and executed. For the quantitative level, the data collected consisted of categorical and continuous data which were analysed using the statistical software package SPSS. On the inter-regional level, the data collected were longitudinal in nature therefore; the same analysis was repeated

three times for each time point. Selecting participants for the qualitative strand followed this quantitative analysis phase. The interview participants (n=17) at the inter-regional level were chosen from the CG which consisted of multi-level roles of the participants (the Coordinator, Regional Lead partners and representatives of triple helix in each region). The interview data was coded and analysed using NVivo software. In order to protect the anonymity of the key informants, designators were used throughout the analysis and presentation of the data collected (for the list of designators, see Chapter 7, Table 7.1).

As well as the interview data collected, *e*DIGIREGION documents (such as conference calls and meeting minutes) and e-mail data (n=573) were also analysed for the network sociogram to show the communication between the partners. The findings from both the quantitative and qualitative phases were then interpreted by triangulating the findings from both regional and inter-regional level.

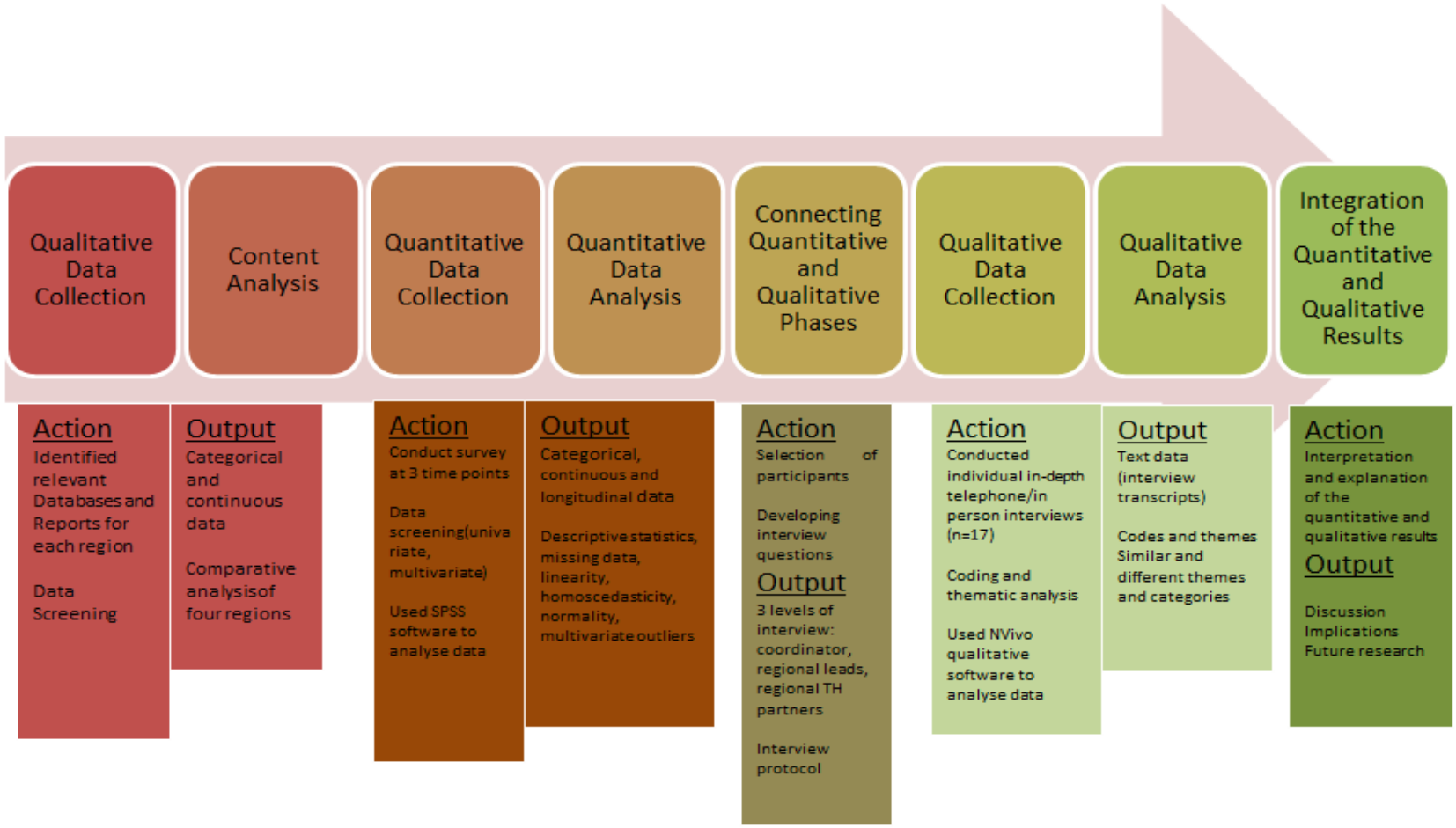


Figure 4.9: Research Analysis Flow Chart *(Source: Current research)*

4.4 Chapter Summary

This chapter presented the research methodology and approach of this current research. The perspective that this research was approached from was a pragmatist worldview. This research was concerned primarily with understanding the "real world" experiences of regional and inter-regional institutions as they interacted and collaborated towards creating an inter-regional innovation system. Thus, a variety of methods were employed. Firstly, desk research was conducted to understand the regional institutional frameworks and their influence at the regional level. Secondly, a longitudinal survey was conducted at three different time-points, which enriched the understanding of changes in the institutions' perception of their collaboration over time. Finally, interviews (n=17) were conducted in order to have an in-depth understanding of the CG and their collaboration at the inter-regional level. The current research methodology framework is summarised in Figure 4.10.

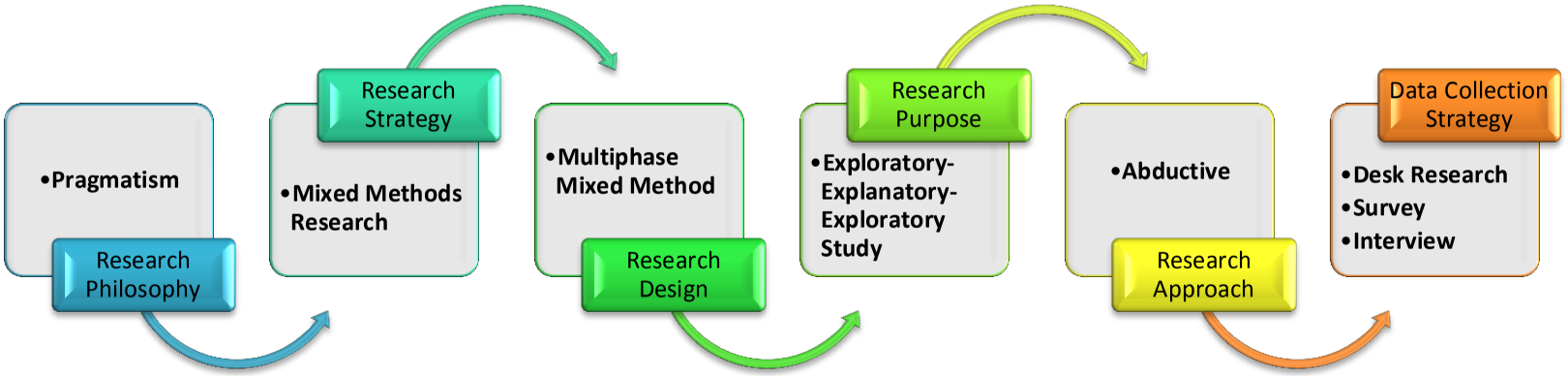


Figure 4.10: Research Methodology Framework *(Source: Current Research)*

Figure 4.10 presents the summary of the research methodology employed in the current research. The research inquiry was based on the assumption that collecting both qualitative and quantitative data is required to best provide a complete understanding of the complex nature of regional institutional frameworks and their influence on the evolution of an inter-regional innovation system. Hence, the research is influenced by pragmatism as the research philosophy. The research strategy employed was mixed methods research wherein a multiphase mixed method approach was used for the research design.

Since a multiphase mixed method design was employed, the research purpose was based on an exploratory-explanatory-exploratory study. Accordingly, the abduction research approach was used as it facilitated going back and forth between induction and deduction (Morgan, 2007) thereby allowing the current research to move from a more general approach to the more specific using deductive inference and following up with the interesting findings through the inductive approach. Thereby, this research employed three data collection strategies wherein desk research was conducted to understand each regional institutional framework which was followed by a three time-point longitudinal survey which was then followed by interviews.

The next chapter presents the first of three findings chapters, Profiling the Four Research Regions which outlines the profiles of the four regions involved in this research in order to understand each regional institutional framework.

5 Profiling the Four Research Regions

The purpose of this research is to explore the influence of institutional frameworks on the evolution of an inter-regional innovation system. In order to achieve this objective, a significant amount of data collection was undertaken (outlined in Chapter 4) to inform this research. The research used *e*DIGIREGION as a sample collaborative network to answer the research question. The four regions involved in the *e*DIGIREGION project were Bucharest-Ilfov, Romania, Castilla-La Mancha, Spain; Central Hungary and South East Ireland with triple helix partners in each region (research / academic, government agencies, and industry). This chapter outlines each region's environment and highlights their capabilities and structure in order to better understand the interaction of the four regions at an inter-regional level. Hence, this chapter outlines regional profiles of the four regions in the current research in order to understand each region's setting and identify the actors in each region by exploring each region's governance structure to understand how policies are formulated and implemented thereby providing insights into the four regional institutional frameworks. The regional profile is presented based on three themes: 1) Economy, 2) Research, Development and Innovation (RDI) and 3) Governance and Policy.

5.1 Economy

Central Hungary (Közép-Magyarország) region is the economic, commercial, financial, administrative and cultural centre of Hungary and the most developed region accounting for 46% of total GDP in 2016[6], while Bucharest-Ilfov region's GDP accounted for 28% of the state total GDP[7]. However, Castilla-la Mancha and South East Ireland regions play a minor role in their respective countries' economies in terms of GDP[8]. The unemployment rate in the four regions has been increasing since the economic crisis in 2008 (see Figure 5.1) however, these regions' economic recovery has begun. For example, in Bucharest-Ilfov the unemployment rate reached 8% in 2013, highlighting its diminishing competitiveness. However, the region is gradually recovering, with a

[6] Eurostat data (nama_10r_2gdp)
[7] Own calculation from Eurostat data (nama_10r_2gdp)
[8] Castilla-la Mancha 3.4%, South East Ireland-6.83%

4.3% unemployment rate in the region in 2017. For Castilla-La Mancha, the unemployment rate has slowly decreased since 2013 (30%) reaching 20% as of 2017. Since 2008, the unemployment in Castilla-La Mancha region has been consistently higher than the national average. As for Central Hungary region, the unemployment rate increased significantly after the economic crisis in 2008 reaching its all-time high in 2012 (9.5%). However, by 2017, the region's unemployment rate decreased to 2.7% which is lower than that of 4.5% in 2008 before the economic crisis. The region's unemployment rate has always been lower than the national average. South East Ireland region, on the other hand, has the highest unemployment rate in Ireland. However, it has decreased from 19.2% in 2011 to 9.4% in 2016.

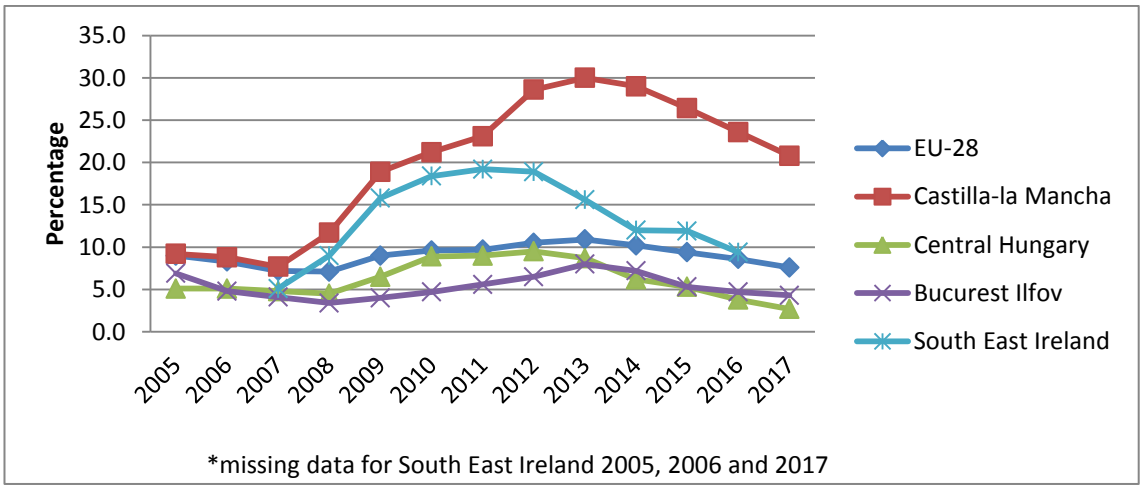


Figure 5.1: Unemployment rate (Source: Eurostat and CSO, 2018[9])

The economic activity rate[10] (see Figure 5.2) for Bucharest-Ilfov region shows an upward trend which had no significant decrease due to the economic crisis in 2008 unlike its unemployment rate (Figure 5.1) which increased since the crisis. Also the economic activity for Bucharest-Ilfov has been consistently higher than the national average since the economic crisis. Nevertheless, the total labour force in 2017 was 1,181,400 out of which 1,130,500 was in employment and unemployment rate decreased to 4.3% as compared to that of 2013, which saw the highest unemployment

[9] Eurostat data lfst_r_lfu3rt and CSO Ireland, 2018 *data dated 05/07/18 and extracted on 07/07/18*
[10] Economic activity rate is the fraction of a population that is either employed or actively seeking employment

rate (8%) since 2005. The economic activity rate[11] increased from 64.7% (in 2016) to 65.3% (in 2017). The total labour force in 2017 was 987,100 out of which 782,000 were employed. The economic activity rate illustrates a fluctuation for Castilla-La Mancha region since 2005, which shows no decrease even after the economic crisis in 2008. However, with the decrease in unemployment rate, the activity rate also decreased as of 2017 with a rate of 65.3%, which for the first time since 2005 is higher than the national average. This is a positive sign for the Castilla-La Mancha region. The economic activity rate for Central Hungary shows an upward trend, with no significant decrease due to the economic crisis in 2008 unlike its unemployment rate (Figure 5.1), which increased after the crisis. Nevertheless, the total labour force in 2017 was 1,463,500 out of which 1,423,500 was in employment. As for South East Ireland region, the economic activity rate shows a downward trend after the economic crisis hit Ireland in 2008. However, it has slowly started to increase which corresponds with the decrease in unemployment rate. The total labour force in 2016 was 237,000 out of which 214,800 was in employment.

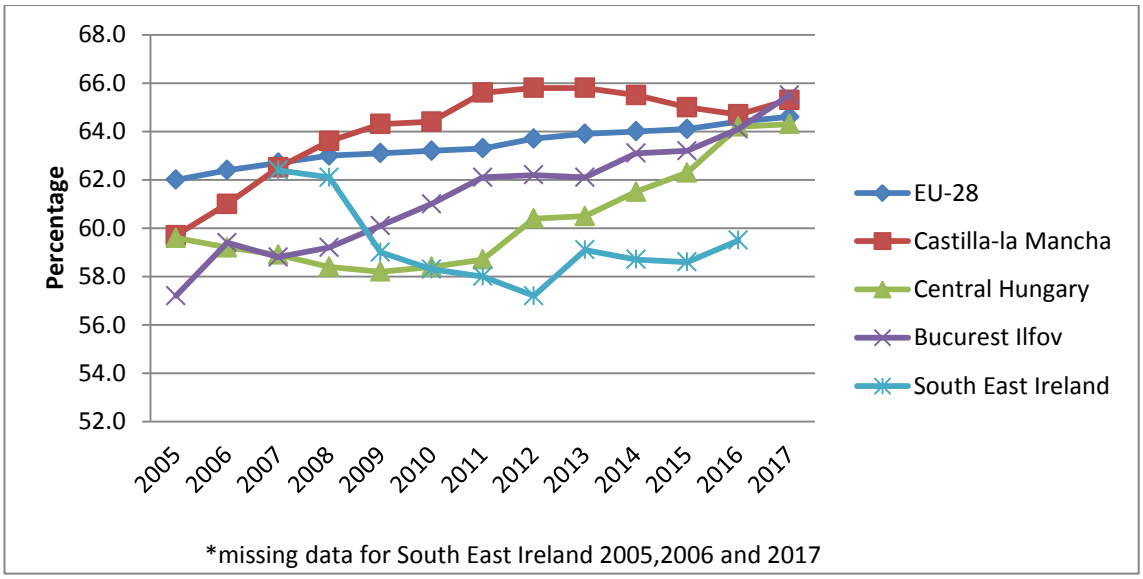


Figure 5.2: Economic Activity Rate (Source: Eurostat and CSO, 2018[12])

The services sector generates around 70 % of the EU's GDP and employment[13], this is also evident in all the regions (see Appendix B for the graphs). The main economic

[11] Economic activity rate is the fraction of a population that is either employed or actively seeking employment

[12] Eurostat data lfst_r_lfp2actrt and CSO Ireland, 2018 *dated 05/07/2018 extracted on 06/07/2018*

[13] http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Tertiary_sector

sector in which the civilian population is employed is 'wholesale and retail trade; transport; accommodation and food service activities' for the four regions. For Bucharest-Ilfov, the industry sector experienced a gradual decline since 2010 and by the beginning of 2013 employment in 'professional, scientific and technical activities; administrative and support service activities' sector gradually increased, surpassing the industry sector's employment in 2014 and as of 2017, it employed 12.29% of the region's workforce. Contrary to the other three regions analysed, Bucharest-Ilfov does not have data for 'real estate activities' for the years 2008-2009, 2011-2012 and 2016-2017. However, this does not have a significant impact on the regional analysis as it is constantly the sector with the lowest level of employment during the years available.

As for Castilla-La Mancha, 'Public administration, defence, education, human health and social work activities' sector was the only sector with increased employment after the crisis in 2008 but fluctuated since 2011 reaching its all-time low in 2013 with 168,800 people in employment. However, by 2017 it was the second highest employment sector in the region with 190,100 people in employment, which is 24.3% of the total labour force. The construction sector saw the most significant drop in employment after the economic crisis in 2008, which employed 136,400 (16% of the labour force) in 2008. By 2014, it employed only 45,800, however, it slightly increased by 2017, employing 58,600 (7.5% of the total labour force).

For Central Hungary, the industry sector experienced a gradual decline between 2008 and 2012. However, it has steadily increased since 2012 and by 2017 the sector employed 230,000, which is 17% of the total labour force in the region. 'Professional, scientific and technical activities; administrative and support service activities' sector has been increasing since 2011, and by 2017, the sector employed 13.3% of the work force in the region (178,800 people).

Employment in agriculture, forestry and fishing fluctuated over the 7 years amounting to 9% of total employment in the South East Ireland region. Construction saw the most significant drop in that region after the economic crisis, which however has shown a slight increase since 2013. In 2015, construction employed 16,700 people in the region which amounted to 8.1% of the total employment compared to 12.4% in 2008. The industry sector experienced a decline after the crisis and reached its all-time low in 2015

plummeting to 27,000 in employment, which is 13% of the total employment, a decrease of 4.1% points from that of 2014.

5.2 Research, Development and Innovation (RDI)

The two regions of Bucharest-Ilfov and Central Hungary being located in the capital of their respective countries have high concentrations of university-based research in their regions. The capital city Bucharest alone has 16 public universities making the region's RDI potential to be the strongest in the country. In 2017, the high-tech sector accounted for 9.6%[14] of total employment in the region which has been the highest in the country since 2008. Whereas Budapest hosts the Hungarian Academy of Sciences and the majority of Hungarian Academy of Science affiliated research institutes. Also the headquarters of the European Institute of Innovation and Technology is located in the region. A large share of the head offices of R&D-intensive multinational enterprises (MNEs) have production facilities in other regions of Hungary but have established their R&D or technology competence centres in Budapest.

On the other hand, Castilla-La Mancha has a public university known as the University of Castilla-La Mancha (UCLM), which is the main higher education institution in the region. This institution was created in 1982 and is divided into four centres spread, in different cities, across the whole region. Currently UCLM has 30,043 students (1,988 of them are postgraduates and PhDs candidates) and 2,386 lecturers/professors. There are 115 research groups in the unoversity whose work has led to 67 valid patents, areas ranging from humanities and social sciences to technical disciplines. As well as the centres being devoted to both education and research, UCLM has a network of centres and institutes and contributes to the regional development by transferring technology to companies and opening up the possibilities for future graduates to enter the job market. There is a presence of other universities in the region, but they have a limited impact in the region (i.e. University Alcalá de Henares campus based in Guadalajara or Distance Education University). There is a total of seven Polytechnic/Technological Schools in the region in fields such as Computer Science, Engineering and Chemistry. However, in South East Ireland, none of Ireland's seven universities are based in the region.

[14] Eurostat(tgs00039) extracted 11/0712018

Nevertheless, the region has two of the country's fourteen Institutes of Technology (IoTs). The research centres within these IoTs engage with and render services to industries. For instance, the Telecommunications, Software and Systems Group (TSSG) in Waterford Institute of Technology (WIT) is an internationally recognised centre of excellence for ICT research and innovation which engages with over 340 organisations globally. The Pharmaceutical and Molecular Biotechnology Research Centre (PMBRC) which is also at WIT is an applied research centre which aims to support growth of the pharmaceutical and healthcare industry in the region. It has a state-of-the-art facility which allows companies to embed R&D into their activities and has links with national and international partners in industry, academia and medical care. Another research centre at WIT is the South East Applied Materials (SEAM) Research Centre. It is an industry focused applied research centre recognised worldwide providing innovative materials engineering solutions for companies from a wide range of sectors, including bio-medical devices, pharmaceuticals, micro-electronics, precision engineering and industrial technologies. One of the research centres in Institute of Technology Carlow, designCORE is an established centre for innovation and commercialisation in design and new product development. The team of dedicated researchers and designers has the expertise and skill to understand consumer motivations, culture and human behaviours to provide real market gain for their clients and establish collaborative relationships with industry. There are also public body research centres in the region, for example, Teagasc which is an agriculture and food development authority which provides integrated research, advisory and training services to the agriculture and food industry and rural communities. It is the leading organisation in the fields of agriculture and food research in Ireland, undertaking innovative research in: animal and grassland research and innovation crops, environment and land use as well as food and rural economy and development. Teagasc collaborates extensively with Irish universities and Institutes of Technologies (IoTs) through their post-graduate fellowship programme, which supports more than 100 MSc and PhD students annually in their research centres.

5.2.1 Regional RDI expenditure

RDI expenditure in the Bucharest-Ilfov region amounted to 51.82% of national RDI funds in 2015. The region also employed 49% of Romania's R&D personnel in 2015[15], of which, 41% were employed in the government sector and 28% were employed in the business sector. The region's Gross Domestic Expenditure on R&D (GERD) in 2015 was €405.27 million which is 0.91% of its GDP. Regional public (GOVERD) and higher education (HERD) expenditures on R&D in 2015 amounted to €239 million while the business sector (BERD) amounted to €164 million which is 59% and 40.5% respectively of the total R&D expenditures.

Whereas in Castilla-La Mancha, Gross expenditure on R&D (GERD) was €203m in 2015. Regional GERD has decreased since 2012 but in 2015 the regional GERD saw an increase from that of the previous year. The public expenditure on research and development expenditure regional public (GOVERD & HERD) and private (BERD) expenditures on R&D values in 2015 were low, with Public expenditure reaching an all time low in 2012 and decreasing between 2010-2014. As for Central Hungary, the regional GERD[16] has been increasing since 2007 and by 2015 it was €965 million, which was 64% of national GERD. While the regional public (GOVERD & HERD) expenditures were low (€241 Million), private (BERD) expenditures were at an all-time high (€727.4 million) in 2015. The difference in public and private spending on R&D could be attributed to the private R&D boom in the country[17] because of increasing FDI (for example, Bosch, Suzuki and Audi building their R&D centres in Budapest). While the RDI expenditure data are not available for South East Ireland, instead it is measured at the country level. In 2016, GERD reached its highest level since 2006 at €3.243m which was a 47% increase over the 2006 figure of €2.214m. The highest expenditure on R&D in Ireland is in the business sector (BERD) where €2.293m was invested in research programmes in 2016. The higher education sector (HERD) has seen a decline in R&D expenditure since 2008. However, since 2013 there has been an increase with R&D expenditure reaching €817m in 2016. The Government sector (GOVERD) is the

[15] rd_p_persreg dated 31/3/16 extracted on 24/11/16
[16] Eurostat data (rd_e_gerdreg)
[17] https://financialobserver.eu/ce/hungary/rd-spending-in-hungary-second-highest-in-eu/ accessed on 20/08/2018

smallest sector in Ireland with €134m spend in 2016 with R&D carried out in government institutions such as Teagasc and The Marine Institute (GOVERD figures include an estimate for government funded Hospital performed R&D of €35 million)[18].

5.2.2 Tertiary Education and infrastructure

While the Bucharest-Ilfov region has the largest university centre in Romania with 16 public universities existing in Bucharest alone, the region has had a relatively low innovation performance, in spite of absorbing the largest share of RDI resources. There were 30 applications to the European Patent Office (EPO) from Bucharest-Ilfov in 2011[19], which is half of the total number of EPO[20] applications in Romania, and less than 50% in comparison to the EU28 average. However, the region has high population of tertiary education. As of 2017, the region has 36% of its population having tertiary education which is 120% above the EU average. Consequently, many higher education entities, research scientific development and innovation agencies exist which function under the different Ministries of Romania. One such agency is The Executive Agency for Higher Education Research and Innovation Funding (UEFISCDI), which is a public institution with legal entity and the subordination of the Ministry of National Education and Scientific Research (MENCS) and functional advisory committees of MENCS with responsibilities in higher education, research, scientific development, and innovation. Moreover, UEFISCDI acts for the promotion of Romanian R&D and its integration in the international scientific community, by cooperating with similar organisations in Europe and worldwide and supporting Romanian R&D actors to develop international partnerships. UEFISCDI is the sole public funding agency, in Romania, for research and innovation which liaises with other agencies such as The National Research Council (CNCS). CNCS supports fundamental research in all fields of science, which are selected through competitive, merit-based review. CNCS is a consultative body of the Minister of Education and Science, all 19 members being appointed by the Minister and works with UEFISCDI towards cooperating with other similar national or international councils in the administration, research programme field or research evaluation process

[18] https://dbei.gov.ie/en/Publications/Publication-files/R-D-Budget-Survey-Report-2016-2017.pdf
[19] Eurostat (pat_ep_rtot)
[20] European Patent Office decides whether to grant a patent for an invention. The patents granted by the European Patent Office are called European patents.

according to the Ministry delegation and also coordinating the National Plan for Research, Development and Innovation Programmes.

In order to provide the interface between the scientific community and the Ministry of Education, Research, Youth and Sports, the National Council of Scientific Research (NURC) represents the government and functions as an advisory body to the Minister of Education, Research, Youth and Sports. NURC helps in the allocation of funds for research in universities and assessment of performance in scientific research. One of the initiatives undertaken in the region to enhance excellence and technical evolution was to invest in the Extreme Light Infrastructure Facility in the region, creating innovation and technological transfer centres, science and technology parks and providing support to clusters and university – business partnerships. One such example is the Laser Valley[21]- Land of lights, which is an initiative to capitalise on the uniqueness of the scientific and technological Pan-European research infrastructure Extreme Light Infrastructure - Nuclear Physics (ELI-NP), creating an economic growth pole as a regional science, innovation and entrepreneurship ecosystem, and also an accelerator of territorial transformation for Romania's development

Whereas in Castilla-La Mancha region, 27.6 % of the population has tertiary level education in 2017, compared to 36.4% of the country's total population who have tertiary level education, which is above EU average. The Regional Government is the sole funding agency in the region. The Regional Government of Castilla-La Mancha, through the Institute of Finance of Castilla-La Mancha, Sodicaman, Aval Castilla-La Mancha[22], offers expert advice to businesses and entrepreneurs in financial matters, which determines the most appropriate solutions and funding for business projects. In order to provide the region with a new infrastructure for scientific and business development in the most advanced fields of knowledge and communications, the Regional Government of Castilla-La Mancha, Universidad de Alcalá, Guadalajara City Council, County Council, Ministry of Science and Innovation jointly funded the Science and Technology Park in Guadalajara. The park aims to be a space designed to facilitate technology transfer, as well as managing and providing the means to stimulate and

[21] http://www.laservalley.ro
[22] http://adelante-empresas.castillalamancha.es/adelante/instituto-de-finanzas-de-castilla-la-mancha

facilitate direct contact between universities, public research institutions and businesses.

Additionally, in 2001, the Regional Government of Castilla-La Mancha, the University of Castilla-La Mancha, the city of Albacete and Albacete Provincial Council jointly founded the Science and Technology Park of Albacete Foundation (PCYTA) to encourage the creation of an innovative environment. The park has enabled the creation of a space where research centres and the university have coexisted with companies promoting knowledge transfer between business, university and science in order to improve the competitiveness of the economy of Castilla-La Mancha.

Universities in Budapest have developed knowledge clusters, and intensified cooperation with the business sector equipping the region with outstanding and well-equipped science and competence centres, accredited innovation clusters and the demonstration effects arising from the concentration of innovation-intensive activities. The region also has a population with high levels of tertiary education (35.6%) which has consistently increased year on year since 2008. Even though it decreased since 2016, the region's tertiary educated population was well above 120% of the EU average. The region also has innovation agencies that render Information and Communication support instruments and resources for regional development and innovation. For instance, the Pro Regio Agency[23] monitors and analyses regional processes and manages the programming and planning systems. Pro Regio Agency is a key intermediary actor in regional innovation management, specifically for the management of the Central Hungary Operational Programmes. It also provides services (technical assistance for tendering, innovation management advice, training, organisation of business events and partner search) to its partners/clients and ensures a smooth information flow among regional and national stakeholders.

While South East Ireland region only has two higher education institutes, it saw an increase in third level[24] workforce in the region with 37% of the population having third

[23] http://www.proregio.hu

[24] Third-level education in the Republic of Ireland includes all education after second-level, encompassing higher education in universities and colleges and further education on Post Leaving Certificate (PLC) and other courses. It is equivalent with tertiary education.

level education as of 2017. With Ireland striving to create a world-class research system that drives innovation and economic success, the government disburses and manages higher education funding through a primary agency called the Higher Education Authority (HEA). In addition to this main function, the HEA is responsible for the management of the Programme for Research in Third Level Institutes (PRTLI). The programme was launched in 1998 and has awarded €1.22 billion in exchequer and private matching funding to date[25] and has helped to establish Ireland as a premier location for performing world-class research and development. Science Foundation Ireland (SFI)[26], established in 2000, is the largest funder of research in Ireland and its primary focus is on biotechnology, green energy, and information and communications technology. SFI invests in academic researchers and research teams who are most likely to generate new knowledge, leading-edge technologies and competitive enterprises in the fields of Science, Technology, Engineering and Mathematics (STEM). The Foundation also promotes and supports the study of, education in, and engagement with STEM and advances co-operative efforts among education, government, and industry that support its fields of emphasis and promotes Ireland's ensuing achievements around the world. There are also investment agencies such as The Industrial Development Authority (IDA) and Enterprise Ireland (EI) (both are government agencies). IDA is Ireland's inward investment promotion agency and it partners with foreign investors, helping them to set up and develop their businesses in Ireland. The IDA has secured investment in Ireland from some of the world's largest companies- six of the top 10 companies on Forbes' (2018) list of The World's Most Innovative Companies have Irish operations[27]. The regional office of IDA in South East region is located in Waterford Business & Technology Park. The Business Park offers high specification office accommodation, advanced technology buildings and greenfield areas to suit both manufacturing and international services sectors.

Enterprise Ireland (EI)[28] on the other hand is the government organisation responsible for the development and growth of Irish-owned enterprises in world markets. This includes supporting indigenous enterprises to develop their research and development

[25] http://www.hea.ie/en/funding/research-funding/programme-for-research-in-third-level-institutions
[26] http://www.sfi.ie/
[27] The companies are ServiceNow, Workday, Salesforce, Amazon, Hindustan Unilever and Facebook. https://www.forbes.com/innovative-companies/list/#tab:rank
[28] https://www.enterprise-ireland.com

portfolios supporting sustainable economic growth, regional development and secure employment. EI's initiative for entrepreneurship called New Frontiers is Ireland's national entrepreneur development programme for innovative, early-stage startups. It is a three-phased programme, based in 14 campus incubation centres across the country. The South East region has one New Frontiers Programme which is based in, and jointly managed by, the two IoTs in the region. Each year, New Frontiers funds 150 companies nationwide.

There also exists other agencies for anyone seeking information and support on starting or growing a business in Ireland, such as the Local Enterprise Office (LEO). There are thirty one (31) dedicated teams across the Local Authority network in Ireland, with five (5) LEOs in the South East region, it is a one-stop shop for people interested in starting up a new business or are already in business including entrepreneurs, early stage promoters, start-ups and small businesses looking to expand. However, these agencies primarily focus on local enterprises within their own local government jurisdiction.

5.3 Governance and Policy

Out of the four regions involved in this study, Castilla-La Mancha is the only one with a decentralised system of government which means most of the actions taken by the regional government that support science, technology and innovation development are implemented by the following organisations:

- **Regional Ministry of Employment and the Economy**[29] is in charge of elaborating and controlling the execution of Regional Government's policies and economic plans to foster the development of the region and the promotion of employment. Moreover, the Ministry steers its policies to R&D areas, mainly in order to develop and manage grant programmes and incentives to promote innovation, and the establishment and modernisation of industry to promote industrial competitiveness;

- **Regional Ministry of Education, Culture and Sports** - its main functions regarding R&D are the definition, programming and implementation of R&D

[29] http://www.castillalamancha.es/gobierno/economiaempresasyempleo

educational policies and to set general R&D policies and support programmes and incentives including the development and promotion of infrastructure and services to support research, development and innovation, in coordination with the Deputy Ministry of Economy.

The Regional Government seeks to ensure that innovative businesses and research projects find support so that they can be performed in Castilla-La Mancha and contribute towards its economic and social progress. As well as these organisations, there are other actors involved in R&D support such as:

- Albacete and Guadalajara have a **Science and Technology Park** where universities, research institutions and business interact and promote the creation and development of new businesses;
- **CYTEMA (Energy and Environment Science and Technology Campus)** forms part of the University of Castilla-La Mancha (UCLM) and is recognised as a "Campus of International Excellence". CYTEMA was a project undertaken by UCLM to take advantage of the strengths in R&D in energy and environment within the university to improve teaching capacity, research and knowledge transfer in the field of energy and environment;
- There are 2 **Singular Scientific and Technical Infrastructures**: The National Centre for Experimentation Hydrogen Technologies and Fuel Cells and the Yebes Astronomical Observatory. They both are large facilities, resources and services, which are dedicated to cutting edge research and technological development, as well as to promote exchange, transmission and preservation of knowledge and technology.

The Regional Plan for Scientific Research, Technological development and Innovation (PRINCET) 2011-2015, approved by the Governing Council of Castilla-La Mancha, was based on research and tracking results from the previous plan (2005-2010). PRINCET objectives were to increase and optimise existing resources, to promote an innovative and competitive business network, to foster the internationalisation of the public and private regional system of science and technology, to promote public-private collaboration, to boost research excellence in the public system and to promote scientific and technological culture.

This plan was structured along the thematic areas covered by FP7[30] and through six main action lines (internationalisation, training, collaboration between public and private sectors, fostering business activity, dissemination of science and technology and to boost research excellence in the public system). In addition, three new instruments of coordination were created: RETCAM (Technology Network of Castile-La Mancha) designed to foster business competitiveness; a Science Public Dissemination Unit that aims at spreading scientific culture; and the Institute of Agroforestry research in Castilla-La Mancha that will be devoted to agrarian and rural development.

The main strategy of PRINCET was to focus on the development of international training programmes, promote the growth of human resources in R&D and support services through technological centres and science parks, as well as new funding opportunities for industrial research and the promotion of science. As a result of the cooperation between university and research centres, R&D and innovation projects are being undertaken in different scientific-technical areas that are considered essential to increase regional competitiveness. Key areas of development for PRINCET are: social science, environmental science, physics, chemistry and mathematics, health, agriculture, food and biotechnology, information and communication technologies, materials, civil and industrial engineering and energy.

The region also has policies such as Estrategia de especialización inteligente de Castilla-La Mancha (2014-2020)[31]. This is the region's Smart Specialisation Strategies which integrates territorial economic transformation agendas through which the Regional Government has opened a platform-forum where all citizens, business people, social partners, and entities of Science-Technology-Innovation System of Castilla-La Mancha can reflect together on what they want for the future of the region.

Programa de Desarrollo Rural Castilla-La Mancha (2014-2020) is the Rural Development Program of Castilla-La Mancha which finances modernisation projects for approximately 3,500 farms and 2,000 projects for processing and marketing of food products. It also focuses on succession planning for 1,800 young farmers in order to

[30] FP7 is the short name for the Seventh Framework Programme for Research and Technological Development. This is the EU's main instrument for funding research in Europe which ran from 2007-2013.

[31] http://ris3.castillalamancha.es/que-es-la-ris3

ensure generational change. Castilla-La Mancha continues its efforts for the conversion and maintenance of organic farms and the forest natural heritage by mobilising about 30% of the budget, especially for operations of forest fire prevention and reinforcement of these ecosystems. Through these actions, the programme is expected to create 2,000 new jobs in the region.

On the other hand, Bucharest-Ilfov region includes one municipality (Bucharest), 8 towns in Ilfov, 32 townships and 91 villages. It has no administrative or legal status, but as a NUTS2 territorial unit, it is the framework for elaborating, implementing, monitoring and evaluating regional development policies funded through national programmes and Structural Funds. National co-ordination of the regions is ensured by the National Council for Regional Development. Regional coordination is performed by the Regional Development Council (RDC) and its executive body, the Bucharest-Ilfov Regional Development Agency (ADRBI). RDC is chaired by the general mayor of Bucharest capital city and the Ilfov county council president by rotation.

ADRBI was responsible for PHARE[32] regional implementation and has been an intermediary organism for the Regional Operational Programme funded by EU Structural Funds during 2007-2013. It is also in charge of coordinating the strategy-building process for the Regional Development Strategy and Plan 2014-2020 and coordinating the implementation of the 2014-2020 structural and investment funds operational programmes in the region. Measures combining regional planning with RDI investments are included in the new Plan and are performed jointly by the local authorities and stakeholders. This development aims to increase ADRBI's regional coordination role and interaction with the local Chambers of Commerce, professional associations, and NGOs for integrating public and private investments.

Romania has no regional RDI policy, and its regions have no role in RDI policy-making. RDI policies are nationally designed and coordinated by the Ministry of Education and Research without regional focus. The Ministry has a limited role in

[32] The PHARE Programme is the European Union's initiative which provides grant finance to support its partner countries to the stage where they are ready to assume the obligations of membership of the European Union.

regional RDI policy and exerts little RDI territorial coordination. Similarly, no regional digital agenda strategy toward building a more inclusive information society exists. This could be due to the high degree of administrative centralisation in the region and mainly due to the existence of the Digital Agenda Strategy for Romania.

Furthermore, the consolidation of the Bucharest-Ilfov Metropolitan Area which was estimated to be finished by 2016 will expand the region to 62 localities. The enlarged metropolitan area is expected to be based on an integrated polycentric approach and play the role as another potential source of facilitating innovation in the region. Local governance performance is, however, generally weak, which has been reflected in the slow pace of setting-up the Metropolitan Area.

As Romania has no regional RDI policy, RDI policies are nationally designed and coordinated by the Ministry of Education and Research without regional focus resulting in the regions having no role in RDI policy-making. Consequently, the Ministry has a limited role in regional RDI policy and exerts little RDI territorial coordination (Regional Innovation Monitor Plus, Bucharest-Ilfov, 2016). In 2013, the Bucharest-Ilfov Regional Development Agency (ADRBI), in partnership with local stakeholders elaborated an important innovation policy trend for a stronger role of RDI in the 2014-2020 Regional Development Plan.

The draft Regional Development Strategy 2014-2020 proposed three strategic objectives for focusing regional investments, including: consolidating regional competitiveness; reducing intra-regional disparities; sustainable urban and rural development. It includes three specific objectives related to increasing regional competitiveness and consolidating (Research, Technology Development and Innovation (RTDI) activities these are:

- Developing the business support infrastructure through creating science and Technology (S&T) parks and business incubators, providing seed funding for start-ups, supporting SMEs in creative industries, new forms of tourism and innovative services, supporting entrepreneurial education and developing regional information networks;
- Supporting SMEs' transition to knowledge activities, in view of creating innovative products, services, processes and commercialization channels;

- Support for RTDI infrastructure towards enhancing excellence and technological evolution through investing in the Extreme Light Infrastructure Facility in the region, creating innovation and technological transfer centres, S&T parks and providing support to clusters and university – business partnerships.

The aim of this plan is to strengthen research, technological development and innovation with regards to the development of innovative products and services. The regional strategy aims to support SMEs for a better guidance to support the creation of products, services, processes and marketing channels based on innovation, as well as supporting the development of research infrastructure and innovation. The aim is to foster excellence in the field of research, innovation and technological developments by investing in the development of the largest laser in the world (Extreme Light Infrastructure - Nuclear Physics), including investments related to it, investments in innovation centres and technology transfer, investments in science and technology parks, support and promotion of clusters, cooperative partnerships between actors in research, education and innovation and infrastructure development in R&D businesses, including specific sectors like agriculture.

Recent policy trends were set by the Regional Development Plan 2007-2013, which included a priority on promoting economic growth and employment. A project that ADRBI initiated was PRO SME BISNet, providing access to SMEs to the Enterprise Europe Network. Since 2012, the RDA is also a partner in the INTERREG IVC project TR3S - Towards Regional specialisation for Smart Growth.

ADRBI's role as an Intermediary Body for the Regional Operational Programme (ROP) 2007-2013, funded through European Regional Development Fund (ERDF), was also to contribute to providing support to businesses through Axis 4[33] of the ROP. As a result, by December 2012, there were 5 business support infrastructure projects and 165 micro-enterprise projects contracted within Axis 4 (ARDBI, 2012).

The successor of Regional Operational Programme (ROP) 2007-2013 is the Regional Operational Programme (ROP) 2014-2020, managed by the Ministry of Regional Development and Public Administration as the Managing Authority, was adopted by the

[33] The ERDF aims to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions. There are 10 Priority Axis in total and Priority Axis 4 funds proposals 'Supporting the Shift Towards a Low Carbon Economy in All Sectors'

European Commission (EC) on June 23, 2015. The overall objective of ROP 2014-2020 is aimed at economic competitiveness and improved living conditions of local and regional communities by supporting business development, infrastructure and services for sustainable development of regions, so that they can effectively manage their resources and their potential for innovation and assimilation of technological progress.

The ROP managing authority works closely with the Ministerul Fondurilor Europene (MFE)[34], which operates as a specialised body of central public administration, with legal personality, subordinated to the Government. As of July, 2016, the ROP Managing Authority launched the Applicant's Guide for Investment Priority 2.1.A within the 2014-2020 Regional Operational Program, Priority Axis 2[35]: Improving the competitiveness of small and medium sized enterprises. In accordance with the Applicant's Guideline, funding claims could be submitted until January 2017 through the MFE.

In Central Hungary, strategy implementation is centralised under the National Development Steering Committee (NDSC). However, the strategy design takes place at a regional level. Innovation strategy development in Hungary is a bottom-up, participatory exercise. For instance, INNOREG, which is the Central Hungarian Regional Innovation Agency (RIA), is the designated main regional actor for regional innovation policy. It is the coordinator of the regional innovation network. The region's RIS3[36] design was coordinated by INNOREG. However, the agency has restricted autonomy and is limited to representing the region in innovation-specific discussions (for example, with the National Office for Research and Technology, or within the network of the Hungarian RIAs) and the design of various regional innovation management actions, events and services.

The deficiencies in the regional governance (Egedy and Kovács, 2010) are highlighted in the two-tier administrative system of Budapest. Its overlapping responsibilities and conflicting political interests hinder the design and the implementation of an integrated

[34] Ministry of European Funds http://www.fonduri-ue.ro/

[35] The ERDF aims to strengthen economic and social cohesion in the European Union by correcting imbalances between its regions. There are 10 Priority Axis in total and Priority Axis 2 funds proposals 'Enhancing access to, and use and quality of, ICT'

[36] Research and Innovation Strategies for Smart Specialisation (RIS3) supports the creation of knowledge-based jobs and growth not only in leading research and innovation (R&I) hubs but also in less developed and rural regions.

urban development strategy. Both the capital and its districts have municipal governments with independent functions and powers, i.e. the local governments of both the capital itself and its 23 districts have equal status and power. However, county councils and municipalities have different roles and separate responsibilities relating to local government. The role of the counties are basically administrative and focus on strategic development, while preschools, public water utilities, garbage disposal, elderly care and rescue services are administered by the municipalities.

In summary, the main governance level for the design and implementation of innovation policy in Central Hungary is at the national level. The geographical location of Central Hungary region can, to some extent, explain the concentration of national innovation performance in this region and the high spillover effects of regional investments.

The most important strategic programme that shapes Central Hungary's development and innovation policy in the 2014-2020 programming period is the 'Operational Programme for a Competitive Central Hungary'. This Operational Programme and the Economic Development and Innovation Operation Programme constitute the framework of Central Hungary's innovation and development strategy implementation. Both Operational Programmes are managed centrally. Consequently, innovation strategy implementation will remain centralised. The Managing Authorities of Operational Programmes (OPs) are subordinated to the ministries that are represented in the National Development Steering Committee (NDSC).

According to the region's RIS3 and the two Operational Programmes that constitute the framework of strategy innovation implementation, the overall policy objectives include the enhancement of business innovation, and particularly SMEs' innovation activity, improvement of universities' R&D infrastructure, creation and development of knowledge clusters, improvement of human resources, and spread of innovation culture and improvement of energy efficiency. The sectors and technologies identified as drivers of regional innovation-driven growth include ICT, creative industries, health industry, biotechnology and environmental technologies. These selected areas are more or less in line with the specialisation of the Accredited Innovation Clusters (AICs) that currently operate in Central Hungary. Policy measures address these strategic objectives through promotion of SMEs' investment in technology upgrading, support to basic and applied research and to universities' investment in research infrastructure; support to

cluster-based innovation collaboration and to research performers' participation in international research undertakings. Funding from the Research and Technological Innovation Fund is concentrated in Central Hungary, targeting research organisations' infrastructure, participation in international research projects and SMEs' market-oriented innovation. Some policy measures target innovation intermediaries such as incubators, technology parks and innovation clusters, supporting the improvement of services and to the development of these organisations' infrastructure. Consequently, it also focuses on the development of tertiary education, improvement of curricula and higher education institutions' student services.

On the other hand, Ireland has a centralised government. The Council of Europe report titled Local Democracy in Ireland (2013)[37] found the Government unwilling to devolve power to local authorities. It also addressed the lack of transparency on how local authorities are funded and said the system for allocating the Local Government Fund "remains a mystery to practically everyone in the local government system" (p. 27)[38]. The centralised nature of the government is evident in the funding agencies, as there are no regional funding agencies in Ireland.

According to the report, despite promises of reform, the system remains "excessively centralised" (p.17)[39] by international standards. However, reform of the local government has been on Ireland's political agenda. Under the Local Government Reform Act 2014[40], the former eight (8) regional authorities and two (2) regional assemblies were consolidated to form three regions: Southern; Northern and Western; and Eastern and Midland regions. These three new Regional Assemblies act as administrative appointees of the national government.

Following the enactment of the Local Government Reform Act 2014, a number of changes were made to the regional structures in Ireland. The eight regional authorities were dissolved on the 1st June 2014 and their functions and staff were transferred to the Border, Midland and Western (BMW) Regional Assembly and to the Southern and Eastern (S&E) Regional Assembly. The three new Regional Assemblies already mentioned above came into being on 1st January 2015. These new Assemblies

[37] https://rm.coe.int/168071a75c accessed on 20/08/2017
[38] Ibid
[39] Ibid
[40] http://www.irishstatutebook.ie/eli/2014/act/1/enacted/en/html Accessed on 30/02/2016

incorporate the functions of both the former regional authorities and assemblies, with significant enhancement of some powers, particularly in relation to spatial planning and economic development. One of the major tasks the Assemblies have to perform is to prepare a new Regional Spatial & Economic Strategies for their regions with the main objective being to support the implementation of the National Spatial Strategy and the economic policies and objectives of the Government by providing a long-term strategic planning and economic framework for the development of the region. The Southern Region now includes:

- South East Region: Carlow, Kilkenny, South Tipperary, Waterford City and County, and Wexford,
- South West Region: Cork City and County, Kerry
- Mid-West Region: Clare, Limerick City and County, North Tipperary

The Southern Regional Assembly (SRA), as a managing Authority is not directly involved in budgetary allocations, project selection and payments but it undertakes consultations with all the relevant stakeholders at national and regional level in the identification of Operational Programmes' priorities. However, the enterprise and innovation policy measures are developed, nationally, by the Department of Business, Enterprise and Innovation[41] but are implemented locally by the Local Enterprise Offices (LEOs). As well as the Assembly, there are local authorities. Local authorities in Ireland operate within specific geographic areas called local government areas. There are 31 local government areas in Ireland and each one has a local authority. They are the multi-purpose bodies responsible for delivering a broad range of services in relation to roads; traffic; planning; housing; economic and community development; environment, recreation and amenity services; fire services and maintaining the register of electors[42]. In the South East, there are five (5) county councils, viz. Carlow County Council, Kilkenny County Council, Tipperary County Council, Waterford City and County Council and Wexford County Council. The members of the council are elected. The council is the policy making forum of the local authority; the municipal district members act as a decision-making sub-formation of the overall council in respect of their municipal district area. Elected councils (operating at local authority or municipal

[41] Previously known as the Department of Enterprise, Jobs and Innovation
[42] http://www.environ.ie/local-government/administration/local-government-administration#sthash.fY83BXi8.dpuf Accessed on 30/03/2016

district level) exercise 'reserved functions' defined in law across a range of legislation. The day-to-day management of a local authority is carried out by the executive, i.e. the full-time officials led by the Chief Executive. The Chief Executive has a duty to advise and assist the elected council in the exercise of their functions. He or she is appointed by the local authority on a recommendation of the Public Appointments Service[43].

In February 2012, the government of Ireland agreed to the implementation of the Research Prioritisation Steering Group (RPSG). The report recommended the alignment of the majority share of competitive State funding in research and innovation to 2017[44]. The Steering Group identified 14 (fourteen) research priority areas (see Table 5.1).

Future Networks & Communications	Food for Health
Data Analytics, Management, Security & Privacy	Sustainable Food Production & Processing
Digital Platforms, Content & Applications	Marine Renewable Energy 10 K Smart Grids & Smart Cities
Connected Health & Independent Living	Smart Grids & Smart Cities
Medical Devices	Manufacturing Competitiveness
Diagnostics	Processing Technologies & Novel Materials
Therapeutics – Synthesis, Formulation, Processing & Drug Delivery	Innovation in Services & Business Processes

Table 5.1: Research priority areas for Ireland (*Source: DJEI, 2014)*[45]

The focus of Ireland's funding is now on these priority areas, smaller number of research centres, closer to market research measures, public-private partnerships, particularly in the mobilisation of risk and venture financing, and applied research and activities for industrial clients through the development of a smaller number of Research and Technology Organisations (RTOs)[46].

[43] Public Appointments Service is the centralised provider of recruitment, assessment and selection services for the Civil Service. They also provide recruitment and consultancy services to local authorities, health boards, the Garda Siochana and other public bodies.

[44] https://www.djei.ie/en/Publications/Publication-files/Forf%C3%A1s/Implementation-of-Research-Prioritisation.pdf

[45] *https://dbei.gov.ie/en/Publications/Publication-files/RIS3summary2014.pdf)*

[46] RIM Plus Repository https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/base-profile/southern-eastern-se-region Last accessed on 30/03/2016

The European Commission established an initiative in 1991 to aid the development of sustainable rural communities following the reforms of the Common Agricultural Policy (CAP). The initiative (LEADER[47]) became available in Ireland in 1992 and 17 groups were selected for participation in what was essentially a piloting of the initiative. This saw the inception of the 'bottom-up' approach to rural development, with the implementation of business plans and decisions on funding being made at a local level on projects.

The Rural Development Programme (LEADER 2014-2020) provides €250 million in financial resources to rural communities administered by the Local Action Groups (LAGs). LAGs are partnerships of both public and private entities from a defined geographical area. The South East region has five (5) LAGs, one in each county. They are responsible for selecting and approving projects in their respective areas in accordance with business plans agreed with the Department of Housing, Planning, Community and Local Government.

In September 2015, the government of Ireland launched the South East Action Plan for Jobs (SEAPJ), aimed at delivering 10-15% employment growth in the region over the coming years. Since 2012 the South East has had the fastest rate of jobs growth of any region in the country[48], with 25,300 extra jobs created in the region in 3 years, representing a 13.9% increase. The plan includes 194 actions to be delivered over the period 2015-2017 and the key sectors targeted as part of the plan include agri-food, tourism, life sciences, manufacturing, retail and financial services/business services.

Although there are no specific regional enterprise policies, Enterprise 2025 was launched in November 2015 to set the strategic framework for coherence across government departments and focus resources in order to foster a better future and to deliver sustainable enterprise growth and jobs in Ireland. The Enterprise 2025 strategy aims to make Ireland the best place to succeed in business by delivering sustainable employment and higher standards of living for all. Thereby, making innovation, competitiveness and productivity the cornerstones of the strategy. It seeks to:

[47] http://www.housing.gov.ie/community/rural-development/leader/eu-rural-development

[48] https://www.djei.ie

- achieve the potential for growth in Irish owned manufacturing and service exports by between 6 and 8 percent annually to 2020;
- realise increased export intensity of Irish owned firms to between 55 and 60 percent; and
- support geographic market diversification (including to high growth emerging markets) so that Irish owned exports to non-UK markets increase by 50 percent; and
- attract and grow export oriented foreign direct investment.

A new report which was published in March, 2018, Enterprise 2025 Renewed[49], stated that the ambition which was set out in the strategy to have unemployment in each NUTs III region to be no more than 1 percent higher than the national average, has already been achieved in a number of regions, with the Midlands region (at 2.4 percent) and the Mid-West region (at 1.5 percent) facing greater challenges. While there are still differences in performance among the regions, the strategy acknowledged that companies are not only attracted to invest in locations where they can access skills they also look for where people will want to live and work and where the surrounding infrastructures are supportive of business. Thereby, increasing the trend toward urban areas of scale and concentrations of economic activity. Consequently, Project Ireland 2040, which was published in February 2018, is considered to be the key instrument for realising the potential of the regions. Project Ireland 2040 aims to Brexit[50]-proof Ireland by investing in the future with a particular focus on the Border Region[51]. This government policy document is the first of its kind in Irish history where planning and investment have been linked, it includes four new funds designed to stimulate renewal and investment in rural and urban areas through the environment and innovation. There is also a significant focus on the environment with €22 billion allocated to tackling and dealing with climate change across transport, energy and commercial State agencies[52].

[49] https://dbei.gov.ie/en/Publications/Publication-files/Enterprise-2025-Renewed.pdf
[50] Brexit is an abbreviation for "British exit," referring to the UK's decision in a June 23, 2016 referendum to leave the European Union (EU).
[51] Border region is a NUTS III statistical region and refers to its location along the Republic of Ireland–United Kingdom border. It comprises of the Irish counties of Cavan, Donegal, Leitrim, Monaghan and Sligo.
[52] http://npf.ie/project-ireland-2040-launched/

5.4 Chapter Summary

This chapter outlined the profiles of the four regions involved in the current research in order to understand each region's settings and identify the relevant actors in each region. Each regional profile outlined the region's demographics as well as its economic activities and information regarding research, development and innovation. This chapter also explored each region's governance structure to better understand how policies are formulated and implemented thereby providing insight into their differences and similarities (see Table 5.2 for the comparison of the four regions in the study).

Indicators	Bucharest-Ilfov	Castilla-la Mancha	Central Hungary	South East Ireland
Unemployment rate (2017)	4.3%	20%	2.7%	9.4% (2016)
Economic Activity rate (2017)	64.1%	64.7%	64.2%	60.1% (2016)
Highest Employment Sectors (2017)	Wholesale and retail trade; transport; accommodation and food service activities	Wholesale and retail trade; transport; accommodation and food service activities	Wholesale and retail trade; transport; accommodation and food service activities	Wholesale and retail trade; transport; accommodation and food service activities (2015)
Disposable income (PPP) Euros (2015)	16,300	12,800	9,600	19,503
At risk of poverty rate (2015)	13.7%	8.5%	17.5%	20.3%
Deprivation rate (2015)	20.5%	36.7%	24.3%	26.1%
Population with tertiary education (2017)	36.1%	27.6%	35.6%	37%
System of Government	Centralised	Decentralised	Centralised	Centralised
Regional Innovation Scoreboard (2017) Innovation Performance	Modest+ Innovator	Moderate Innovator	Moderate+ Innovator	Strong+ Innovator

Table 5.2: Comparison of the four regions *(Source: Current Research)*

Like most European regions, the research regions (Bucharest-Ilfov, Castilla-La Mancha, Central Hungary and South East Ireland) were also affected by the economic crisis in 2008. However, the analysis of the regional data shows evidence of recovery. Even though the rate of unemployment increased in all four regions after the economic crisis,

the numbers of people back in work has increased over the last few years. For example, Central Hungary's unemployment rate as of 2017 (2.7%) is well below the unemployment rate in 2008 (4.8%). While the unemployment rate for Bucharest-Ilfov and Central Hungary is lower than their national unemployment rate, on the other hand, Castilla-La Mancha and South East Ireland's unemployment rate has consistently been higher than their national unemployment rate. However, a positive sign for the Castilla-La Mancha region can be seen as of 2017, where the economic activity rate of 65.3% is, for the first time since 2005, higher than the national average. The economic activity rate of South East Ireland reached its lowest in 2012 with 57.2%, however, it has seen a gradual increase and by 2016 (59.5%) it is only 0.6% lower than the country's economic activity rate. The service sector generates around 70 % of the EU's GDP and employment which is also evident in all of the four regions as the highest employment sector is the 'wholesale and retail trade; transport; accommodation and food service activities' sector.

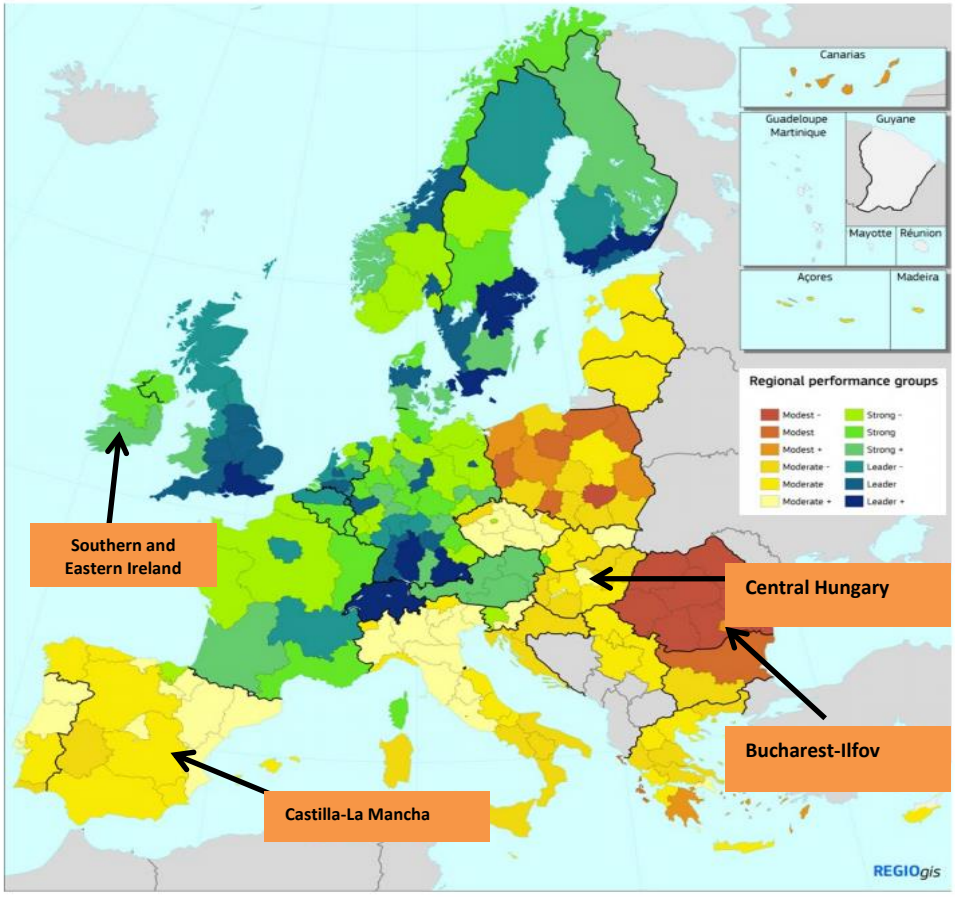
According to the Regional Innovation Scoreboard[53] (RIS, 2017), Europe's regions are grouped into different and distinct innovation performance groups based on their relative performance on the Regional Innovation Index compared to that of the EU. The thresholds in relative performance are the same as those used in the Innovation Union Scoreboard[54]. Based on the performance on the Regional Innovation Index, regions are grouped into different and distinct innovation performance groups. Regions that perform 20% or more above the EU average are classified as Regional Innovation Leaders whereas Regional Strong Innovators are regions performing between 90% and 120% of the EU average. Regional Moderate Innovators are regions performing between 50% and 90% of the EU average and Regional Modest Innovators perform below 50% of the EU average. The RIS, 2017 introduced three subgroups within each performance group to allow for more diversity at the regional level, these are: the top one-third regions (+), the middle one-third regions and the bottom one-third regions (-) (see Figure 5.3).

[53] The regional innovation scoreboard (RIS) is a regional extension of the European innovation scoreboard, assessing the innovation performance of European regions on a limited number of indicators.
[54] The Innovation Union Scoreboard (IUS) gives a comparative assessment of the innovation performance at the country level of the EU Member States and other European countries.

- Innovation Leaders are shown using three shades of blue, with the darkest blue showing the Innovation Leaders + and the lightest blue the Innovation Leaders -.
- Strong Innovators are shown using three shades of green, with the darkest green showing the Strong Innovators + and the lightest green the Strong Innovators - .
- Moderate Innovators are shown using three shades of yellow, with the lightest yellow showing the Moderate Innovators + and the darkest yellow the Moderate Innovators -.
- Modest Innovators are shown using three shades of orange, with the lightest orange showing the Modest Innovators + and the darkest orange the Modest Innovators -.

The regional performance of the four regions in this research is shown in Figure 5.3. Since the South East region of Ireland does not have separate data in RIS[55], the data shown is for the Southern and Eastern region.

[55] RIS data shows NUTS I and NUTS II regional data and South East Ireland is NUTS III region.



For Cyprus, Estonia, Latvia, Lithuania, Luxembourg, and Malta, performance group membership is identical to that in the European Innovation Scoreboard 2017 report. For these countries, the corresponding colour for the middle one-third group in the respective performance group has been used.

Figure 5.3: Regional Performance Group *(Source: RIS, 2017 pg. 17)*

According to RIS (2017), Bucharest-Ilfov is the only Modest+ Innovator performance group (50% below EU average) in Romania whereas all the other regions in the country are classified as Modest-. This difference could be attributed to Bucharest-Ilfov region because it is in the capital and has a major university and R&D centre, the region has a high share of its population with tertiary education (36%) which is above 120% of the EU average. The region also has 52% of the country's R&D expenditure and a public R&D expenditure as share of GDP at 90-120% of EU average.

Likewise, Castilla-La Mancha is ranked as a Moderate Innovator with an innovation performance between 50-90% of EU average. While the region moved from Modest Innovator (RIS, 2016) to Moderate Innovator in RIS, 2017, the biggest weakness of the region is the public R&D expenditure as a share of GDP which is 50-90% below EU average. Conversely, Kozep Magyarorszag's (Central Hungary) innovation indicators are far above the national average and are classified as a Regional Moderate+ Innovator.

The region's relative strengths are the share of population with tertiary education performing above 120% of the EU average. Its relative strength is the private R&D expenditure which is 65% of the national gross expenditure on R&D. On the other hand, South East Ireland's expenditure on R&D data is not available but is measured at the country level. The private R&D expenditure has seen an increase since 2012 reaching €2,293m in 2016. While the higher education sector (HERD) has seen a decline in R&D expenditure since 2008, there has been an increase with R&D expenditure reaching €817m in 2016. The region also has 37% of the regional population with tertiary education compared to 45% of the country's population has tertiary education.

Castilla-La Mancha is the only region in this research that has a decentralised system of government, thereby having their own regional policy. For example, the regional plan for scientific, technological development and innovation (2011-2015) was approved by the government in order to promote innovative and competitive business networks, to increase and optimise the region's existing resources and to promote public-private collaboration. As a result of this strategy, cooperation between universities and research centres led to R&D and innovation projects which are being undertaken in different technical areas. The region also has a smart specialisation strategy (2014-2020) through which the regional government opened a platform-forum where all citizens, industries and stakeholders in the science, technology and innovation system of the region can reflect together on what they want for the future of the region.

On the other hand, Romania has no regional RDI policy as they are nationally designed and coordinated by the Ministry of Education and Research resulting in regions having no role in the policy-making. However, Bucharest-Ilfov Regional Development Agency (ARDBI) plays a role as an intermediary body for the Regional Operation Programme (ROP). ARDBI has been elaborating innovation policy trends for the future in partnership with the local stakeholders for a stronger RDI in the region by developing business support infrastructures such as creating science and technology parks and business incubators. The aim of the strategy is to foster excellence in the fields of research, innovation and technological developments by investing in the development of the largest laser in the world (Extreme Light Infrastructure - Nuclear Physics), including investments related to it, investments in innovation centres and technology transfer, investments in science and technology parks, support and promotion of clusters,

cooperative partnerships between actors in research, education and innovation and infrastructure development in R&D businesses, including specific sectors like agriculture.

Similarly, Hungary being a centralised form of government has operational programmes which are managed centrally. Regional Operational Programmes constitute the framework of strategy innovation implementation, the overall policy objectives include the enhancement of business innovation, and particularly SMEs' innovation activity, improvement of universities' R&D infrastructure, creation and development of knowledge clusters, improvement of human resources, and the spread of innovation culture and improvement of energy efficiency. The sectors and technologies identified as drivers of regional innovation-driven growth include ICT, creative industries, health industry, biotechnology and environmental technologies. Policy measures address these strategic objectives through the promotion of SMEs' investment in technology upgrading, support to basic and applied research and to universities' investment in research infrastructures; support to cluster-based innovation collaboration and to research performers' participation in international research undertakings. It also targets innovation intermediaries such as incubators, technology parks and innovation clusters, supporting the improvement of services and to the development of these organisations' infrastructures. Consequently, it also focuses on the development of tertiary education, improvement of curricula and higher education institutions' student services.

Similar to Hungary and Romania, Ireland also has a centralised form of government and regional policies are formulated by the central government. But there is also a Rural Development Programme (LEADER 2014-2020) in Ireland which provides €250 million to rural communities that are administered by the Local Action Groups (LAGs). LAGs are partnerships of both public and private entities from a defined geographical area. The South East region has five (5) LAGs, one in each county which are responsible for selecting and approving projects in their respective areas in accordance with business plans agreed with the Department of Housing, Planning, Community and Local Government. While there are no specific regional enterprise policies, Enterprise 2025 was launched in November 2015 to set the strategic framework for coherence across government departments and focus resources in order to foster a better future and to deliver sustainable enterprise growth and jobs in Ireland. The policy aims to have

unemployment in each NUTs III region to be no more than 1 percent higher than the national average, has been achieved in a number of regions, with the Midlands region (at 2.4 percent) and the Mid-West region (at 1.5 percent) facing the greater challenge. While there are still differences in performance among the regions in Ireland, the strategy acknowledged that increasing the trend toward urban areas of scale and concentrations of economic activity will attract companies to invest in locations where they can access skills and also look for where people will want to live and work and where the surrounding infrastructures are supportive of business. Consequently, Project Ireland 2040, which was published in February 2018, is considered to be the key instrument for realising the potential of the regions.

In order to answer the Research Question *"How do regional level institutional frameworks influence the evolution of an inter-regional innovation system?"* this chapter addressed one of the six research objectives, namely;

Research Objective 1: To understand the construct of the institutional framework within regions

While the four regions have similarities such as the increasing trend of recovery after the economic crisis of 2008, these regions are still not at the level of competitiveness compared to that of the EU level. Accordingly, there is increasing funding from the EU towards regional collaboration to make peripheral regions more competitive. Therefore, this research aims to understand how regions that do not share borders can develop an inter-regional innovation system.

This chapter outlined regional profiles of the four regions in the current research in order to present each region's settings and their capabilities in order to better understand how their frameworks influence collaboration at an inter-regional level. The next chapter presents findings from the longitudinal data on the perceptions of regional institutions in these four regions as they collaborate at an inter-regional level.

6 Inter-regional Interactions of Institutions

The purpose of this research is to explore the influence of regional institution frameworks on the evolution of an inter-regional innovation system. As outlined in Chapter 4 (Conceptual and Methodological Frameworks), a significant amount of data collection was undertaken to inform this research. However, within this chapter, the quantitative analysis is presented which includes the longitudinal data collected at three (3) time points using the Wilders Collaboration Factors Inventory (WCFI) tool. WCFI is used as an instrument to understand the perception of participants about their collaboration process. The WCFI score helps in assessing the strengths and weaknesses of their collaborative activities. In the current research, WCFI scores are used to determine if the collaboration works and to identify the changes in the Collaborative Group's (CG's) perception over the three time points. In addition to the WCFI scores, this chapter presents an additional analysis of the factors using ANOVA tests which provide details on the differences in perceptions among the CG.

In order to answer the research question, *"How do regional institutional frameworks influence the evolution of an inter-regional innovation system?"* the current research employs multi-phase mixed methods. The previous chapter presented the regional profiles of the four regions used in the current research in order to provide an understanding of the regions' similarities and differences. This chapter presents the quantitative findings which includes the three time-points longitudinal data. The research aims to understand if collaboration can be successful over a distance. Accordingly, the *e*DIGIREGION collaborative partnership (group) was used as a vehicle to answer the research question, it must be stressed that this research and thesis are not about the *e*DIGIREGION project. Rather the unit of analysis and observation were the collaborative partner organisations constituting the *e*DIGIREGION project. This chapter provides findings from the longitudinal data analysis in order to establish if the CG can develop a successful collaboration over a distance. Since it has been stated that the partners in the CG were collaborating from a distance, the aim of the survey questionnaires was not to enquire about geographical proximity, but rather to establish if the CG had a successful collaboration and how this collaboration evolved.

Hence, the WCFI tool was used as a mechanism to gather the data. The WCFI tool was developed and validated by the Wilder Research Centre which identified 20 factors (see Appendix A) that influence successful collaborations. All factors have been tested in multiple studies and are deemed generalisable by the researchers (Mattessich, Murray-Close and Monsey, 2001). Accordingly, the Wilder Research Centre created a questionnaire designed to address the 20 factors with 40 Likert-scale style questions that investigate the details of organisations' actions related to collaboration and partnership. Upon review of the questionnaire for this current research, two extra questions were added to the beginning of the survey. These additions were made in order to capture the basic descriptive/demographic data of the participants in this study as they represent different regions (Bucharest-Ilfov Romania, Castilla-La Mancha Spain, Central Hungary and South East Ireland) and organisational types (Higher Education Institutes, Government and Industry). The two questions are, firstly, participants were asked to name the region they represent and secondly participants were asked to identify the organisation they represent.

The Wilder Collaboration Factors Inventory (WCFI) was administered during three *e*DIGIREGION[56] partner meetings at three (3) different time points (see Figure 6.1). The data collection allows testing for changes in the perception of the collaborative group (CG) during the collaboration process.

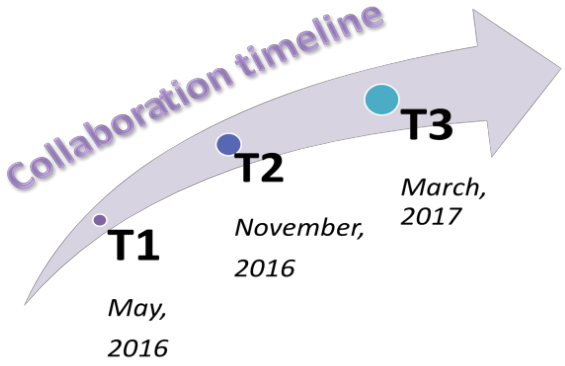


Figure 6.1: Collaboration Timeline *(Source: Current research)*

[56] *e*DIGIREGION was a unique collaborative project which involved fifteen (15) partners from four EU regions: South-East Ireland, Castilla-La Mancha, Spain; Central Hungary and Bucharest-Ilfov, Romania with triple helix partners in each region (research / academic, government representative, and industry).

The first distribution of the survey (May, 2016) gathered 26 completed surveys, the second distribution of the survey (November, 2016) gathered 30 completed surveys and the third distribution of the survey (March, 2017) gathered 27 completed surveys. All the institutions were represented at each of the three time points and 24 of the respondents were also the same for each time point. Therefore the data gathered and the analyses are both valid and reliable. The WCFI research separates the 20 factors into six categories (see Table 6.1). While the WCFI factors are divided into 6 categories, the WCFI scoring mechanism is not generally performed at category level. Therefore, the current research did not analyse the WCFI factors at the category level. Because, analysing at the category level would have limited the findings to just the six categories listed in Table 6.1. Therefore, in order to get a broader understanding of the dynamics involved in a collaboration process and to avoid being confined to just the six categories, the current research analysed WCFI at the factor level (20 factors, see Table 6.1).

Category	WCFI factors
Environment	1. History of Collaboration or cooperation in the community 2. Collaborative group seen as a legitimate leader in the community 3. Favorable political and social climate
Membership	4. Mutual respect, understanding, and trust 5. Appropriate cross section of members 6. Members see collaboration as in their self-interest 7. Ability to compromise
Process and Structure	8. Members share a stake in both outcome and process 9. Multiple layers of participation 10. Flexibility 11. Development of clear roles and policy guidelines 12. Adaptability 13. Appropriate pace of development
Communication	14. Open and frequent communication 15. Established informal relationships and communication links
Purpose	16. Concrete, attainable goals and objectives 17. Shared vision 18. Unique purpose
Resources	19. Sufficient funds, staff, material, and time 20. Skilled leadership

Table 6.1: List of categories from WCFI factors *(Source: Adapted from Mattessich, Murray-Close and Monsey, 2001)*

The following sections present the descriptive statistics from the three separate time points respectively and also provide further analyses of the combined data.

6.1 Descriptive Statistics-*the* survey *respondents*

Descriptive statistics are often used to create a foundation and visual of the data collected by describing and summarising the data at basic levels. Descriptive statistics can be presented as tabulated or graphical descriptions or represented through commentary. In this study, descriptive statistics were used to form a basis for more extensive analysis, to describe the distinguishing characteristics of the organisations involved and the regions they represent and elevate the basic understanding of the level of collaboration based on the factors and categories of the WCFI.

Respondents' regions

Of the 26 complete survey responses in the first time point (T1), 34.6% represented Bucharest-Ilfov region Romania followed by South East region Ireland with 27%. Central region Hungary and Castilla-La Mancha region Spain represented 19.2% respectively (see Table 6.2).

Whereas, at the second time point (T2), 30.00% represented Central Hungary region followed by South East Ireland region and Bucharest-Ilfov with 26.77% respectively and Castilla-La Mancha region represented 16.6% (see Table 6.2).

In the third time point (T3), out of the 27 completed survey, 29.7% represented Bucharest-Ilfov, which was followed by South East Ireland and Castilla-La Mancha region with 25.9% respectively, and Central Hungary region represented 18.5% (see Table 6.2).

Time point	T1	T2	T3
Location where survey was administered	Bucharest, Romania	Albacete, Spain	Waterford, Ireland
Data collection month	May 2016	Nov 2016	Mar 2017
Number of respondents	26	30	27
Regions			
Central Hungary	19.2%	30.0%	18.5%
South East Ireland	27.0%	26.7%	25.9%
Bucharest-Ilfov	34.6%	26.7%	29.7%
Castilla-La Mancha	19.2%	16.6%	25.9%
Total	100%	100%	100%

Table 6.2: Descriptive Statistics-Respondents' regions (Source: Current research)

The *e*DIGIREGION partner meetings were held in a different region each time (see Table 6.2), which explains the changes in the number of respondents per region, as all the partners could not travel to every meeting. Since the survey was administered at different points in time throughout the collaboration process, in order to capture the uniformity in the perception at a particular time point, partners who were not present at these meetings were not followed up to respond to the WCFI survey, it was only those that attended all three meetings that were sent the survey for completion .

Organisation Type

Each region is represented by the triple helix (TH) of organisations (see Table 6.3) viz., Higher Education Institute (HEI), Industry (IND) and Government (GOV) representatives. In the first time point (T1), GOV represented 46.15% of the total respondents followed by HEI and IND with 34.62% and 19.23% respectively. However, in the second time point (T2), HEI represented 43.33% of the total respondents followed by IND and GOV with 30.00% and 26.67% respectively. While in the third time point (T3), GOV represented 37.04% of the total respondents followed by HEI and IND and with 33.3% and 29.63% respectively (see Table 6.3).

From the three time points it can be noted that the participation of IND increased as the collaboration progressed. The GOV participation declined in the second time point (T2) whereas, HEI increased in time point (T2). The differences in the mix of respondents

may have a bearing on the collaborative group's (CG) perception of the collaboration at each time point.

Time point	T1	T2	T3
Location where survey was administered	Bucharest, Romania	Albacete, Spain	Waterford, Ireland
Data collection month	May 2016	Nov 2016	Mar 2017
Number of respondents	26	30	27
Organisation type			
Higher Education Institutions (HEI)	34.62%	43.33%	33.33%
Government Representatives (GOV)	46.15%	26.67%	37.04%
Industry (IND)	19.23%	30%	29.63%
Total	100%	100%	100%

Table 6.3: Descriptive Statistics-Respondents' Organisation *(Source: Current research)*

6.2 Descriptive statistics- Likert *scale variables*

The Likert scale questions used to form the factor-level[57] variables present the perceptions and understanding of the level of collaboration between the different regional organisations at an inter-regional level. As a general rule of interpreting WCFI scores, scores of 2.9 and below are of concern that should be addressed by the CG. However, scores between 3 and 3.9 ought to prompt discussion by the CG to determine if the CG needs to devote attention to these factors. Whereas, a score above 4 indicates the strength of the CG on a factor which does not require attention.

Figure 6.2 illustrates averages of the factor scores from the three time points in WCFI. In T1, all averages fall between 3.25 and 4.58 on the five-point Likert-scale. Factor 6 (members see collaboration as in their self-interest) has the highest average score at 4.58. Factor 1 (history of collaboration or cooperation in the community) has the lowest factor scores in T1. In T2, all averages fall between 3.55 and 4.53 on the five-point

[57] See Appendix A for list of factors in WCFI

Likert-scale. Factor 20 (skilled leadership) has the highest average score at 4.53, while Factor1 (history of collaboration or cooperation in the community) is the lowest score with 3.55. In T3, all averages fall between 3.57 and 4.48 on the five-point Likert-scale. Factor 20 (skilled leadership) has the highest average score at 4.48, while Factor1 (history of collaboration or cooperation in the community) is the lowest score with 3.57. In T2 and T3, Factor 1 continued to be the lowest score.

Even though some of the WCFI scores were borderline and deserve discussion, no intervention was made at any of the time points as the researcher wanted to study the natural progression of the collaboration without external intervention. Therefore, the scores of the CG were not made available to any of the members in the CG. It is understandable that Factor 1 (history of collaboration or cooperation in the community) scored the lowest in T1 as the CG had just started their collaboration process. However, it is well worth noting that some of the partners in the CG had a history of collaborating together on other and previous projects to *e*DIGIREGION, which probably influenced the scores to be higher than what would be expected from a CG that just started their collaboration process from scratch. However, it is clear from the factor scores (Factor 6-Members see collaboration as in their self-interest) that the members believe that they will benefit from their involvement in the CG which could explain the motivation for joining the CG[58].

[58] The lowest and the highest scores for each time points are highlighted in red in Figure 6.2

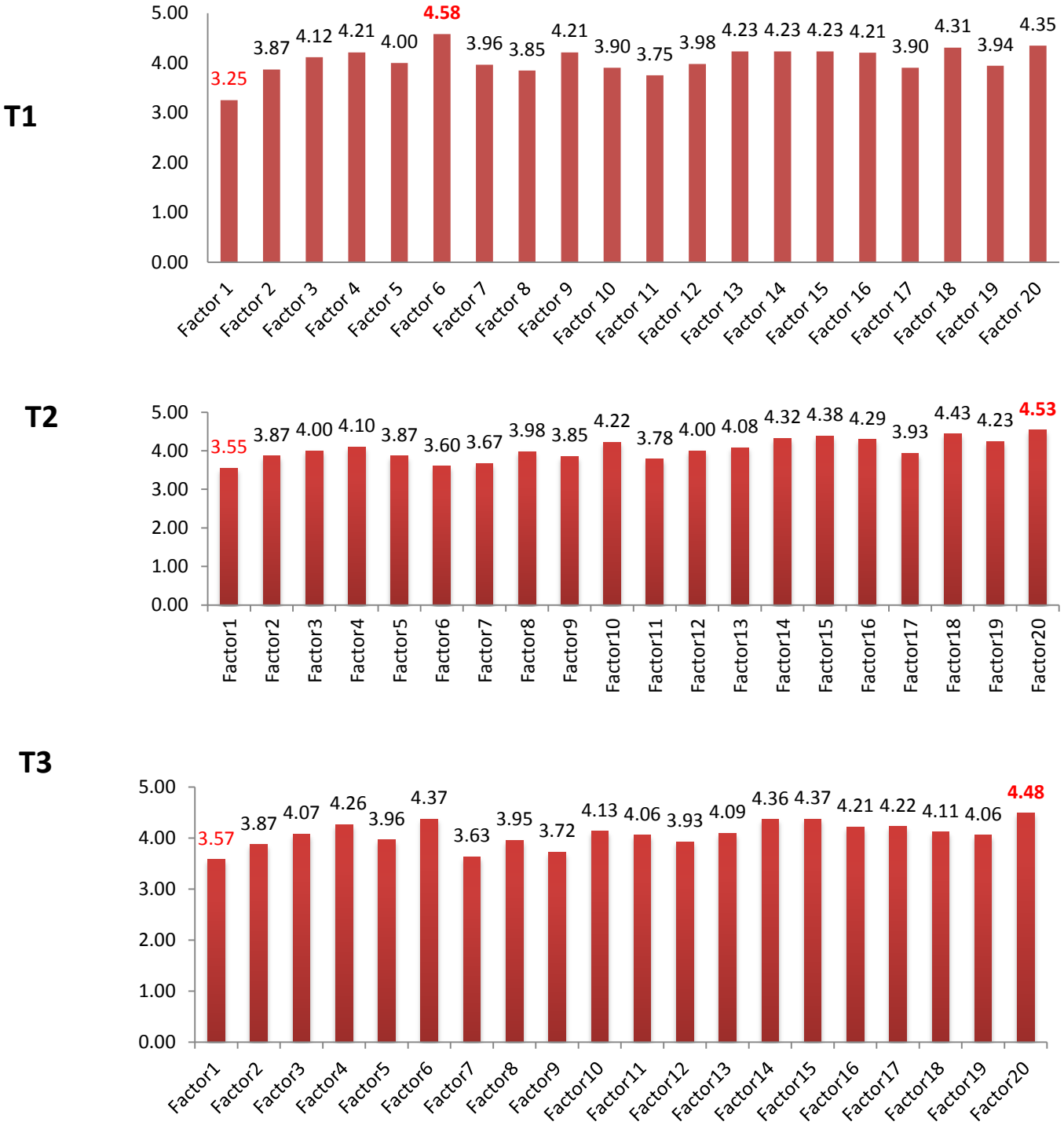


Figure 6.2: Averages of calculated factor scores *(Source: Current research)*

The collaboration of the consortium partners lasted for 36 months; however, the collaboration on an inter-regional level started 18 months from the start of the project. Since the collaboration at the inter-regional level lasted for a total of eighteen (18) months, the CG could see this as a short amount of time to regard it as having history of collaborating with each other. However, as the collaboration progressed, it is noted that

the CG scored Factor 20 (Skill Leadership) as the highest factor, which means the CG sees the leader has organising and interpersonal skills and performs the role with fairness. This speaks volumes for the leadership role (Coordinator), as it is important to have good leadership in any collaboration and also to have the respect or legitimacy from the collaborative partners.

The above section presented the descriptive statistics of Likert Scale variables at three separate time points (T1, T2 and T3). According to WCFI, scores of 1.0 to 2.9 is of concern, which should be addressed, however, all the factor scores in the CG reached the threshold above 3.0 in all the three time points. Even though scores between 3 and 3.9 ought to prompt discussion by the CG to determine if the CG needs to devote attention to the factors, it does not mean it is of great concern or the CG is not working effectively. Even though the factors scores imply that this CG works effectively, whether the perception of the respondents differs among the CG was not shown through the WCFI scores. Therefore, in order to understand the differences in perception among the CG and their variations among and between groups, further analysis was done with the help of ANOVA. The next section introduces the analytical tool employed and the analyses of the three time points using this tool.

6.3 Analysis of Variance (ANOVA)

The nature of the data collected using the WCFI in the current research is Likert scale data. In addition to the WCFI questionnaires, after the pilot study analysis, two extra questions were added to the beginning of the survey. These additions were made in order to capture the basic descriptive/demographic data of the respondents. The two questions are, firstly, participants were asked to name the region they represent and secondly participants were asked to identify the organisation they represent. These two added questions are the independent variables for this analysis. The independent variable is a stimulus or a treatment input, which is manipulated or changed to ascertain its relationship to an observed phenomenon (Jha, 2014). This stimulus variable allows for finding its effect on other (dependent) variables and operates either within a person or within an environment to affect behaviour. Therefore, it is the cause for change in other variables. In the current research, the two additional questions are the two categorical independent variables – (i) Respondents' region and (ii) Respondents'

organisation (see Table 6.4) which will be used to test their effects on the change in behaviour of the dependent variables (i.e. each of the 20 WCFI factors). The dependent variable is the response variable or output, which is observed and measured to determine the effect of the independent variables. For the current research, the dependent variables are the 20 WCFI factors as the answers to the factors are dependent on the descriptives of the respondents (the two categorical independent variables).

Independent Variables	**Dependent Variables**
1. Respondents' region **2.Respondents' organisation**	The Wilders 20 factors (see Table 6.1)

Table 6.4: Independent and Dependent Variables (*Source: Current research)*

Since the analysis at hand requires a test that accommodates categorical independent variables (more than 2 categorical groups) and continuous dependent variables, the assumption for independent t-test was violated. Therefore, the one-way ANOVA was used to determine whether there are any statistically significant differences between the independent variables (see Table 6.4) and the WCFI factors (dependant variables) at three different time-points. Therefore, one-way ANOVA test was run twice at both these levels as the study has two independent variables: (i) respondents' regions and (ii) respondents' organisation.

While the research used one-way ANOVA for analysis, different analytical tools were also considered. For instance, ordinal logistic regression was considered as Likert scale is ordinal by default. Nevertheless, as the analysis was conducted, multiple errors were generated by SPSS. Linear regression was also considered as a possible tool for analysing the data. However, the two independent variables in the current study are categorical and do not pass the assumptions of the test. As this study aims to capture the differences of perception among the CG based on 1) the regions and 2) type of organisations the CG represented, not all tools were valid due to the combination of small respondent base, types of variables, and reduction of variables to factors.

The following sections present the one-way ANOVA tests, firstly based on respondents' regions followed by the organisations they represent.

6.3.1 One-way ANOVA test by respondents' regions

A one-way ANOVA was used to determine the test of significance between the respondents' regions and organisations they represent. After running one-way ANOVA (see Appendix C for descriptives) on all the 20 factors to test the significant differences for the three time points, 8 Factors (see Table 6.5) varied by the respondents' region. In T1, the factor level analysis did not show great differences between the respondents and the regions they represent. The lack of significant variable results in ANOVA analyses shows that regardless of whether a factor is ranked high or low, most respondents involved in the CG see their collaboration similarly in T1. The one-way ANOVA assumes that the population variances of the dependent variable are equal for all groups of the independent variable. If the variances are unequal, this can affect the Type I error rate. However, there was homogeneity of variances, as assessed by Levene's test of homogeneity of variances (p = .225). Since the homogeneity of variances was met, further investigation was done using the Tukey post hoc test to determine where exactly the differences lie. The Tukey post hoc analysis (Table 6.5) revealed that there was a statistically significant (p =0.006) difference between South East Ireland and Central Hungary, but no other group differences were statistically significant. This means that the perception that the CG has support from the political leaders and the general public (or at least they do not oppose the collaboration) is relatively lower in actors representing Central Hungary than that of the actors representing South East Ireland.

In T2, 10 factors varied by the respondents' regions with each significance value below 0.05. Hence, the respondents' perception was statistically different for respondents in different regions regarding the factors that influence their collaborative group (CG). The descriptives (Appendix C) suggests that respondents from South East Ireland rank Factor3 (Favourable political and social climate) higher than the rest of the respondents representing the three regions (mean of 4.69), which is consistent with the findings from T1 (Table 6.5). Respondents' perception of Factor 4 (Mutual respect, understanding and trust) was significantly different between all the regions involved. Bucharest-Ilfov

ranked this factor higher than the rest of the regions with mean of 4.75. Factor 5 (Appropriate cross section of members) was ranked highest by South East Ireland with mean of 4.31 whereas, Bucharest-Ilfov ranked Factor 8 (Members share a stake in both process and outcome) the highest. Furthermore, respondents from Bucharest-Ilfov ranked Factor 9 (Multiple layers of participation), Factor 11 (Development of clear roles and policy guidelines), Factor 14 (open and frequent communication), Factor 15 (Established informal relationships and communication links), Factor 16 (Concrete, attainable goals and objectives) and Factor 17 (shared vision) the highest compared to the other regions involved in the CG. Tukey post hoc analysis (Table 6.5) revealed that there was a statistically significant difference between South East Ireland and Central Hungary (*p=0.001)* and South East Ireland and Castilla-La Mancha (*p=0.015)* for Factor 3 (Favourable political and social climate) and Factor 5 (Appropriate cross section of members). On the other hand, there was statistically significant difference between Bucharest-Ilfov and Castilla-La Mancha (*p=0.046)* and Bucharest-Ilfov and Central Hungary (*p=0.001)* for Factor 4 (Mutual respect, understanding and trust).

For Factor 9 (Multiple layers of participation), there was a statistical difference between South East Ireland and Castilla La Mancha (*p=0.011)* and also between Bucharest-Ilfov and Castilla-La Mancha (*p=0.002).* Accordingly, there was a significant difference between South East Ireland and Central Hungary (*p=0.006)* and Bucharest-Ilfov and Central Hungary (*p=0.01)* for Factor 16 (Concrete, attainable goals and objectives).

As the collaboration process progressed, at T2 the perception of the CG changed. For instance, for Factor 3 (Favourable political and social climate) it can be seen that the mean for South East Irela nd (4.69) did not deviate much from that of T1 (mean=4.71) which is the same for Central Hungary, thus the statistical difference between this two regions, as the perception of respondents from Central Hungary is relatively low as compared to that of South East Ireland. This indicates that respondents from Central Hungary, even after six months of undertaking the collaboration still do not feel they have the support from their region's policy makers and/or general public. In order to create a favourable condition, collaborating partners need to spend time interacting and spreading awareness of the collaboration objectives to the key public leaders and the public. The analyses did not show the lack of engagement thereof, however, this is an interesting matter to follow up for the interview strand since there are other regional

representatives (Castilla-La Mancha) in the CG whose perception changed from that of T1. Accordingly, it is interesting to note the change in the perception of the representatives from Castilla-La Mancha. Even though the representatives felt that they have the support from policy makers and general public initially (mean T1=4.1), it declined in T2 (mean=3.6). Hence, it was relatively lower as compared to South East Ireland.

It is also interesting to note that the perception for Factor 5 (appropriate cross section of members) is statistically different in the CG and that the differences lie between South East Ireland and Central Hungary and also South East Ireland and Castilla-La Mancha similar to that of Factor 3. Since Factor 3 requires collaboration partners to engage with other stakeholders outside of the CG and the inclusion of other stakeholders outside of the CG (Factor 5) would require this engagement in order to identify their mutual needs. Therefore, the engagement with stakeholders outside of the CG or the lack thereof could influence whether appropriate cross section of members exist in the CG.

In T3, three factors varied by the respondents' regions with each significance value below 0.05. The descriptives (Appendix C) suggest that respondents from South East Ireland rank Factor16 (Concrete, attainable goals and objectives) and Factor18 (Unique purpose) higher than the rest of the respondents representing the other three regions (mean of 4.53 and 4.64 respectively). Both South East Ireland and Bucharest-Ilfov regions ranked Factor17 (Shared vision) highest with mean of 4.5. Overall, the factor level analysis showed differences in perception based on the respondents' regions they represent. However, regardless of whether there is difference between the CG, it does not inform which perceptions of respondents differed by region. Nevertheless, Tukey post hoc analysis (Table 6.5) revealed that there was a statistically significant difference between South East Ireland and Castilla-La Mancha (*p=0.019)* for Factor 16 (Concrete, attainable goals and objectives) and South East Ireland and Castilla-La Mancha (*p=0.020)* for Factor 18 (Unique purpose). This means that the goals and objectives of the CG were clear to all the partners and were realistically achievable, however, representatives from Castilla-La Mancha perceived this differently than that of representatives from South East Ireland.

Dependent Variable	(I) Respondent's region	(J) Respondent's region	Mean Difference (I-J)	Std. Error	Sig.
T1					
Factor 3 (Favourable political and social climate)	Central Hungary	South East Ireland	-1.31429*	0.35421	0.006
T2					
Factor 3 (Favourable political and social climate)	Central Hungary	South East Ireland	-1.24306*	0.28365	0.001
	Castilla La Mancha	South East Ireland	-1.08750*	0.33279	0.015
Factor 4 (Mutual respect, understanding, and trust)	Central Hungary	Bucharest Ilfov	-.75000*	0.26985	0.046
Factor 5 (Appropriate cross section of members)	Central Hungary	South East Ireland	-.75694*	0.26288	0.037
	Castilla La Mancha	South East Ireland	-.91250*	0.30842	0.031
Factor 9 (Multiple layers of participation)	Castilla La Mancha	South East Ireland	-1.16250*	0.34357	0.011
	Castilla La Mancha	Bucharest Ilfov	-1.41250*	0.34357	0.002
Factor 16 (Concrete, attainable goals and objectives)	Central Hungary	South East Ireland	-.73611*	0.20184	0.006
	Central Hungary	Bucharest Ilfov	-.69444*	0.20184	0.01
T3					
Factor 16 (Concrete, attainable goals and objectives)	Castilla La Mancha	South East Ireland	-.76190*	0.23794	0.019
	Castilla La Mancha	Bucharest Ilfov	-.69643*	0.23038	0.029
Factor 18 (Unique purpose)	Castilla La Mancha	South East Ireland	-1.07143*	0.33604	0.020

Table 6.5: Tukey HSD by respondent's region for three time points *(Source: Current Research)*

In T1, Factor 3 (Favourable political and social climate) showed a statistical significance of difference between Central Hungary and South East Ireland. This means that the perception about the support from the political leaders and the general public regarding the collaborative group is relatively lower among actors representing Central Hungary than that of the actors representing South East Ireland. Whilst there are 5 Factors that show statistical significance of difference among the regions in T2, there are only 2 factors that are statistically significant in T3 (see Table 6.5 for details). Even though the WCFI score indicates that the inter-regional collaboration was working effectively, the analysis based on respondents' region and the WCFI factors highlighted that there are still differences in perception regarding their CG.

6.3.2 One-way ANOVA test by respondents' organisations

The one-way ANOVA test was conducted to test if there are any significant differences between the 20 factors and respondents' organisation types and shows that none of the factors were significant for T1. However for T2, five of the factors were significant (see Appendix D). Consequently, the differences in perception of the CG between the organisation types vary from that of the regions they represent. For example, Factor 6 (Members see collaboration as in their self-interest), Factor 8 (Members share a stake in both process and outcome), Factor 11 (Development of clear roles and policy guidelines), Factor 12 (Adaptability) and Factor 14 (Open and frequent communication) varied by the respondents' organisation type with a significance value $p< 0.05$. The descriptives (Appendix D) suggest that respondents representing Government (GOV) ranked Factor 6 (Members see collaboration as in their self-interest) highest with a mean of 4.13 and Higher Education Institute (HEI) with the lowest mean of 2.93. Additionally, Government representatives ranked Factor 8 (Members share a stake in both process and outcome), Factor 11 (Development of clear roles and policy guidelines) and Factor 14 (Open and frequent communication) the highest as compared to the other organisations involved in the CG. Overall, the factor level analysis showed differences between the respondents and the organisations they represent and HEI representatives consistently rank the lowest in all the factors. These differences show that the institutional differences have an impact on the perception of the respondents regarding how they view their collaborative process. Tukey post hoc analysis (Table 6.6) revealed that there was a statistically significant difference between GOV representatives and HEI representatives for Factor 11 (Development of clear roles and policy guidelines) (*p=0.004)* and for Factor 14 *(*Open and frequent communication*) (p=0.024)*. On the other hand, there was statistically significant difference (p=0.027) between IND representatives and HEI representatives for Factor 12 (Adaptability). This shows that representatives from HEIs perceive that other organisations in the CG do not clearly understand their roles, rights and responsibilities and do not feel that the CG has the ability to adapt to changes in the collaboration process. It is also interesting to note that while representatives from GOV think that there is regular interaction and communication chain to convey necessary information to one another, representatives from HEI feel otherwise. This difference in perception regarding open and frequent

communication among the collaborating organisations is an important aspect, which will be followed up through the interview process in the next phase of this research.

In T3, three of the factors: Factor 5 (Appropriate cross sections of members), Factor 8 (Members share a stake in both process and outcome) and Factor 11 (Development of clear roles and policy guidelines) varied by the respondents' organisation types with a significance value $p < 0.05$. Tukey post hoc analysis (see Table 6.6) revealed that there was a statistically significant difference between GOV and HEI ($p=0.003$) for Factor 8 (Members share a stake in both process and outcome). Subsequently, there was significant difference for Factor 11 (Development of clear roles and policy guidelines) between GOV and HEI ($p= 0.021$). This implies that representatives from GOV feel that all the members in the CG feel ownership regarding the way the CG works and that roles and rules are clearly understood by all the members whereas, representatives from HEI feel otherwise. This finding is similar to that of T2. The different institutional make up and the influence this has on respondents' perceptions will be explored in the qualitative phase of this research (see Chapter 7, The evolution of an Inter-regional Innovation System).

Dependent Variable	(I) Respondent's Organisation	(J) Respondent's Organisation	Mean Difference (I-J)	Std. Error	Sig.
T2					
Factor 11 (Development of clear roles and policy guidelines)	HEI	GOV	-1.20673*	0.33523	0.004
Factor 12 (Adaptability)	HEI	IND	-.65812*	0.23892	0.027
Factor 14 (Open and frequent communication)	HEI	GOV	-.65705*	0.23322	0.024
T3					
Factor 8 (Members share a stake in both process and outcome)	HEI	GOV	-1.10000*	0.29156	0.003
Factor 11 (Development of clear roles and policy guidelines)	HEI	GOV	-.73889*	0.25483	0.021

Table 6.6: Tukey HSD by respondent's organisation for three time points *(Source: Current Research)*

6.3.3 Institutional gaps

Overall, the one-way ANOVA was performed on all the 20 factors to test the significance of differences, for three time points, by respondents' organisations. None of the factors in T1 had statistically significance of differences among the triple helix organisations. However, in T2, three factors (Factors 11, 12 and 14) had statistically significance of difference among the organisational respondents. Finally, in T3, Factors 8 and 11 show a statistical significance of difference between Higher Education Institutions (HEI) and Government representatives (GOV). The analysis based on respondents' organisations and the WCFI factors underlined that there are differences in perception regarding their CG not only based on the regions they represent but also by the organisations they represent. The differences in perception based on the respondents' organisations and regions they represent highlight the institutional gaps (Van den Broek and Smulders, 2014) in the inter-regional collaboration. This is interesting to note as institutional gaps can act as a barrier to collaboration however, these gaps did not hinder the collaboration among the CG.

6.4 Chapter Summary

This chapter addressed the perception of the collaborative group (CG) during the collaboration process in order to investigate whether collaboration can happen without the existence of geographical proximity on an inter-regional level. Overall, the findings from WCFI suggest that the institutions in different regions identify different favourable conditions at different points in time. At the start of their collaboration process, the members of the consortium believed that they had general public support regarding their collaborative group in their respective regions. However, it was shown that there are differences in perception between regions and indicate that there was statistically significant difference between South East Ireland and Castilla-La Mancha. This suggests that even though the CG as a group believed that they have the support for their CG objectives from policy makers and general public, there was difference in this perception among the collaborating regions. Nevertheless, this perception of public support continued within the CG understanding their roles and expectations and at the same time gaining understanding and respect for the other members of the CG. Even

though the CG sense its members feel 'ownership' of the process and outcome and that roles are clearly developed, the members believe they lack a sense of compromise, flexibility and adaptability.

However, all the members of the CG agree the goals and objectives are clear and attainable and have the same vision with clearly agreed upon strategy. The CG also maintained their perception on the skills of the leadership and that the role is carried out with fairness which granted the leader respect or 'legitimacy' by the CG.

Overall, the findings from WCFI suggest that the CG was working[59] from the beginning (T1) despite the fact that the perception of respondents differed based on regions and organisations they represent. The CG continued to collaborate effectively despite their differences throughout their collaborative process. This, contrary to conventional wisdom, is evident from the research to date that geographical proximity is not an optimal condition for an inter-regional innovation system as the CG works effectively without the existence of geographical proximity.

In order to answer the Research Question *"How do regional level institutional frameworks influence the evolution of an inter-regional innovation system?"* this chapter addressed two of the five research objectives, namely;

> Research Objective 2: To understand the construct of an inter-regional institutional framework
>
> Research Objective 3: To establish how stakeholders in an inter-regional institutional framework interact with each other at an inter-regional level.

The inter-regional institutional framework examined in this research consists of actors in different regional triple helix institutions that do not share contiguous borders and are in a CG to develop an inter-regional innovation system. Even though literature suggests that geographical proximity is advantageous as it reduces coordination costs and transfer of tacit knowledge is possible, the findings suggest that inter-regional institutions involved in the *e*DIGIREGION project established an interaction and collaboration that works effectively over a distance.

[59] The general rule of WCFI suggests that scores below 2.9 raises concern about the effectiveness of the collaboration, and all the scores from T1 were above 3.

The next chapter (Chapter 7, The evolution of an Inter-regional Innovation System) presents the findings from the qualitative phase of this research which includes data collected from seventeen (17) interviews.

7 The evolution of an Inter-regional Innovation System

The purpose of this research is to explore the influence of regional institution frameworks on the evolution of an inter-regional innovation system. As outlined in Chapter 4 (Conceptual and Methodological Frameworks), a significant amount of data collection was undertaken to inform this research. In this chapter, the qualitative analysis is presented which includes data based on interviews conducted with seventeen (17) key informants[60] (See Figure 7.1). The preceding chapters of findings, Profiling the Four Research Regions (Chapter 5) and Inter-regional Interactions of Institutions (Chapter 6) identified the relevant institutional frameworks in a region and their interactions at an inter-regional level. It was shown through these chapters that inter-regional collaboration over a distance among non-contiguous regions is possible. This is contrary to popular opinion that the existence of geographical proximity is absolutely necessary because it is advantageous for innovation (Doloreux and Parto, 2004; Isaksen, 2001; Gust-Bardon, 2012), as being close to each other reduces coordination cost and allows for transfer of tacit knowledge. However, this chapter presents data on how the inter-regional innovation network, studied for this research, emerged and how it worked.

In order to understand how inter-regional innovation systems evolve, the *e*DIGIREGION Collaborative Group (CG) was used as a medium to address the research question. Hence, a purposive sampling technique was employed. While the *e*DIGIREGION project was used as a vehicle to answer the research question, it must be stressed that this research and thesis are not about the *e*DIGIREGION project. Rather the unit of analysis and observation were the collaborative partner organisations constituting the *e*DIGIREGION project. The focus of this research was to study the development of an inter-regional innovation system (iRIS) and how regional level institutional frameworks influence the evolution of an iRIS. The essence aim and objectives of eDIGIREGION project was to create an iRIS, thus its consortium partners were used as a convenient sample for this research.

[60] 1 Coordinator, 4 Regional Lead and 3 triple helix representatives in 4 regions.

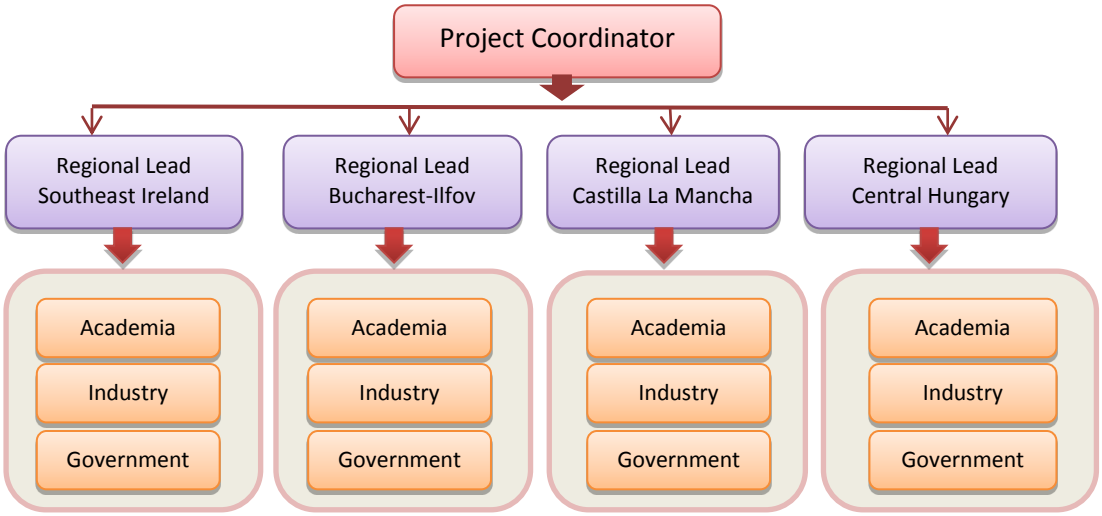


Figure 7.1: Key informants *(Source: Current research)*

The interviews were conducted at three different levels in order to cover all perspective from different aspects of participation. Therefore, the set of questions (see Appendix E, F and G) were different for the three levels of partners in the *e*DIGIREGION project structure (refer to Figure 7.1). Gathering the perspectives of the coordinator and regional leads regarding their roles was important in order to understand the workings of the collaboration from the management level. The set of questions for Coordinator (see Appendix E) includes questions regarding the role and the challenges as the coordinator of the innovation collaboration. The Regional Leads (see Appendix F) questionnaire includes questions relating to their role and challenges as a regional lead, their respective regional focus and Inter-regional collaboration focus. Finally, the Triple Helix representatives' (see Appendix G) questionnaire includes questions, which have a regional and inter-regional focus. All three levels of questions include sets of questions in line with the Wilders Collaboration Factor Inventory (WCFI) (see Chapter 6) in order to derive a deeper understanding of what makes the collaboration work. The following sections present the profile of the interview key informants, the emerging themes (such as proximity, openness to learn and share, leadership and management, and institutional framework) from the interview data collected and the analysis of interview data.

7.1 Profile of key informants

The key informants of the interview phase were the partners from the *e*DIGIREGION project. As well as the coordinator and the regional leads in each region, the triple helix

(TH) representatives were chosen at random from the represented institutions in the consortium. All the informants participated in the longitudinal survey (WCFI) which was conducted throughout the inter-regional collaboration process (see Chapter 6). The profile of all the informants of the interview phase is presented in Table 7.1.

Case Code	Region	Organisation type	Participation level	Role in organisation
Cord	South East Ireland	Academia	Coordinator	Director of research centre
RLie	South East Ireland	Academia	Regional Lead	Project Manager of EU funded projects
RLro	Bucharest- Ilfov	Government Representative	Regional Lead	Head of Innovation Department
RLes	Castilla-La Mancha	Academia	Regional Lead	Professor of Computer Architecture
RLhu	Central Hungary	Government Representative	Regional Lead	National Contact Point for EU projects
GOVie	South-East Ireland	Government Representative	TH Representative	Assistant Director of SE Regional Authority
GOVro	Bucharest-Ilfov	Government Representative	TH Representative	Coordinator and Expert in the agency for regional development
GOVes	Castilla-La Mancha	Government Representative	TH Representative	Director of Universities, Research and Innovation
GOVhu	Central Hungary	Government Representative	TH Representative	Manager of ICT Support Team
HEIie	South East Ireland	Academia	TH Representative	Researcher of Regional Innovation System
HEIro	Bucharest-Ilfov	Academia	TH Representative	Assistant Professor of Computer Architecture
HEIes	Castilla-La Mancha	Academia	TH Representative	Associate Professor of Computer Architecture
HEIhu	Central Hungary	Academia	TH Representative	Head of Technology and Knowledge Transfer Office
INDie	South East Ireland	Industry	TH Representative	Manager of Irish Software Innovation Networks
INDro	Bucharest- Ilfov	Industry	TH Representative	President and CEO
INDes	Castilla-La Mancha	Industry	TH Representative	Project Manager of EU projects
INDhu	Central Hungary	Industry	TH Representative	Director of Hungarian Mobility and Multimedia Cluster's Management Office

Table 7.1: Key informants and their affiliations (*Source: Current research*)

7.2 Key Findings

The qualitative data garnered from the interview process allowed for greater understanding of the workings of the Collaborative Group (CG) at the inter-regional level and the identification of what makes the inter-regional collaboration (IRC) work from a distance. The interview technique described in the Conceptual and Methodological Frameworks chapter (see Chapter 4, Section 4.3.7) shows the dyadic multi-level approach of the interview strand for the inter-regional level, which enabled the author to have an in-depth understanding of the CG from the perspectives of different levels of roles in the CG. The following section presents the key findings from the qualitative data.

7.2.1 Proximity

From the survey results it was established that the locational distances between members of the CG did not have a negative impact on the inter-regional collaboration. However, this scenario was further investigated with the interview questions to establish to what extent did geographical proximity have an impact on the inter-regional collaboration. All of the key informants agree that distance did not hinder the collaboration, moreover, it was pointed out that it was the nature of European projects to have partners that are not geographically close to each other. For example, according to RLie,

> "There is no way around that, I mean European projects will typically have partners which are not in close proximity to each other and I think that's just the nature of this type of project. I don't think it particularly impacted on the success of the project." (RLie)

One of the informants also pointed out that the different modes of transportation to get to the other partners did not matter. They mentioned their history of working with partners that are in close proximity with each other and that they still have to use other modes of transportation to meet. For example according to one respondent,

> "The distance did not have an impact nor was it a problem because we have to work with people who we are actually close with regards distance but we still have to drive to get there. So whether you are sitting in a car, train or airplane, anywhere in Europe is reachable so I don't think the distance affected anything." (GOVhu)

One of the interesting things that was pointed out was the nature of the collaboration. Since the collaboration was policy based, the informants did not feel that regular face-to-face interaction was required to achieve the objectives. For example, according to GOVie,

> "It depends on the nature of the collaboration because the project was more about policy so it is a softer kind of collaboration. It probably would be different if the collaboration was more linked to specific domains or projects where face-to-face contact on a regular basis was needed. But in this case, I would not say that distance impacted on our collaboration and project." (GOVie)

The other aspect that was discovered during the analysis was the relationship between the partners, which helped the collaboration, and with the use of technology, regular communication was possible. GOVro mentioned,

> "I don't think that the distance between us had any negative impact on the collaboration because of technology. The meetings we had together were frequent enough to have good contact with one another." (GOVro)

Overall, the informants did not think the physical distance between the institutions in different regions hindered their inter-regional collaboration. This result supports the findings from the quantitative analysis (see Chapter 6) that inter-regional collaboration can exist without the existence of geographical proximity. While previous research on innovation and collaboration emphasises the importance of geographical proximity as it facilitates knowledge transfer and reduces coordination cost (Storper, 1997; Lawson and Lorenz, 1999; Howells, 2002), the current research suggests that collaboration over a distance can work effectively. However, with the increasing amount of research performed on the importance of different dimensions of proximity (Knoben and

Oerlemans, 2006; Broekel and Boschma, 2012; Hansen, 2015; Fitjar, Huber and Rodriguez-Pose, 2016; Garcia, Araujo, Mascarini, Santos and Costa, 2018), the current research also explored the different dimensions of proximity. The current research suggests that when geographical proximity does not exist, it is substituted by other non-spatial forms of proximity in order to develop an inter-regional collaboration.

Social Proximity

The social proximity as explained in Chapter 3 (Theoretical Frame) is the socially embedded relations between the actors at the micro level. The CG highlighted the importance of the social/informal relationship, which was formed among the collaborating partners. While it was acknowledged that some of the partners had a history of collaborating in the past and some informal relationships were formed, the partners who did not have a history of collaboration with any of the organisations also developed an informal relationship during their collaboration process. This was considered important and helpful for the collaboration in order to increase the trust among the CG as it allowed the interaction environment to be more comfortable and friendly.
One of the informants noted:

> "Normally, the distance would not affect the collaboration if we have the opportunity to get to know each other. When I know the partners personally and I have met them physically once or twice, after that collaboration even with huge distance is not a problem. In my experience physical distance is not a problem." (HEIhu)

This highlights that even without the existence of geographical proximity; the informants felt that as long as they establish an informal relationship, physical distance was not a problem. The informal relationship was also regarded as a critical part of the success of the collaboration. In the words of the project Coordinator,

> "If you do everything just on a formal basis then there is little room for interaction. So having a social aspect to the meetings was a very important part of developing a cohesive collaborative process between the partners" (Cord).

Informal relationships were also considered to be a necessity for a good collaboration and the informants highlighted that CG partners had ample opportunities to develop such relationships through the project activities and the physical meetings which were organised to take place at least two times a year. As RLie mentioned,

> "I think at the end of the day when you strip everything away, it comes down to human interactions and human relationships on a social level, so I think the partners got on extremely well from that point of view and again that was very much down to the fact that that there were physical meetings at least twice a year. So people became more comfortable on a personal level and that helped in the progress of the project." (RLie)

According to Boschma and Frenken (2009), the existence of common relationships (with friendship and trust) is supposed to diffuse informal knowledge and facilitates collaborations. This certainly proved to be the case in this current research. While it is difficult to explain respect and trust, the interview process highlighted some of the perceptions of the informants regarding respect and trust among the CG. Understanding the level of trust and respect among the CG is imperative especially for a collaboration that is operating from a distance, as it could hinder or help the success of the collaboration. All the informants agreed that there was mutual respect and trust among the CG partners. For example, HEIro stated,

> "I think all the partners were respectful and they tried their best to reach the project goals. At times, some partners would even help other partners with their tasks though it was not specifically mentioned as their task in the project." (HEIro)

While the CG believed that mutual trust and respect existed among the partners in the CG, 47% of the informants believed that this mutual respect and trust was sufficient for the collaboration to work well. As mentioned by RLie,

> "I think the mutual respect and trust was sufficient for the collaboration to work well and I think the fact that some of us have worked with each other previously

> helped this. From the very beginning, there was some level of trust across the entire consortium and I think it continued for all the three years of the project." (RLie)

One of the informants also highlighted that the level of mutual respect and trust could not be the same across the CG but agreed that it was sufficient for the collaboration to be successful.

> "In general it was sufficient for the collaboration to work well. However, it was a big partnership so there will always be partners that are more passive and would wait for directions and there would be partners there are more engaging contributing to the collaboration." (INDes)

While 47% of the informants believed that mutual respect and trust was sufficient for the collaboration to work well, 6% did not feel it was sufficient for the collaboration to have been successful as they believed collaboration required much more than trust and respect alone to be successful. However, 47% of the informants think it was a good starting point for the collaboration and regarded it as an enabling factor which was developed over the course of the collaboration. For one of the informants (GOVie), mutual respect and trust was a good starting point but pointed out that respect alone does not get the work done on its own and requires proactive and ongoing management of the collaboration by all the partners involved in the CG. One of the ways the CG can maintain an effective collaboration is by communication. Therefore, interview questions were directed at understanding the frequency of the communication, be it among the partners, from the coordinator and from their own regional lead partner. The overall findings are that the communication was open and also frequent. For example, 29% of the informants expressed that the communication was more frequent when they were involved in specific tasks while the others think that the communication became better as the collaboration process continued. For example, GOVie stated,

> "Yes the communication was frequent but it would have been more so when you are actively involved in work packages and the degree of communication would have been good but if you weren't so intimately involved in activity or work

> packages, it probably was less but at the same time you have less need to be communicated with." (GOVie)

The communication from the regional leads and coordinator was regarded as open and frequent. The emphasis was made on the communication from the Coordinator as one of the informants stated:

> "It was very appropriate and the Coordinator did very well. I think it is a challenge for a Coordinator to deal with different regions equally." (HEIhu)

The researcher's involvement in the project also allowed for access to the email communication data among the CG. This email data (573 emails) was used to generate a Network Sociogram (see Figure 7.2) to show the level of email communication among the CG.

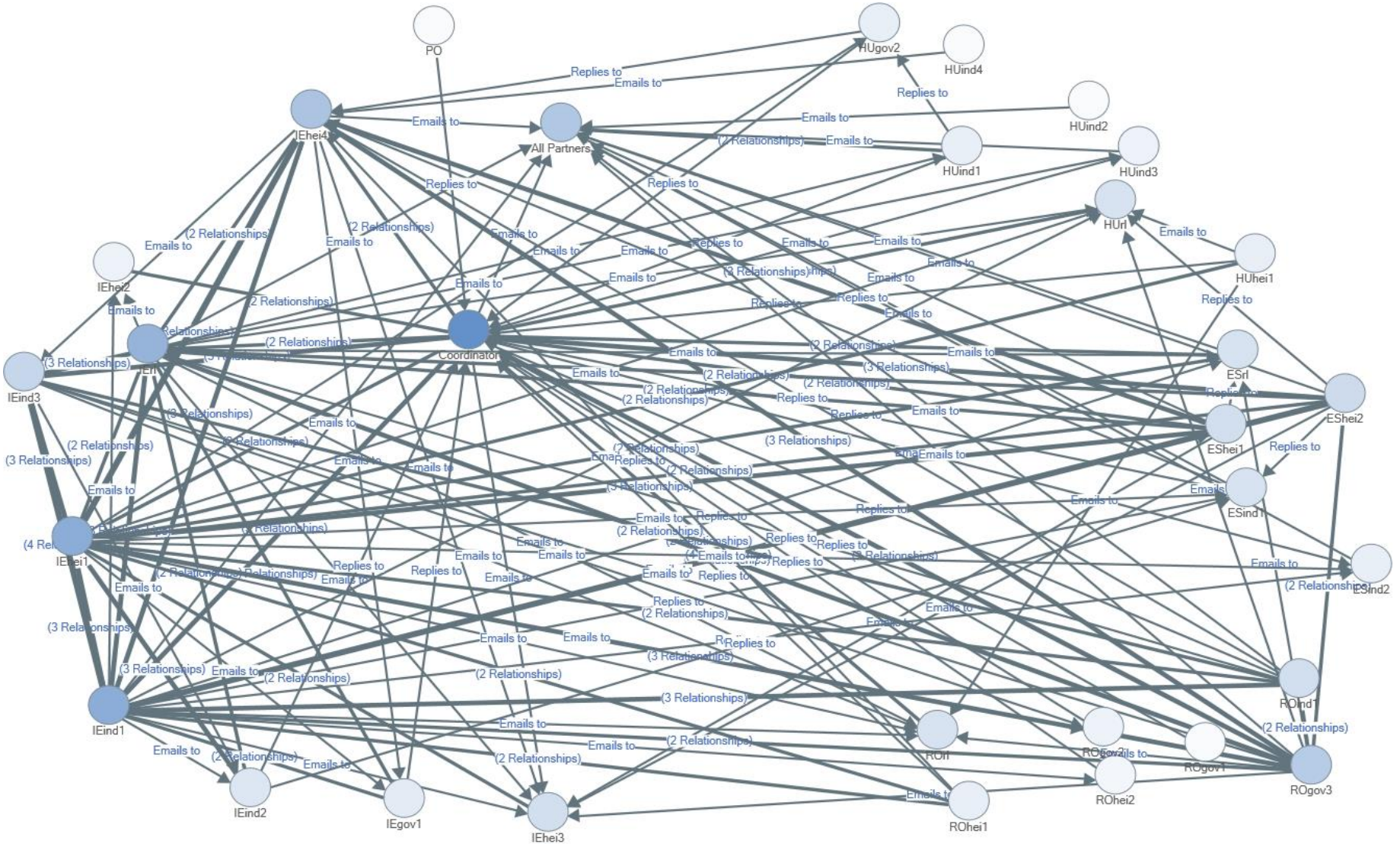


Figure 7.2: Network Sociogram of Email communication *(Source: Current Research)*

The Network Sociogram (Figure 7.2) is a graphic representation of social links between the members of the CG. Each vertex (circle) represents the partners in the CG; the darker the vertex, the higher the degree of links. The edge (line) represents the relationship among the partners; the thicker the edges, the stronger the number of relationships. Figure 7.2 shows the highest concentration of links around the Coordinator, which indicates the frequency of communication to and from the Coordinator and also reflects the informants' perception of the Coordinator's communication and management style. HEIro, for example emphasised,

> "I can tell you that I was very pleased with the professional coordination honestly. The coordinator is very able to coordinate an activity, looking very closely to all the things related to the project. So I was very pleased about his management and dedication to the project." (HEIro)

While the Network Sociogram shows the email interactions among the members of the CG, the researcher had more access to the emails among the South East Ireland regional partners compared to the access to the partners from the other regions. Therefore, the data in Figure 7.2 shows stronger edges among the South East Ireland partners. Hence, this figure is not a representation of the Regional Leads communication (or non-communication) within their own regions but the interactions of the CG as a whole.

Cognitive Proximity

According to Boschma (2005), cognitive proximity in terms of a shared knowledge base is required for actors to communicate, understand, absorb and process new information successfully. One of the interesting themes that emerged from the interviews was the openness to learn from each other and willingness to share knowledge and collaborate. While there were challenges and difficulties, the CG acknowledged this with openness and overcame these by sharing best practices and learning from each other. The informants were appreciative of the opportunity to be able to learn and share information where their region or organisation might not have necessarily been strong. For example, INDes mentioned,

> "I think the success of the collaboration is the way you look at it. Personally, it was a learning experience and a positive one so this also makes you improve your own skills in terms of collaboration because you learn from it." (INDes)

Table 7.2 presents some of the informants' expressions of openness to learn and exchange of information among the CG.

Informant	Expression of willingness to collaborate and openness to learn
RLes	I think the possibility to continue collaborating with the partners even after the end of the project is one of the aspects that worked well in the collaboration. ***We have learned a lot and we are still willing to learn more.*** I think our region is still far from developing what other regions are already establishing. So I think this is very important for our region to have the possibility to collaborate again.
HEIhu	We did not have any collaboration with other partners before and that was very interesting; and I do like the ***learning curve***.
GOVro	I think the exchange of information was what worked well in the collaboration. ***I appreciate the knowledge exchange*** I was a part of, from the partners and especially from Ireland.
RLhu	I think we have a very different work culture, maybe not necessarily just the work culture but culturally it was very different as well. I think at this point it is quite common in European projects to collaborate with different regions so ***you learn something from the other partners and you benefit from their network and also learn from their different approaches***. This was a positive learning experience definitely because good practices were passed on.
INDro	***Sharing of knowledge and best practice*** was one of the aspects that worked really well. It was a pleasure for me to get new knowledge to reframe my ideas and strategies.

Table 7.2: Openness to learn and share *(Source: Current Research)*

It is evident from the findings that there are similarities in actors' perceptions, interpretations and overlap in their knowledge bases. This is very much in line with Knoben and Oerlemans' (2006) research which identified that cognitive proximity, which is based on the notion that sharing routines, cultures, values and norms, facilitates the interaction of actors over geographical distances. While the CG partners were willing to learn and share openly, the informal relationships that existed contributed to this as it diffused informal knowledge and facilitated collaborations. Additionally, identifying the history of previous collaboration before the CG started this particular collaboration provides greater understanding of how this inter-regional collaboration worked. Therefore during the interviews, direct questioning was aimed at having the

key respondents determine the status of their previous collaborations with other partners in the CG. It emerged that 71% of the institutions in different regions had a history of working with other institutions, whether within their region or with other institutions in other regions. Out of the fifteen (15) institutions in the consortium, only five (5) did not have any experience working with the existing CG partners before this collaboration. While some institutions only had experience working with institutions within their region, for example HEIro expressed,

> *"We have a history of working only with regional partners. We have been involved in two other projects with INDro"* (HEIro)

On the other hand the Coordinating partner had experience working with institutions outside of their region; as Cord mentioned,

> "I have worked with a number of partners before. Within both an Irish and European context, I have worked with one of the Romanian partners before. However, I haven't work with any of the partners from Spain or Hungary before." (Cord)

The results from the interview data also explain the findings from quantitative analysis as the findings from WCFI (see Chapter 6, Section 6.2,) showed that throughout the three time points, the history of collaboration scored the lowest but existed to some extent. The findings from the interview data explain the WCFI score by showing that there existed, to an extent, some history of collaboration among the partners.

Organisational Proximity

One of the interesting findings from the WCFI analysis (Chapter 6) was that the perception the CG partners had of the leadership position increased after the first time point and ranked *leadership* the highest for the rest of the time points. While the interview questions did not specifically ask regarding the leadership and management in general, the theme emerged from the data analysis. In particular, the Coordinator was regarded as a good leader, not only did the CG appreciate the coordinator's vision and

management skill, but his dedication to the CG was also held in high esteem. For example, HEIes mentioned,

> "I think that the coordinator of the project did a great job especially when things happened which were not planned; which, in turn, resulted in the partners were flexible to the changes." (HEIes)

Accordingly, an informant praised the leadership as motivating for the CG, by stating, "I think the leadership was concise and motivating for other partners." (HEIro)

The efforts of the Coordinator and Regional Leads were also regarded as one of the reasons why the inter-regional collaboration worked. As HEIie put it, "overall, it worked well. I think it was because of the effort of the regional leaders and the coordinator."

While the interview questions did not specifically ask questions regarding leadership and management, these were highlighted by the informants in the interview process which contributed to this finding. The CG was structured in such a way that there were three levels of participation (refer to Figure 7.1 for the structure). The top level involved the Coordinator, while the second level included the four Regional Lead partners who were the main contact points in each of the regions and the last level included the triple helix representatives in each region. This structure was considered to be effective for collaboration, especially as it involved many institutions in different regions. For example, GOVie elaborated,

> "I see it did work because of the way the partnership was set up. It was set up with four regions with a number of institutions in each region. We did need that kind of hierarchical structure in order to deliver and manage the project. It also provided the balance between the inter-regional nature of the project and on the regional nature of the project." (GOVie)

Even though the effectiveness of the structure was established, it does not guarantee that all partners participate to the same degree of engagement or work rate. The Coordinator and the Regional Leads expressed their efforts to encourage participation from every

level of the structure. While all the triple helix representatives agreed to the encouragement of participation from every level, it was also expressed that this encouragement to participate did not assure participation from all the partners in the CG. For example, HEIhu suggested,

> "Participation in the project was open to every level but that doesn't mean everyone took the opportunity to participate all the time. In the case of my region it was mixed. That was because of us more than the other regions. We could not seize opportunity as much as we should have." (HEIhu)

When there are many institutions involved in a CG, developing clear roles and tasks and making sure every partner involved is aware of the assigned tasks could be difficult and can also impact the smooth process of successful collaboration. The tasks were developed for the CG and were disseminated to all the partners in the consortium. The Coordinator (Cord) of the CG expressed that the tasks were developed clearly for everyone to understand.

> "I think the tasks were clear, they were in the project description of work packages (document) and all the partners have a copy of this document. In the first partners' meeting, we went through the document step-by-step so that everyone could understand what was required of them in the process. So it was very clearly written and very clearly communicated. If the partners do not understand what needs to be done, it is of course very difficult for them to be involved." (Cord)

One of the interviewees (RLie) also agreed that the tasks were clearly stated, but even with that there were delays in delivering tasks. But this interviewee did not believe this was the result of the tasks being unclear and suggested that,

> "I think people who put the proposal together were very experienced and I think the work plan of the project worked well. The only problem was that there was a slippage in the beginning of the project but we caught up on the schedule. But I don't think in any way the slippage was because the work packages were unclear. I think the tasks were very clear and well understood." (RLie)

While the tasks were defined and developed, other informants noted there was confusion for the roles of partners who might not necessarily be the task leaders of specific tasks.

As HEIro opined,

> "The tasks were clearly defined, however, for certain work packages (WPs), although a task leader was clearly mentioned, the level of involvement required from other partners was not specified." (HEIro)

GOVro also shared this perception, but also credited the Coordinating teams for taking the initiative to clarify whenever there were such confusions. According to GOVro,

> "Maybe sometimes there were issues that were not so clear but the coordinating team did their best to clarify what should be the result or what was needed from the work package." (GOVro)

Hansen (2015) stated that the degree of hierarchy in intra or inter-organisational arrangements impacts the ability of the organisations to coordinate their economic activity and avoid uncertainty and opportunism. However, the current study suggests that inter-regional collaboration at a distance was working because of the existence of a good hierarchy of management and leadership in the CG.

7.2.2 Institutional framework

The main objective of this research is to understand how regional institutional frameworks influence the evolution of an inter-regional innovation system. While the institutional frameworks for each region has been established (Chapter 5), the interview process allowed for greater understanding of the respective regional environments. This included understanding the effect of their system of government on policymaking, the existence of a triple helix in their regions and its effect on regional development and its influence at the inter-regional level, the differences in the institutions in the collaboration and the existence of infrastructures for the development of innovation processes in their respective regions.

Out of the four regions involved in the inter-regional collaboration, Castilla-La Mancha is the only region with a decentralised system of government. While the region has autonomy in implementing policies and allocating funds, the differences in regional capabilities makes it ineffective for policies to implement. For example, INDes said,

> "If we compare our region to other Spanish regions, we can see that our region is still at the bottom in the field of innovation, so policies are not very effective. We can see the northern part of Spain for example, which is far ahead and more advanced in the fields of industries and policies." (INDes)

Among the three regions which have a centralised system of government, South East Ireland is the only region which is not centred around the capital of its country. The effect of the centralised government was expressed by interviewees wherein it was suggested that the decisions may not be favourable for the region as policies are made for the country as a whole. For example GOVie stated,

> "The centralised system of government does affect the region significantly. Primarily, policies are driven from central government and it has very much been a top-down approach. Therefore local and regional government has little discretion over policy development at their level where they can bring forward policies and adapt policies suited to their locations. They have to align their policies with the overarching national policy guidelines and national parameters." (GOVie)

Informants from the Bucharest-Ilfov region expressed that even though the polices are debated and developed by national government and then implemented by regional authorities or by ministries at national or regional level, the region being the capital has an advantage over the other regions. RLro iterated,

> "I think for a region which is in the centre where all the decision-making happens, it is easier for our region and that probably explains why our region is the most developed region in our country. It has direct access to all the resources." (RLro)

On the other hand, the Central Hungary region is located around the capital of the country which also has a centralised system of government. While there are no regional development bodies and agencies in the country and policies are created by the central ministry, the informants expressed that this system makes sense for the country. For example, GOVhu said,

> "Most of the relevant decisions are done at the central level so there's no regional authority. There used to be a regional authority but everything has become more centralised. I think in Hungary it makes sense the way it is right now because of the way the whole country is built." (GOVhu)

The four regions have different innovative capabilities and regional structures. However, this does not hinder the inter-regional collaboration among the collaborative group (CG). The regional triple helix institutions in the CG are different from each other, therefore, the interview data was analysed to identify the different institutional gaps that could influence the collaboration process. On analysing the data, it was found that the informants identified different institutional gaps in the inter-regional collaboration as per the normative and cultural-cognitive and regulative gaps (See Table 7.3). Regulative gaps refer to the barriers of cooperating among actors resulting from formal institutions such as rules and regulations. On the other hand, normative and cultural-cognitive gaps refer to the gaps that can occur due to the limited knowledge of the values, norms and cultures (refer to Chapter 3, Section 3.5.2, for more details). Table 7.3 highlights the gaps that were identified by the key informants. However, these institutional gaps did not hinder the inter-regional collaboration.

Normative and Cultural-Cognitive gap
"Perhaps, each type of organisation has different expectations. For example, finding what we can do together at an inter-regional level to make sense of all the different options and deliverables was not an easy thing to do" (GOVhu)
"I think it stems from the same thing like finding what is common. In the end some goals were not relevant for everybody and I think that is expected so I would not say it didn't work well but just some things are not so relevant for my organisation" (RLhu)
"I guess it is getting to the kernel of what you are trying to achieve to undertake the objectives of the project with so many organisations being involved. It can be very difficult sometimes to bring a consensus or clarity to what you are doing and so you might guess that the final outcome could be not what you have envisaged at the onset." (GOVie)
"The main difference is the resources and commitment to achieve the goals" (HEIes)
"I think the organisational cultures are quite different so it was also another challenge of the project because you are not only talking about the culture differences between the regions or the countries, we are also talking about organisational difference. That adds difficulty to the culture differences" (INDes)
"I think we have a very different work culture maybe not even just work culture but culturally it was also very different as well. I think at this point, it is quite common in European projects so you learn and benefit from the network and from different approaches. Being exposed to these differences was a positive definitely because good practices were passed on but on the negative side, sometimes it was difficult to move along with some decisions because of the different cultures." (GOVhu)
"I think the main thing was the difference between the organisational cultures. The fact that some of them are from academia, some are from industry and some are from the public sector. And I think with time people got to know each other and the difference in culture did not matter." (RLro)
Regulative gap
"I think the biggest problem was related to the triple-helix with the government, regional or central government. Some relations with the governmental stakeholders were different and challenging. This is a very difficult situation so it was very difficult to engage with government stakeholders especially in the beginning because we did not know who to contact in the government". (HEIhu)
"In the CG we had to deal with different kinds of institutions. For example, we are dealing with more bureaucratic institutions like universities, so they cannot really make all their decisions by themselves as they have their own structure and then we also have smaller companies where the hierarchy most probably is flexible. So decision-making is easier. Perhaps for the coordinating partner, it could be a little challenging but it was quite an experience to deal with different working styles" (INDes)
"If you look at the type of institutions that are in collaboration, for example, in our own region we have the government agencies which have their own rules and we have higher education institutions which have a different set of rules and way of operating, and also you had various mind-sets of people with wonderful attribute sets from those institutions. And you have people coming into the project for the first time trying to understand how the project or how the collaboration works so whichever country you are from you will always have a totally different mind-set and culture and dynamic between the triple-helix institutions." (INDie)
"Probably that our regions are very very different that were involved in the project. So some of the regions were much more decentralised. We are a much centralised region with lots of big universities and big population." (RLhu)

Table 7.3: Institutional Gaps identified by informants (*Source: Current Research*)

Table 7.3 highlights the different institutional gaps which were identified by the informants on their inter-regional collaboration. The informants were aware that the CG was a big partnership with many institutions and realised that it is difficult to have all the partners equally motivated and actively participate. They also highlighted the difference in not only organisational culture but also the differences in their countries' cultures, which was sometimes a difficulty when trying to make decisions. While they pointed out these differences, they also acknowledged that as the collaboration progressed they got to know each other much better and these differences did not negatively impact on making their collaboration work. While the differences in the rules and regulation of each institution was also highlighted: from a more bureaucratic institutions like universities to a more flexible hierarchy of smaller companies where decision-making is easier, the informants emphasised the experience and the learning that was gained by being exposed to the different working styles in the CG. Overall, different institutional gaps did exist in the CG, which however, did not hinder the inter-regional collaboration. For example, RLro highlighted one of the institutional gaps that existed in the CG, which however did not affect the collaboration, as follows:

> "I think the main thing was the difference between the organisational cultures. The fact that some of them are from academia, some are from industry and some are from the public sector. And I think with time people got to know each other and the difference in culture did not matter." (RLro)

The preceding sections addressed how inter-regional innovation collaboration happens and how regional institutional frameworks have an influence on developing an inter-regional innovation system (iRIS). Seventeen (17) key informants were interviewed to gather the data for the analysis. Overall, the findings suggest that the differences in the collaborative group (CG) did not hinder the collaboration. Even though it has been established in Chapter 6 that the inter-regional collaboration worked, the interview phase provided an in-depth understanding of the informants' perceptions regarding the inter-regional collaboration process. The findings suggest that distance did not have a negative impact on the collaboration and that it is common among European projects to collaborate with regions that are not necessarily close to each other and are non-contiguous in nature. It was also found that distance did not impact the collaboration

because of the type of collaboration the CG was in. The soft (policy) research involved in the collaboration did not require constant face-to-face interaction while other types of collaboration that need constant face-to-face interaction and transfer of tacit knowledge could be impacted by the distance between the regions. The analysis uncovered differences (institutional gaps) such as culture, organisational and work culture. However, these differences did not hinder the collaboration as the informants felt it was a good opportunity to learn from each other and share knowledge not only regarding the project but the workings of each other's region.

In order to answer the research question *"How do regional institution frameworks influence the evolution of an inter-regional innovation system?"* the preceding sections addressed one of the five research objectives, namely;

Research Objective 4: To examine the extent of effects of different types of proximity at an inter-regional level.

The different forms of proximity were addressed in this chapter. Firstly, the geographical proximity where the findings suggest that it did not influence the workings of the CG. Secondly, social proximity was explored. The informal relationship was one of the key themes, which emerged as one of the most important elements, which made the inter-regional collaboration effective. Thirdly, cognitive proximity was explored; here the findings presented that there are similarities in actors' perceptions, interpretations and overlap in their knowledge bases which was crucial in the interaction of actors over geographical distances. Fourthly, organisational proximity was presented wherein the leadership and management were regarded as one of the most important factors that made the inter-collaboration worked. Finally, regional institutional frameworks were explored. The findings suggest that the CG partners have different systems of government and while it impacts their policy making for the region, collaborating on an inter-regional level allowed them to learn from the other regions.

Overall, the findings suggest that even though there were many challenges and regional institutional frameworks are not ideal, the inter-regional collaboration worked because of leadership and good management (organisational proximity), the relationships (social

proximity) which existed among the CG partners, especially the informal relationships and their openness to learn and share knowledge (cognitive proximity) with each other.

While the preceding sections addressed the fourth research objective "To examine the extent of effects of different types of proximity at an inter-regional level", they do not directly address the fifth research objective, to investigate if regional institutional frameworks have an effect on the evolution of an inter-regional innovation system (Research Objective 5). The following sections present how the findings from the current research are triangulated in order to address the fifth research objective.

7.3 Inter-regional Interaction and the Evolution of an iRIS- bringing it all together

The purpose of this research was to explore the influence of regional institutional frameworks on the evolution of an inter-regional innovation system. A significant amount of data collection was undertaken to inform this research (see Chapter 4, Conceptual and Methodological Frameworks) in order to address the research question:

> How do regional level institutional frameworks influence the evolution of an inter-regional innovation system?

In order to address the research question and objectives, a multiphase data collection method was undertaken (wherein desk research (Regional Profiles), three time-point longitudinal surveys were administered (WCFI) and interviews were conducted with the collaborative group (CG).

Firstly, a desk research (Chapter 5, Profiling the Four Research Regions) was conducted on the four regions to understand the regional settings and the actors that are involved in the regional institutional frameworks. Each regional profile outlined the region's demographics as well as its economic activities and information regarding research, development and innovation. While the findings suggests that the four regions have similarities such as increasing trends of recovery after the economic crisis of 2008, these

regions are still not at the level of innovativeness compared to that of the EU level[61]. Chapter 5 outlined regional profiles of the four regions in order to understand each region's settings and their capabilities, and their governance structure, which provided a better knowledge of how policies are formulated and implemented thereby providing insight into the regions' institutional frameworks. Thus, Chapter 5, Profiling the Four Research Regions, addressed the first research objective: to understand the construct of institutional frameworks within regions (**Research Objective 1**).

Secondly, a longitudinal survey was conducted (Chapter 6, Inter-regional Interactions of Institutions) at three (3) time points using the Wilders Collaboration Factors Inventory (WCFI) tool. This tool was developed and validated by the Wilder Research Centre which identified 20 factors that influence successful collaborations. These factors have been tested in multiple studies and are deemed generalisable by the researchers (Mattessich, Murray-Close and Monsey, 2001). The longitudinal approach provides for a better understanding of the collaborative group (CG) as the collaboration progresses and also provides data for testing changes in the respondents' perceptions from one time point to another. Overall, the findings from WCFI suggested that the CG was working from the beginning (T1) despite the fact that the perception of regions and organisations differ. The CG continued to collaborate effectively despite their differences throughout their collaborative process. This, contrary to conventional wisdom is evident from the research to date that geographical proximity is not an optimal condition for an inter-regional innovation system as the CG worked effectively without the existence of geographical proximity. Chapter 6 addressed two of the five research objectives, namely; to understand the construct of an inter-regional institutional framework (**Research Objective 2**) and to establish how stakeholders in an inter-regional institutional framework interact with each other on an inter-regional level (**Research Objective 3**). The inter-regional institutional framework examined in this research consists of actors in different regional triple helix institutions that do not share contiguous borders and are in a CG to develop an inter-regional innovation system. The findings suggested that inter-regional institutions involved in the *e*DIGIREGION

[61] While Southern and Eastern region of Ireland is a strong innovator, South East Ireland region alone is not.

project established an interaction and collaboration that works effectively over a distance.

While the longitudinal data established that interaction and collaboration worked effectively on an inter-regional level, interviews were conducted with seventeen key informants from the CG (Coordinator, n=1), each of the regional leads (n=4), and a randomly selected representative from each element of the Triple Helix in each of the four regions (n=12) to understand how the *e*DIGIREGION inter-regional innovation network emerged and how it worked. The interview phase (Chapter 7, The Evolution of an Inter-regional Innovation System) provided an in-depth understanding of the informants' perceptions regarding the inter-regional collaboration process. The findings suggest that distance did not have a negative impact on the collaboration and that it is common among European projects to collaborate with regions that are not necessarily close to each other and are non-contiguous in nature. It was also found that distance did not impact the collaboration because of the type of collaboration involved in the *e*DIGIREGION project. The soft (policy) research involved in the collaboration did not require constant face-to-face interaction while other types of collaboration that need constant face-to-face interaction and transfer of tacit knowledge could be impacted by the distance between the regions. The findings also suggest that the CG partners have different systems of government and while this impacts their policy making for the region, the informants highlighted that engaging their regional government was challenging. Additionally, the different forms of proximity were also addressed. Firstly, the geographical proximity where the findings suggest that it did not influence the workings of the CG. Secondly, institutional proximity was examined where different institutional gaps were identified. However, the findings suggest that these gaps did not hinder the collaboration. Furthermore, social, cognitive and organisational proximity were addressed. The informal relationships among the CG partners, openness to learn and share from each other and good management and leadership in the CG were the key themes, which emerged as the most important elements, which made the inter-regional collaboration effective. Thus, Chapter 7 (sections 7.1 to 7.2.2.) addressed the fourth research objective, to examine the extent of effects of different types of proximity on an inter-regional level **(Research Objective 4**).

While these chapters of findings addressed four of the five objectives of the current research, they do not directly address the fifth objective, to investigate if regional institutional frameworks have an effect on the evolution of an inter-regional innovation system (Research Objective 5). In order to address this objective, the findings from profiling the four research regions (Chapter 5) and the evolution of an inter-regional innovation system were triangulated (see Figure 7.3). The different regional institutional frameworks identified for the four regions provided an understanding of the region's settings and their capabilities, and their governance structure, which provided a better understanding of how policies are formulated and implemented. These provided an insight to the differences and similarities among the institutional frameworks which helped in the investigation of their effect on the development of inter-regional innovation system (iRIS).

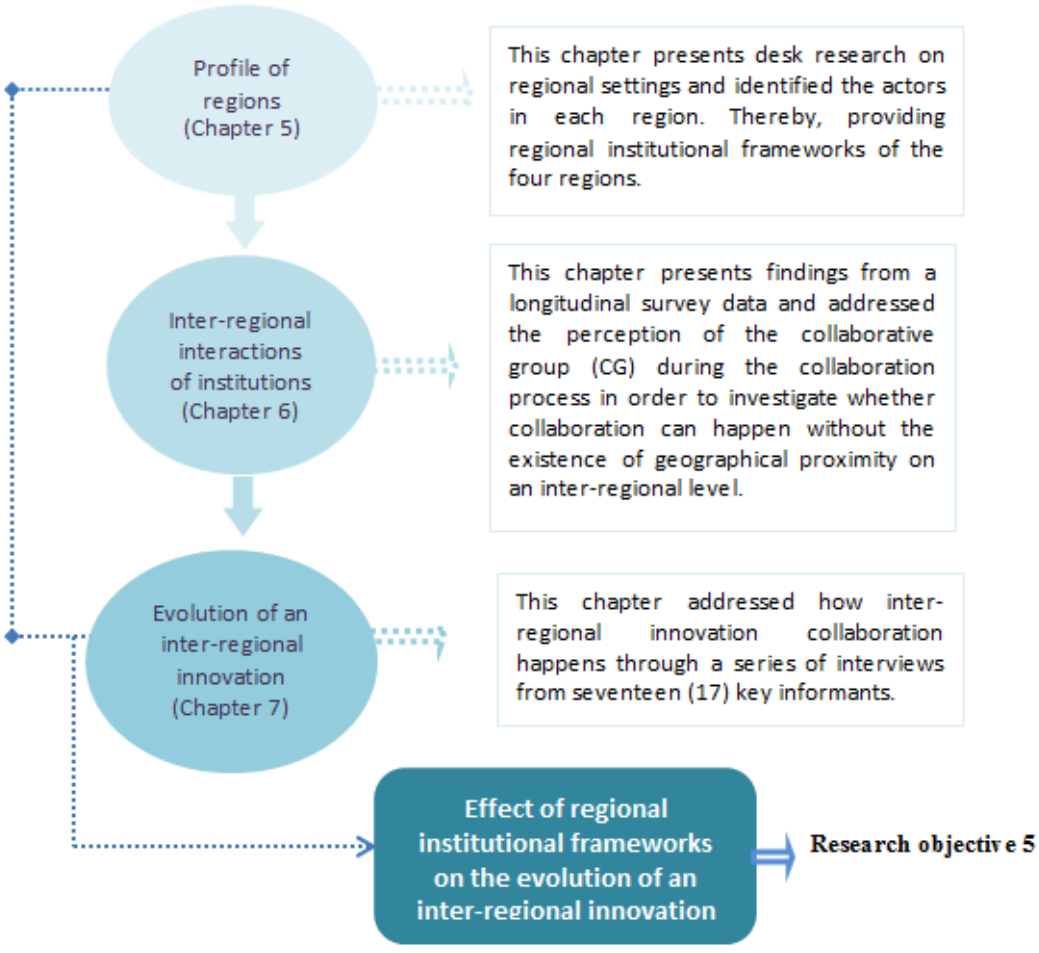


Figure 7.3: Structure of findings chapters *(Source: Current Research)*

An institutional framework, which was established in Chapter 5, is generally understood as the system of formal laws, regulations, and procedures, and informal conventions, customs and norms that broaden, mould and restrain socio-economic activity and behaviour (Donnellan, Hanrahan and Hennessy, 2012). The institutional framework holds the formal and informal rules, the organisational set where certain actors interrelate in order to achieve specific goals, establish policies and procedures. While the four regions in this research have different systems of formal laws, regulations and procedures, they have policies formulated by their governments to initiate collaboration among industries and universities for regional development. The findings also showed that there is sufficient human capital with third level education in each region for performing research and innovation activities as well as physical infrastructure such as Science Parks, incubation centres and accelerator programmes. The interview findings suggest that, in each of the four regions, there is a development towards a cohesive regional institutional framework in the form of triple helix (TH) institutions. However, it was also addressed that there is a gap in sharing knowledge or information between the TH partners. Nevertheless, there are initiatives for programmes to encourage collaboration among the TH partners and the informants also feel that collaborating on an inter-regional level would bridge this gap.

Although the findings suggested differences in the regional institutional frameworks, it also acknowledged that as inter-regional collaboration progressed, the institutions involved got to know each other much better (creating both formal and informal relationship) therefore; these differences did not negatively impact on making their collaboration work. On the other hand, the differences in the rules and regulations of each institution were also highlighted (from a more bureaucratic institution like universities to a more flexible hierarchy of smaller companies where decision-making is easier). However, the informants emphasised the positive experience and the learning that they gained as a result of being exposed to the different working styles in the CG.
Hence, this section addressed the Research Objective 5: *Investigate if regional institutional frameworks have an effect on the evolution of an inter-regional innovation system.*

Overall, different institutional gaps existed in the CG, which however, did not hinder the evolution of an inter-regional innovation system. In fact, 2.5 years after the completion of the *e*DIGIREGION project, many of the CG partners are still collaborating on various project proposals for EU funding and also on the six (6) inter-regional joint action plans (iJAPs). The iJAPs are:

1) Establishment of a trans-regional industrial doctorate (iPhD)
2) Bringing universities curricula to meet industry market needs
3) Create a Transnational Research Network (TRN)
4) Preparation of project proposals
5) Establish thematic groups of experts
6) Increase understanding about the "4.0" approach

7.4 Chapter Summary

The different forms of proximity were addressed in this chapter. Firstly, the geographical proximity where the findings suggest that it did not influence the workings of the CG. Additionally, social proximity was explored. The informal relationship was one of the key themes, which emerged as one of the most important elements, which made the inter-regional collaboration effective. Consequently, regional institutional frameworks were explored. The findings suggest that the CG partners have different systems of government and while it impacts their policy making for their respective regions, collaborating at an inter-regional level allowed them to learn from the other regions. Overall, the findings suggest that even though there were many challenges and that regional institutional frameworks are not ideal, the inter-regional collaboration worked because of leadership and good management (organisational proximity), the relationships (social proximity) which existed among the CG partners, especially the informal relationships and their openness to learn and share knowledge (cognitive proximity) with each other. Secondly, institutional proximity was examined where different institutional gaps were identified. However, the findings suggest that these gaps did not hinder the collaboration.

Additionally, the chapter presented how the findings chapters were triangulated in order to address the research question "How do regional level institutional frameworks influence the evolution of an inter-regional innovation system". The next chapter

presents discussion on the findings of the current research and the framework for developing an inter-regional innovation system.

8 The Influence of Institutional Frameworks and Proximity in developing an iRIS

The objective of this research was to investigate whether institutional frameworks at a regional level influence collaboration at an inter-regional level for the evolution of an inter-regional innovation system. In other words, the aim was to examine if the interactions on an inter-regional level are effected by the dynamics of the regional environment. Therefore, the research question was:

How do regional level institutional frameworks influence the evolution of an inter-regional innovation system?

In order to address this research question, the objectives of the research were to:

1. Understand the construct of the institutional framework within regions
2. Understand the construct of an inter-regional institutional framework
3. Establish how stakeholders in an inter-regional institutional framework interact with each other on an inter-regional level.
4. Examine the extent of the effects of different types of proximity at an inter-regional level.
5. Investigate if regional institutional frameworks have an effect on the evolution of an inter-regional innovation system

Answers to these questions were sought using mixed methods in order to provide for a rich understanding of the influence of institutional frameworks in an inter-regional innovation system in a real world setting. A purposive sample of four (4) European regions that collaborated at an inter-regional level were chosen as a medium to answer the research question. The regions were, Bucharest-Ilfov, Romania, Castilla-La Mancha, Spain, Central Hungary, Hungary and South East Ireland, Ireland. These four regions collaborated in a European Commission funded project called *e*DIGIREGION.

However, as already stressed in Chapter 1, Section 1.1, the focus of this research is on the inter-regional collaboration between institutions from the four regions; it is not about the *e*DIGIREGION project. The key findings from the current research are:

1. Inter-regional collaboration can happen without the existence of geographical proximity.
2. A combination of three non-spatial proximities (cognitive, social and organisational proximity) was considered to be vital for inter-regional collaboration.
3. The different regional institutional frameworks do not hinder the development of an inter-regional innovation system.

The following sections discuss the key findings of this research in detail.

8.1 The impact of geographical proximity

It has been argued that proximity is a very important factor for innovation (Knoben and Oerlemans, 2006; Hansen, 2015) highlighting that a certain form of proximity is required for successful knowledge interactions. Boschma's (2005) seminal paper focused on how proximity facilitates interaction and reduces coordination costs. At the same time, it also explored how proximity may reduce the possible advantages from collaborating due to a lack of complementarity leading to lock-in. While research on innovation and collaboration emphasises the importance of geographical proximity as it facilitates knowledge transfer and reduces coordination cost, an increasing amount of research has been performed on the importance of different dimensions of proximity (see for example Knoben and Oerlemans, 2006; Broekel and Boschma, 2012; Hansen, 2015; Fitjar, Huber and Rodriguez-Pose, 2016; Garcia, Araujo, Mascarini, Santos and Costa, 2018). Similarly, the current research explored the different dimensions of proximity, specifically on an inter-regional collaboration in the absence of geographical proximity. The empirical results from this research show that inter-regional collaboration can happen even where there is no geographical proximity. The longitudinal surveys, which were administered at three different time points of the collaboration process, revealed that the inter-regional collaboration was working from the beginning (T1). This suggests that the spatial distance among the regions involved

in the Collaborative Group (CG) did not hinder the collaboration process. Even though the CG was not in close proximity, it had good and frequent communication be it through emails, video calls and physical meetings (in the form of partner meetings or conferences) and the informants stated that the distance did not impact their collaboration because even when the partners are in close proximity they still had to travel (by car or train).

The CG in the current research consisted of partners in the *e*DIGIREGION project. The *e*DIGIREGION consortium consisted of 15 partners from four EU regions. The four regions (Bucharest-Ilfov, Romania, Castilla-La Mancha, Spain, Central Hungary, Hungary and South East Ireland, Ireland) do not share contiguous borders; hence the 15 partners collaborated from a distance. While the role of tacit knowledge in innovation is the primary basis for the importance of the geography of innovation (Gertler, 2003), empirical studies (Huber, 2012; Hansen, 2015; Fitjar et al, 2016) have examined the substitution effect for geographical proximity with other forms of proximity. Consequently, the current research also examined the possibility of substituting geographical proximity with the non-spatial forms of proximity. While these previous research looked at substitution mechanisms, they have considered the substitution of geographical proximity with just one other form of proximity. For example, Garcia et al. (2018) looked at substituting geographical proximity with cognitive proximity for an university-industry collaboration from a distance while Hansen (2015) looked at the possibility of substituting geographical proximity with non-spatial forms individually. However, the current research explored substituting geographical proximity with three other forms of proximity, viz., social, cognitive and organisational proximity for an inter-regional collaboration from a distance. The existence of a good social relationship, the openness to learn and share and the good leadership and management contributed to the success of an inter-regional collaboration where all the collaborating partners were not in close proximity. Hence, the findings from this research indicated that these three non-spatial forms of proximities were considered to be the key determinants (see Section 8.4) for detailed discussion) of making an inter-regional collaboration work.

The findings from this research suggest that inter-regional collaboration can exist without geographical proximity. All of the key informants agreed that distance did not hinder the collaboration, moreover, it was pointed out that it was the nature of European

projects to have partners that are not geographically close to each other. While certain studies (Katz, 1994; Gertler, 2003; Storper and Venables, 2004; Pan, Kaski and Fortunato, 2012) have provided evidence of the advantages of being close to one another and that geographical distance can be an impediment to collaboration, the current research provided evidence that collaboration can happen even at a distance and that geographical proximity is not a prerequisite for collaboration. This evidence was shown based on the *e*DIGIREGION's successful collaboration on implementing its 6 iActions. The iActions were:

1. Establishment of trans-regional industrial doctorate (iPhD),
2. Bringing universities curricula to meet industry market needs,
3. Create a transnational research network (TRN),
4. Preparation of project proposals,
5. Establish thematic group of experts and
6. Increase understanding about the '4.0' approach.

One of the interesting aspects that was also highlighted in the current research was the nature of the collaboration. Since the collaboration was policy based, the informants did not feel that regular face-to-face interaction was required to achieve the objectives. However, the temporary geographical proximity through partners' meetings and conferences helped in overcoming the distance between the regions.

8.2 The influence of non-spatial proximities

As the CG in the current research were collaborating from a distance, the advantages that cross-border and geographically proximate regions have are not existent. Hence, the research explored substitution mechanism for geographical proximity with other forms of proximity for collaboration over a distance. Based on the findings of the research, three critical non-spatial forms of proximities were determined in order to develop an inter-regional collaboration. These three key determinants are:

1. Social Proximity (Networking)
2. Cognitive Proximity (Openness to learn and share)
3. Organisational Proximity (Good leadership and management)

All three dimensions of proximity were critical in developing a successful inter-regional collaboration especially in the absence of geographical proximity.

8.2.1 Networking (Social Proximity)

Literature indicates that economic relations are to some extent always embedded in a social context (Polanyi, 1944; Granovetter, 1985), which in turn affect economic outcomes (Boschma, 2005). Furthermore, literature suggests that the more socially embedded the relationships are the more interactive the learning is and the better the innovative performance. Accordingly, the current research also showed that one of the most important determinants of inter-regional innovation collaboration was the social proximity within the CG. The interviews during the qualitative dimension of this research highlighted the importance of establishing informal links within the CG as it was considered essential and helpful for the collaboration in order to increase the trust among the CG, as it enabled the interaction environment to be more comfortable and friendly. As RLie stated,

> "I think at the end of the day when you strip everything away, it comes down to human interactions and human relationships on a social level, so I think the partners got on extremely well from that point of view and again that was very much down to the fact that that there were physical meetings at least twice a year. So people became more comfortable on a personal level and that helped in the progress of the project." (RL)

The informal relationship was also considered helpful in order to strengthen the ties between the partners in the CG and the sharing of knowledge not only about the project but also beyond the scope of the project. The interviews were conducted one year after the project ended but the partners were still collaborating with each other on different project proposals. Therefore, informal relationships that were formed during the collaboration process were regarded as a critical part of the success of the collaboration. Thus, supporting literature that informal relationships can diffuse informal knowledge and facilitates collaborations (Boschma and Frenken, 2009) where the reputation and trust effects created by the experience of past collaborations and repeated contacts between partners makes them more likely to collaborate (Balland, 2012).

Within the span of three years, the CG took initiatives to establish an informal relationship and organised social events every time the partners met in person, in order

to create an environment where everyone could learn from and share freely with each other. The initiative of developing an informal relationship among the CG led to a creation of trust which thereby reduced the perceived risk of conflict as social proximity adds to trust among organisations (Boschma and Frenken, 2009). While most of the partners in the CG had a history working with each other, five (5) out of the fifteen (15) institutions did not have any prior experience of working with the other partners in the consortium before this collaboration; the first meeting (Kick-off meeting) was dedicated to helping the partners to get to know each other. Therefore it involved a lot of team building exercises and going through the project descriptions in great detail to ensure everyone understood what their respective roles were in the collaboration. The CG realised from the beginning that a good social relationship was crucial and in order to establish this, social events were regarded as an important aspect for the first partners' meeting. Thus, team building events such as archery and treasure hunt were organised to foster team engagement during the kick-off meeting. Not only did the CG have repeated interaction with each other, the importance given to the social aspect was helpful in building trust and familiarity among the CG which in turn supports the CG partners to continue collaborating even after the end of the project. Even though literature does not specify the impact of social proximity on the sustainability of collaboration, the current research suggests that social proximity can help in building sustainable collaboration even after the span of its initial collaboration process. Figure 8.1 represents pictures taken at the first kick off meeting and a picture of the consortium at the final conference in March 2017.

Figure 8.1: *e*DIGIREGION consortium (Source: *e*DIGIREGION)

The coordinator (Cord) of the consortium stressed the importance of the social aspect at the partner meetings in order to develop a cohesive collaborative process between the partners. Hence, opportunities to develop informal relationships were provided at every physical meeting so people became more comfortable on a personal level which helped in the progress of the project.

While it has been argued that too much social proximity may weaken the learning capability of the organisations (Boschma, 2005), the current research suggests that the better the social proximity, the more likely collaboration will succeed as the more the CG get to know each other, they interacted more comfortably and also led to continued collaboration even after the project ended. For example, an informant, RLes, stated that:

> "I think the possibility to continue collaborating with the partners even after the end of the project is one of the aspects that worked well in the collaboration. We have learned a lot and we are still willing to learn more. I think our region is still far from developing what other regions are already establishing. So I think this is very important for our region to have the possibility to collaborate again." (RLes)

8.2.2 Openness to learn and share (Cognitive Proximity)

Knowledge creation and innovation are often cumulative. This accumulation relies on the capacity to learn (Gracia et al., 2018). However, effective transfer of knowledge requires absorptive capacity to identify, interpret and exploit new knowledge (Nooteboom, 2000; Boschma, 2005). Hence, cognitive proximity is commonly defined as the similarities in actors' perception, interpretation and evaluation of new ideas or the degree of overlap in actors' knowledge base (Knoben and Oerlemans, 2006). Boschma (2005) considered cognitive proximity as a prerequisite for an interactive learning process to take place and other scholars (such as Paci, Marrocu and Usai, 2014; Capello and Caragliu, 2018) have claimed that cognitive proximity can substitute geographical proximity because of the existence of similar capabilities and common channels of communication which can stimulate interaction over a long distance. While the current study supports Boschma's (2005) claim that cognitive proximity is a prerequisite, it does not prove that cognitive proximity alone contributed to the success of an inter-regional collaboration. Based on the findings of the current research, social and organisational proximity along with cognitive proximity played a vital role in making an inter-regional collaboration especially in the absence of geographical proximity. When good formal and informal relationships are established, trust is built among the CG which supported the development of a cognitive understanding of other partners involved. Additionally, a CG without good management and leadership may not be as successful or efficient even if there is an existence of good social and cognitive proximity. Hence, the three forms of proximity (social, cognitive and organisational) contributed to the success of an inter-regional collaboration. Hansen (2015) also empirically tested that cognitive proximity can substitute geographical proximity in long distance collaboration but however did not explore the overlap between other forms of proximity in substituting geographical proximity.

The current research suggested that cognitive proximity is one of the key determinants for an inter-regional collaboration but did not find any suggestions that cognitive proximity alone contributed to the success of long distance collaboration. While it posits that cognitive proximity is developed through a certain degree of social proximity, different attributes contributed to developing a cognitive proximity especially when different kinds of institutions from different regions are involved in such collaboration.

The similarities in actors' perception, interpretation and the openness to learn and share knowledge were developed through different partners:

(i) having a history of collaboration,

(ii) similar motivation to achieve the objectives

(iii) valued the uniqueness of the collaboration,

(iv) frequent communication, and

(v) building mutual respect and trust overtime.

All these attributes played a vital role in developing a cognitive proximity which evolved over time with the existence of a close informal relationship.

8.2.3 Leadership and Management (Organisational Proximity)

Knoben and Oerlemans (2006) stressed the importance of organisational proximity for inter-organisational collaboration (IOC). The reason behind stressing the importance of organisational proximity is that IOCs are more efficient and lead to better results when the organisational context of the interacting partners are similar as it facilitates mutual understanding. Organisational proximity can be defined as the degree to which organisations have similar routines and incentive mechanisms (Metcalfe, 1994). Therefore, the current research followed this definition of organisational proximity keeping in mind that "knowledge creation also depends on a capacity to coordinate the exchange of complementary pieces of knowledge owned by a variety of actors within and between organisations" (Boshma, 2005 p. 64). The current research showed that good coordination management and leadership played a vital role in the success of the inter-regional collaboration. The CG established a good formal and informal relationship among the partners involved which also helped in building trust and mutual understanding especially when different kinds of institutions are involved in the collaboration process. However, no collaboration is ideal hence, certain circumstance arise which are unforeseen. Thus, a capacity of the leadership to manage effectively is vital in order to achieve results of the CG. According to the results, the partners involved in the collaboration considered the management by the leadership and the

structure of the collaboration process as being effective in the success on their inter-regional collaboration. This effectiveness is attributed to the capability of the leadership to effectively coordinate thereby creating a participation structure and defined tasks which were put together by the leaders of the project (executive team).

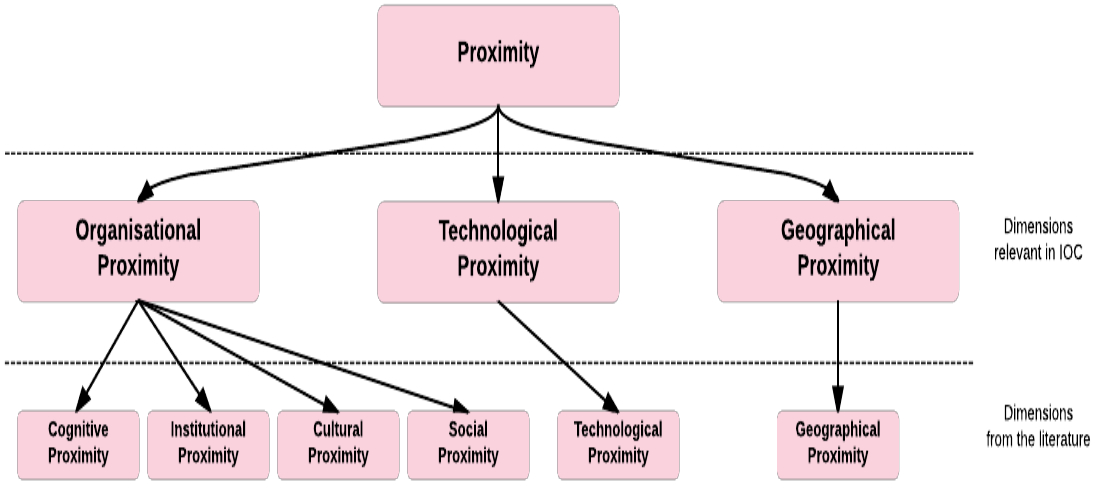


Figure 8.2: Dimensions of proximity at dyadic level *(Source: Knoben and Oerlemans, 2006, p. 80)*

Knoben and Oerlemans (2006) proposed a dyadic composition of proximity reflecting all the components of organisational proximity as depicted in Figure 8.2 based on the definition of organisational proximity by Rallet and Tore (1999) as "the set of routines, explicit or implicit, which allows coordination without having to define beforehand how to do so" (p. 375). This research posits that other forms of proximity (such as cognitive, institutional, cultural and social) should be stand-alone forms of proximity and not be integrated into a single dimension (organisational proximity).

The results from the current research suggest that even when cultural and institutional proximity did not influence the development of an inter-regional collaboration, cognitive, and social proximity played a vital role. Hence, stating that when organisational proximity influences the collaboration, all four dimensions of proximity (as proposed by Knoben and Oerlemans, 2006) do not necessarily influence the evolution of an inter-regional innovation system. Based on the findings of the current research, the results show no indication that when organisational proximity influences the collaboration, cognitive, social, cultural and institutional proximity do not necessarily have an influence on that collaboration. Therefore, this research posits that

cognitive, social, cultural and institutional should be stand-alone forms of proximity and not be integrated into an organisational proximity dimension.

8.3 The influence of regional institutional frameworks

An institutional framework is generally understood as the system of formal laws, regulations, and procedures, and informal conventions, customs and norms that broaden, mould and restrain socio-economic activity and behaviour (Donnellan, Hanrahan and Hennessy, 2012). The institutional framework holds the formal and informal rules, the organisational set where certain actors interrelate in order to achieve specific goals, and to establish policies and procedures (UNEP, 2006). Therefore, the different institutional frameworks in the four regions are particularly important in order to understand the influence they have on inter-regional collaboration. While the current research explored regions that do not share borders, the advantages that cross-border regions have regarding geographical proximity are non-existent in this current research scenario. However, barriers with cross-border collaboration can also be expected on an inter-regional collaboration, especially with the absence of geographical proximity. Van den Broek and Smulders (2014) stated that the nation state border itself can act as a barrier to cross-border learning by hindering interaction between actors on both sides of the border. In order to tackle this, the current research also looked at substituting geographical proximity to that of a non-spatial one.

The institutional aspect is prominent in defining regional innovation systems (RIS) as an institutional infrastructure supporting innovation within the region (Asheim and Gertler, 2005). Since the definitions of RIS mainly highlight the importance of interaction among different actors within the system such as the regional production structure or knowledge exploitation subsystem which consists mainly of firms, and the regional supportive infrastructure or knowledge generation subsystem which consists of public and private research laboratories, universities and colleges, technology transfer agencies, and vocational training organisations (Cooke, Uranga and Etxebarria, 1998), the current research therefore, investigated the actors, specifically in institutions such as government, academia and industry. The different institutional settings of academia versus industry versus government actors can be a hurdle for interactions (Etzkowitz and Leydesdorff, 2000), especially when regions collaborate with different institutions

across borders. The relevant norms and beliefs alter as well as the rules and regulations under which they interact. Consequently, this study also conceptualised that institutional gaps (Van den Broek and Smulders, 2014) exist at an inter-regional level, which may influence the collaborative process between regions.

Accordingly, the study indicated differences in regional institutional frameworks such as the different systems of formal laws, regulations and procedures even though they have policies formulated by the government to initiate collaboration among industries and universities for regional development. However, the differences in systems of government do affect the policymaking and the non-existences of a regional triple helix collaboration effected regional development. Although three (Bucharest-Ilfov, Central Hungary and South East Ireland) out of four regions have a centralised system of government, South East Ireland is the only region which is not located in the capital of the country whereas, Bucharest-Ilfov and Central Hungary regions are located in the capital of their country. This difference in the location of the region influenced the perception of the informants regarding policymaking. For example, an informant RLro stated:

> "I think for a region which is in the centre where all the decision-making happens, it is easier for our region and that probably explains why our region is the most developed region in our country. It has direct access to all the resources" (RLro).

Informants from the Bucharest-Ilfov region expressed that even though the polices are debated and developed by national government and then implemented by regional authorities or by ministries at national or regional level, the region being the capital has an advantage over the other regions. Similarly, the Central Hungary region is also located around the capital of the country. While there are no regional development bodies and agencies in the country and policies are created by the central ministries, the informants expressed that this system makes sense for the country. On the other hand, Castilla-La Mancha is the only region with a decentralised system of government with the region having autonomy in implementing policies and allocating funds. Even though the region has autonomy in implementing policies, the regional capabilities are still underdeveloped in the field of innovation (INDes) as compared to other regions in Spain, making it difficult to effectively implement policies in the region.

Although the findings suggest differences in the regional institutional frameworks, the findings also acknowledge that as inter-regional collaboration progressed, the institutions involved got to know each other much better, creating both formal and informal relationships. Therefore, the differences in the regional institutional frameworks did not negatively impact the inter-regional collaboration process. Van den Broek and Smulders (2014) acknowledged that different cooperation themes face different kinds of institutional gaps and that these gaps can be unstable because of the willingness to cooperate and the change in external regulatory environment. Accordingly, the differences in the rules and regulations of each institution in the current research also led to a notion that there are gaps in sharing knowledge or information between the regional triple helix (TH) actors.

8.3.1 Institutional gaps in inter-regional collaboration

While there is an inclination that institutions facilitate interactions in regional innovation systems, Van den Broek and Smulders (2014) argued that in a cross-border RIS, institutions' influence on actors on both sides of the borders could create institutional gaps hindering cross-border cooperation and undermine innovation activity. Following this concept, the current research conceptualised that institutional gaps occur in inter-regional innovation systems and further categorised the gaps into three pillars proposed by Scott (2001): regulative, normative and cultural-cognitive. Regulative gaps refer to the barriers of cooperating among actors resulting from formal institutions such as rules and regulations. On the other hand, normative and cultural-cognitive gaps refer to the gaps that can occur due to the limited knowledge of the values, norms and cultures. These institutional gaps can arise in cross-border and inter-regional collaboration as stakeholders from different regions are embedded in different national and regional institutional structures which could hinder the evolution of inter-regional innovation systems. While institutions provide rules of the game, they do not provide actors with clear answers on how to act (Beckert, 1999), thus if the institutions conflict, actors may fall into institutional gaps (Van den Broek and Smulders (2014). While the current research suggested that these institutional gaps (such as regulative, cultural-cognitive and normative) existed in the inter-regional collaboration, they however, did not hinder the development of an inter-regional innovation system.

The findings clearly identified that there were differences not only in organisational culture but also differences in their countries' cultures, which was sometimes a difficulty when trying to make decisions. For example, GOVhu stated that:

> "Being exposed to these differences [cultural and organisational] was a positive definitely because good practices were passed on. But on the negative side, sometimes it was difficult to move along with some decisions because of the different cultures." (GOVhu)

However, the findings also implied that these differences are common when working in European projects, as such projects usually require collaborating with different regions in Europe, more often than not with non-contiguous borders. Although these differences could hinder the workings of not only cross-border but the inter-regional collaboration, the current research suggested that the differences provided a positive learning experience where good practices were shared and in turn built a good informal and learning network. One of the interviewees also regarded the success of the collaboration in terms of the positive learning experience that was gained from the collaboration; he said:

> "I think the success of the collaboration is the way you look at it. Personally, it was a learning experience and a positive one so this also makes you improve your own skills in terms of collaboration because you learn from it." (INDes).

On the other hand, formal gaps (regulative gaps) were also highlighted in the findings where there were differences in the rules and regulation of each institution. While it is harder to induce formal institutional change (Van den Broek and Smulders, 2014), the differences not only in how policies are implemented or decisions are made in each institution, were regarded by the collaborative group (CG) as a gained valuable experience by being exposed to the different working styles in the CG. For example, INDes stated that:

> "In the CG we had to deal with different kinds of institutions. For example, we are dealing with more bureaucratic institutions like universities, so they cannot really make all their decisions by themselves as they have their own structure and then we also have smaller companies where the hierarchy most probably is flexible so decision-making is easier. Perhaps for the coordinating partner, it

could be a little challenging but it was quite an experience to deal with different working styles". (INDes)

Overall, the different institutional gaps which existed in the CG, however, did not hinder the collaboration.

Whilst the current research indicated that collaboration can exist even at a distance, the research also identified what influences the evolution of an inter-regional innovation system. Therefore, based on the findings of this research, the current research presents a framework for developing an inter-regional innovation system (iRIS).

8.4 Developing a framework for inter-regional innovation system (iRIS)

The current research established that inter-regional collaboration can happen even without geographical proximity, contrary to the popular notion that geographical distance can be an impediment to collaboration. While regional institutional frameworks were taken into consideration, the differences in the four regional institutional frameworks did not hinder the evolution of an inter-regional innovation system despite the institutional gaps. Hence, the current research provides the key determinants for making an inter-regional collaboration work. The three main dimensions viz., social, cognitive and organisational proximity (which were presented in Sections 8.2.1, 8.2.2 and 8.2.3) played a vital role in establishing an inter-regional innovation system especially without the existence of geographical proximity. Even though the regional institutional frameworks in the current research did not hinder the development of iRIS, it should be considered when developing an iRIS as different regional institutional frameworks could vastly differ from each other which could hinder the development of iRIS. Thus, based on the findings of the current research, a framework for inter-regional innovation system was developed (see Figure 8.3).

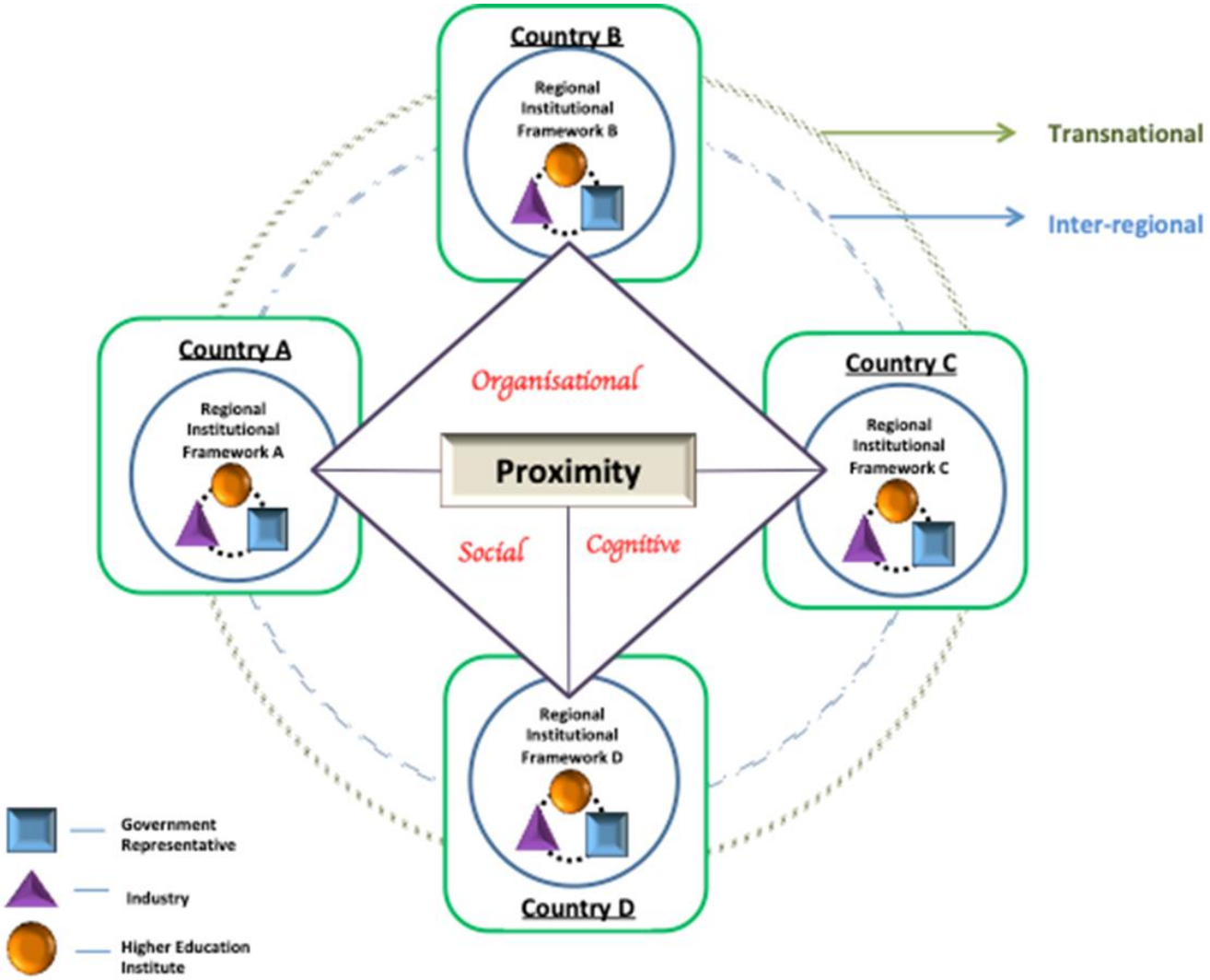


Figure 8.3: Inter-regional Innovation System Framework *(Source: Current Research)*

Figure 8.3 illustrates a framework for an inter-regional innovation system (iRIS) which, in this instance, shows four different regional institutional frameworks (A, B, C and D) which are within each country (A, B, C and D, however the number of countries involved in the collaboration does not have tom be limited to four). It visualises the geographical distances and no two regions shares borders or are in close proximity. The iRIS framework also highlights the three main forms of proximity (namely, cognitive, social and organisational) as integral to developing an inter-regional collaboration. Based on the Inter-regional Innovation System (iRIS), comprising the four regions in this research study, the current research postulates key ingredients to develop a successful inter-regional innovation system. They are:

1. **Regional Institutional Framework**: Understanding regional institutional frameworks is vital in order to develop a successful iRIS. The collaboration among triple helix institutions (Academia, Government representatives and Industry) accommodate both institutional and individual roles in innovation, and explore the complex dynamics of knowledge society and inform policy-makers at national, regional and international levels in the design of new innovation and development strategies. While the institutional framework holds the formal and informal rules, the organisational set where actors (such as triple helix) interrelate in order to achieve specific goals, establish policies and procedures, it can also hinder collaboration on an inter-regional level. For example, the system of government affects policy making for regions. Regions with a centralised form of government have polices made by the central ministries with little or no influence from the regional government, thereby effecting the policy making and effective collaboration on an inter-regional level. Though the differences in institutional frameworks and the non-existence of triple helix collaboration in the four regions comprising the iRIS did not influence the success of the iRIS, it is well worth noting that no two regional institutional frameworks will be the same. Thereby, its influence at an inter-regional level could also vary. Additionally, the difference in regional institutional frameworks could influence the iRIS, which could also develop institutional gaps (such as cultural-cognitive, normative and regulative) that could affect the evolution of an iRIS. . Regulative gaps refer to the barriers of cooperating among actors resulting from formal

institutions such as rules and regulations. On the other hand, normative and cultural-cognitive gaps refer to the gaps that can occur due to the limited knowledge of the values, norms and cultures (Van den Broek and Smulders, 2014). While institutions provide rules of the game, they do not provide actors with clear answers on how to act (Beckert, 1999), thus if the institutions conflict, actors may fall into institutional gaps (Van den Broek and Smulders (2014). Different institutional gaps did exist in this study's iRIS; however, they did not hinder the development of a successful iRIS. It is important to realise if institutional gaps exist as they could hinder the creation and development of an iRIS; on the other hand, institutions can overcome these gaps and develop a successful iRIS.

2. **Temporary geographical proximity**: As regions collaborating on an inter-regional level are not close to each other and do not share borders, the advantages of being close to one another such as sharing of tacit knowledge and low cost of coordination does not exist. Therefore, temporary geographical proximity through physical meetings and meeting at conferences are vital in establishing a successful inter-regional collaboration.

3. **Critical dimensions for successful iRIS:** The most important determinants for establishing an iRIS are social, cognitive and organisational proximity. These three determinants are the critical dimensions for a successful iRIS. According to this study's iRIS where geographical proximity did not exist, the iRIS can be developed when these three proximities exist. Cognitive proximity is developed through a certain degree of social proximity. The similarities in actors' perception, interpretation and the openness to learn and share knowledge were developed through establishing informal relationships, different partners having a history of collaboration, similar motivation to achieve the objectives and valued uniqueness of the collaboration, frequent communication and building mutual respect and trust overtime. Good coordination management and leadership also play a vital role in the success of the inter-regional collaboration. The effectiveness of leadership contributes to the development of a clearly defined participation structure and tasks, which is vital for managing a consortium with different institutions for a successful iRIS.

While a framework for innovation systems had been extensively studied in literature, inter-regional innovation system is heavily overlooked. Needless to say, the perception of region as a locus of innovation has been emphasised in the innovation processes perceiving geographical proximity as a competitive advantage, which does not exist in the case of inter-regional innovation system. However, innovation system studies have been explored mainly conceptually while empirically, cross-border regional innovation system (CBRIS) has been approached precisely through single industry case studies (Makkonen and Rohde, 2016). These sectors ranges from manufacturing and business service sectors (Koschatzky, 2000; Lundquist and Winther, 2006) to bio- and clean-technology (Coenen, Moodysson and Asheim, 2004; Hansen, 2013; Kiryushin, Mulloth and Iakovleva, 2013) and low-tech fields of horticulture (van den Broek and Smulders, 2014). The analysis and discussion in these studies has commonly included the Triple Helix type of cross border collaboration which has been included in the empirical literature on CBRIS. In their review of the CBRIS literature, Makkonen and Rohde (2016) highlighted and examined the mismatch between the conceptual and empirical studies. One of the difficulties in applying the concept of CBRIS in empirical literature according to authors is the fuzziness in the varying definitions of proximity. Hence, in order to effectively test and integrate in literature, different types of proximity should also be defined in a way it is also suitable for empirical purposes. While the dynamics of proximities are an important issue, it has not been sufficiently addressed (Balland, Boschma, and Frenken, 2015). Accordingly, the current research addressed the lack of the dynamics of proximity by highlighting the dynamic interplay and interdependence of the three non-spatial forms of proximity that enable the inter-regional innovation between the CG. While other studies (see for examples: Davenport, 2005; Malmberg and Maskell, 2006; Hansen, 2015; Garcia et al, 2018) have explored the role of non-spatial proximity in substituting geographical proximity for collaboration and knowledge transfer, these studies have only looked at one non-spatial proximity with geographical proximity. However, the current research contributed to this area of literature by providing the evidence of the interplay between three different forms of non-spatial proximity in order to develop an inter-regional innovation system. While the current research contributed to the empirical study of iRIS, it is important to note that Collaborative Group (CG)

may not be representative of all inter-regional collaborative partnerships and therefore the findings are not generalisable.

8.5 Chapter Summary

This chapter discussed the findings and results of the current research and answered the research question *"How do regional level institutional frameworks influence the evolution of an inter-regional innovation system?"* The research found that regional institutional frameworks did not hinder the evolution of an inter-regional innovation system. Although regional triple helix does not exist in all the four regions studied for this research, this did not hinder the collaboration at an inter-regional level. However, the findings suggest that three key determinants (social, cognitive and organisational proximity) are critical for developing a successful inter-regional innovation system.

In this research study where geographical proximity did not exist the four regions, the differences in institution and culture did not adversely influence the development of an inter-regional innovation system (iRIS) between these four regions. Rather, social, cognitive and organisational proximity played a vital role in the evolution of this iRIS. While cognitive proximity is considered a prerequisite for an interactive learning process to take place and can substitute geographical proximity which can stimulate interaction over a long distance, it is not a sole dimension which is required to develop an iRIS. Cognitive proximity is developed over time which is evident from the longitudinal research and it is complemented greatly by the existence of social proximity among the actors in the Collaborative Group (CG) in this research study. Additionally, the current research also challenged the notion that too much proximity can be detrimental to learning and innovation as the evidence shows that the more the social proximity increased, cognitive proximity also increased which was a critical determinant for the success of the iRIS. Furthermore, leadership and management of the collaborative group also influenced the evolution of the iRIS where good coordination and clear structure and tasks were essential to achieve the objectives of the CG. In addition, a framework for an inter-regional innovation system was developed based on

the findings from the current research (Figure 8.3) and identified key ingredients for developing a successful iRIS.

The next chapter concludes this thesis and outlines the implications and major contribution of this research. Furthermore, the limitations of this research and recommendations for future work are also presented.

9 Research contributions, Limitations and Future Research

This chapter concludes the thesis and outlines the major contributions to both theory and practice. The chapter also presents the limitations of this research, followed by the recommendations for future research arising from the research conducted. This study was concerned with investigating the influence of regional institutional frameworks on an inter-regional level collaboration for the evolution of an inter-regional innovation system (iRIS). Therefore, the research question posed is:

> 'How do regional level institutional frameworks influence the evolution of an inter-regional innovation system?'

In order to address this research question, the objectives of the research were to:

1. Understand the construct of the institutional framework within regions
2. Understand the construct of an inter-regional institutional framework
3. Establish how stakeholders in an inter-regional institutional framework interact with each other at an inter-regional level.
4. Examine the extent of effects of different types of proximity at an inter-regional level.
5. Investigate if regional institutional frameworks have an effect on the evolution of an inter-regional innovation system

In order to answer these questions and address the objectives, mixed methods research was employed providing for a rich understanding of the influence of institutional frameworks on an inter-regional innovation system in a real-world setting. The next section presents the major contributions of this research.

9.1 Major Contributions of this research

This thesis presents a number of valuable contributions to both theory and practice. The major contributions of this research are fourfold. Firstly, this research contributes to theory by providing evidence as to the substituting of geographical proximity with other forms of proximity. While geographical proximity has been regarded as being advantageous for innovative collaboration to happen, this research provided evidence for the possibility of collaborating over a distance and establishing a successful inter-regional innovation system. Additionally, this research adds to the argument of a substitution mechanism for geographical proximity with other forms of proximity. Although previous empirical research (Hansen, 2015) has explored substitution mechanism, this research explored the overlap between other forms of proximity (namely, social, cognitive and organisational) in substituting geographical proximity. Furthermore, the current research also challenged the notion that too much proximity can be detrimental to learning and innovation as the evidence of this research shows that the more the social proximity increased, cognitive proximity also increased which was a critical determinant for the success of the iRIS.

Secondly, this research contributes to theory by employing The Wilder Collaboration Factors Inventory (WCFI) Survey (Mattessich, Murray-Close and Monsey, 2001) in a new research setting. The WCFI is generally used in a practical setting to administer whether a collaboration process is working or not and to intervene in the process where needed. Therefore, it is recommended to be administered before or during a collaboration process. However, the current research administered the WCFI survey at three different time points (at the beginning, during and towards the end) without intervention. This added to understanding the natural progression of a collaboration process providing a better understanding of the actors' perceptions of their collaborative group (CG) as the collaboration progressed.

Thirdly, the development of a novel framework for inter-regional innovation system (iRIS) which can be applied to regions that wants to collaborate from a distance. The framework (presented in Figure 8.3, Chapter 8) describes key ingredients (namely, the existence of social, cognitive and organisation proximity) in developing an iRIS where

geographical proximity does not exist. Thus, it provides a more comprehensive theoretical view of developing an inter-regional collaboration network from a distance.

Finally, this research contributes to practice by providing measurement tools which can be used by partner organisations in a Collaborative Group (CG) to improve their collaboration process. The WCFI survey used in this research helps to identify what makes the collaboration work/or not, and can be used for measuring the effect of interventions during the collaboration process. However, this research also provided ANOVA as an analytical tool to identify where exactly the differences (from WCFI) in perception lie. By using these measurement tools, organisations can improve their collaboration process. Additionally, while contributing to theory, the iRIS framework can be expanded as the research provided a methodology for developing the iRIS framework which can be implemented by regions and different institutions that want to establish an effective inter-regional collaboration.

9.2 Limitations of research

In every research study, there are some limitations to be noted. The limitations of this research are presented as follows:

Firstly, a limitation on this research was that the longitudinal survey was administered 18 months into the collaborative process. The purpose of administering the survey was to understand the Collaborative Group (CG) perceptions of their collaboration at an inter-regional level. However, it is likely that the data collected may be more informative if it was collected from the first month of the CG collaboration rather than 18 months into the project.

Secondly, within the data collection methods, desk research was performed in the first phase which informed the research regarding the regional institutional frameworks. While the content analysis provided valuable information to understand the regional environment, it is likely that conducting interviews or administering surveys with regional stakeholders from the four regions may have provided a deeper understanding of each regional institutional framework.

Thirdly, the regional differences which were highlighted through the data analysis were not followed through which would have would have added a richness to understanding the impact of the Collaborative Group on each region's institutional framework.

Fourthly, the author's direct involvement with the eDIGIREGION (the setting for this research) team exposed the research to the possibility of insider bias. While being an 'insider' reduced many problems such as gaining access to data and key informants, establishing rapport with the CG and not altering the flow of social interaction unnaturally. On the contrary, the author's access to the CG facilitated the collection of longitudinal data as well as providing access key informants to perform seventeen interviews which may not have been possible (or at least extremely difficulty otherwise. Nonetheless, the author's role as an insider is one of the limitations of the research, even though every precaution was taken to avoid insider bias.

Finally, the research was conducted on only one inter-regional Collaborative Group; therefore, the findings are not deemed generalisable. While the research explored four different regions and 15 types of institutions, the participants were all from one CG. Therefore, it would have been highly informative to conduct this research on more than one CG.

9.3 Recommendations for future research

The current research provided significant contribution to both theory and practice. Hence, indicating a possibility for further in-depth work in the design and application of an inter-regional innovation system (iRIS) for innovative project collaboration from a distance. Thus, a number of recommendations for future research emerged from this study.

Firstly, the inter-regional collaboration of the current research was administered after the collaboration had already started. Therefore, an approach for future research would be to administer the WCFI surveys from the beginning of the collaboration process. This may result in understanding the progression of the attitudes and perceptions of actors involved regarding their Collaborative Group (CG) from the nascent or pre-engagement stage of the collaboration process. Thereby providing an opportunity to

identify and implement interventions to support the ongoing development of the CG. This would lead to a more robust longitudinal Action Research process yielding more informed methodologies and structures for the sustainable development of non-contiguous inter-regional CGs.

Secondly, future research into institutional frameworks, as well as performing secondary research, should also conduct surveys and interviews with the regional actors. This would provide a better understanding of the regional institutional frameworks and generate more informed research and valuable information that desk research, alone, cannot deliver.

Thirdly, as mentioned in the limitations of this research, based on the regional differences which were highlighted by the stakeholders it would be valuable to understand the effect (if any) of the CG on each region. Therefore, future research should to extend the existing methodology to also involve interviews with the CG members to establish if learning and experience gained from the CG has an impact on institutional frameworks in their respective regions.

Fourthly, the current research was conducted on one inter-regional collaborative group; therefore, the findings were not deemed generalisable. A suggestion for future research, therefore, is to conduct the same research on more than one CG at the same time, with both contiguous and non-contiguous regions.

Finally, this research indicated that the regional institutional frameworks did not hinder the collaboration on the inter-regional level. However, the characteristics of different institutional frameworks may vary over time (and situational circumstance, such as political, economic, or environmental changes) which could in turn hinder the collaboration process at an inter-regional level. Therefore, a suggestion for future research would be to extend the longitudinal time frame of the study. Such research and results would yield a more robust but flexible, adaptive and sustainable framework for the development of iRIS.

9.4 Conclusions

This thesis was concerned with understanding the influence of regional institutional frameworks on an inter-regional innovation system (iRIS). The focus of this research

was on the dynamic actor-centric collaborative group which comprised of different institutional types from four different regions and their influence on developing an inter-regional innovation system without the existence of geographical proximity. A multiphase mixed methods research design was employed with three different phases of data collection, including a three time point longitudinal data.

Table 9.1 presents the five research objectives and how each was addressed.

Research Objective	**How Addressed [Chapters]**
1. To understand the construct of the institutional framework within regions	This objective was addressed by conducting a desk research (regional profiles) on the four regions. The regional profiles provided the research with an understanding of the regional innovation environment and highlighting the institutions at play. [Chapter 5]
2. To understand the construct of an inter-regional institutional framework	Objectives 2 and 3 were addressed by conducting a three time-point WCFI survey with participants from an inter-regional collaborative initiative. The longitudinal data provided an understanding of the institutions on an inter-regional collaboration process and established an interaction that worked effectively over a distance. [Chapter 6]
3. To establish how stakeholders in an inter-regional institutional framework interact with each other at an inter-regional level.	
4. To examine the extent of effects of different types of proximity at an inter-regional level.	This objective was addressed by conducting interviews with the inter-regional actors (n=17). The interview data gathered addressed how the inter-regional collaboration happened without the existence of geographical proximity and highlighted the three forms of proximity (social, cognitive and organisational) which contributed to the success of the collaboration. [Chapter 7]
5. To investigate if regional institutional frameworks have an effect on the evolution of an inter-regional innovation system	This objective was addressed by triangulating the findings from both the interview strand (Chapter 7) and the regional profiles (Chapter 5). The findings suggested that institutional gaps do exist in the CG but it did not hinder the development of an inter-regional innovation system [Chapter 7].

Table 9.1: Research Objectives and how it was addressed (*Source: Current Research*)

In terms of the first objective, the regional profiles provided an understanding of each region's settings and identified the relevant actors in each region. Each regional profile outlined the region's demographics as well as its economic activities and information regarding R&D and innovation. The regional profiles also explored each region's governance structure, which provided a better understanding of how policies are formulated and implemented thereby providing insight into the regions' differences and similarities.

With regard to the second and third objectives, the three time-point longitudinal WCFI survey provided an understanding of the institutions on an inter-regional collaboration process and established an interaction that worked effectively over a distance. The inter-regional institutional framework consisted of actors in different regional triple helix institutions that do not share contiguous borders and are engaging in a collaborative group (CG) to develop an inter-regional innovation system. Even though literature suggests that geographical proximity is advantageous as it reduces coordination costs and transfer of tacit knowledge is possible, the findings from this research suggest that inter-regional institutions involved in the inter-regional collaboration initiative in this study established an interaction and collaboration that works effectively over a distance.

The fourth objective of the research was addressed by conducting interviews with the inter-regional actors (n=17). The interview data uncovered differences such as culture, as well as organisational and work culture. However, these institutional gaps did not hinder the collaboration as the informants felt it was a good opportunity to learn from each other and share knowledge, not only regarding the project but the workings of each other's region. The different forms of proximity were addressed wherein the geographical proximity did not influence the workings of the CG. Institutional proximity was examined where different institutional gaps were identified which however also did not hinder the collaboration. Social proximity was also explored and the research suggests that the informal relationship was one of the key themes, which emerged as one of the most important elements, which made the inter-regional collaboration effective. Overall, the research intimates that even though there were many challenges and regional institutional frameworks are not ideal, the inter-regional collaboration worked because of leadership and good management, the relationships which existed among the CG partners and their openness to learn and share knowledge with each other.

The fifth objective was addressed by triangulating the findings from regional profiles and interview data. While the research shows that institutional gaps do exist in the CG, they did not hinder the development of an inter-regional innovation system. Even though the regional institutional frameworks did not hinder the evolution of the inter-regional innovation system, key determinants (namely, social, cognitive and organisation proximity) facilitating inter-regional collaboration work were identified. Furthermore, a framework for developing an inter-regional innovation system was developed based on the findings of this research.

9.5 Conclusion Summary

This chapter presented the conclusions of this research in the context of each of the research objectives. It has been established through this research that institutional gaps do exist but the differences in each regional institutional framework did not hinder the development of an inter-regional innovation system (iRIS). Furthermore, the research concluded that inter-regional collaboration can happen over a distance and provided a framework for developing an iRIS.

This chapter also presented major contributions of this research to both theory and practice while also highlighting the limitations of the research. Additionally, recommendations for future research were provided.

Finally, in order to ensure that the research is published, the author has identified a number of journals that she will target for the dissemination of this research; including, but not limited to the following:

- Regional Studies;
- Science and Public Policy:
- Triple Helix Journal
- Journal of Mixed Methods Research.

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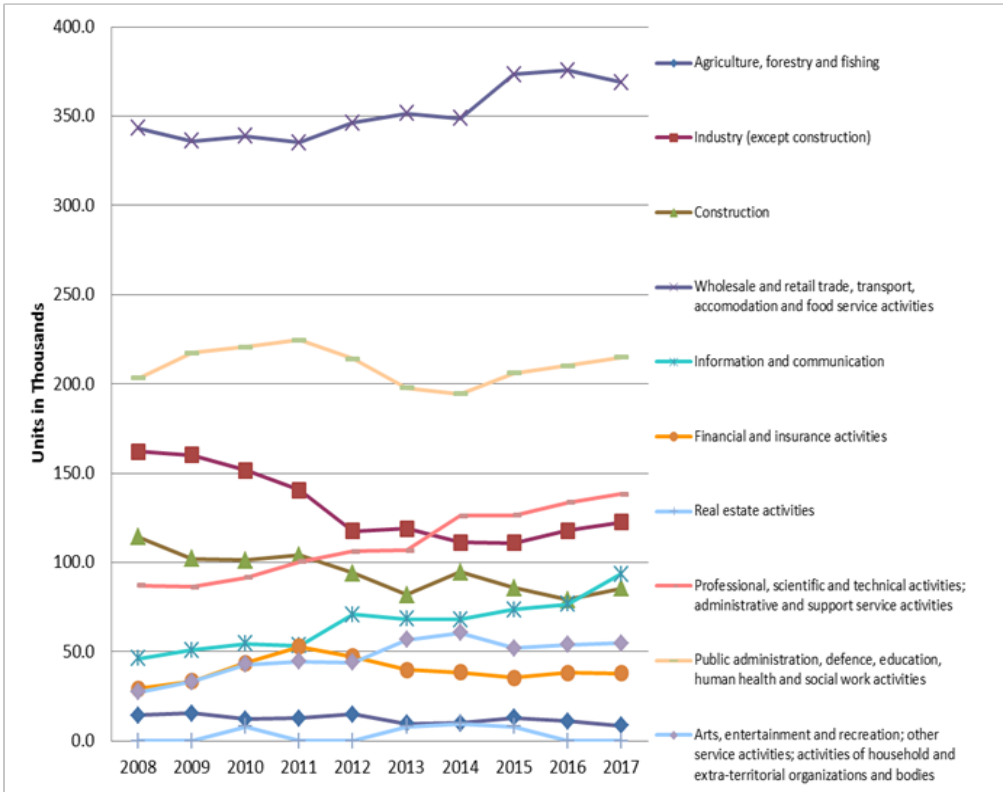
Appendix A Wilder Collaboration Factor Inventory

Factors	Statement
1. History of Collaboration or cooperation in the community	Agencies in our community have a history of working together
	Trying to solve problems through collaboration has been common in this community. It's been done a lot before.
2. Collaborative group seen as a legitimate leader in the community	Leaders in this community who are not part of our collaborative group seem hopeful about what we can accomplish.
	Others (in this community) who are not a part of this collaboration would generally agree that the organizations involved in this collaborative project are the "right" organizations to make this work.
3. Flavourable political and social climate	The political and social climate seems to be "right" for starting a collaborative project like this one.
	The time is right for this collaborative project.
4. Mutual respect, understanding, and trust	People involved in our collaboration always trust one another.
	I have a lot of respect for the other people involved in this collaboration.
5. Appropriate cross section of members	The people involved in our collaboration represent a cross section of those who have a stake in what we are trying to accomplish.
	All the organizations that we need to be members of this collaborative group have become members of the group
6. Members see collaboration as in their self-interest	My organization will benefit from being involved in this collaboration.
7.Ability to compromise	People involved in our collaboration are willing to compromise on important aspects of our project.
8. Members share a stake in both outcome and process	The organizations that belong to our collaborative group invest the right amount of time in our collaborative efforts.
	Everyone who is a member of our collaborative group wants this project to succeed.
	The level of commitment among the collaboration participants is high.
9. Multiple layers of participation	When the collaborative group makes major decisions, there is always enough time for members to take information back to their organizations to confer with colleagues about what the decision should be.
	Each of the people who participate in decisions in this collaborative group can speak for the entire organization they represent, not just a part.
10. Flexibility	There is a lot of flexibility when decisions are made; people are open to discussing different options.
	People in this collaborative group are open to different approaches to how we can do our work. They are willing to consider different ways of working
11. Development of clear roles and policy guidelines	People in this collaborative group have a clear sense of their roles and responsibilities.
	There is a clear process for making decisions among the partners in this collaboration.

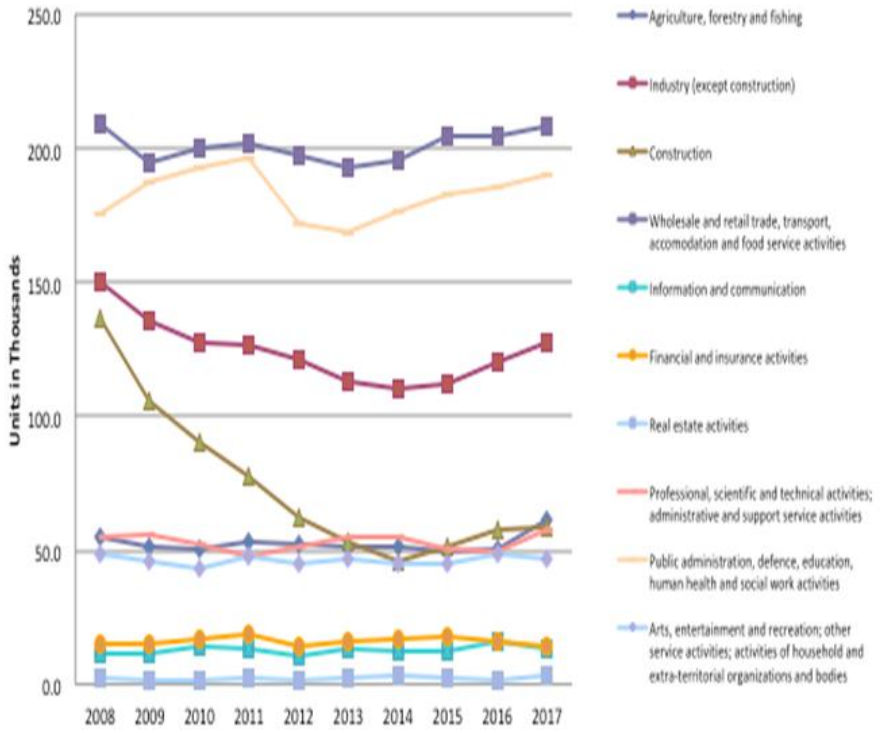
Factors	Statement
12. Adaptability	This collaboration is able to adapt to changing conditions, such as fewer funds than expected, changing political climate, or change in leadership.
	This group has the ability to survive even if it had to make major changes in its plans or add some new members in order to reach its goals.
13. Appropriate pace of development	This collaborative group has tried to take on the right amount of work at the right pace.
	We are currently able to keep up with the work necessary to coordinate all the people, organizations, and activities related to this collaborative project
14. Open and frequent communication	People in this collaboration communicate openly with one another.
	I am informed as often as I should be about what goes on in the collaboration.
	The people who lead this collaborative group communicate well with the members.
15. Established informal relationships and communication links	Communication among the people in this collaborative group happens both at formal meetings and in informal ways.
	I personally have informal conversations about the project with others who are involved in this collaborative group.
16. Concrete, attainable goals and objectives	I have a clear understanding of what our collaboration is trying to accomplish.
	People in our collaborative group know and understand our goals.
	People in our collaborative group have established reasonable goals.
17. Shared vision	The people in this collaborative group are dedicated to the idea that we can make this project work.
	My ideas about what we want to accomplish with this collaboration seem to be the same as the ideas of others.
18. Unique purpose	What we are trying to accomplish with our collaborative project would be difficult for any single organization to accomplish by itself.
	No other organization in the community is trying to do exactly what we are trying to do.
19. Sufficient funds, staff, material, and time	Our collaborative group had adequate funds to do what it wants to accomplish.
	Our collaborative group has adequate “people power” to do what it wants to accomplish.
20. Skilled leadership	The people in leadership positions for this collaboration have good skills for working with other people and organizations.

Appendix B Employment by Sector

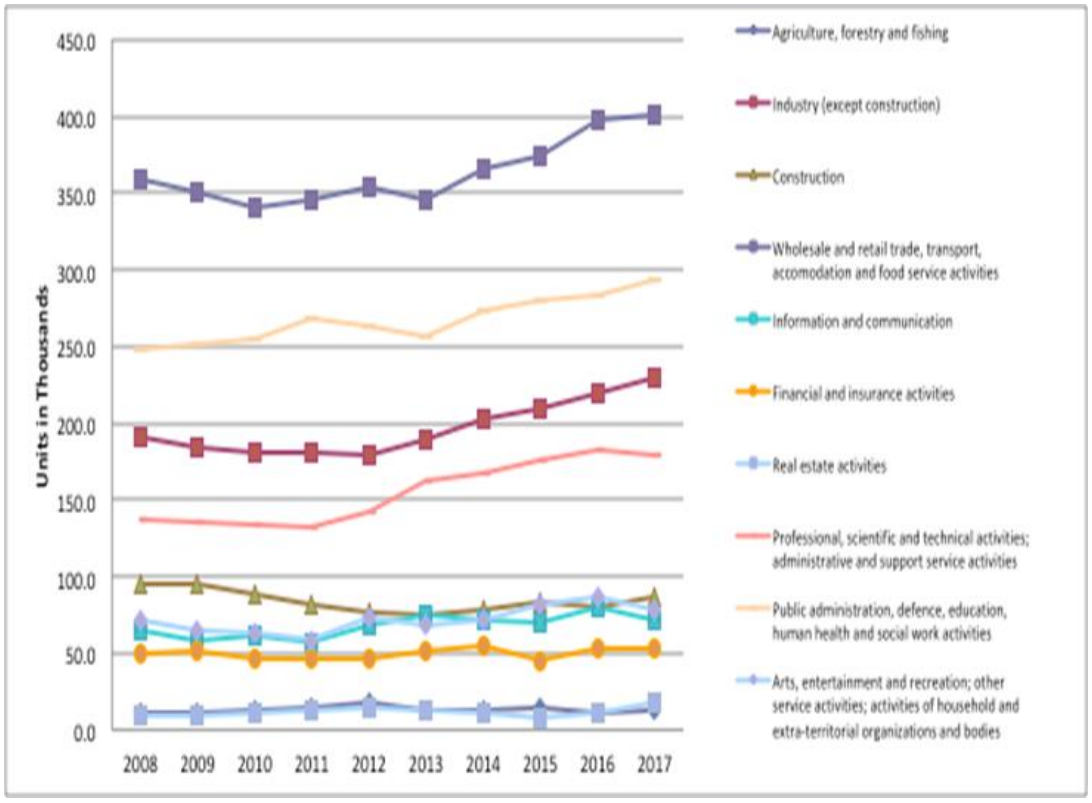
Employment by Sector (Bucharest Ilfov)



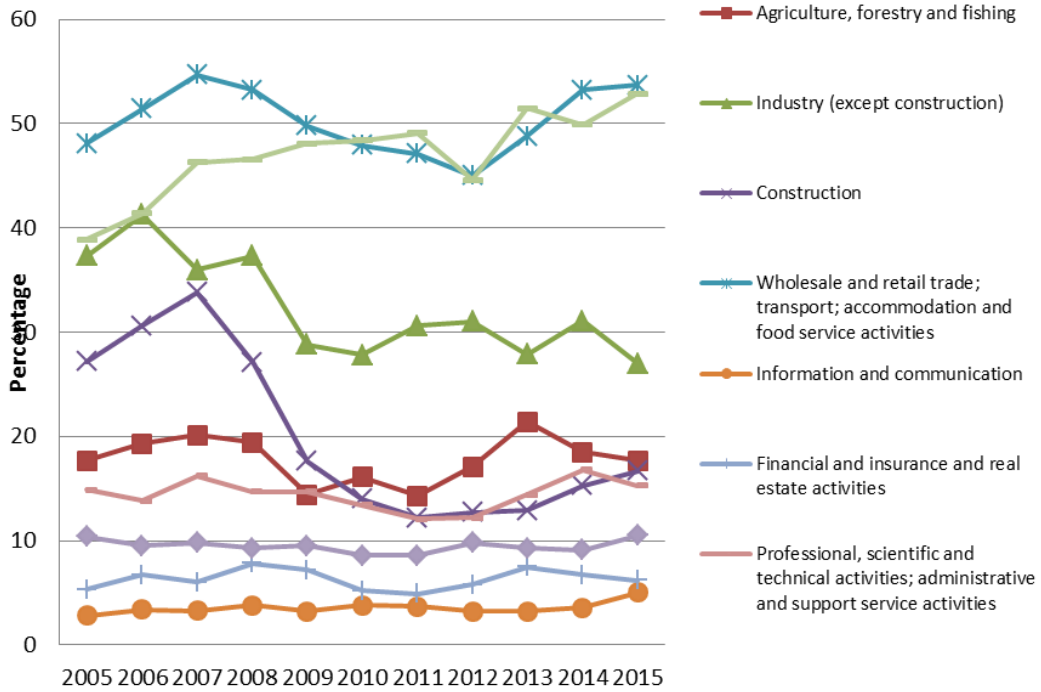
Employment by Sector (Castilla La Mancha



Employment by Sector (Central Hungary)



Employment by Sector (South East Ireland)



Appendix C Descriptives for One-Way ANOVA- respondents' region

The descriptives suggest that in T1 and T2 respondents from South East Ireland rank Factor 3 (Favourable political and social climate) higher than the rest of the organisations representing the other three regions (mean of 4.7143 and mean of 4.69) respectively, Respondents' perception of Factor 4 (Mutual respect, understanding and trust) was significantly different between all the regions involved. Bucharest-Ilfov ranked this factor higher than the rest of the regions with mean of 4.75. Factor 5 (Appropriate cross section of members) was ranked highest by South East Ireland with mean of 4.31 whereas, Bucharest-Ilfov ranked Factor 8 (Members share a stake in both process and outcome) the highest. Furthermore, respondents from Bucharest-Ilfov ranked Factor 9 (Multiple layers of participation), Factor 11 (Development of clear roles and policy guidelines), Factor 14 (open and frequent communication), Factor 15 (Established informal relationships and communication links), Factor 16 (Concrete, attainable goals and objectives) and Factor 17 (shared vision) the highest compared to the other regions involved in the CG. Additionally, in T3, respondents from South East Ireland rank Factor16 (Concrete, attainable goals and objectives) and Factor18 (Unique purpose) higher than the rest of the respondents representing the three regions (mean of 4.53 and 4.64 respectively). Both South East Ireland and Bucharest Ilfov region ranked Factor17 (shared vision) highest with mean of 4.5.

T1									
		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Factor3	Central Hungary	5	3.4000	.65192	.29155	2.5905	4.2095	2.50	4.00
	South East Ireland	7	4.7143	.48795	.18443	4.2630	5.1656	4.00	5.00
	Bucharest-Ilfov	9	4.0556	.72648	.24216	3.4971	4.6140	3.00	5.00
	Castilla-La Mancha	5	4.1000	.41833	.18708	3.5806	4.6194	3.50	4.50
	Total	26	4.1154	.72536	.14226	3.8224	4.4084	2.50	5.00

T2

		N	Mean			N	Mean
Factor 3	Central Hungary	9	3.44	**Factor 11**	Central Hungary	9	3.56
	South East Ireland	8	4.69		South East Ireland	8	4.06
	Bucharest-Ilfov	8	4.19		Bucharest-Ilfov	8	4.25
	Castilla La Mancha	5	3.60		Castilla La Mancha	5	3.00
	Total	30	4.00		Total	30	3.78
Factor 4	Central Hungary	9	4.00	**Factor 14**	Central Hungary	9	4.04
	South East Ireland	8	4.06		South East Ireland	8	4.46
	Bucharest-Ilfov	8	4.75		Bucharest-Ilfov	8	4.71
	Castilla La Mancha	5	3.30		Castilla La Mancha	5	4.00
	Total	30	4.10		Total	30	4.32
Factor 5	Central Hungary	9	3.56	**Factor 15**	Central Hungary	9	4.11
	South East Ireland	8	4.31		South East Ireland	8	4.56
	Bucharest-Ilfov	8	4.06		Bucharest-Ilfov	8	4.75
	Castilla La Mancha	5	3.40		Castilla La Mancha	5	4.00
	Total	30	3.87		Total	30	4.38
Factor 8	Central Hungary	9	4.07	**Factor 16**	Central Hungary	9	3.89
	South East Ireland	8	3.83		South East Ireland	8	4.63
	Bucharest-Ilfov	8	4.58		Bucharest-Ilfov	8	4.58
	Castilla La Mancha	5	3.07		Castilla La Mancha	5	4.00
	Total	30	3.98		Total	30	4.29
Factor 9	Central Hungary	9	3.78	**Factor 17**	Central Hungary	9	3.72
	South East Ireland	8	4.06		South East Ireland	8	4.31
	Bucharest-Ilfov	8	4.31		Bucharest-Ilfov	8	4.38
	Castilla La Mancha	5	2.90		Castilla La Mancha	5	3.00
	Total	30	3.85		Total	30	3.93

T3									
		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Factor16	Central Hungary	5	4.00	0.47	0.21	3.41	4.59	3.33	4.67
	South East Ireland	7	4.52	0.47	0.18	4.09	4.95	3.67	5
	Bucharest-Ilfov	8	4.46	0.53	0.19	4.01	4.90	3.67	5
	Castilla-La Mancha	7	3.76	0.25	0.10	3.53	3.99	3.33	4
	Total	27	4.21	0.53	0.10	4.00	4.42	3.33	5
Factor17	Central Hungary	5	3.90	0.22	0.10	3.62	4.18	3.5	4
	South East Ireland	7	4.50	0.58	0.22	3.97	5.03	3.5	5
	Bucharest-Ilfov	8	4.50	0.53	0.19	4.05	4.95	3.5	5
	Castilla-La Mancha	7	3.86	0.38	0.14	3.51	4.21	3	4
	Total	27	4.22	0.54	0.10	4.01	4.44	3	5
Factor18	Central Hungary	5	4.00	0.47	0.21	3.41	4.59	3.33	4.67
	South East Ireland	7	4.52	0.47	0.18	4.09	4.95	3.67	5
	Bucharest-Ilfov	8	4.46	0.53	0.19	4.01	4.90	3.67	5
	Castilla-La Mancha	7	3.76	0.25	0.10	3.53	3.99	3.33	4
	Total	27	4.21	0.53	0.10	4.00	4.42	3.33	5

Appendix D Descriptives for One-Way ANOVA- respondents' organisation type

In T2, the descriptives suggest that respondents representing Government (GOV) ranked Factor 6 (Members see collaboration as in their self-interest) highest with a mean of 4.13 and Higher Education Institute (HEI) with the lowest mean of 2.93. On the other hand, Government representatives ranked Factor8 (Members share a stake in both process and outcome), Factor 11 (Development of clear roles and policy guidelines) and Factor 14 (Open and frequent communication) the highest as compared to the other organisations involved in the CG. These differences show that the institutional gaps have an impact on the perception of the respondents regarding how they view their collaborative process. In T3, the respondents representing GOV ranked Factor 5 (Appropriate cross sections of members), Factor8 (Members share a stake in both process and outcome) and Factor 11 (Development of clear roles and policy guidelines), the highest as compared to the other organisations involved in the CG.

T2									
		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Factor6	HEI	13	2.92	1.32	0.37	2.13	3.72	1	4
	GOV	8	4.13	0.35	0.13	3.83	4.42	4	5
	IND	9	4.11	0.60	0.20	3.65	4.57	3	5
	Total	30	3.60	1.10	0.20	3.19	4.01	1	5
Factor8	HEI	13	3.33	0.94	0.26	2.76	3.90	2	4.33
	GOV	8	4.58	0.30	0.10	4.34	4.83	4	5
	IND	9	4.37	0.45	0.15	4.02	4.72	3.67	5
	Total	30	3.98	0.88	0.16	3.65	4.31	2	5
Factor11	HEI	13	3.23	0.93	0.26	2.67	3.79	2	5
	GOV	8	4.44	0.50	0.18	4.02	4.85	4	5
	IND	9	4.00	0.61	0.20	3.53	4.47	3.5	5
	Total	30	3.78	0.89	0.16	3.45	4.11	2	5
Factor12	HEI	13	3.73	0.53	0.15	3.41	4.05	2.5	4.5
	GOV	8	4.00	0.71	0.25	3.41	4.59	3	5
	IND	9	4.39	0.42	0.14	4.07	4.71	4	5
	Total	30	4.00	0.60	0.11	3.78	4.22	2.5	5
Factor14	HEI	13	4.05	0.54	0.15	3.72	4.38	3	5
	GOV	8	4.71	0.60	0.21	4.20	5.21	3.33	5
	IND	9	4.37	0.39	0.13	4.07	4.67	4	5
	Total	30	4.32	0.57	0.10	4.11	4.54	3	5

Appendix E Interview Questions for Coordinator

Coordinator

1. As the project coordinator, did you think all the regions participated equally? Elaborate
2. The structure of *e*DIGIREGION has three levels, the coordinator, the regional leads and the triple helix representatives, why was this structure the way it is? Who decided on the structure?
3. Do you think the structure is effective for this collaboration to work?
4. Would you have structure it differently, if so, why?
5. Did you feel that the regional lead partners managed their own regions well? Did you have to step in at times?
6. What were the main challenges (if there are any) you faced as a coordinator in making this collaboration from a distance work. How did you overcome the challenges?
7. Do you see it differently if you were to coordinate a collaborative group which are not at a distance such as cross-border or regional?
8. Was your motivation aligned with the objectives of the project? Please elaborate.

   -If not, did it create issue? Elaborate.

WCFI follow up questions

1. Did you have any history of working with other partners from the consortium before this project? How often?
2. What aspects of the *e*DIGIREGION collaboration worked well? Why do you think so?
3. What aspects of the *e*DIGIREGION collaboration didn't work so well? Why do you think so?
4. Have you continued to work with members of the group, after *e*DIGIREGION project?
   a. If yes, please explain what you did together b. If not, why not?

5. Do you think there was mutual respect and trust among the collaborative group?
6. Was mutual respect and trust sufficient for the collaboration to be successful?
7. To what extent did the CG encourage participation from different levels of members
   - Only among the executive team?
   - regional lead?
   - Or was open for every level
8. Did you think the tasks required to achieve (WPs etc) were developed clearly for everyone?
9. When things don't go as planned (missing deadlines etc), were other organisation open to the changes in plans?
10. Was the communication between partners open and frequent?
11. Did you think informal relationships among the partners were helpful for the collaboration? To what extent?
12. Were the goals and objectives set out achievable and clear? How so?
13. Was the purpose of the project different than other groups (projects) who are also collaborating with other regions? How so?
14. Do you think your inter-regional collaboration works (or worked) well overall? Please elaborate

Appendix F Interview Questions for Regional Lead

Regional Lead

1. As a regional lead partner, did you feel like you ensured all the institutions participated equally? How so?
2. The structure of *e*DIGIREGION has three levels, the coordinator, the regional leads and the triple helix representatives, why was this structure the way it is? Who decided on the structure?
3. Do you think the structure is effective for this collaboration to work?
4. Did the coordinator give you freedom to lead your own region? Did you ever require him to step in to help? If so, did he?
5. What were the main challenges you faced as a regional lead in making this collaboration work? How did you overcome these challenges?
6. Was there interaction between the regional leads? How did it work? And was it helpful in achieving the inter-regional collaboration?

Regional focus

1. What kind of system of government do you have in your country?
   -centralised? decentralised?

2. How does your system of government effect policy making for your region?
3. Does collaboration exist between academia, government and industry in your region?
   a. If yes, to what extent does it happen. Explain.

4. In your opinion to what extent does this collaboration (or non-collaboration) affect regional development?

5. Is there availability of physical infrastructures such as science park or incubation centres for small companies or R&D unit of large companies in the region? Elaborate
   -If so, how does it help the region?
6. Does HEIs in the region provide human resources with specific skills? Elaborate
7. Does NGOs facilitate collaboration between different institutions for regional development in the region

Inter-regional focus

1. Has your participation in *e*DIGIREGION collaboration led to changes within your organisation in the way/extent you collaborate
   -within your region
   -nationally
   -internationally
2. From your organisation perspective, what would you do differently if you were to collaborate with different organisations in different regions again? Why so?

3. In your opinion to what extent does the collaboration (or non-collaboration) between regional triple helix institution influences the collaboration on inter-regional level?
4. How similar and different were the organisations' cultures in the collaborative group?
    a. Did these affect the collaborative group?
    b. How?
5. Collaborating with organisations in different regions entails collaborating from a distance; does this have an impact on the collaboration?
    a. How?
    b. If there were issues in the collaborations, what was done to overcome them?
6. What was the biggest challenge of collaborating with different types of institutions
   -from your region
   -with institutions from other regions
7. What was the biggest advantage of collaborating with different types of institutions
   -from your region

   -with institutions from other regions

WCFI follow up questions

1. Did you have any history of working with other partners from the consortium before this project? How often?
2. What aspects of the *e*DIGIREGION collaboration worked well? Why do you think so?
3. What aspects of the *e*DIGIREGION collaboration didn't work so well? Why do you think so?
4. Have you continued to work with members of the group, after *e*DIGIREGION project?
    b. If yes, please explain what you did together b. If not, why not?

5. Do you think you have the support from regional stakeholders and policy makers to achieve the objectives of the project?
6. Do you think there was mutual respect and trust among the collaborative group?
7. Was mutual respect and trust sufficient for the collaboration to be successful?
8. Did your organisation engage with stakeholders outside of the CG?
   - If not, why? - If yes, was it helpful, to what extent
9. What was the motivation for your organisation to take part in this CG?
10. Is your motivation aligned with the objectives of the project? Please elaborate
    -If not, did it create issue? Elaborate

11. To what extent did the CG encourage participation from different levels of members
    - Only among the executive team?
    - regional lead?
    - Or was open for every level
12. Did you think the tasks required to achieve (WPs etc) were developed clearly for everyone?
13. When things don't go as planned (missing deadlines etc), were other organisation open to the changes in plans?
14. Was the communication between partners open and frequent?
15. Was communication from the coordinator open and frequent?
16. Did you feel your organisation was communicated to openly and frequently by the CG?
17. Did you think informal relationships among the partners were helpful for the collaboration? To what extent?
18. Were the goals and objectives set out achievable and clear? How so?
19. Was the purpose of the project different than other groups (projects) who are also collaborating with other regions? How so?
20. Do you think your inter-regional collaboration works (or worked) well overall? Please elaborate

Appendix G Interview Questions for Triple Helix Representatives

Regional focus

1. What kind of system of government do you have in your country?
   -centralised? decentralised?

2. How does your system of government effect policy making for your region?
3. Does collaboration exist between academia, government and industry in your region?
   a. If yes, to what extent does it happen. Explain.

4. In your opinion to what extent does this collaboration (or non-collaboration) affect regional development?

8. Is there availability of physical infrastructures such as science park or incubation centres for small companies or R&D unit of large companies in the region? Elaborate
   -If so, how does it help the region?
9. Does HEIs in the region provide human resources with specific skills? Elaborate
10. Does NGOs facilitate collaboration between different institutions for regional development in the region

Inter-regional focus

1. Has your participation in *e*DIGIREGION collaboration led to changes within your organisation in the way/extent you collaborate
   -within your region
   -nationally
   -internationally
2. From your organisation perspective, what would you do differently if you were to collaborate with different organisations in different regions again? Why so?
3. In your opinion to what extent does the collaboration (or non-collaboration) between regional triple helix institution influences the collaboration on inter-regional level?
4. How similar and different were the organisations' cultures in the collaborative group?
   a. Did these affect the collaborative group?
   b. How?
5. Collaborating with organisations in different regions entails collaborating from a distance; does this have an impact on the collaboration?
   a. How?

   b. If there were issues in the collaborations, what was done to overcome them?
6. What was the biggest challenge of collaborating with different types of institutions
   -from your region
   -with institutions from other regions
7. What was the biggest advantage of collaborating with different types of institutions
   -from your region

   -with institutions from other regions

WCFI follow up questions

1. Did you have any history of working with other partners from the consortium before this project? How often?
2. What aspects of the *e*DIGIREGION collaboration worked well? Why do you think so?
3. What aspects of the *e*DIGIREGION collaboration didn't work so well? Why do you think so?
4. Have you continued to work with members of the group, after *e*DIGIREGION project?
   c. If yes, please explain what you did together b. If not, why not?
5. Do you think you have the support from regional stakeholders and policy makers to achieve the objectives of the project?
6. Do you think there was mutual respect and trust among the collaborative group?
7. Was mutual respect and trust sufficient for the collaboration to be successful?
8. Did your organisation engage with stakeholders outside of the CG?
   - If not, why? - If yes, was it helpful, to what extent
9. What was the motivation for your organisation to take part in this CG?
10. Is your motivation aligned with the objectives of the project? Please elaborate
    -If not, did it create issue? Elaborate
11. To what extent did the CG encourage participation from different levels of members
    - Only among the executive team?
    - regional lead?
    - Or was open for every level
12. Did you think the tasks required to achieve (WPs etc) were developed clearly for everyone?
13. When things don't go as planned (missing deadlines etc), were other organisation open to the changes in plans?
14. Was the communication between partners open and frequent?
15. Was communication from the coordinator open and frequent?
16. Did you feel your organisation was communicated to openly and frequently by the CG?

17. Did you think informal relationships among the partners were helpful for the collaboration? To what extent?
18. Were the goals and objectives set out achievable and clear? How so?
19. Was the purpose of the project different than other groups (projects) who are also collaborating with other regions? How so?
20. Do you think your inter-regional collaboration works (or worked) well overall? Please elaborate