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**Master programme in Innovation  
and Spatial Dynamics**

**The interplay of regional dynamics, firm characteristics,  
and knowledge bases in establishing global innovation  
networks – A case study of the video game cluster in the  
Skåne region of Sweden**

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This paper investigates the spatial distribution of different knowledge sourcing mechanisms by a network of video game developers in the Skåne region of Sweden. The video game industry has evolved considerably since its inception; transforming from a localized niche industry to one of the fastest growing media industries in the world. This paper aims to address how industry evolution engenders both a paradigm shift in the type of knowledge variety needed, and the spatial proximity from where that knowledge is sourced. This paper also explores, the mechanisms and dynamics which facilitate firms to engage in global innovation networks. It is understood that the engagement of global innovation networks is contingent on both the regional dynamics and knowledge base of the industry. However, little is understood on the driving mechanisms of these networks and why firms engage in them. The thesis is based on data collected through a survey and interviews of firms developing video games in the Skåne region to gain insight into their global and regional networks, through which different knowledge was sourced. Network data was analyzed via social network analysis and cross-referenced with relevant theoretical conceptualizations and interview transcriptions to ensure sound analysis and triangulation. The results suggest a new hybrid configuration of global-local networks: Global innovation networks were established via key strategic actors in the region who act as gatekeepers to international networking. The social network analysis reveals that network centrality is more important than regional centrality in the establishment of these global innovation networks. Actors in the core of the network had less need to establish these networks than actors in the peripheral area of the network. Furthermore, engagement in these networks was contingent on the regional knowledge pool and the firms target market and business strategy. Industry globalization engendered a need for disparate knowledge varieties to be sourced over heterogeneous spatial proximities.

*Key words:* Economic geography, global innovation networks, regional innovation systems, industrial knowledge base, social network analysis, Sweden, innovation, and spatial dynamics

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# 1 Introduction

It is understood in economic geography that different industries denoted by their industrial knowledge base are thought to exchange knowledge over different spatial proximities. The spatial proximities over which knowledge exchanged are contingent upon the type of knowledge (Scientific, Engineering, & Artistic) needed, and whether that knowledge is codified or tacit (Asheim & Coenen, 2005; Aslesen & Freel, 2012; Grillitsch & Trippel 2013; Martin & Moodysoon, 2013). Technological change, innovation, and internationalization have engendered a paradigm shift in which knowledge and innovation have become somewhat globalized. However, this globalization of knowledge exchange and innovation has historically agglomerated around strategic regions, which is evident from the existence of business clusters (Silicon Valley, Third Italy, Paris-Saclay, and Bangalore etc.). The formation of economies of agglomeration (business clusters) and strategic regions have inspired a substantial array of literature on regional dynamics and their role in the process of internationalization and globalization. The literature identifies regions as heterogeneous entities which can constrain or facilitate the engagement of firms in the region in the globalization process, which will be contingent on the endowments of the region (Isaksen & Trippel, 2014; Tödtling & Trippel, 2005).

The globalization process has led some regions to specialize in key strategic industries; however, little is known about how *small and medium enterprises* (SMEs) engage in global innovation networks, and what mechanisms facilitate these exchanges. *Global innovation networks* refer to the globalized, integrated and interconnected operations of firms and relevant institutions that cooperatively engage in the development of innovations (Barnard & Chaminade, 2017). The two most influential factors for firms engaging in GINs are the industrial knowledge base of the firm and the regional dynamics (Chaminade & Asheim, 2014). The literature on knowledge bases postulates that firms with an industrial knowledge base will source knowledge at analogous spatial proximities to other firms with the same knowledge base. However, the literature fails to consider the heterogeneity of firms, the evolution of industries, and the impact that globalization has in the process of knowledge sourcing through disparate spatial proximities. Industries are believed to source a plethora of different knowledge varieties (Grillitsch & Trippel, 2013; Manniche, 2012) from different spatial proximities, which have been engendered by industry evolution and globalization. This paper aims to expound on previous research through an analysis of the spatial proximities and the extent of knowledge exchange in firms. This paper focuses on analyzing the knowledge base of a network

of small-medium-enterprise video game developers in southern Sweden (Skåne). As opposed to a top down approach at the industry level, a bottom up analysis at the firm level is applied to capture the heterogeneity of firms. Previous studies on knowledge exchange through disparate spatial proximities have focused on generally one indicator to map spatial patterns of knowledge exchange (Martin & Moodysson, 2011), such as formal collaborations, labor mobility, and patents etc. There are a multitude of mechanisms in which knowledge can be exchanged (formal and informal). Focusing on one variable does not effectively capture the dynamics of knowledge exchange in innovative activity, as industries with different industrial knowledge bases may have different process (formal and informal) in the role knowledge sourcing. Furthermore, the level of knowledge exchange between SMEs would not be effectively captured by analyzing more formalized methods, as SMEs are thought to exchange knowledge through more informal channels.

On the regional level, regional variety is thought to have an impact on the firms' ability to engage in internationalization which is contingent on the level of organizational thickness/thinness of the region (the degree of diversification and specialization in the region). Firms in organizationally thick and diversified regions may have the absorptive capacity to engage in GINs but not the need, as they can access knowledge on the regional level due to industry diversification. Firms operating in organizationally thin regions may have the need to engage in GINs, but may lack the absorptive capacity to do so due to an underdeveloped infrastructure. Firms in organizationally thick and specialized regions may have both the absorptive capacity and need to engage in GINs due to regional specialization (Chaminade & Plechero, 2013). Previous studies on GINs have primarily focused on *multinational corporations* (MNCs); however, it is understood that in the case of Sweden there are a variety of SMEs engaging in GINs (Chaminade & Asheim, 2014). This study aims to understand which mechanisms and to what extent SMEs in Sweden engage in GINs from the perspective the industrial knowledge base of the firm and the regional dynamics.

## 1.1 Structure of the Thesis

The introductory chapter of the thesis serves as the background and rationale for this study. It delineates the research questions posed in the paper and the rationale for the questions presented, from the perspective of the research gap addressed. The second chapter of this paper discusses the theoretical background of the study, which serves as the foundation from which the research

questions were formulated. It details the core concepts and theories discussed throughout this paper and aims to bridge the research gap identified in the literature that inspired the research questions. The third chapter of this paper relates to the research design of the study. This chapter outlines the epistemological and ontological approach taken. It also details the consideration of triangulation and the methods employed in collecting and analyzing the data. The research design chapter also frames the ethical considerations of the study and the limitations and rational of the methodological approach employed. The fourth chapter of this paper introduces the regional, industry, and cluster profile. The fifth chapter of this paper serves as an analysis and discussion of the findings presented in this paper. The findings are discussed from the perspective of the SNA visualizations, charts, and tables which are then cross referenced with the theoretical background to understand if the findings are consistent with the theoretical assumptions outlined in the literature. The sixth and final chapter of the paper serves as a summary of the study. It presents a conclusion of the findings and how they relate to the initial research questions presented at the beginning of this paper. It details the research aims and objective of this paper and how they have been achieved. It also includes a recommendation on how this research could be further developed.

## 1.2 Aims and contribution of the thesis

One of the aims of this thesis is to expound on the literature of combinatorial knowledge bases and how SMEs source knowledge over different spatial proximities. This paper departs from previous studies in that it takes into consideration both formal and informal mechanisms and how they facilitate knowledge exchange as opposed to focusing on more formalized exchanges, such as research and development and collaboration, which have been the barometer of analysis of previous studies of knowledge exchange. This paper also includes the knowledge exchange of business functions (management & marketing), which to the author's knowledge, has not been used in previous studies on the analysis of knowledge exchange in industrial knowledge bases. This paper also seeks to explore the regional link between the globalization process and how SMEs engage in GINs on the regional level. Little is understood on how SMEs engage in GINs and to what extent; this paper seeks to enrich our understanding of the role of regional dynamics, industrial knowledge bases, and how they affect the propensity of firms to engage in GINs. The three main research questions are as follows:

- 1: To understand the mechanisms and types of knowledge transfer between disparate spatial proximities, and to analyze the diversity of knowledge networks, linkages, and their spatial patterns.
- 2: To investigate the mechanisms and dynamics which facilitate the engagement of SMEs in GINs, and to describe how, why, and to what extent this engagement occurs.
- 3: To investigate the relationship between regional dynamics and the propensity of SMEs to engage in GINs.

This paper aims to address a gap in research regarding the exploration of regional dynamics and their influence on SME's engagement with GINs. It also aims to contribute to the research gap by analyzing the knowledge linkages of firms more broadly, by analyzing (level of firm) knowledge diversity and spatial patterns. This is done by assessing the sourcing of knowledge via a plethora of indicators, as opposed to previous research that primarily focused on more formalized mechanisms. This paper aims to triangulate the diversity and linkages of knowledge from both the conceptual framework of regional innovation systems and the industrial knowledge base epistemology. Assessing knowledge diversity and linkages from these conceptualizations will help explain the relationship between the region, knowledge base, and how they increase or reduce a SME's capacity to engage in GINs. The purpose of the above research questions is also to shed light on the level of combinatorial knowledge sourcing and their spatial patterns in the video game industry. Understanding the spatial patterns of knowledge variety in the industry is important on the regional level, as it can compel institutions to foster industry diversification once the lack of industry diversification has been identified. The purpose of this paper is to also understand why firms engage in GINs as understanding why firms engage in GINs can expound on any regional deficiencies which relate to the previous question posed in this paper. Do firms engage in GINs to be strategic? Or do they engage in these GINs due to organizational thinness and lack of industry diversification on the regional level? The final motivation and purpose of this paper is to understand how GINs are established on the regional level and to explore the correlation between regional and geographical proximities, and the propensity of SMEs engaging in GINs. Understanding globalization from a regional perspective is important because it adds to the dialogue on geographical proximity and knowledge transfer in the globalization process.



## 2 Literature Review

The conceptual framework of this paper is grounded in the realm of “*evolutionary economic geography*” (EEG). The literature on evolutionary economic geography theory began to formulate in the mid-1990s and was developed from an amalgamation of traditional economic geography theory and schools of thought from other areas outside of economics, such as social sciences. It departs from traditional economic geography theory in that it adds a broader approach to the assessment of economic growth. The cultural and historical legacy of a region, institutions and the dynamics between them play a significant role in EEG (Boschma & Martin, 2010). The conceptual background and theoretical review of this paper is rooted in the realm of EEG, in which a broad analysis of how regional dynamics and the industrial knowledge base of a firm affect the globalization process.

There is a prodigious amount of work on the role of geography and its impact on development and the transfer of knowledge, which covers a vast array of disparate theoretical approaches. However, among the literature, there are common prominent concepts and theoretical approaches that appear throughout. This literature review covers some of the most predominant conceptualizations identified in the literature, which act as the groundwork for the analysis and motivation of this paper. The formulation of the theoretical background of this paper has been developed from five major themes which play a significant role in contemporary EEG theory.

The first theme explored in the literature review is the dimensions of knowledge and how different modes of knowledge are exchanged. The second theme explores the industrial knowledge base epistemology which delineates the relationship between disparate industries and how knowledge is sourced over different geographical proximities. The next theme expounds on the geography of knowledge and how the role of geography in knowledge sourcing interplays with the dimensions of knowledge. The theme that follows, focuses on the diversity of knowledge sourcing mechanisms and the role of global innovation networks. Finally, the review focuses on the role of regional innovation systems and their influence on global innovation systems. The above themes offer a disparate rationale for the interplay between geographical proximity and knowledge transfer. These disparate conceptualizations do have some overlap; however, for this reason they are used. The variables analyzed are done via a heterogeneous yet common theoretical approaches to ensure a

level of triangulation in data analysis. The remainder of this chapter focuses on a review and analysis of the theoretical approaches which serve as the foundations of this paper.

## 2.1 The Dimensions of Knowledge (Tacit/Codified)

It is well acknowledged in economic geography, that industries characterized by different industrial knowledge bases show disparate trajectories of spatial distribution (Asheim & Coenen, 2005; Aslesen & Freel, 2012; Grillitsch & Trippel 2013; Martin & Moodysoon, 2013). The literature on industrial knowledge bases: delineates how different industries will take on characteristics in accordance with the knowledge base from which the industry draws knowledge. Under the knowledge base epistemology, the transfer of knowledge: tacit or codified and their spatial flows and transfer of knowledge will be contingent on the underlying knowledge base of the industry. Tacit knowledge is generally thought to be spatially sticky whereas codified knowledge may be easily transmitted across different mechanisms across space (Asheim & Gertler, 2005). The two main types of knowledge signifiers identified under the knowledge base epistemology are that of *codified* and *tacit* knowledge.

*Codified knowledge* (explicit knowledge) is knowledge that can be easily articulated, stored and verbalized. When knowledge can be coded, and expressed in written form (e.g. encyclopedias, academic journals, and bodies of work containing information pertinent to a relevant subject) then that knowledge may be considered codified. Taking the above into consideration one can conclude that all knowledge that can be articulated can also be codified and vice-versa (Johnson, Lorenz & Lundvall, 2001). Codified knowledge can be used to transmit rules, standards, and principals that can then be expressed in written form. As codified knowledge is spread, actors may add and draw from it until a unified standard has been created (Cowan, David & Foray, 2000). For example, codified knowledge can take the form of open source computer software, in which various actors all contribute to the code until a standard has been set in which henceforth, new actors can access, share, and reference the pool of knowledge via a competent system. Considering the above interpretation of codified knowledge, one can take away that any knowledge than can be easily expressed and transmitted in written form, may be referred to as codified knowledge. Thus, codified knowledge is knowledge that can then adhere to a universal set of principles and standards based upon formalized models and applications of universal knowledge.

Whilst codified knowledge consists of knowledge that is easy to articulate and verbalize, *tacit* knowledge takes on the opposite characteristics of codified knowledge. Tacit knowledge first entered the lexicon of academia by the writings of Polanyi (1958, 1966). He expounded on the tacit dimension of knowledge by stating how people have a certain degree of awareness and how they perceive the world around them; this method of perception and learning may not easily be transmitted. Knowledge accumulated via rational perception may not always be easy to transmit (Cowan et al, 2000). There is an element of knowledge created via human consciousness that can be difficult to transfer and this is due to the tacit nature of said knowledge. Facial and voice recognition is something any conscious person can differentiate. However, being able to transmit how a person perceives, how somebody looks and/or sounds may be difficult to pass onto another person; this is the tacit dimension of knowledge. You may be able to recognize a person by their face and voice; however, transmitting your knowledge of their voice and face so that another person can recognize the same person can be laborious. The tacit nature of knowledge makes it difficult to transmit, which also means that tacit knowledge is spatially sticky to a degree. Previous studies have attributed this tacit dimension of knowledge to the formation of geographical clusters, agglomerations, and innovative activity confined within tacit knowledge hubs (Gertler, 2003). Tacit knowledge in the region may be transferred by regional actors who share the same social context, reinforcing the notion that spatial proximity is pertinent in the transfer of knowledge. Tacit knowledge may be acquired by sharing the same social context and codified knowledge may be acquired by actors via written documentation such as documents on scientific principals or instruction manuals etc. (Gertler, 2003). Tacit knowledge is transmitted via channels of personal face to face interaction and shared personal experiences and social groups with other actors, which are facilitated by a degree of trust (Goffin & Koners, 2011). Due to the features of tacit knowledge mentioned above, the tacit aspect of knowledge is un-codified (Cowan et al, 2000).

Codified and tacit knowledge are not mutually exclusive. Take cooking for example, two parties can attempt to recreate the same recipe (that was codified). The two outcomes may be analogous or disparate and this is due to the tacit component of knowledge that went into making the recipe.

Table 1: Dimensions of Knowledge Taxonomy

	Knowledge Transfer	Knowledge Accumulation	Spatial Sensitivity of Knowledge Distribution	Knowledge Examples
<b>Codified Knowledge</b>	Can be articulated, verbalized and transmitted easily	Knowledge is ascertained primarily through a deductive process. Knowledge may be accessed via pure research, formalized models and scientific principles	Due to the codified nature of the knowledge, it can easily be written, verbalized, and articulated making it less sensitive to spatial proximity	Instructional Manuals, Formalized Procedures, Systems and Models, Scripts, and Principals
<b>Tacit Knowledge</b>	Difficult to articulate and verbalize. Knowledge is transmitted via face to face interactions and shared experiences with other actors and social groups	Knowledge is ascertained through practical experience which can be contextually and culturally embedded	Due to the highly-contextualized nature of tacit knowledge it can be very sensitive to spatial proximity	Facial and Voice recognition, Body Language, Leadership, Swimming, Aesthetic Sensibility, and Driving

Source: Based on Johnson et al, 2001; Cowan et al, 2000; Gertler, 2003; Goffin & Koners, 2011

## 2.2 The Knowledge Base Epistemology

Tacit and codified knowledge act as core components of the knowledge base epistemology which segments knowledge into three classifications; analytical, synthetic, and symbolic. This typology views different knowledge bases as proximate sources of outputs for disparate modes of innovation (Asheim & Gertler, 2005; Aslesen & Freel, 2012). Whilst the initial knowledge base conceptualization captured the inputs and process of knowledge used for innovation, the literature has been expanded on by attributing industrial knowledge bases signifiers such as; science, engineering, and art, which allows analysts to capture the outputs (Asheim, Coenen, Moodysson, & Vang, 2005). The two main dimensions of knowledge encapsulated in the industrial knowledge base epistemology are those of codified and tacit knowledge. The transfer and flow of knowledge relating to innovative activities is dependent on the industrial knowledge base from which information is sourced (Asheim & Gertler, 2005). The knowledge base epistemology captures the following inputs, outputs and processes: *Analytical (Science)*, *Synthetic (Engineering)* and, *Symbolic (Creative)*.

An analytical knowledge base is one in which knowledge is created via scientific knowledge and formalized principles. Analytical knowledge base industries operate under a stringent formalized network. The dimension of knowledge creation via scientific knowledge and formalized principals engenders knowledge being drawn from codified as opposed to tacit knowledge (Asheim, Boschma, and Cooke, 2011). Industries that draw from an analytical knowledge base are: biotechnology, nanotechnology, photonics, aerospace, robotics, artificial intelligence, bioinformatics, and nuclear physics etc. Due to the scientific and codified elements of analytical knowledge bases, university and industry linkages are tantamount in the creation and transfer of knowledge which is ascertained via an inductive process based on the application of scientific principals and formalized models. Knowledge creation is proliferated by: reading academic journals, formalized research and development, and the application of scientific research. The output of this analytical knowledge is usually recorded via academic journals, patents, and electronic databases. Due to the high level of scientific knowledge sourced, the knowledge requirements are that of pure research as opposed to applied research. Innovations in analytical industries are usually radical innovations due to the primacy of formalized R&D and strong network linkages between academia and industry. Product and process innovations via formalized and structured R&D process generally lead to patents. The radical and process innovations proliferated by analytical industries are instrumental in the creation of new firms and spin-offs, capitalizing on newly founded innovations (Asheim et al, 2011).

A synthetic knowledge base is a knowledge base in which innovation occurs through the implementation of applying knowledge from already existing pools of knowledge and reconfiguring them in different ways to produce novel outcomes and new innovations. Unlike analytical knowledge base industries which create new and radical innovations, synthetic knowledge base industries reconfigure already existing pools of knowledge to come up with solutions which generally results in incremental innovations. Industries that operate within a synthetic knowledge base include: naval engineering, automotive, plant engineering, and specialized industrial machinery (Asheim & Gertler, 2005, pp.295). Formalized research and development play a minimal role in product innovation which means that radicalized processes and product innovations are less likely to occur here than in analytical knowledge bases. Unlike analytical knowledge bases that source knowledge from formalized institutions and models; synthetic knowledge, and product innovation is usually a result of firm interaction with customers and suppliers. Product creation may be by a response to a problem in which the firm interacts with local actors (customers and suppliers) to

combat a problem in the value chain of production (Asheim et al, 2005). Synthetic knowledge bases are marked by a degree of both codified and tacit knowledge. However, the tacit dimension of knowledge takes primacy in a synthetic knowledge base. Due to this mixed dimension of knowledge requirements, the role of university linkages in the field of applied research (practical application of science) takes precedence over that of pure research. Knowledge creation in a synthetic knowledge base is also usually generated via a deductive process of experimentation with different methods and processes, on-site training and experience (Asheim & Gertler, 2005, pp.295).

The concept of symbolic knowledge base is based on the original workings of Allen J. Scott, (1997) and his research on the cultural economies of cities. Symbolic knowledge base industries generally agglomerate around cities which act as hubs of culture and commerce. Unlike analytical and synthetic knowledge base industries, there is a salient idiosyncratic cultural component that goes into the production of goods in a symbolic industry (Scott, 1997). To an extent, the same can be said of all knowledge bases due to cultural heritage playing a somewhat significant role in all aspects of production. However, with symbolic based industries, the cultural influence is more pertinent to the production process. The output from these industries is that of: craft, textiles design, branding, digital and media production across industries such as: video games, movie, music, fashion, publishing, and advertising (Scott 1997). Innovation in symbolic industries revolves around the commodification of new ideas. In symbolic industries, the production process is based on aesthetic value.

The primacy of aesthetic value in the methods of production means that artistic skills are more valued than cognitive skills in symbolic based industries. The aesthetic component of symbolic based industries means that the knowledge used in the production of these goods is generally ascertained by observation and interpretations of cultural norms and platitudes (Asheim, Coenen & Vang, 2007). This dimension of knowledge transmission makes products of symbolic knowledge-based industries more spatially embedded, as the output is germane to the geographical proximity from where production occurs. Products produced in symbolic industries are thought to be distinctly localized. The cultural and localized facets of the production process engender a high degree of tacit knowledge, as the design and creation process is thought to be culturally contextual (Asheim, et al, 2011). Knowledge creation in symbolic based industries is less formalized than that of analytical and synthetic based industries. Knowledge is created and transmitted via practice and experience, as opposed to formal education in universities and applied learning

institutes. Knowledge is generated through experience and informal contacts with other actors in the same industry (Asheim et al, 2005).

One of the main criticisms of the knowledge base epistemology is that industries are often characterized by more than one knowledge base, and that firms that fall under a specific industrial knowledge base have been found to draw knowledge from a plethora of sources and knowledge bases. Furthermore, the dominant knowledge base of an industry may change over time due to technological change e.g. the publishing, advertisement, art, and movie industries etc. While it may be applicable at the micro-level in a theoretical context, when applied on the macro and meso level, findings suggest that firms are heterogeneous and disparate firms in an industrial knowledge base will draw from various forms and combinations of knowledge variety. Which is ineffectively captured by analyzing the firm at the level of the industry. Studies on combinatorial knowledge bases have shown that firms, business clusters, and regional innovation systems generally source knowledge from a variety of heterogeneous knowledge types and sources and not from a single source as assumed by the industrial knowledge base taxonomy. The knowledge base of the industry may not always be reflective of the knowledge base of the firm and vice-versa (Grillitsch & Trippl, 2013; Manniche, 2012).

Whilst the top down approach of the industrial knowledge base taxonomy provides a sound conceptual framework for the innovative inputs, outputs, and processes, it fails to capture all the diverse mechanisms behind these inputs such as the heterogeneity of firms and regional dynamics. A bottom-up approach to analyzing the knowledge base from the perspective of the firm and regional innovation system allows for these disparate mechanisms to be considered. The ICT revolution has engendered a rise of new industries that mix traditional symbolic knowledge bases with that of analytical and synthetic knowledge bases and vice-versa; blurring the lines between art, technology, and science. The original static view of knowledge attribution to an industry is a product of its time which fails to capture the dynamics of new industries that have entered the global economy via innovation and technological change. It also fails to capture the evolution of industry. Technology has not only changed art and traditional symbolic industries but has also changed the dynamics of analytical and synthetic industries. It has also changed how we communicate, and create, and this change has generated a need for the sourcing of a variety of disparate knowledge types which the top-down approach to the industrial knowledge base taxonomy fails to capture.

In assessing the knowledge base taxonomy from the perspective of the firm; the arrangement of different methods of combinatorial knowledge at the level of the firm will not only be contingent on business context of the firm but also the pool of knowledge that is available to the firm at the regional level. Different regions are dominated by firms of varying industrial knowledge bases. The knowledge base structure of actors in the region will shape the identity of the regional knowledge pool (Asheim & Hansen, 2009; Martin, 2012). Some regions may have a diversified knowledge base and others may have a specialized knowledge base and this will be shaped by the variety of actors in the region. On the firm level, the knowledge pool available will be contingent on the level of regional knowledge base diversification and specialization. In the context of the geography of these linkages, the spatial distribution and knowledge variety linkages are said to be dependent on the industrial knowledge base (Asheim & Coenen, 2005; Aslesen & Freel, 2012, Grillitsch & Trippel, 2013; Martin & Moodysson). The next section of this paper will expand on the spatial distribution of geographical linkages and how they relate to dimensions of knowledge (tacit and codified).



Table 2: Knowledge Base epistemology – Summary

Knowledge Base (Input)	Analytical	Synthetic	Symbolic
<b>Foundations (Output)</b>	Science Based	Engineering Based	Artistic (Aesthetic and Creativity) Based
<b>Knowledge Pool</b>	Primarily codified as it is based on universal knowledge but can draw on requirements of tacit knowledge	Can draw from both codified and tacit knowledge. The tacit component generally takes precedence in these industries	High degree of tacit knowledge due to the cultural embeddedness of the production process
<b>Knowledge Formation</b>	Knowledge is generated via scientific principles, formalized models, and research and development	Knowledge is generated via applying knowledge from already existing pools of knowledge and reconfiguring them in different ways to produce novel outcomes. May involve some degree of research and development	Knowledge is generated via artistic experience and merit
<b>Types of Research</b>	Pure Research (Basic Research)	Applied Research	Experience Based Learning
<b>Knowledge Process</b>	Inductive	Deductive	Creative
<b>Networks</b>	Formalized networks with research centers, universities and public and private institutions	Networks consist primarily of customers and suppliers	Networks consist of informal contracts with actors of the same or similar related industries
<b>Spatial Sensitivity of Knowledge Distribution</b>	Due to the strong codified element, there is very little spatial sensitivity	Depending on the tacit component and requirement of specialized knowledge, there can be a degree of spatial sensitivity	Due to the cultural embeddedness and tacit component of production, there can be a high degree of spatial sensitivity
<b>Industries</b>	Biotechnology, Nanotechnology, Photonics, Aerospace, Robotics, Artificial intelligence, Bioinformatics, and Nuclear Physics etc.	Naval Engineering, Automotive, Plant Engineering, and Specialized Industrial Machinery etc.	Video Games, Movie, Music, Fashion, Publishing and Advertising etc.

Source: Based on Asheim et al, 2011; Asheim & Gertler, 2005; Asheim et al, 2007; Asheim, 2005 Aslesen & Freel, 2012; Scott, 1997

## 2.3 The Geography of Knowledge (Buzz and Pipelines)

The type of dominant knowledge base is understood to have an impact on the geographical distribution of knowledge. Tacit knowledge is said to be exchanged on the local level whereas codified knowledge is to be exchanged more on the global level. The literature on “*buzz*” and “*pipelines*” expounds on the knowledge transfer of tacit knowledge from buzz on the regional level and codified knowledge from pipelines on the global level (Bathelt, Malmberg, & Maskell, 2004). Buzz refers to the exchange and flow of information within a regional innovation system or business cluster in which actors transmit information and knowledge through local face-to-face interaction, spontaneous meetings, and shared cultural and institutional settings etc. It is in these settings in which tacit information may be exchanged and actors can benefit from the flow and exchange of knowledge just by being in the shared locality. The level of buzz will be dependent on the openness and level of trust between actors. The value of the buzz will be dependent on the diversification of heterogeneous knowledge pools and its usefulness in allowing firms to exploit strategic knowledge (Bathelt, Malmberg, & Maskell, 2004).

Whilst buzz refers to the more tacit local dimension of knowledge exchange, pipelines is understood to relate to the codified dimension of knowledge and global interactions firms undertake in the exchange of knowledge. However, the dichotomy of buzz-tacit-local and pipelines-codified-global has been criticized by Moodysson, (2008) and Grillitsch and Trippel, (2013); who indicated that buzz can also be global. In the pursuit of knowledge at the firm level, the diversification of local knowledge may be lacking. When regional knowledge is lacking, firms will seek knowledge globally via strategic international partnerships and collaborations. The creation of pipelines requires a degree of trust and can be time consuming and costly, unlike buzz which has little to no transaction costs and is transmitted via shared context and proximity. The establishment of pipelines also comes with a degree of uncertainty due to dissimilar institutional settings, language, and cultural norms. Engaging in pipelines allow firms to break away from the economic trajectory of the business or regional cluster by allowing firms to exploit knowledge, markets, and partnerships with actors in different competitive regions. Knowledge ascertained through pipelines can also then strengthen the business cluster by means of local buzz (Bathelt, Malmberg, & Maskell, 2004).

Under the knowledge base epistemology, it would follow that firms with an analytical knowledge base would engage more in global pipelines, and synthetic and symbolic firms would be more

engaged in local buzz. The limitations of this approach will be addressed subsequently. Industries with an analytical knowledge base are not sensitive to spatial proximity as the knowledge pool of these industries is usually that of codified knowledge, which is thought to be easily transmitted through distant spatial proximities. Industries drawing on a synthetic knowledge draw from both tacit and codified knowledge. Industries with a symbolic knowledge base are also thought to be highly sensitive to spatial proximity due to regional and culture embeddedness (Asheim & Gertler, 2005; Asheim et al, 2005; Aslesen & Freel, 2012). The tacit dimensions of the knowledge type in these industries (synthetic & symbolic) imply that they are sensitive to spatial proximity. Previous research has shown that the geography of analytical, synthetic, and symbolic knowledge base industries is consistent with the theoretical assumptions of spatial proximity (Martin, 2013; Martin & Moodysson, 2011; Martin & Moodysson, 2013). However, under the knowledge base assumptions of the spatial locality of knowledge, the heterogeneous nature of firms is omitted from the geographical locality on whether firms operate more on the local or global level. Take for example the video game industry which falls somewhere in-between an industry with a symbolic and synthetic knowledge base. The market of the video game industry can be bisected into two main markets; the *indie* (Independent) market and the *AAA* (Mainstream) market. One would expect game designers developing for an indie market, in which products are usually targeted at niche audiences for a singular regional market, to source knowledge locally due to financial constraints and the small scope of the project. These are generally passion projects that have little to no funding and sell via word of mouth. They may break into other markets due to positive word of mouth (buzz) but are generally not created with the intention of mass market appeal. However, in developing an AAA product, which is usually created with the intention of mass market appeal, one would expect that more external knowledge would be needed due to fierce competition with market leaders. The risk profile of these products is generally lower than that of indie games due to the disparity in development costs. The high development costs attributed to AAA development means that developers should adhere to international product standardization. The international standardization of the product creates a need for the knowledge stock to be more global than local to keep up with international competition. Indie and AAA video game developers have different business models, development process, and intended markets that are not sufficiently captured by the model as both firms are analogous entities under the industrial knowledge base epistemology.

The heterogeneous nature of firms means that going local or global will be contingent on the business model and target market of the firm. Whilst the buzz and pipelines concept expounds on

the rationale for engaging in local buzz and global pipelines, it fails to capture some of the important mechanisms that drive these linkages. One of the main criticisms of the buzz and pipelines taxonomy is that it delineates both the local and global attributions of knowledge exchange without expounding on the mechanisms that engender the creation of knowledge; it also omits the type of knowledge that is exchanged (Moodysson, 2008). The mechanisms to source knowledge are not analogous for all firms due to the heterogeneous nature of firms and the variety of mechanisms in which knowledge can be sourced. Different firms will engage in different mechanisms in their sourcing of knowledge and at different spatial proximities. Previous research on the mechanisms of knowledge sourcing focused primarily on the collaboration dimension of geographical patterns of knowledge sourcing. Sourcing knowledge through other channels such as labor mobility and monitoring have been done via an analysis of the organizational patterns and structure with the omission of the geographical pattern of these exchanges (Martin & Moodysson, 2011; Martin & Moodysson, 2013). Focusing only on the spatial distribution of collaboration as means of knowledge sourcing means that the geographical patterns of other sources of knowledge will not be captured by the analysis. In the context of SMEs, this is particularly problematic when analyzing the spatial patterns of knowledge distribution, as their means of knowledge sourcing is generally through more informal channels and not via direct collaboration, to an extent. As direct formal means of collaboration via contractual partnerships, R&D, and other activities are not generally undertaken by SMEs due to financial limitations. The open innovation model of knowledge acquisition in the realm of SMEs is generally through more informal channels, as there is less financial commitment (Vrande, Jong, Vanhaverbeke, & Rochemont, 2009)

The buzz and pipelines taxonomy also fails to consider the disparity between the absorptive capacity of firms and their ability to translate and utilize the knowledge ascertained via local buzz (Trippel, Tödting, & Lengauer, 2008). Previous studies have shown that in economic geography, different regions have heterogeneous capabilities regarding the capacity to absorb and distribute knowledge which is dependent on the knowledge infrastructure of the region and this heterogeneous aspect of regions is omitted from the buzz and pipelines taxonomy (Isaksen & Trippel, 2014; Tödting & Trippel, 2005). The regional variety will then be a contingent factor in the creation of buzz that can circulate in a regional innovation system. Furthermore, the knowledge stock available to a firm in a region will also be a deciding factor on whether the firm sources knowledge locally or globally, depending on the absorptive capacity of the firm. Whilst the disparate modes of the geographical proximity of knowledge exchange is the '*raison d'être*' of the

buzz and pipelines taxonomy of understanding the geographical distribution of knowledge, there are other dimensions that can facilitate or constrain the flow and diffusion of knowledge that are not explained in the literature such as: cognitive proximity, organizational proximity, social proximity, institutional proximity, and geographical proximity. These proximity channels delineate a system in which shared and somewhat homogenous proximities help facilitate the flow of knowledge between actors. The more heterogeneous the proximities are the more difficult it becomes to transmit and diffuse knowledge through these channels. The flow of knowledge can be diffused or constrained by the proximity channels outlined above depending on the absorptive capacity of the firm or lack thereof regardless of geographical proximity (Boschma, 2005).

## 2.4 Diversity of Knowledge Sourcing (Global Innovation Networks)

Whilst previous studies on the diversity of knowledge linkages and their spatial patterns tend to generally focus on one indicator to map spatial patterns of knowledge and knowledge exchange such as formal collaborations, labor mobility, patents, and monitoring etc. A narrow approach of focusing on only one indicator of the globalization of innovation fails to capture the dynamism of other indicators that may contribute to knowledge acquisition needed for innovative activity. Furthermore, the heterogeneous nature of firms who source knowledge through a variety of different channels and diverse networks will not be captured by using only one indicator. Knowledge can be sourced through a variety of different diverse mechanisms when firms engage in global innovation networks.

The mechanisms that facilitate the flow of knowledge on both the local and global level are complex as innovation has now become somewhat globalized. To better understand the diversity of knowledge exchange there has been an emergence of literature around the concept of Global Innovation Networks. *Global Innovation Networks* (GINs) refer to the globalized, integrated, and interconnected operations of firms and relevant institutions that corporately engage in the development of innovations (Barnard & Chaminade, 2017). There is a diversity of ways in which knowledge can be exchanged and acquired. Knowledge can generally be intentionally exchanged by both formal and informal networks, trade (knowledge embodied in products), R&D, and foreign direct investment (FDI) etc. Knowledge can also be exchanged unintentionally by labor mobility

and spillovers (Chaminade & Plechero, 2015). The literature on GINs identifies three main modes of the globalization of innovation such as: the *global exploitation of innovation*, the *global sourcing of technology*, and *global research collaboration*. The global exploitation of innovation is when firms implement strategies to gain access to certain international markets in which they can sell their goods & services. The global sourcing of technology is when firms go outside of their national borders to ascertain knowledge via international R&D, international training, international organizations and firms, R&D collaboration, and the licensing of software, machinery, and equipment. Global research collaboration is when firms engaged in international R&D also collaborate with a host of other actors such as universities, local governments, research centers, and other firms (Plechero & Chaminade, 2013).

Previous studies on GINs have found that major actors engaging in GINs are medium sized firms. It was also found that there was no correlation between firms engaging in GIN and the level of innovation in the firm. The findings also suggest that some of the most innovative firms operate more on the regional and national level (Barnard & Chaminade, 2011). In the case of the video game industry, these theoretical assumptions are consistent with real world practicalities. As most of the innovative video game industry leaders engaging in AAA production develop their engine technology in-house, e.g. Square-Enix (Luminous Engine), Capcom (MT Framework), Konami (Fox Engine) and Ubisoft (Anvil Engine). SMEs are less likely to develop their engines in house and usually engage in GINs to obtain a license to use the engine for use in the development of their products by industry engine specialists such as Unity Technologies (Unity Engine) and Epic Games (Unreal Engine). However, the level of engagement with types of knowledge by SMEs is not entirely understood. There has been a little research on the level of engagement of SMEs engaging in GINs and the type of knowledge ascertained through these linkages. Furthermore, there is limited understanding on how regional dynamics influence the propensity of small firms to engage in global innovation networks, as we will discuss next.

## 2.5 Regional Innovation Systems

Although globalization has engendered opportunities for new regions to act as specialized economic zones, there is a disparity between the absorptive capacity of regions to engage in GINs. The heterogeneous nature of regions means that global interactions are still “*pinned down*” to regions

with the absorptive capacity and capabilities to do so (Chaminade, & Plechero, 2013). Whilst the knowledge base epistemology views innovation from the perspective of knowledge inputs and outputs in the innovation process. The *regional innovation system* (RIS) epistemology focuses on the spatial and geographical arrangement of networks and actors involved in the sourcing of knowledge. The RIS concept was first espoused in the 1990s and was borne from the workings of Freeman and Lundvall and their workings on innovation and national systems of innovation (Asheim & Gertler, 2005, pp.299). Lundvall (2010) sees innovation as being a major factor of economic development and purports the notion that when barriers prohibiting the flow and transferal of interactive learning between actors in an RIS are eliminated economic development and innovative activity will thrive. He notes that institutional factors such as international markets may be harmonized; however, the same cannot be said of educational standards, the family structure, gender imbalances, socio-political relations, and labor markets. Any asymmetrical imbalances in these systems will constrain the flow of interactive learning (Lundvall, 2010). The systems that Lundvall (2010) referred to relate to the previous work that Boschma (2005) did on proximities of knowledge exchange. The RIS concept views organizational and institutional actors as instrumental in proliferating innovation and innovative activities (Grillitsch & Trippl, 2013). Innovation and innovative activity is not geographically symmetrical and knowledge intensive industries tend to be more geographically clustered (Asheim & Gertler, 2005). The presence of spatially sensitive business clusters and agglomerations are antithetical to academic theory relating to the flattening of the world and death of distance (Friedman, 2005) due to advancements in ICT and communication technology. The presence of global finance centers (New York, London, and Luxembourg) and business clusters (Silicone Valley, East London Tech City, and Paris-Salacy) have given credence to academic theories purporting the notion that geography matters (Asheim & Gertler, 2005, pp.291).

In the RIS literature, a regional innovation system is composed of universities, research centers, technological transfer agencies, public, and private institutions. Proponents of the RIS view interactions between actors at the regional level auspicious for the facilitation of innovation and innovative activity. The primacy of innovation by actors at the regional level has been engendered by the idea that tacit knowledge can be easily transferred among actors in a sound RIS which is pertinent in espousing economic growth and innovation (Grillitsch & Trippl, 2013). Due to the spatial sensitivity of tacit knowledge, there is a greater chance of tacit knowledge transfer in a sound RIS due to close geographical proximity. Tacit knowledge in an RIS is transferred via monitoring,

labor mobility, mentoring, and communication between actors in the RIS (Cooke, 2002). Spatial proximity and the transfer of tacit knowledge are key for innovation (Asheim and Gertler, 2005, pp.293). A sound RIS is contingent on the absorptive capacity of the region, which is marked by its financial, learning, and cultural characteristics (Cooke, Uranga & Etxebarria, 1997).

Asymmetrical imbalances and heterogeneous disparities among institutions and actors in an RIS mean that RISs are not homogeneous and will vary among regions based on the level of integration between actors in the system. Tödting & Trippel, (2005) and Isaksen & Trippel, (2014) expounded on the regional innovation system literature to add a conceptual dimension that captures the lack of homogeneity among RIS. They delineated a conceptual framework in which they posited three distinct variants of RIS; *organizational thick and diversified regional innovation systems*, *organizational thick and specialized innovation systems* and, *organizational thin regional innovation systems*. Organizationally thick and diversified regional innovation systems are characterized by: high levels of interaction among actors in the RIS, strong linkages between private and public institutions, a variety of research organizations, high level of R&D, high level of industry diversification, variety of business cluster heterogeneity, potential for radical innovation, outward looking networks, and heterogeneous knowledge pools and spillovers that regional firms can exploit. These RIS are often found in core and urbanized regions. An organizational thick and specialized regional innovation system is marked by: industry specialization, business cluster and industry homogeneity, a conservative institutional set up that facilitates industry specialization, inward looking networks, the potential for incremental innovation, and linkages in related industries. These RIS are often found in old industrial areas. The final RIS type, organizationally thin regional innovation systems, are marked by: little to no business clusters, a low number of institutions and research centers, weak network linkages, presence of SMEs, inward looking, high level of social capital (hampering to outside ideologies), and small potential for product and process innovation. These RIS are often found in more rural peripheral regions. (Isaksen & Trippel, 2014; Tödting & Trippel, 2005).

The above characteristics of different regional varieties determine the propensity of firms to engage in GINs favorably or adversely. The literature suggests that the organizational thickness or thinness in a region contributes to a firms' propensity to engage in GINs (Chaminade & Asheim, 2014). An organizationally thick and diversified RIS is when there is a strongly developed diversified infrastructure among actors in the region and a degree of collectivism and shared cultural norms. These regions foster conditions conducive to innovative activity due to the high level of support infrastructure and interactions among actors. These regions are dominated by business clusters and



*multinational corporations (MNC)*. Firms in these regions may have the best capabilities to engage in GINs, however, they may not need to due to the regional diversification. Organizationally thick and specialized regions, may have a somewhat developed infrastructure but lack industry diversification. Firms in these regions may have both the need to engage in GINs due to lack of industry diversification, and the absorptive capacity to do so; depending on infrastructure. An organizationally thin RIS is when there is a weakly developed infrastructure among actors in the region. These regions are marked by a lack of MNC presence. An embryonic infrastructure constrains any type of innovative activity in these regions. Firms in these regions may have a need to engage in GINs but lack the absorptive capacity to do so; due to an underdeveloped infrastructure (Chaminade & Plechero, 2013).

*Table 3: Regional variety – Summary*

<b>Regional Variety</b>	<b>Organizationally thick and diversified</b>	<b>Organizationally thick and specialized</b>	<b>Organizationally thin</b>
<b>Location</b>	Core urbanized regions	Old industrial areas	Peripheral rural areas
<b>Infrastructure</b>	Developed diversified infrastructure	Developed or underdeveloped specialized infrastructure	Embryonic infrastructure
<b>Innovation potential</b>	Radical	Incremental	Potential for process product innovation
<b>Business clusters</b>	Heterogeneous	Homogenous	No business clusters
<b>Networks</b>	Strong linkages between diversified public and private institutions (Outward)	Linkages between specialized actors in the region (Inward)	Strong linkages and social capital among actors (Inward)
<b>Absorptive capacity and need to engage in global innovation networks</b>	Capacity to engage in GIN. Due to regional diversification, there may be no need for actors to engage in GINS	Depending on thickness/thinness may have both the absorptive capacity and need to engage in GINs	Lacks absorptive capacity to engage in GIN. Biggest need to engage in GINs

*Source: Based on Isaksen & Trippel, 2014; Tödting & Trippel, 2005*

Engaging in GINs is contingent on both the industrial knowledge base of the firm and the absorptive capacity of the region. Analytical knowledge base industries have the highest capacity to engage in GINs whereas synthetic and symbolic knowledge base industries are thought to exchange knowledge on a regional level. Previous studies have shown that a correlation exists between the organizational thickness/thinness in a region and the likelihood in engaging in GINs (Aslesen et al, forthcoming). Firms operating in organizationally thick and diversified regions tend to network and engage more with firms and institutions in their regional locality. Firms operating in organizationally thin regions, while they may need to engage in GINs to augment their standing from lack of knowledge at the regional level, may not have the absorptive capabilities and capacity to engage in GINs. The previous research suggests that a region which is neither organizationally thick or thin is most conducive for firms to engage in GINs and this is due to these types of regions having both the need to engage in GINs and the absorptive capacity to do so (Chaminade & Plechero, 2013). Taking the above into consideration, we know that a region's propensity to engage in GINs is contingent on both the regional variety and organizational thickness/thinness of the region.

GINs can be used to augment regional deficiencies that may exist within an RIS. Firms in organizationally thin or specialized regions can ameliorate themselves from the absence of knowledge spillovers and agglomerations by engaging in GINs. However, the ability for the firm to engage in GINs will be contingent on the absorptive capacity and in-house capabilities of the firm to engage in these networks (Grillitsch & Nilsson, 2015). While it is understood that the regional variety will have an impact on the firm's ability to engage in GINs, little is understood about the mechanisms and processes that facilitate firms to engage in GINs. Engaging in GINs can help firms and institutions speed up the production and innovation process, as they may access knowledge from a variety of sources that their firm/institution may be lacking on a regional and/or industrial level. Engaging in GINs also allows firms and institutions to ascertain funding and talent from outside of their internal networks (Pilat, Backer, Basri, & Box, 2008). Cross-cultural knowledge sourcing and partnerships are also pertinent in allowing specialized firms operating in disparate regions to connect with other specialized firms and exploit strategic idiosyncrasies, which can help facilitate and foster innovative activities. These forms of knowledge sourcing and collaborations can augment any deficiencies arising from regional and knowledge base variety. In the case of SMEs operating in Sweden, there has been a degree of internationalization and firms, both SMEs and MNCs have been found to engage in GINs. Previous research has shown that in

Sweden there has been an emergence of specialized and diversified SMEs operating in industries with a symbolic knowledge base, which are actively engaging in GINs (Chaminade, Zabala, & Treccani, 2010). However, the mechanisms influencing the propensity of these SMEs to engage in GINs are not yet fully understood. There has also been no previous analysis on the impact of the region and the propensity of SMEs to engage in GINs from the regional perspective. Exploring the mechanisms that engender SMEs to engage in GINs from the regional perspective may prove auspicious for future regional development as we know that organizationally thick and specialized regions and organizationally thin regions may augment their position by engaging in GINs. Analyzing how firms engage in GIN is important, as it can impact future regional policy in which regional institutions can create new instruments that can encourage firms in these regions to engage in GINs. This will boost innovative activity in the region and allow regions to break out of negative path dependent trajectories. These GINs may also promote path renewal and path creation. While we know that industries characterized by different knowledge bases portray different geographies of their knowledge networks, at least when they are proxied through sourcing of knowledge. What we still do not know is how firms in the same industry and region might use different mechanisms to acquire different types of knowledge at the local and global scale.

### 3 Research Design

This chapter of the paper will address the research design which includes the methodological approach and methods employed to answer the research questions delineated in chapter 1. This chapter begins with a brief introduction which expounds on how the research was conducted. The introduction is followed by the epistemological and ontological position of the paper. Then, there will be an introduction to the methods used in carrying out both collection and analysis of the data and how data triangulation was considered. The chapter will conclude with a section on the ethical considerations of the study and the limitations and rationale for the methodical approach chosen.

To address the research questions presented in this paper, data analysis and collection is done via a multi-method approach. The first process involves analyzing secondary data and existing literature on regional innovation systems, knowledge bases, and global innovation networks. The data is analyzed within the conceptual framework outlined in the literature review. Existing studies on the spatial dimension of GINs have tended to use one variable when mapping the spatial dimensions of knowledge flows so the analysis of existing literature was pertinent in the formulate analysis of using other variables that have not been previously explored.

Whilst the first stage of analysis is primarily by means of secondary data. The second stage of the data procurement involves gathering primary data through an online survey and semi-structured interviews. The purpose of the online survey is to gain insight into the firm networks of the new media video game industry in the Skåne region. The online survey is primarily concerned with the spatial flows and types of knowledge within a firm's network. The interview stage of data collection involves interviewing firms, which act as a follow up to the second stage (online survey). Interviews are conducted to verify the data collected via the online survey. The interviews also serve as means to procure data not captured by the initial online survey. The interviews enhance our understanding of both the dynamics of the firm in contrast to the RIS and the dynamics of the firm from the perspective of their networks on the regional, national, and global level. Analyzing the knowledge networks and linkages, via the conceptual framework of GINs, allows for a multitude of variables to be captured. They can then be mapped spatially which, to the author's knowledge, has not been previously done.

The data were designed and analyzed via a mixed method approach. The first stage involves the identification of the firms to analyze. The second stage of the process involves obtaining data from the identified actors in the network via online surveys and interviews. The third stage of the process involves compiling the survey data to construct a social network database for the video game cluster of the Skåne region. The final stage involves coding and analyzing the data through *Social Network Analysis* (SNA). The interview data is aggregated, compiled, and cross-referenced within the network. The second part of the process involves analyzing the results of the SNA and interview data through the lens of the conceptual framework for triangulation. A mixed methods approach is used to answer the research questions outlined in this paper. SNA analysis alone can only show the network, it cannot explain the mechanisms and drivers that facilitate these exchanges. In that regard, the interviews and survey provide the information on the mechanisms that drive it.

### 3.1 Epistemological and Ontological Position

*“You couldn’t reduce statements about the world (ontology) to statements about our knowledge of the world (epistemology)”* (Bhaskar, 2014). Critical realism is a philosophical ideology which was espoused by Roy Bhaskar in the 1970s. Critical realism aims to not only understand reality but also to validate it. It deals with both the philosophy of science and the philosophy of social science. In critical realist theory, a tripartite of domains is delineated, consisting of the domain of reality (real domain), actuality (actual domain), and experience (empirical domain). The real domain consists of reasoning as to what and why events and instances are happening, the actual domain consists of knowledge of events and instances that are happening, and the empirical domain consist of knowledge that is perceived to be happening. (Alexander, 2013).

A key assumption of critical realism is that there is a reality that exists which is unconstrained by observers. Critical realists see the world as a set of social constructs. In critical realism two broad types of research method are identified: extensive and intensive. The extensive approach involves employing surveys and questionnaires etc. to understand any type of generalizations and patterns in the empirics. The Intensive approach deals more with interviews and qualitative analysis to understand why a phenomenon is happening (Easton, 2009). For the purposes of this paper, both the intensive and extensive approach are employed due to the heterogeneity of the research questions. The extensive approach is used in answering the research question on the networks of

actors in the video game industry whereas the intensive approach is used in answer the question as regarding the firms' propensity to engage in GINs.

Critical realism is a multifaceted philosophy that considers a plethora of mechanisms that may cause a phenomenon to occur, *“critical realism is concerned with the nature of causation, agency, structure, and relations, and the implicit or explicit ontologies we are operating with”* (Archer, Decoteau, Gorski, Little, Porpora, Rutzou, Smith, Steinmetz & Vandenberghe, 2016). A critical realist approach involves using a wide variety of theories and methods in trying to understand a phenomenon. This is primarily due to critical realists objecting to any type of theoretical finality as they see theories as social constructs that can be very rarely be verifiable hence the critical realist approach of using mixed methodologies and triangulation as tools to ascertain a level of understanding of the phenomenon being studied via a multifaceted approach from the perspective of the three domains of reality, actuality, and experience (Modell, 2009). The process of critical realism in understanding a phenomenon generally involves *“in-depth empirical investigations, preserving an interpretive element, with abstract theorizing”* (Modell, 2009). The skepticism of critical realists has engendered the employment of triangulation as a tool for critical realist researchers to help analyze, understand, and validate a phenomenon being studied.

## 3.2 Methods

The following section of this chapter will expound on the research methods employed for the data collection and analysis. Firstly, I will describe how the network was identified, then the online survey and interview process will be explained, followed by an introduction to social network analysis, which is the main tool used for the analysis of the data in this thesis. The methods sections of this paper will conclude with a section on how triangulation of the data was considered.

### *3.2.1 Identification of the Network*

The preliminary stage of data collection for this thesis consisted of the identification of the firms in which the analysis is based. In the case of this study, the network sample consists of all standalone firms with an employee count of more than 0 but less than 250, developing video games in the Skåne region of Sweden. This thesis was written in the framework of a project that focuses on SMEs in the IT and New Media industry in Skåne, in an international perspective. The list of

companies was composed using reports from dataspelsbranschen (Swedish Games Industry) and Game City to identify actors in the Skåne region that fit the prerequisites of the network. When a gaming company in the desired network was identified, the company was then cross-referenced using the retriever database to ensure that they were still active, registered as game developers, and developing video games in the Skåne region. The initial work identified 29 firms in the region; however, due to the dynamism and volatility of the industry a further level of analysis was needed to ensure that the firms met the prerequisites delineated above. The volatility of new firms entering and exiting the video game industry is not effectively captured by the formal reports issued by Dataspelsbranschen and Game City, and the updates issued by the retriever database. A manual selection process was necessary to ensure further sample consistency and validity. The company data was then cross-referenced using the firms' official websites and social media accounts such as: Facebook, Twitter, and LinkedIn. This level of analysis was to ensure that the firm matched the prerequisites of the network. The next stage of network construction involved searching for the firms address', contact persons, contact e-mails and/or contact phone numbers. The final stage of analysis was contacting the firm to ensure that they met the prerequisites of the network.

The final stage of the analysis identified 21 actors in the network. Data collection for the network consisted of two stages, the online survey and semi-structured interviews. Questionnaires were e-mailed to the firms before the interview stage. A proportion of the online surveys were filled out during the interview stage as some of the firms did not complete the questionnaire before the interview stage of data collection). Out of the 21 firms in the network, the response rate for interview requests was 71% and the response rate for the online survey was 85%.

### *3.2.2 Data collection: Online Survey*

Collecting primary data for this thesis consisted of two stages, the online survey and semi-structured interviews. The online survey stage involved sending out online questionnaires to all the actors in the network that was constructed. Once the network (SMEs in the video game industry of Skåne with an employee count of more than 0 but less than 250) was established, online questionnaires were sent out to all firms in the network. The original intent was that the survey would be finished before the second stage of data collection which was the interviews. However, that was not always possible due to time constraints of the firms in the sample. The online surveys

were constructed using Google Survey. The goal of the survey was to ascertain information about the firms' knowledge networks.

The online survey contained questions about the firm's networks with five different types of knowledge partners: game companies (regional), education organizations (regional), support organizations (regional & national), major platform holders (international) and other (firms not mentioned in the survey choices). There are 4 types of knowledge linkages in the survey: paid knowledge acquisition, paid knowledge exchange, unpaid knowledge acquisition, and unpaid knowledge exchange. In other words, the knowledge linkages presented in the survey follow the broad definition of global innovation networks which was expounded on in the literature review chapter of this paper. The survey also enquired about the type of knowledge being transferred: scientific (analytical), engineering (synthetic), artistic (symbolic), business functions (marketing and managerial) and other (mixed knowledge pool).

The information presented in the survey helps expound on the spatial flows and knowledge dynamics of actors in the industry. This is done by identification of the type of linkages, the knowledge being exchanged, the location of the firm exchanging the knowledge, and the importance of the knowledge that is being exchanged. The survey also contains a question regarding the importance of these knowledge linkages and exchanges in which the knowledge exchange relationships are enumerated on an ascending scale of 1 to 5 in terms of importance. The data collected during the survey is directly related to the knowledge networks and linkages of actors in the network. However, collecting data via online surveys can be problematic as the validity of the data rests on the successful interpretation and comprehension of the questions being asked to the respondent. Furthermore, it also rests on how much information the respondent is willing to disclose. These problems can lead to respondents not following the instructions of the survey efficaciously, failing to address questions posed in the survey, and omitting sections that they may not feel are relevant to them (Drennan, 2002). To address the shortcomings of the online survey and to ensure triangulation of the data, time was allocated in the interview stage to verify the network data which was submitted via the online survey. The template of the online survey can be viewed at the appendix section of this paper (appendix A)



### *3.2.3 Data collection: Interviews*

The goal of the interviews was to understand the behavior of the firms in the network sample. Open-ended interviews in economic geography are an important tool that can be used to gather data to challenge traditional economic theories and principals (Schoenberger, 1991) and help formulate hypotheses. The employment of interviews to gather data has been a common methodological approach in economic geography (Clark, 1998). A semi-structured interview with open-ended questions allows the interviewer to understand the history and behavior of the firm from the context of its organizational structure, firm culture, production methods, and market position etc. (Schoenberger, 1991)

The next stage of primary data collection was the semi-structured interviews. The firms interviewed in the sample represent 71% of all SME video game companies in the Skåne region with less than 250 employees. A total of 15 interviews were conducted. The interviews took place from February 2017 until March 2017 and were roughly 60 minutes long. Interviews were recorded and transcribed. The respondents of the interviews consisted of 13 CEOs, 1 community manager, and 1 operations manager. The interviews were conducted throughout the Skåne region of Sweden. Most of the interviews were taken on-site at the location of the respondents' firm; exception of cases where the respondent did not have an office space and the interview was conducted in a café or incubator in the locality of the interviewee. Upon completion of the interview stage of data collection, audio files of the interviews were sent to a company to be transcribed.

The interview stage followed a semi-structured interview format in which questions were asked openly. The most important strategy in preparing for an interview is for the researcher to be well versed in both the industry and the firm of the respondent. This helps reassure the respondent that the researcher is versed in knowledge relevant to the discussion and is thus more likely to be more open (Schoenberger, 1991). Preparation for the semi-structured interviews involved constructing a company profile for each of the firms being interviewed. Information in the company profiles consisted of a brief description of the company, the history of the company, the products and services offered by the company, and information about the company's team members and their functions. The company profile was constructed using information from the press kit sections of their respective websites and their social network accounts (Facebook, Twitter, and LinkedIn). Preparing a company profile prior to the interview ensured that the open-ended questions

expounded on by the interview prompts were tailored and germane to the firm being interviewed. The heterogeneous nature of firms in the network meant that follow-up questions had to be relevant to their firm as some firms specialized in games as a service, games as a product, virtual reality, and educational games. Background knowledge of the firm was necessary for being apt at eliciting desired information relevant to the framework of the interview questions.

The interview was separated into 4 different sections: innovation activities, knowledge linkages (online survey), the role of the regional innovation system, and internationalization processes. All sections of the interview were designed to gather data relevant to the spatial distribution of knowledge, how firms engage in GINs, and the role of the regional innovation system. The template of the interview questionnaire, can be viewed at the appendix section of this paper (appendix B)

#### *3.2.4 Data analysis: Social Network Analysis (SNA)*

Social network analysis is a methodological technique that is used to study the relationship of the flow and exchange of information among actors (actor refers to any participant in the network: individuals, institutions, and firms etc.) in a social network. A social network is comprised of both nodes and edges (the nodes represent the actors and the edges represent the flows of exchange connecting to other nodes in the network). Just like a geographical map connects places by roads, SNA connects nodes by edges showing how exchanges flow between the actors in the network. It allows us to see the patterns and relationships that exist in a network by means of a network visualization. SNA can help us understand the organizational flow of knowledge in a social environment. The purpose of SNA is to construct a network that mirrors the social structure of what is being analyzed (Haythornthwaite, 1996). The network can then be used to examine the relationships of the actors in the network, it can also help expound on the hegemonic structure of a network in which certain actors may be core components whilst other actors may take on a peripheral component. SNA is a powerful tool when employed with other methods of research, as it can help validate data sets and deepen our understanding of the data. Whilst the employment of social network analysis alone is a powerful tool, it can only show us the relationships, ties, and flows of information in a network but not the proximate cause of these relationships. SNA works as a powerful complementarity to other methods, such as methods which can expound on our

knowledge of the mechanisms which create and engender these social networks, like interviews or surveys.

The employment of social network analysis in economic geography has burgeoned over the past decade. Social network analysis has been used in economic geography to analyze the structure and spatial interactions of regions and clusters. It is understood within the academic community of economic geography “*that networks are an appropriate conceptualization of inter-organizational interaction and knowledge flows*” (Ter Wal & Boschma, 2009); thus, validating the employment of SNA within the field of economic geography. SNA helps expound on some of the academic debates that the literature has been unable to address. There is an ongoing scholarly debate in economic geography as to what is more conducive to economic growth; the networks of the firm or the region in which the firm operates? SNA can elucidate on these relationships by analyzing the networks of the firm and the spatial proximities of these networks. SNA can be used as a powerful tool in economic geography especially when used as a complementarity to the literature (Ter Wal & Boschma, 2009).

The process of SNA for this paper consisted of first constructing and identifying the actors in the network to be analyzed. After the network database was compiled, the online surveys were sent to the actors in the network and follow-up interviews were arranged. After both the online survey and interview data was collected, the data was cross-referenced with the interview audio files and transcriptions to ensure the accuracy of the data and interpretation of the data. The next stage was coding the data to input the information into the SNA software. The SNA software used for coding and data analysis was Gephi. Gephi is an open source industry standard SNA tool which has been used in a plethora of fields such as journalism and academia. After the data has been coded and programmed into the SNA software the data is reconfigured through an algorithm to create a visualization of the network. The final stage is to cross reference the social network analysis within the scope of the literature review and theoretical background of the paper to review and analyze the data. For the purposes of this paper, SNA is employed to map the spatial distribution of knowledge exchange (scientific, engineering, artistic, business functions, & other) and the mechanisms facilitating the knowledge exchange (paid knowledge exchange, paid knowledge acquisition, unpaid knowledge exchange, and unpaid knowledge acquisition).

### 3.2.5 *Triangulation of the data*

Triangulation, as defined by Denzin, (1978) is a method that involves using combinatorial methods to address the study of a singular phenomenon (Denzin, 1978, pp.291). The purpose of triangulation is to address the phenomenon being studied by cross-referencing between disparate methods and methodologies. The use of Triangulation ensures validity and consistency of results by analyzing those results from a broad perspective of heterogeneous methods and methodologies. The employment of the triangulation method can ensure a more contextual analysis of the phenomenon being studied and can capture any regularities/irregularities that may be missed by the employment of a single method (Jick, 1979).

The literature identifies four different types of triangulation; data triangulation, investigator triangulation, theory triangulation, and methodological triangulation (Denzin, 1978, pp.295). This thesis strives for efficacy in triangulation by considering all four subset measures outlined above. Data triangulation refers to ascertaining data by using different sources (Denzin, 1978, pp.295). The sources of data used in this research were actors in the network of the video game industry. The level of analysis is that of "*the collectivity*" in which the individual sources make up the network which is then analyzed via a structural-functional analysis. (Denzin, 1978, pp.296). The level of aggregate analysis is also employed to take the possibility of outliers into consideration.

Investigator triangulation refers to the employment of one or more observers to collect and analyze the empirics (Denzin, 1978, pp.297). Data was collected by two interviewers in the early stages of data collection. Data collection for this paper was done as part of an internship in which I was employed by CIRCLE to act as a research assistant for an international project. My colleague and I attended 5 out of the 15 interviews together in which we would discuss the empirics. Throughout the entire data collection process, the other project researchers and I maintained a constant dialogue regarding the observations of the findings thus ensuring investigator triangulation.

The next area of triangulation is that of theoretical triangulation, which is when data is analyzed from different theoretical frameworks (Denzin, 1978, pp.297). The conceptual framework through which data for this paper is analyzed, is that of the knowledge base epistemology and regional innovation systems. Both conceptual frameworks act as complementarities to each other. However, both offer disparate approaches to predict how a variable will react based on several

prerequisites delineated in their respective literature. The data collected exists within the empirical realm and is, therefore, germane to both conceptual models. Analyzing the data from the perspective of both theoretical approaches ensures a degree of theoretical triangulation.

The final type of triangulation is that of methodical triangulation; which involves using more than one methodology in the level of analysis. There are two types of methodological triangulation; within-method triangulation and between-method triangulation. Within-method triangulation is when multiple strategies are used to examine the data from one method. Between-method triangulation is when heterogeneous methods are employed to analyze the same unit (Denzin, 1979, pp.302). This paper is concerned with the between-method of triangulation, as the data is examined via social network analysis and qualitative data analysis of the interviews. All aspects of triangulation have been taken into consideration regarding the empirical analysis of this paper to ensure consistency of the findings. Whilst there are various definitions and rationalizations for the employment of triangulation, this paper strives for triangulation from the perspective of Carter & New, (2005) who postulated that *“triangulation does not merely validate claims or strengthen data sets. It also offers ways to enrich data analysis”* (Carter & New, 2005).

### 3.3 Ethical Considerations

Throughout the data collection period, several procedures have been employed to ensure ethical integrity. All the participants were made fully aware of the goals and the requirements for the project. Prior to the interviews, written information was given stating both the scope of the interview and time the interview process would take. In determining an interview location and date, preference was always given to the interviewee and most of the interviews were conducted on-site. The interviewees were made aware at the start of the interview that all information provided would be strictly confidential unless we needed to mention a company specifically, in which case permission would be sought and, if declined, respected. Before starting, permission was also sought to record the interview. All the firms interviewed have been assigned *coded names* (e.g. RF1, RF2, and RF3 etc.) throughout this paper to ensure confidentiality.

### 3.4 Limitations and rationale for methodological approach

When conducting SNA, a complete network is propitious as an incomplete network can hamper the validity of the entire network. In this paper, 71% of respondents in the network completed the survey. Henceforth, when this paper refers to the network it refers to the 71% of the network (unless otherwise stated) that was captured by the data and not the complete network as there are missing actors who declined to participate in the survey. Problems with an incomplete dataset are that the network analyses can be biased, as missing actors are unable to be analyzed. However, whilst the network is incomplete, 71% network coverage is auspicious considering the difficulty in ascertaining full coverage when relying on the participation of individuals. This paper argues that 71% network coverage is somewhat representative, as the industry is so dynamic and volatile that it is constantly changing at a rapid speed. Any network captured at a point in time would be ephemeral due to the dynamism of both the video game industry, which is still somewhat embryonic, and the volatile character of SMEs. Throughout the short time span between constructing the network and interviewing respondents, new firms entered and exited the network and there was rapid mobility between CEOs and actors exiting and entering new firms. The network data is representative of the volatility of the industry, and whilst it cannot capture the dynamism of the industry, it can provide a static view of the interactions between actors in the industry.

Another limitation of this study is that of the integrity of the data collected from the respondents. Every effort was considered to ensure the interviewee was versed in knowledge of the project and the expected response format; however, the aspect of human error regarding answering the questions especially regarding the three firms that filled out the online questionnaire but declined the invitation to interview, must be considered. In the case of these three firms, the only way to ensure triangulation of the data provided was through secondary sources. Another limitation of the data is the respondents' knowledge of the questions posed in the interview. Whilst most of the interviewees (13) were CEOs, a considerable amount of the SMEs interviewed had multiple CEOs and founders and each had a different functions and roles relating to their respective firms. Whilst most of the respondents were versed in all aspects of the business functions, some had more specialized roles such as a computer programmer or graphic artist and may not have much knowledge of the firm's networks and knowledge linkages etc. Whilst most of the interviewees had no problems talking about their regional networks and linkages, some of the interviewees were

hesitant at times to engage in a discussion of their global networks. Considering the above, the role of global linkages in the network may be understated. Another limitation of this study is that the generalizability of the results in different industries may be controversial, as the results of this paper will be representative of neither the new media nor symbolic/synthetic industries. As argued earlier in this paper that the heterogeneous nature of firms is sometimes omitted from the conceptualizations of industrial knowledge bases and the new media industry. This study is pertinent to the network of SMEs in the video game industry and whilst the methodological approach may be replicated to conduct analogous studies in different new media or symbolic and synthetic industries, generalizations and analyses of the results germane to this study may be dubious, due to the heterogeneous nature of the industries previously mentioned.

The methodology used in this study is somewhat analogous to the research design of other studies in economic geography. Consideration to the research design of previous studies pertinent to this paper (Martin & Moodysson, 2011; Martin & Moodysson, 2013) is part of the reasoning and justification for the employment of this research design. There is a level of homogeneity that exists between the employment of a certain methodological approach in various specialized fields of economic geography, and a continuation of this trend allows researchers to develop the literature and have a benchmark to cross reference disparate studies in the same field; by the employment of a similar methodological approach.

## 4 The case: the video game industry in Skåne

This chapter of the paper begins with an introductory profile of the Skåne region. The regional profile is followed by a brief historical profile and analysis of the video game industry. Following the regional and industry profile, the video game cluster and network is introduced and discussed.

Regional dynamics is a salient theme in EEG and it also serves as one of the foundations upon which this study is based. A regional profile is introduced as it can help expound on the RIS of the Skåne region and the discussion that follows in the analysis. The knowledge base epistemology is another conceptualization which is pertinent to the foundation of this paper. To understand how the type of knowledge and spatial proximities change over time a historical analysis and profile of the transformation of the video game industry is detailed to strengthen the initial argument outlined in the literature review chapter of this paper. The knowledge base epistemology presents industrial knowledge bases as static entities which do not change over time; however, industries are dynamic and may change over time due to innovation and technological change. The profile of the video game industry seeks to make clear how industrial change engendered by technological change creates a need for different types of knowledge but also how the evolution of the industry generates a need for knowledge to be exchanged at different spatial proximities.

### 4.1 Profile of the Skåne Region (Southern Sweden)

The Skåne region lies in southern Sweden and consists of 33 municipalities. It has a population of roughly 1.5 million and is host to Sweden's 3rd largest city, Malmö, and the historic university town Lund which is host to Sweden's 2nd oldest university Lund University. The Skåne region is also integrated into the regional economy of Denmark due to the formation of the Öresund region which links both Malmö and Copenhagen together by the Öresund bridge. The region is host to a plethora of universities such as Lund University, Malmö University, Blekinge University of Technology, Swedish University of Agricultural Sciences and Kristianstad University. It was named an innovation leader by the ERI scoreboard. Innovation in the region is attributed to prestigious universities, research centers, high level of R&D expenditures, and patent applications (European Commission, 2017). The region has substantially high education rates with one in three people aged 25-64 holding 3rd level certification (Skåne, 2017).



The biggest industries in the region are agriculture, manufacturing, construction, and commerce. However, regional development since the 1980s has resulted in a modest shift from industry to services. Regional development has seen an increase in the number of people working in the private sector and a decline in the number of people working in traditional manufacturing and agricultural industries (Skåne, 2017). The decline of employment in these industries may be attributed to the growth of recent business clusters that have developed in the region. The region is host to several business clusters which strategically specialize in IT and new media, ICT, life sciences, environmental engineering, packaging, and food sciences (European Commission, 2017; Skåne, 2017). The rise of these business clusters in the region has attracted several international firms that have set up operations in the region. This thesis focuses on one of these business clusters: IT and New Media.

Industrial shift in the region has been strengthened by local government policies that support these business clusters by designing policies to help finance startup companies and support internationalization. One such support organization is Region Skåne which was set up to promote growth and development in the region. One of Region Skåne's main functions is to create linkages between universities, research centers, and local firms to bolster innovative activity in the region (Skåne, 2017). The regional government has invested heavily into support organizations, financing programs, and research centers to develop these key strategic industries. One of the prominent business clusters of the Skåne region is the video game cluster, which is part of IT and new Media industry. The social network analysis in this thesis is based on the Skåne video game cluster.

## 4.2 Profile of the Video Game Industry

The video game industry is one of the fastest growing media industries in the world. In 2016, the value of the global market amounted to roughly \$99 billion. The biggest markets in the industry are the Asian-Pacific, North American, and European markets. Roughly half of the market value for Asian-pacific market comes from China, which is the fastest growing market in the industry. The Chinese market was valued at roughly \$10 billion in 2012 and the projected market value for 2019 is roughly \$30 billion (Newzoo, 2016). The video game industry has its historical roots firmly laid in both the USA and Japan. In 1962, one of the first ever video games was created by a group

of students from Massachusetts Institute of Technology. The release of the first video game generated interest in this embryonic industry, however, it was not until the diffusion of the television and the invention of the personal computer that the industry began to burgeon. Throughout the 1970s and 80s, the market was most prominent in the United States due to the attachment rates of televisions and personal computers in the region (Egenfeldt-Nielsen, Smith, & Tosca, 2008).

Throughout the 1980s, new regions in the global economy began to develop video games, with Japan aggressively investing in the industry. In 1983, the first video game was developed in Sweden. The industry achieved rapid growth in the 1990s and 2000s with Japan and the USA acting as industry leaders. In 1992, EA Dice was founded in Växjö, Sweden, and in 1997, Massive studios was founded in Malmö, Sweden. It was not until the early 2000s that Swedish video game developers began to have an influential presence in the industry, which was engendered by the formation of Dice and Massive in the 1990s (Dataspelsbranschen, 2016). As the Japanese economy continued to decline during the late 1990s and 2000s the industry saw a paradigm shift towards western developers with eastern developers still having a presence in the industry but not as big or influential as they had previously. The industry began to grow rapidly throughout the 2000s; however, rising development costs engendered by technological change had a negative impact on the industry. As development costs began to rise rapidly due to innovation, the retail price remained the same as it had in the 1980s. During this period, the market experienced a split between small independent developers and AAA developers. The rising cost crisis had a detrimental impact on the industry with over 70 video game firms closing between the years 2006-2012 (Plunkett, 2012).

Further process and radical innovations in the industry such as digital distribution platforms allowed the industry to recover from the mini-industry crash of the mid-2000s. Digital distribution platforms allowed small developers to self-publish without the need of an international publisher. It also allowed SMEs to bypass the production lines of manufacturers and retailers, as the product was now intangible and made to order, ensuring fewer losses from lack of sales attributed to distribution cost. The 2010s saw the industry grow rapidly with the advent and widespread diffusion of smartphones; it also saw the rise of independent developers. During the 2010s, China began to have an influential presence in the global market and both South Korea and Eastern Europe began to have a modest but growing presence in the industry. In 2011, Minecraft was released by Swedish developer Mojang (Stockholm) and, as of 2017, is the second biggest selling video game of all time. In 2012 Candy Crush was released by Swedish developer King (Malmö)

and became one of the most played mobile video games in the world (Dataspelsbranschen, 2016). The international success of both Minecraft and Candy Crush helped put Swedish video game developers on the map. Sweden now had a globally influential presence in the industry. The global success of independent SME developers in Sweden saw the increase of video game developers in country, with Stockholm and Malmö (Skåne Region) being the centers of video game development. This paper is concerned with the analysis of the video game cluster of southern Sweden.

### 4.3 Innovation and technological change

Technological change and innovation in the industry triggered a shift in both the type of knowledge needed in the industry and the spatial proximity from where that knowledge is sourced. In the embryonic stages of the industry, developers were limited by technological constraints and the knowledge needed was primarily engineering and often artistic. Radical innovations in the industry created a need for new sources of knowledge as the fidelity of computer graphics increased significantly which created more demand for artistic knowledge. As smartphones and personal computers began to diffuse, the video game industry began to cross over into other industries such as education. Video game developers then began to collaborate with academic institutes to meet the need for scientific knowledge. As the industry became globalized it created a need for actors to source knowledge outside of the region. Developers needed to source knowledge globally to be strategically competitive in the global market-place but also to ensure they maintained analogous international standards with their industry peers. The globalization of the industry also meant that firms needed to source market knowledge so they could release their products internationally in the biggest global markets. The literature on knowledge bases fails to mention that technological change and innovation can engender a change in the types of knowledge needed in an industry and firm. The literature identifies an industrial knowledge base as something that remains static; however, evidence suggests that it is dynamic and changes over time with innovation and technological change (Moodysson, 2008). This may not be true of all industries, but it is true with symbolic and synthetic industries, as both art and technology have merged significantly over the past decade, creating hybrid industries that bridge the gap between both art and high technology.

During the 1970-1980s video game markets were very small and locally embedded. American game developers made games for the American market, and Japanese developers made games for the

Japanese market. Developers targeting the domestic market initially sought knowledge from domestic actors in their respective regions. During this period, the games were culturally embedded. If a developer from Japan wanted to sell a product in western markets, they would have to both localize and translate it. For American developers, the process differed, as they generally would only have to translate their products for the Japanese and Asian markets and only localize a very small percentage of the overall product if any. This was due to eastern audiences already being acclimatized to both North American and western culture. As development costs rose video game companies began to target the global market. In 2010, Keji Inafune, who acted as the head of research and development and global head of productions at Capcom (which was one of the biggest and most profitable industry leaders at the time), stated,

*"I hope Japanese game developers are breaking through the stagnation, However, the reality isn't as good as I want it to be. I see they're starting to be aware of the problem and that they have to do something. They know they have to learn more from western games and create games that'll sell more in the western market. However, they don't know what to do or how to do it. I don't think [Japan's game industry] is anywhere near over ... it's something we should be proud of," (Pitcher, 2013).*

His comments were a response to both the globalization of the industry and paradigm shift from Japanese to Western market hegemony. He also went on record to state,

*"So, of course, we can't just rely on our own skill, our own Japanese developer skill and know-how, to steer us through this dark time,. It's going to have to come through collaborative efforts and co-operation. It's our U.S. staff, our European staff, working closely with them. Of course, we are working with a lot of different Western developers as well. It's being able to share their knowledge and information, to collaborate with them on a very in-depth level, that's going to allow us to grow as a company and to be able to understand how the market is changing in the West, and allow us to be competitive in those markets. That's going to be essential for us." (Downes, 2010).*

The response to industry globalization was for firms to source knowledge internationally to be competitive and to create a product void of cultural idiosyncrasy that could be sold on the global market. Again, the literature states that industries dominated by a symbolic or synthetic industrial knowledge base, seek knowledge regionally and nationally due to the cultural embeddedness of production and level of tacit knowledge exchange. However, globalization has engendered a need for video game developers to avoid any instances of cultural embeddedness in the production of video games that are developed for the international market, which means global knowledge is

needed. This is one of the reasons why investigating the role of global innovation networks in the game industry and the type of knowledge that the firms acquire through those networks is of particular interest.

## 4.4 Profile of Skåne Video Game Cluster and Network

The video game cluster of Southern Sweden consists of both the Skåne and Blekinge region. As of 2015, there are 55 organizations actively developing video games in the region (This study focuses on firms that have more than 0 employees but less than 250; which accounts for 21 firms in the region). These 55 organizations hired a total of 692 people. Out of all the firms in the region, 34 firms are located in Malmö. Karlshamn and Helsingborg are hosts to 11 and 6 firms respectively, with the remaining firms located in other parts of the region (Game City, 2015). (The above information is from official statistics for the year 2015. It differs slightly from that of 2017, as firms and their regional locations have slightly changed since the last official profile of the industry. The number of firms and their regional location differ slightly from the firms captured in the analysis section of this chapter.) (Game City, 2015).

A 2014, survey featuring 41 firms in the region, found that the combined turnover of all companies in the survey amounted to roughly €94 million. Over half of the annual turnover for the year 2014 was from RF22. The video game industry in Southern Sweden has experienced rapid growth over the past few years. In 2015, there was a growth rate of roughly 56%. The five most profitable firms in the region are: RF22, RF52, RF25, RF18 & RF51. The firms that achieved the most rapid growth in the year 2013-2014 were: RF48, RF25, RF22, RF1, and RF18 (Game City, 2015).

The region has access to 9 different support organizations, which all have individual functions to facilitate industry growth. Out of all 55 firms in the region, 21 of those firms are SMEs with an employee count of more than 0 but less than 250, which are captured in the network. The firm employee count of the complete network (including firms that did not answer the online survey or participate in the interview) is 151 employees. The average employee count of the firms in the complete network is 7 and the average age of the firms is 8 years. The following discussion will be regarding the firms in the network that were interviewed (71% of the total network) based on the total network data obtained (85% of the total network).

Out of all the firms interviewed, most of the educational backgrounds of the employees consisted of formal education primarily from institutions such as Lund University and Blekinge Institute of Technology. A large portion of firm employees also had a vocational education background from the game assembly. Industries with a symbolic or synthetic industrial knowledge base are said to have a primarily informal educational background, as actors are thought to acquire knowledge from experience and vocational institutes. The video game industry whilst believed to be an industry with a symbolic knowledge base, shares similar traits to an industry with a synthetic knowledge base. It requires a significant amount of engineering knowledge input into product creation; however, the final product output is of a symbolic nature. Whilst identified as an industry with a symbolic industrial knowledge base; it can be argued that it falls somewhere in-between the synthetic and symbolic industrial knowledge base. In this network, formal education institutes played a significant role in the educational backgrounds of the employees. The reasoning for this may be that there has been a cultural lag with regards to educational institutions having the capacity to accommodate the ever-evolving symbolic and synthetic industries. A significant number of employees in the network studied media and game design in formal academic institutions. Programs such as these would not have been offered by academic institutions a decade ago, due to a lack of demand. These niche industries initially have no presence in academia, so the only way to ascertain knowledge is via experience. However, as these industries grow and break into the mainstream, they create a demand for new programs in formal academic institutions. It also creates a demand for reskilling in the industry. This can account for an increased need of knowledge diversity in the industry, as some of the employees specialized in arts and design whilst others specialized in engineering and computer programming. The companies in the network with a higher employee count also had employees with backgrounds in marketing and business studies. As the companies began to expand, they needed to source talent from a multitude of different fields to leverage the quality of their product.

Table 4 displays the profile of the network, it includes: the year the firm was established, the employee count of the firm, the number of regional and national linkages, and the number of global linkages.

Table 4: Network profile

Name	Year Established	Employee Count	Regional and National Networks	Global Network	Name	Year Established	Employee Count	Regional and National Networks	Global Network
<b>RF10</b>	2012	9	37	20	<b>RF30</b>	2007	1	21	1
<b>RF13</b>	2014	4	27	4	<b>RF35</b>	2006	2	26	7
<b>RF15</b>	2008	1	20	3	<b>RF37</b>	2010	8	20	10
<b>RF18</b>	2008	12	8	8	<b>RF42</b>	2002	1	19	2
<b>RF26</b>	2015	5	18	9	<b>RF51</b>	2006	45	30	11
<b>RF5</b>	2011	3	20	3	<b>RF28</b>	2013	2	0	5
<b>RF11</b>	2011	7	31	8	<b>RF36</b>	2009	10	6	8
<b>RF48</b>	2013	12	40	11	<b>RF21</b>	2012	3	9	5
<b>RF12</b>	2007	15	13	12	<b>RF19</b>	2001	2	3	5

Source: Own survey

Actors in the network are highly connected with each other and knowledge is exchanged at high frequency, which is facilitated by a level of trust. There is a considerable amount of knowledge exchange on the global level as well. The interviews and subsequent analysis show that GINs are accessed on the regional level through key actors in the region who act as “gatekeepers” to these global connections. A key feature of the network is the level of innovativeness of the firms. Firms in the network have a relatively small employee count yet are integrated into the global network of the industry. They have strategic collaborative alliances with key international firms, which is unexpected given their endowments. There is also a high level of market diversification of developers in the region. Rapid labor mobility in the region allows firms to enter new video game markets with new knowledge being introduced to regional firms via strategic actors who have industry know-how and know-who. The following chapter of this paper will focus on an in-depth analysis and discussion of the network mentioned, within the framework of the research questions.

## 5 Analysis and discussion

This chapter of the paper focuses on the presentation, analysis, and discussion of the results, based on both the survey and the network analysis. Following an introduction of the tables and figures, the results will be analyzed. After the results are analyzed they will be discussed within the context of the literature review and the research questions presented. The research questions will be presented and answered in order of the SNA visualizations, tables, and figures. To see the exact location of where each node lies in their respective figure, refer to the appendix section (appendix C, D, & E) at the end of this paper. Following the discussion and analyses of the figures, charts, and tables presented, there will be a summary of the overall findings of the data.

### 5.1 Understanding the spatial configuration of the knowledge networks in the video game industry in Skåne (Research question 1)

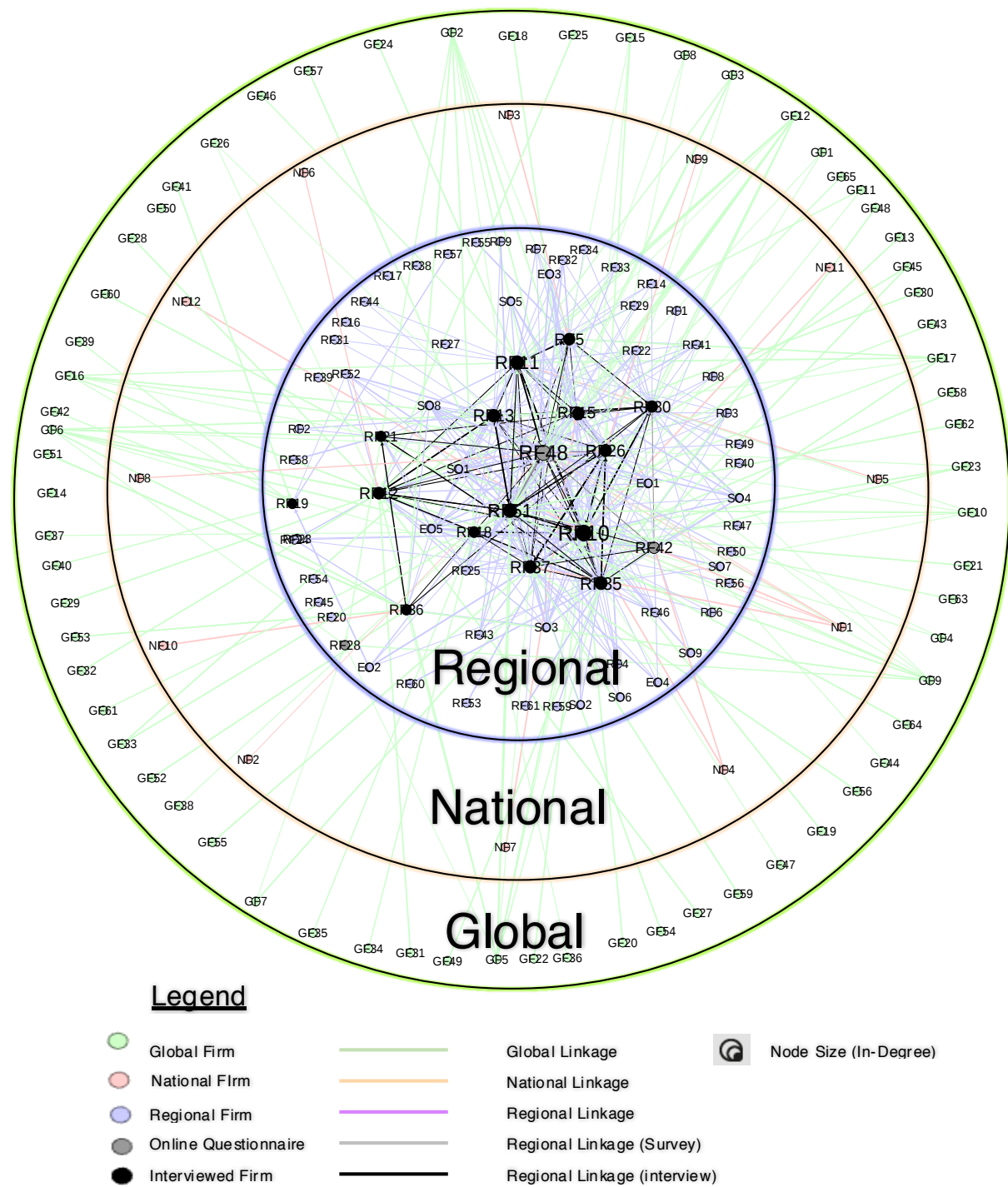
#### *5.1.1 Geographical density of knowledge exchange*

Figures 1, 3, and 5 presents the results of the social network analysis. The graphs consist of 152 nodes, which represent the different actors in the network; and 480 edges, which represent the flows of knowledge between the different actors in the network. The type of knowledge and mechanisms in which these linkages are based which will be explained in more detail in the subsequent figures, 3 and 5. All nodes in the figure are those with which the network has a connection. The number of nodes with linkages on the regional level is 75. Actors on the regional level in the network consist of 61 firms (15 interviewed and 3 who filled out the online survey) plus all other firms that these 18 focused firms have networks with, 5 education organizations, and 9 support organizations. The network linkages on the national level consist of 12 actors and the network linkages on the global level consist of 65 actors totaling 152 nodes in the graph. Figure 1 illustrates the spatial density of actors in the network which is divided into three zones; regional, national, and global. Each zone represents the spatial level in which the actors in the network are located. Each node and edge in the graph are colored to represent the spatial locality of the actors. The node color identifies the type of actor and the edge color identifies the type of linkage. The size of the node represents the importance of the actor in the network, and the width of the edges



represents the importance of the knowledge connection for the actors in the network.

Figure 1: Spatial density of network



Source: Own survey, illustration design inspired by Martin & Moodysson, 2011

Figure 1 helps respond to the first research question posed in this paper which is to understand the spatial distribution of knowledge linkages. The findings present a departure from some of the theoretical assumptions of the geography of knowledge in industries with a symbolic or synthetic knowledge base. As discussed in the literature review, the literature on knowledge bases stipulates that industries with a symbolic or synthetic knowledge base, tend to operate more on the regional level first and then the national level, due to the input of production being spatially and culturally embedded in the region. The degree of cultural and localized input in the production of the product is assumed to draw on a high degree of tacit knowledge from close proximities due to the production output being culturally contextual. The spatial distribution of knowledge transfer in the network is roughly 70% on the regional level, 2% on the national level, and 28% on the global level. The findings contradict the literature in that spatial knowledge exchange on the global level takes precedence over that of exchange on the national level. There also seems to be no correlation to the target market of the firm (International and Domestic) and the propensity of that firm to engage in GINs.

Out of the 15 firms interviewed; 11 of the firms (RF11, RF12, RF15, RF18, RF19, RF21, RF30, RF35, RF36, RF37, & RF51) stated that over 90% of their sales come from the international market, 1 firm (RF13) stated that over 80% of their sales come from the international market, only 2 firms in the network (RF5 & RF10) stated that over 80% of the sales came from the domestic market, and one firm (RF26) has not yet developed a product to market yet so they have no sales as of now. However, they are also aiming for the international market. RF5 & RF10 primarily target the domestic market; however, their position in figure 1 shows them to be both heavily integrated on the regional level and somewhat integrated on the global level. The findings suggest that even firms operating more on the domestic level need to establish GINs in their procurement of knowledge. RF5 has only one GIN and RF10 has seven different GINs spanning seven different countries. The findings with RF10 are interesting, as they are engaging in a high number of GINs at disparate spatial proximities relative to the whole network; yet 95% of their sales come from the domestic market. It would be expected from the literature that a firm primarily operating on the domestic market would source knowledge locally; however, the findings suggest that RF10 sources knowledge globally for a product that is primarily developed for the Swedish market. This could be attributed to the level of innovativeness of the firm as roughly 50% of their GINs are used to source engineering knowledge, which may be obtained abroad from industry experts to retain a level of competitiveness on the regional level.

The findings also present an interesting disparity between the integration of actors on the regional versus the national level. Whilst 70% of all exchange is on the regional level, only 2% of exchange is on the national level. The biggest video game companies in Sweden by revenue are: NF7 (National), RF22 (Regional), and NF1 (National) (Dataspelsbranschen, 2016). The network identifies one exchange with NF7, three exchanges with NF1, and eleven exchanges with RF22. The trends show that once knowledge cannot be sourced regionally, actors will seek to source knowledge globally; as opposed to nationally. This is surprising, as NF1 and NF7 are high profile firms in the industry that operate internationally and have a strong industry presence.

Table 5 presents the geographical distribution of the knowledge linkages by country. The transfer of knowledge is spread across 15 different countries in 3 continents. The most frequent countries for sourcing knowledge are the United States, Great Britain, Japan, and Germany. 40% of all knowledge is sourced within Europe and the remaining 60% sourced outside of Europe.

*Table 5: Global geographical distribution of knowledge linkages by country in percentage %*

<b>Americas</b>	USA	CAN							
<b>(46.15)</b>	(44.6)	(1.5)							
<b>Europe</b>	GBR	DEU	DNK	IRL	FRA	FIN	NOR	CYP	ESP
<b>(40.00)</b>	(15.4)	(7.7)	(4.6)	(3.1)	(3.1)	(1.5)	(1.5)	(1.5)	(1.5)
<b>Asia</b>	JYP	KOR	CHN	IDN					
<b>(13.85)</b>	(9.2)	(1.5)	(1.5)	(1.5)					

*Source: Own survey*

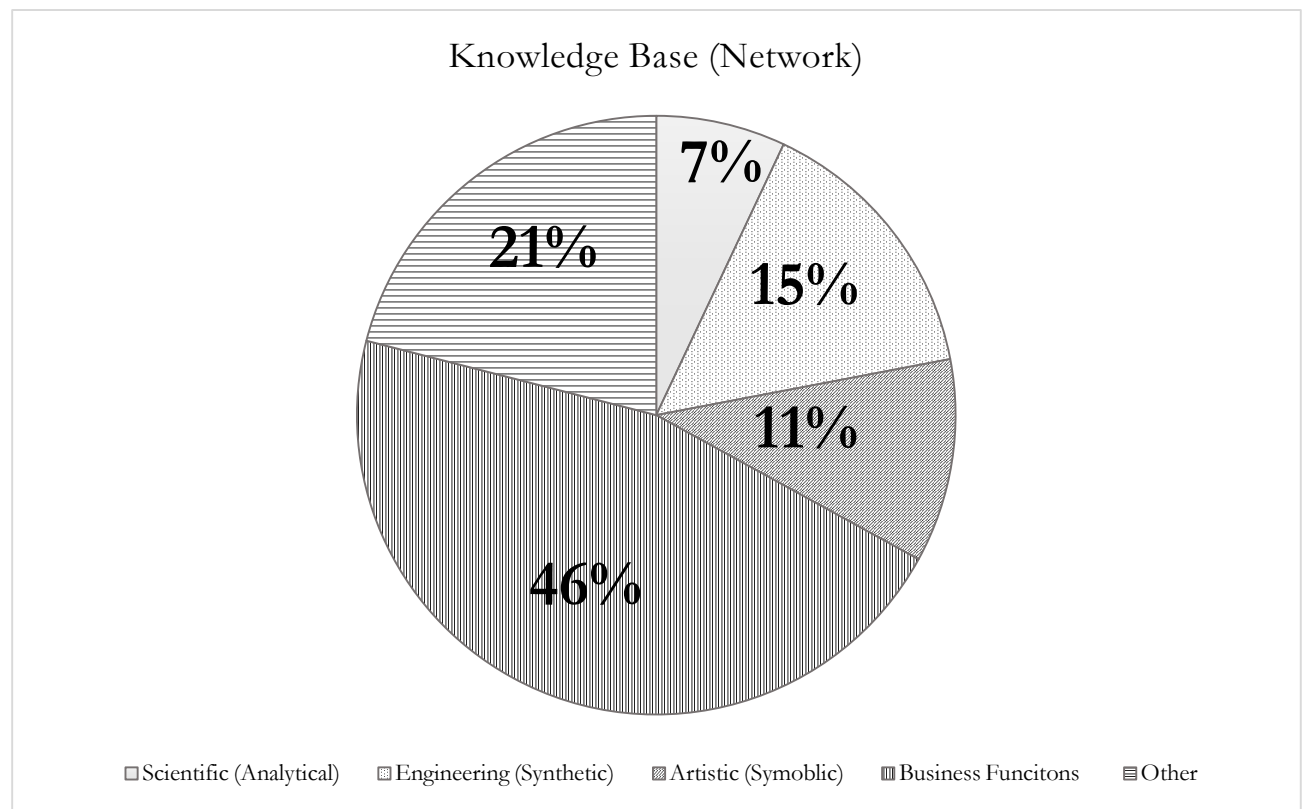
The geography of network linkages is somewhat expected on an industry level. The video game industry has been historically embedded in the USA and Japan; it is only over the past decade that there has been a European and Chinese presence in the industry. However, what is not expected in the results is the level of integration of SMEs within the global industry. It would be expected for medium to large size firms and more mature firms to have this type of global presence, but not SMEs. Furthermore, the age of the firm in this network had no correlation to the propensity for that firm to engage in GINs; 50% of the firms in the network have only been established within the last 7 years with the remaining 50% being established within the last 11 years. The geographical

spread of countries does, however, correlate to the target markets of the firms. Most of the firms interviewed target the English-speaking market first, the USA and the UK; followed by countries with the largest market share in the industry, China and Germany. The top countries in the video game industry by revenue are China, the USA, Japan, Germany, the UK, South Korea, France, Canada, Spain, and Italy (Newzoo, 2017). The countries in which the GINs are located correlate to the countries with the biggest markets in the industry. All the countries with the highest revenue in the industry are represented in the network, except for Italy. The top country location by the frequency of GIN mirrors that of the top countries by revenue in the industry, except for China.

### 5.1.2 Type of knowledge and the geography of innovation networks

Figure 2 shows the total knowledge base composition of the network that is featured in figure 3. From figure 2 we can see that the most important types of knowledge exchange in the network by order of importance are: business functions, other, engineering, artistic, and scientific.

Figure 2: Knowledge base composition of the network

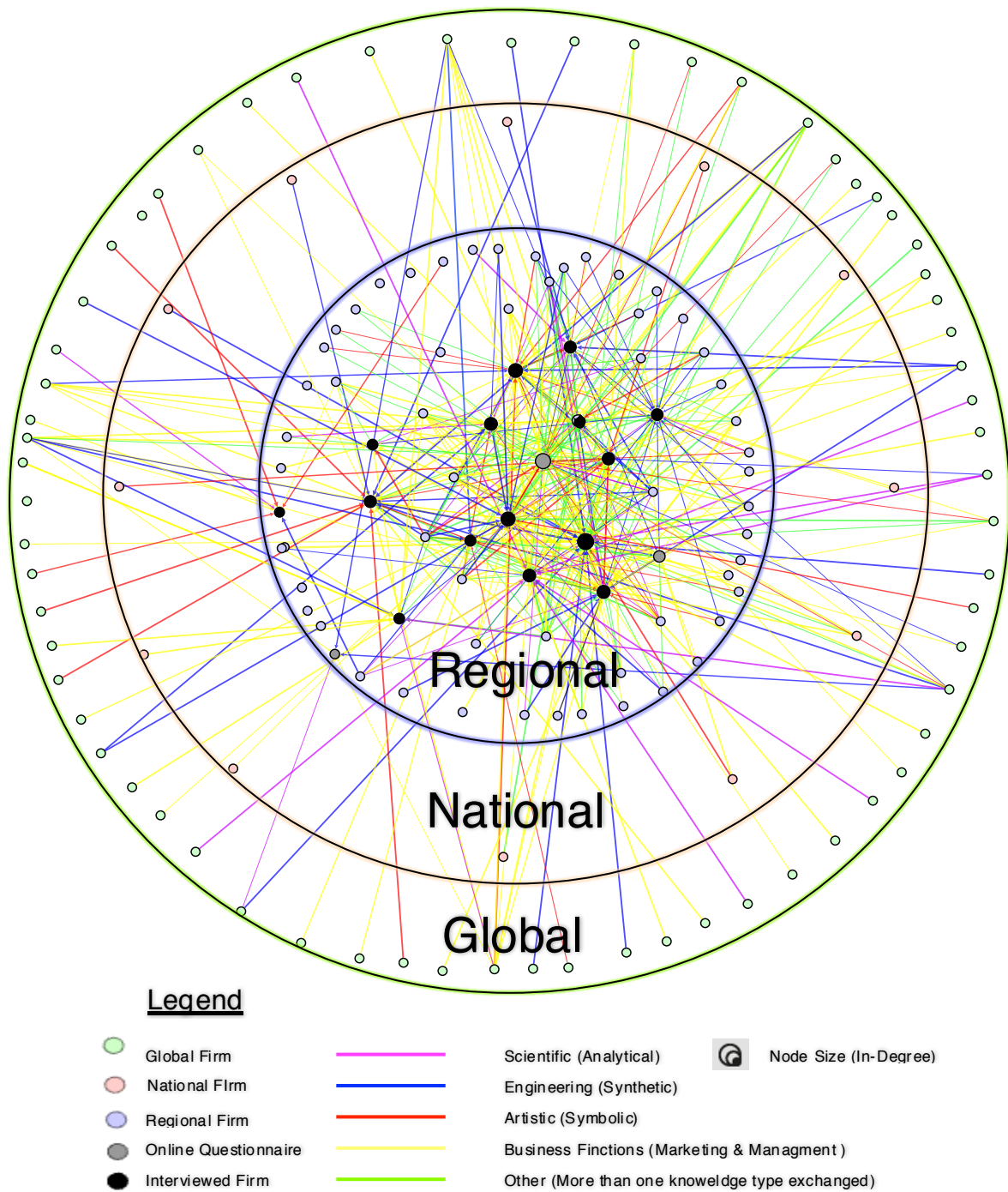


Source: Own survey

The evidence presented in figure 2 supports the literature on combinatorial knowledge bases. The network of the video game industry requires combinatorial knowledge inputs from a variety of different sources. The data is also consistent with the knowledge base literature in that the industry draws heavily on tacit knowledge, with scientific knowledge being the least important type of knowledge exchanged in the network. However, the literature posits that: symbolic knowledge is exchanged regionally, synthetic knowledge is exchanged regionally and domestically, and analytical knowledge is exchanged globally. The findings suggest all the above knowledge varieties were sourced on both the regional and global level. Spatial sensitivity had little impact on the sourcing of different knowledge varieties.

Figure 3 contains the same nodes, edge linkages, no of nodes, and no of edges as in figure 1. Whilst figure 1 helped show the geographical density of the network, this figure shows the types of knowledge transfer in the network and various spatial channels, through which knowledge is exchanged. The edges in this figure represent the spatial distribution of the types of knowledge being transferred (scientific, engineering, artistic, business functions, & other). The edge colors represent the type of knowledge linkage that is exchanged between actors in the network. The findings of the network suggest that all knowledge types are exchanged over a multitude of geographical proximities. The findings of figure 3 will be discussed subsequently.

Figure 3: Spatial distribution of knowledge exchange



Source: Own survey, illustration design inspired by Martin & Moodysson, 2011

Table 6 is a numerical representation of the data presented in figure 3, which shows the spatial proximities of the knowledge that are being transferred on the regional, national, and global level. The types of knowledge in order of importance are that of business functions, other, engineering, artistic, and scientific. The spatial distribution of knowledge transfer is spread out evenly among the network, with roughly 70% being transferred on the regional level, 2% on the national level and 28% on the global level.

*Table 6: Spatial spread of knowledge sourcing by type of knowledge in %*

	<b>Scientific</b>	<b>Engineering</b>	<b>Artistic</b>	<b>Business F</b>	<b>Other</b>
<b>Regional</b>	66	61	65	61	86
<b>National</b>	0	4	6	2	2
<b>Global</b>	34	34	29	31	12
<b>Total</b>	100	100	100	100	100

*Source: Own survey*

The findings in table 6 are interesting, as geographical proximity seems to have no impact on the exchange of codified and tacit knowledge. 66% of scientific knowledge is exchanged on the regional level, with the remaining 34% being exchanged on the global level. The firms that rely more on scientific knowledge in the network are those operating in the market for educational games; RF5 and R10 operate primarily in the domestic market. Their products are generally aimed at Swedish preschoolers, so the scientific knowledge needed is somewhat culturally contextual. Engineering knowledge is exchanged at 61% on the regional level and 34% on the global level. In the context of the industry, it is expected that a portion of the engineering knowledge is sourced globally. Most of the engineering knowledge acquired is that of the licensing out of video game engines, which can be then used in product development. Most firms, especially SMEs, have neither the knowledge nor finances to create their own gaming engine; the process is both costly and time-consuming. Furthermore, even if they do have the tools to develop the engine in-house, it will rarely be as good as one that they could license. What is interesting in this network is that three of the firms interviewed developed their own engine in-house (RF10, RF12, & RF36), which

is unusual for SME video game developers, as they generally license the use of a premade engine; whereas, the large firms in the industry tend to build their own engines for product development. The other type of engineering knowledge in the network is when firms in the network enter strategic partnerships with established global firms, who commission them to develop a product. These partners may give the firm engineering tools or assets to use in the development of the product.

Artistic knowledge is exchanged at 65% on the regional level and 29% on the global level. Again, this is expected, considering the globalization of the video game industry. However, it departs from the literature, which states that artistic exchange is more spatially sensitive due it being localized and culturally embedded. The global market, being the target market for most of the firms in the network, means that they need to source artistic knowledge internationally to be competitive. Most firms in the network, design their products around the climate of the international market; again, this is also dependent on the type of market the firm is targeting internationally. For example, RF12 develops narrative driven story games and, in the interview, they mentioned how their games are made for the English-speaking audience; so, they need to hire voice actors from the U.K. to do voice work for their games. Because the design of the product is intended for the international market, most firms in the network tried to avoid instances of cultural idiosyncrasy in their product. Any aspect of cultural embeddedness in the product could potentially alienate customers in the international market, which would have a negative impact on their revenue streams.

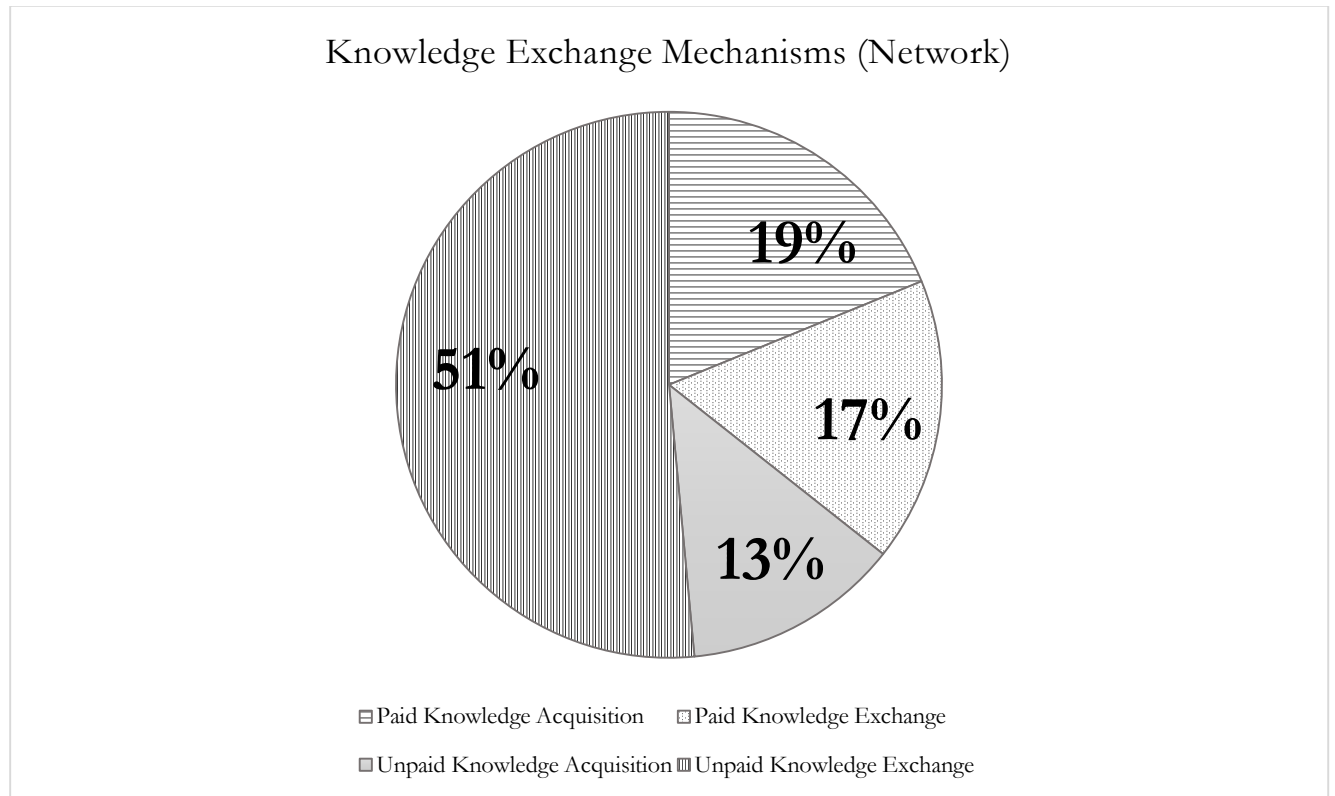
Business functions knowledge is exchanged 61% on the regional level and 31% on the global level. Generally, firms in the network sought both managerial and market knowledge; however, the interviews suggest, that managerial business functions were exchanged more on the regional level with, market business functions being exchanged more globally. Managerial knowledge is exchanged on the regional level along with market knowledge to an extent, but regional actors don't always have knowledge of international markets; this causes actors in the region who want to break into new markets to engage in GINs with international publishers. Several actors in the network commented that the Skåne region has no big-name publishers for the video game industry; so, if they want to break into the international market they need to collaborate with an international publisher. Other knowledge was exchanged 86% on the regional level and 12% on the global level. As stated previously in this paper, other knowledge consists of firms exchanging a variety of different knowledge types. It is mainly exchanged regionally, as the knowledge is generally informal discussions about the industry.



### 5.1.3 Type of mechanisms for knowledge transfer and its geography

Figure 4 shows the total knowledge base composition of the network that is featured in figure 5. Figure 4 will be discussed subsequently after the introduction of figure 5; as they are both relevant to the spatial distribution of knowledge exchange mechanisms.

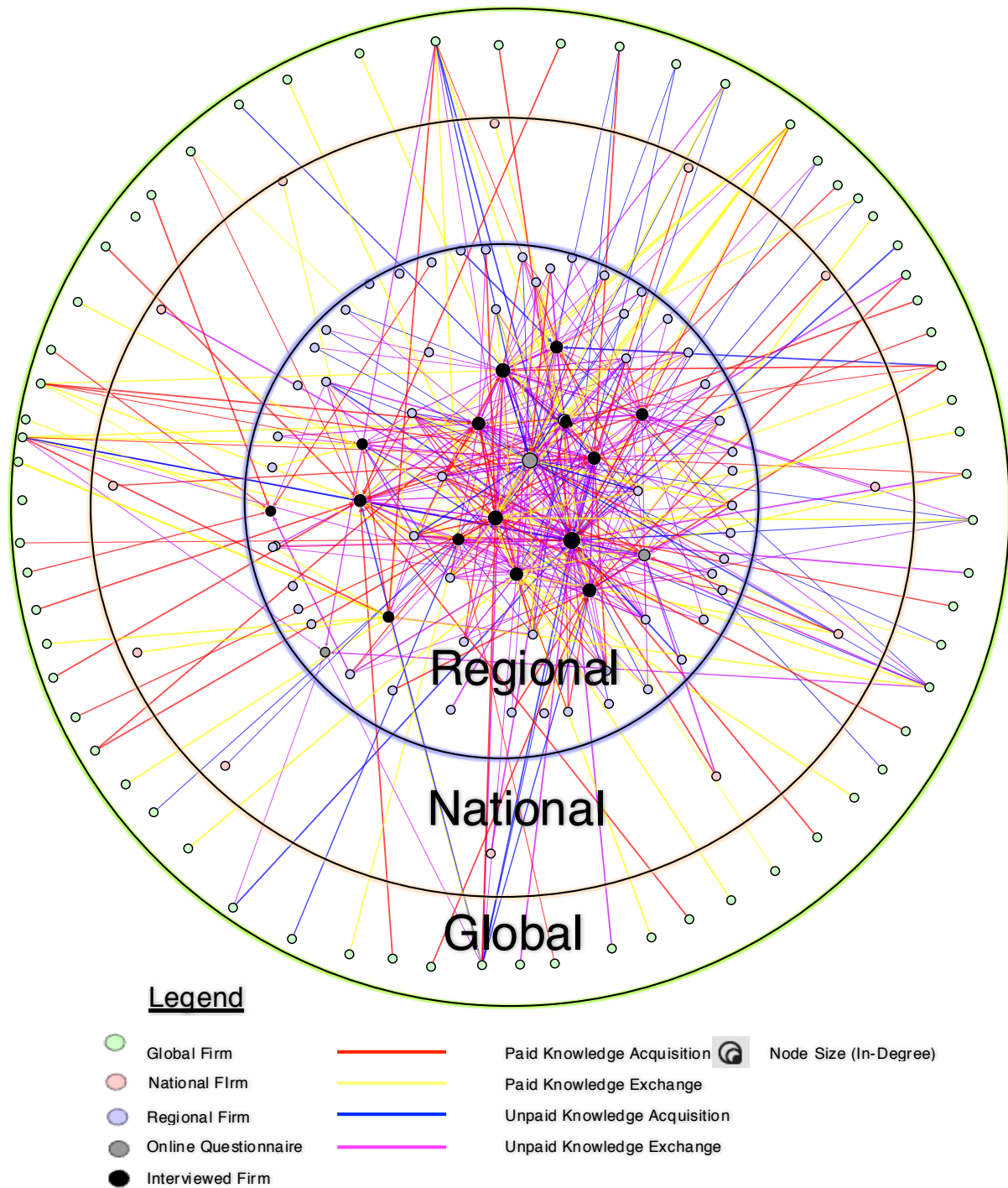
Figure 4 Knowledge exchange composition of network



Source: Own Survey

Figure 5 contains the same number of nodes, edges, and edge linkages as in figures 1 and 3. Figure 1 showed the geographical density of the network, figure 3 showed the types of knowledge transfer in the network and the various spatial channels through which knowledge is exchanged and figure 5 shows the mechanisms that facilitate knowledge transfer in the network and various spatial channels in through which knowledge is exchanged. The edges in this figure represent the spatial distribution of the driving mechanisms that facilitate knowledge transfer. The edge colors represent a type of mechanism that links the actors in the network. The different colored edges consist of paid knowledge acquisition, paid knowledge exchange, unpaid knowledge acquisition, & unpaid knowledge exchange.

Figure 5: Spatial distribution of knowledge exchange mechanisms



Source: Own survey, illustration design inspired by Martin & Moodysson, 2011

Figures 5 and 4 show the different types of knowledge exchange mechanisms used by firms in the network. From these figures, we can see that the most important types of exchange mechanisms in the network in order of importance are: unpaid knowledge acquisition, paid knowledge acquisition, paid knowledge exchange, and unpaid knowledge acquisition. Paid knowledge acquisition consists of recruitment of specialists, buying of consultancy services, and licensing. Paid knowledge exchange consists of contract-based collaboration for innovation. Unpaid knowledge acquisition consists of monitoring of companies via the internet and media. Unpaid knowledge exchange consists of personal and friendship-based relations and discussions at conferences etc.

Table 7 shows the spatial distribution of the knowledge driving mechanisms on the regional, national, and global level. The knowledge linkages are split roughly 50% between the regional and global level. Again, with the national level accounting for a small portion.

*Table 7: Spatial spread of knowledge exchange by mechanisms in %*

	<b>Paid Knowledge Acquisition</b>	<b>Paid Knowledge Exchange</b>	<b>Unpaid Knowledge Acquisition</b>	<b>Unpaid Knowledge Exchange</b>
<b>Regional</b>	52	41	51	90
<b>National</b>	3	5	2	2
<b>Global</b>	45	54	48	8
<b>Total</b>	100	100	100	100

*Source: Own survey*

Unpaid knowledge exchange takes place predominately on the regional level. The findings are consistent with the literature of industries with a symbolic and synthetic knowledge base as these exchanges are based on trust which is more easily formed in close geographical proximities. 50% of paid exchange is on the global level and that is expected. On the global level, most of the paid knowledge acquisition in the network consisted of firms licensing out development engines and using marketing and quality assurance consultancy firms. On the regional level, it involved outsourcing some of the product development to actors in the region; usually artistic and engineering knowledge. It also involved the recruitment of local actors. 54% of paid knowledge

exchange on the global level consisted of firms primarily entering contracts with international publishers in the industry, but also with other firms working outside of the video game industry; within the new media industry. 41% of paid knowledge exchange on the regional level consisted of firms entering contracts with local actors to co-develop products, but also with firms working with local organizations and private institutions in the technology and new media industry to develop solutions; as some of the firms in the network acted as business-to-business providers. Unpaid knowledge acquisition accounted for 51% on the regional level and 48% on the global level. For both the regional and global level, it consisted of firms monitoring competitors and surveying industry trends and statistics via the internet. The results here are unexpected; due to the industry being so global, it would be expected that the firms would monitor the industry more from an international level than a regional level. Unpaid knowledge exchange consisted of 90% on the regional level and 8% on the global level. These results are consistent with the literature; as they are mostly based on personal friendships and relations, which require a level of trust generally facilitated by geographical proximity.

## 5.2 Drivers of the geography of knowledge networks in the video game industry in Skåne (Research question 2)

### *5.2.1 The role of other types of proximities*

A second important aim of this thesis is to understand the factors that facilitate or hamper firms' ability to engage in GINs. It is important to understand what mechanisms and dynamics are conducive or unfavorable for the engagement of firms in GINs. Understanding the processes that facilitate GINs may be auspicious for firms trying to establish global linkages. As discussed in the literature review (chapter 2), whilst geographical proximity has long been thought to be the most important factor for firms engaging in collaboration, there are several other proximities that may have an impact. Whilst it is understood that close geographical proximity is important, especially on the regional level, it is necessary to understand what other proximities are significant once outside of the region. The network is integrated into 4 of the top 5 markets in the industry, except for China. Due to the size and potential for return on investment in China, many of firms in the network want to break into the Chinese market; however, most firms in the sample who tried to

engage in GINs with China had problems establishing the linkage. One firm in the network (RF36) who, is in the process of establishing a GIN, stated on their relationship with a publisher in China,

*“I’m not sure about the formalities of it. It’s in China, so, it’s complicated; we’ve had to sign contracts with the government as well. Different release forms. We’re a bit uncertain what’s going to happen. I think they are targeting online games but the term is very vague and all documentation is in Chinese. It doesn’t really make sense if you Google-translate it. It’s... it’s hard to get any vital informations.”* (Source: Interview RF36).

Another firm (RF51) on their experience of trying to engage in GINs with China stated,

*“some regions are better at communicating. We had...I mean, we had tried to source work from China once, and it didn’t turn out well. I don’t know if...if that made us more reluctant to expand into Asia, But it ended up that we had to do the work ourselves anyway.”* (Source: Interview RF51).

The only firm that established a successful GIN with China was RF18. Whilst a substantial amount of the firms in the network cited language as being a potential barrier to engaging in GINs, the evidence speaks to the contrary. RF36 has already established successful linkages with firms in both South Korea and Japan. RF51 has already established successful linkages and has a working relationship with two major distributors in Japan.

The global linkages in the network are dispersed among 15 countries with 12 different languages spoken. In this network, analogous cognitive and social proximity appear to be conducive for the firms’ propensity to engage in GINs. In the case of actors in the region trying but failing to establish sound GINs with actors in China, it appears that institutional distance acts as a barrier to the successful establishment of GINs in the region. Distance in geographical proximity does not appear to have an impact on the firms’ propensity to engage in GINs. China, Japan, and South Korea all have similar geographical localities, yet firms in the region could establish successful GINs with both Japan and South Korea. However, they were not able to do so with China. Considering the analogous geographical distance of firms in East Asia it can be concluded that disparate geographical proximity (once outside the region) had no impact on the propensity for firms to engage in GINs. 40% of the knowledge in the network is sourced from Europe with the other 60% coming from outside of Europe. The further the linkages move away from Europe, the more distance there is with several of the different proximities delineated above (Geographical, social, and institutional). By process of elimination, once outside of the region (geographical

proximity), closeness in proximities that are conducive for the propensity of firms engaging in GINs in this network appear to be social and cognitive. While distance in institutional proximity acts as a barrier for firms trying to engage in GINs. Distance in organizational proximity had little adverse impact; as network consists of SMEs who are engaged in GINs with international MNCs and local education and support organizations.

### *5.2.2 Market type and the geography of the innovation networks*

Looking at the level of knowledge required on the level of the firm; as opposed to the industry level, as plotted in Figure 3; the results can help expound on the heterogeneous nature of the firms in the industry. There are 5 different types of markets identified in the network, which are based on the market in which the firm targets their products as follows: educational market (RF5, RF10 & RF37), mobile market (RF15, RF18, RF21 & RF36), independent market (RF11, RF26 & RF35), personal computer market (RF13, RF19 & RF30), and console market (RF12, RF48 & RF41). There is also some market overlap with the firms mentioned above. Whilst RF10 is primarily in the market of developing educational products, they develop them for mobile. RF5 historically has made educational products; however, they now are trying to transition into the VR (virtual reality) market. Their products will primarily be sold in the P.C. and console markets. As firm RF5 begins to transition away from educational games and into the VR market, they will have less need for scientific knowledge and more need for engineering knowledge. This example also demonstrates the argument that changes in an industry enact changes in the dominant knowledge base of the firm. RF12 and RF48 primarily target the console market; however, they also outsource work to other companies by commissioning them to port their products to the PC. Their main market is the console market. Given the disparity of markets the firms target above, one would expect the target market to have an impact on the type of knowledge needed for product creation. Depending on the target market of the firm they will be expected to draw on a plethora of different knowledge varieties.

The firms that target the educational markets (RF5, RF10, & RF37 source roughly 40% of all scientific knowledge in the network) draw on more scientific knowledge than firms operating in other markets. Firms that target the console and indie markets (RF11, RF26, RF35, RF12, RF48, & RF51 source roughly 85% of all artistic and 35% of all engineering knowledge in the network) draw on primarily artistic knowledge, with engineering knowledge being somewhat important.

Mobile developers (RF15, RF18, RF21, & RF36 source roughly 11% of all artistic knowledge in the network) rely less on artistic knowledge than the console markets however there is a need for engineering and business function knowledge. Firms in the network targeting the PC market (RF13, RF19 & RF30 source roughly 27% of all engineering knowledge in the network) are generally smaller than the other firms in the network; they draw on primarily engineering knowledge. Again, there is an overlap with the firms mentioned, as most of the firms in the network had knowledge linkages with all the knowledge types mentioned to some extent. However, the primacy of knowledge needed will be somewhat contingent on the target market of the firm. For example, RF12 develops for the console market and draws heavily on engineering and artistic knowledge. Unlike some of the other firms in the network developing console games; their products are very narrative driven, which is part of the company's niche. Whilst, interviewing a member of the firm, they stated that they drew a lot of knowledge from academic texts, which was needed for the development of their game's stories. These stories are inspired by contemporary philosophical and existentialist theory, so they had a requirement for scientific knowledge; even though they are not in the market of making educational games. All the firms in the network had a demand for business functions knowledge, which is the most represented knowledge type in the network. Business functions knowledge consists of both managerial and marketing knowledge. Given that the industry is international and operates on a global level, the need for marketing knowledge is expected. Most of the firms in the network monitored the sales and markets of the industry; so, before they attempt to break into a new market, the sourcing of market knowledge is auspicious for them to successfully implement a new business strategy in a foreign market. With firms who operate primarily in international markets, it would be expected that they would need marketing knowledge more than firms that operate regionally. However, even the firms in the network that operated primarily in the domestic market still had a need to ascertain managerial and market knowledge. Knowledge of how to run the business and market the product is crucial for SME developers in the video game industry. Most of the actors interviewed had very little market and/or managerial knowledge, as their backgrounds were primarily in engineering and programming. There was an innate need for actors in the network to ascertain managerial and market knowledge to augment their position. Only the firms in the sample with a larger employee count, which had the financial resources to hire a PR manager or community relations manager, did so. Most of the market and managerial knowledge was passed through informal channels by more established actors in the industry. They acted as mentors to new entrants in the industry, which has been crucial for the SMEs interviewed.

### 5.2.3 *The rationale for regional firms engaging in GINs – Firm strategy and motivation*

The second research question presented in this paper aims to understand why firms engage in GINs and to what extent. It is important to understand the rationale as to why firms engage in GINs and the extent to which they do so, as it can shed a light on whether they engage in these relationships due to a lack of a certain knowledge on the regional level or they choose to go global for another reason. In the case of SMEs developing video games in the Skåne region, the interviews reveal that they engage in GINs to be competitive and strategic. The SMEs must source information globally, due to that knowledge being unavailable at the regional level; this will be explained subsequently. As stated previously in this chapter, even firms who target primarily the domestic market must go outside both the regional and national borders to ascertain knowledge. The video game industry is an international industry. To keep up with international standards and competition, knowledge must be exchanged on the global level. If firms in the network want to make industry standard products, they need to make those products on industry standard engines; unless they have the resources to make their own. This is not generally not feasible for SMEs in the video game industry.

13 of the firms interviewed primarily targeted the international market. For them break into markets outside of Sweden and Europe, they need to source knowledge globally about the market conditions. This allows them to successfully break into international markets. Actors in some of the firms went to great lengths to acquire an international presence in the industry; a CEO (RF30) even went as far as changing their own name to make it more palatable when dealing with people globally, *“I changed my name so that it would be more international and easier to deal with them when I’m abroad. So, I got rid of my Swedish name”* (Source: Interview RF30). When actors in the network want to go global, they usually do so via strategic partnerships with international publishers. In these partnerships, the developer will develop the product and the publisher will take care of the marketing. On going global, RF37 stated, *“we don’t release games unless we have a strong brand partner”* (Source: Interview RF37). There are no big publishers in Sweden, so for the firms to go global it is necessary to collaborate with an international publisher. The actors in the network do not generally have the resources to translate their products and release them into markets outside of Europe as it is both costly and time-consuming. If an actor in the network wants to release their game in a different language, for example, on the app or android store, they need to provide 5 screenshots



for each language. They also need to optimize those screens for each type of mobile device, totaling 30 screenshots for each language, which is time-consuming and costly. RF15 stated on translating games into multiple languages, *“once you have 2 or 3 languages, you might as well have a bunch, because you’re going to do the work anyway because the game needs to support all the language stuff anyway.”* (Source: Interview RF15). The problem actors in the network found when translating their games was that it was not worth the effort, if doing so without a publisher. The games still need to be marketed in every region in which they are sold. Just translating the game into a foreign language does not imply that the product will be successful; unless it has a powerful marketing strategy pushing it by an international publisher. RF15 stated that they would not translate their products in the future, as the effort it took to do so was not worth the financial return on the investment.

Another reason for firms to engage in GINs is to access senior talent in the industry. Most firms in the network noted a lack of available senior talent in the region; they had to go outside of the region to source senior talent. They said this was problematic at times, due to the time-consuming process of hiring people from abroad; especially when they are from outside the European Union. Some firms in the network operate on a contract-to-contract basis. When they get a big client, they need to hire employees and start developing immediately; this is time-consuming when trying to source talent from outside of Europe. RF10 stated, on trying to source international talent,

*“there are many talented people who sent their CVs, but if they are not from the EU, I find it too difficult to go through that whole process, and it’s such a shame, because I’m sure we could get so much talent from abroad, if the rules were easier”* (Source: Interview RF10).

RF51 on what is lacking on the regional level, *“It’s a senior...senior talent... in...foremost engineering, I would say.”* (Source: Interview RF10). Actors in the periphery of the region, in locations such as Helsingborg (RF36) and Karlshamn (RF5), found that they were in a more difficult position in trying to attract both regional and international talent; as their locations are further from Malmö, which is where most of the industry activity occurs. Actors in the region also described a lack of PR (public relations) and QA (quality assurance) agencies. RF10 had a need to engage in GINs as they stated, *“it’s really difficult to find PR agencies that can work with children’s games, and I don’t actually know of any Swedish companies who do it”* (Source: Interview RF10). RF13 also had to source marketing knowledge outside the region as they also stated, *“maybe help with like, marketing; like marketing people, really hard to come by,; management people is also hard to come by which actually knows what the game industry looks like”* (Source: Interview RF13). RF26 on engaging in GINs, *“Maybe the quality assurance; a firm*

*in England is a good example that I don't even know if there is anyone providing this service in Sweden*" (Source: Interview RF26). RF10 also had to source QA globally, *"I was also in touch with this, QA companies testing companies, because I didn't know there was one in Sweden, who would do the quality assurance and testing for kids games, for instance."* (Source: Interview RF10).

To summarize the first two research questions of the paper which have been answered thus far. The first research question sought to analyze the diversity of knowledge, linkages and their spatial patterns as well as to understand the driving proximities and types of knowledge transfer between disparate spatial proximities. The findings suggest that the network draws on knowledge from a plethora of sources, which can be somewhat contingent on the target market of the firm. Firms targeting the educational market may need access to scientific knowledge, whereas firms targeting the console market may need more access to engineering and artistic knowledge. Whilst different firms may have a need to source one type of knowledge over another, the findings suggest that most of the firms in the network source knowledge from all the different knowledge types identified in the survey. The findings also suggest that geographical distance had little impact on the transfer of tacit knowledge; roughly 30% of both artistic and engineering knowledge was exchanged on the global level. Geographical proximity was important on the regional level, however once outside of the region its importance was less marked. Outside of the region, closeness in both cognitive and social proximities seem to be conducive for firms engaging in GINs. Distance in institutional proximity acted as a barrier for firms trying to engage in GINs. Organizational proximity seemed to have little adverse impact on the propensity for firms engaging in GINs.

The second research question of this paper was to investigate the mechanisms which facilitate the engagement of SMEs in GINs, and to describe how, why, and to what extent this engagement occurs. The engagement of firms in GINs is somewhat contingent on the target market of the firm and the organizational thickness/thinness of the region. The video game industry is a global industry in which developers make products with the intent of targeting the global market. To target the global market, the development process must meet the global standardized requirements. To satisfy the conditions of international product standardization, firms must engage in GINs and source knowledge globally to maintain a strategic and competitive position in the global market. To break into the global market, actors in the network need to license out industry standard development tools and form strategic collaborative agreements with international industry actors. Another reason as to why firms in the Skåne region engage in GINs is due to the organizational thickness/thinness of the region. The Skåne region is identified as being organizationally thick and

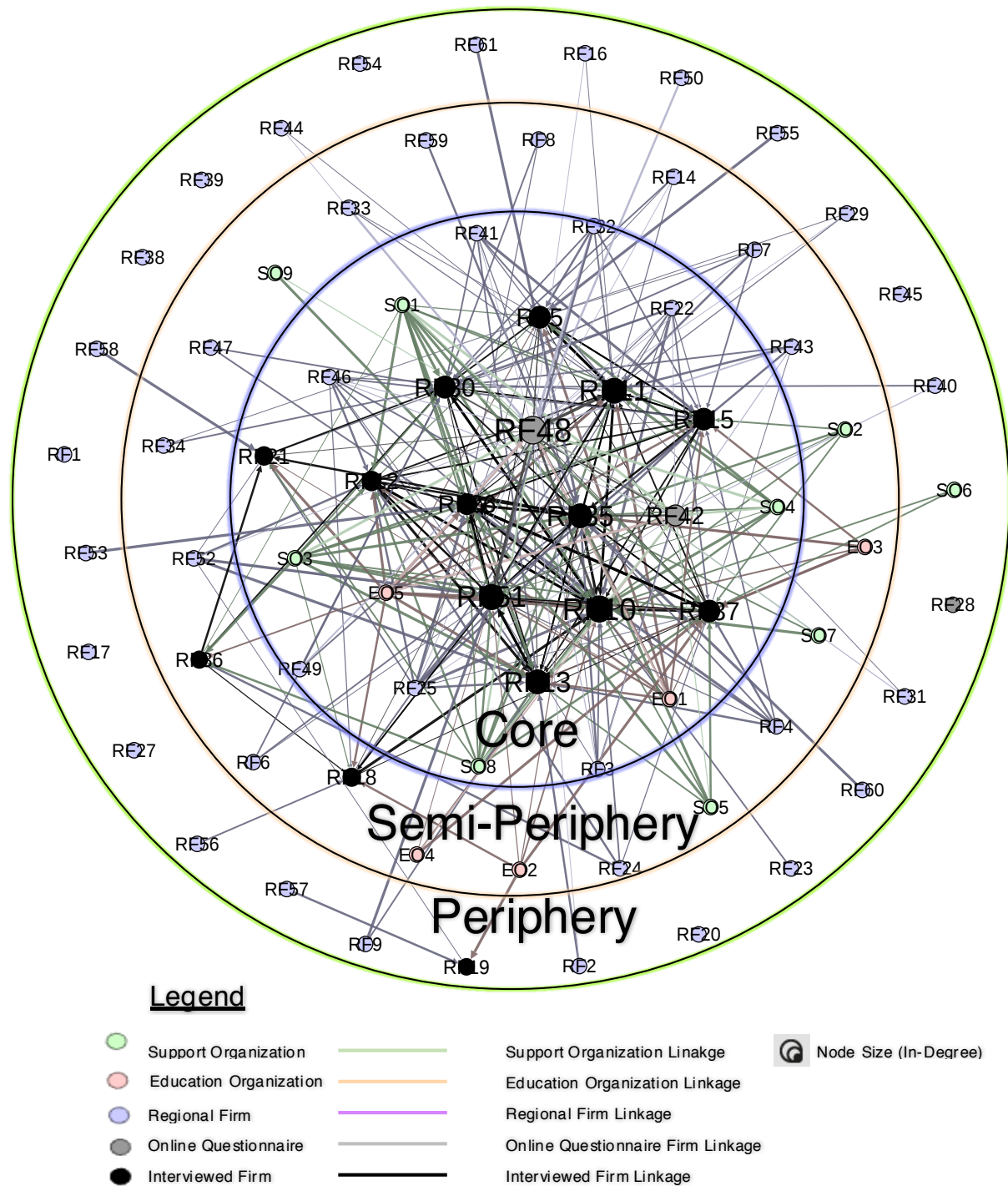
specialized. The region is very specialized in certain industries such as IT and new media. In the case of the video game and new media industry, SMEs can access some variations of specialized knowledge on the regional level; however, the region is not diversified. The lack of industry diversification in the region engenders a need for regional firms to engage in GINs. The region is not organizationally thick enough, in that all knowledge can be sourced regionally; it is also not organizationally thin, in that actors in the region don't have the absorptive captivity to engage in GINs. Actors in the region (many but not all) have both the need and the absorptive capacity to engage in GINs. They do so, as they cannot access that knowledge on the regional level. From the interviews discussed earlier, the findings suggest that actors need to go outside the region to acquire international talent, marketing, and quality assurance knowledge etc. Firms in organizationally thick and specialized regions, who have the absorptive capacity to engage in GINs, can and do engage. This is done to augment regional deficiencies, such as a lack of industry diversification. The following section of this chapter will focus on the third and final research question of this paper, which is to explore the regional dynamics and how it affects the propensity of SMEs to engage in GINs.

## 5.3 Assessing the role of the regions

### *5.3.1 Spatial centrality of regional actors*

Figure 6 represents the spatial dimension of the actors from the perspective of the regional level. The total number of nodes in this figure is 75 (number of actors differs from what was mentioned in the profile of the industry in chapter 4 due to industry change. The figures used in the regional profile were the most recent source of official industry statistics from Game City). Actors consist of 5 education organizations, 9 support organizations, and 61 firms; 15 who were interviewed and 3 who filled out the online survey. There are 335 edges which connect the actors in the network. The figure is composed of three different spatial levels: a core, which is the most densely connected part of the network; a semi-periphery, which is less densely connected than the core but more densely connected than the periphery; and the periphery, which is the least densely connected part of the network. The core, semi-periphery, and periphery represent the node in-degree centrality which is based on, connectivity and integration of the individual nodes in the network. Nodes with more linkages will rest in the core whilst nodes with little to no linkages will rest in the periphery.

Figure 6: Spatial dimensions of the regional network



Source: Own survey

The core consists of 27 actors including; 4 support organizations, 2 education organizations, and 21 regional firms. The semi-periphery consists of 21 actors including; 4 support organizations, 3

educations organizations, and 14 regional firms. The periphery consists of 1 support organization, 0 education organizations, and 26 firms. Roughly 40% of the actors are in the core, with roughly 30% of the actors in semi-periphery, and 30% of the actors in the periphery. Of the whole network: 21 nodes are in the core, 14 are in the semi-periphery, and 26 are located in the periphery. Only 9 nodes in the periphery have zero connections to any of the actors in the network.

Table 8 represents the spatial organization of where the nodes are located in the region. It shows the relationship between where nodes in the region are located and how central these nodes are in the network.

*Table 8: Network centrality by regional location*

Location	Core	Semi-Periphery	Periphery	Total
<b>Malmö</b>	14	8	15	<b>37</b>
<b>Karlshamn</b>	5	3	4	<b>12</b>
<b>Helsingborg</b>	1	3	1	<b>5</b>
<b>Kristianstad</b>	1	0	1	<b>2</b>
<b>Lund</b>	0	0	1	<b>1</b>
<b>Ronneby</b>	0	0	1	<b>1</b>
<b>Eslöv</b>	0	0	1	<b>1</b>
<b>Klippan</b>	0	0	1	<b>1</b>
<b>Höllviken</b>	0	0	1	<b>1</b>
<b>Total</b>	<b>21</b>	<b>14</b>	<b>26</b>	<b>61</b>

*Source: Own survey*

In the network of the Skåne region, there are 9 towns and cities in which firms are actively developing video games. The locations with the most firms in order of representation are Malmö,

Karlshamn, Helsingborg, Kristianstad, Lund, Ronneby, Eslöv, Klippan, & Höllviken. The area with most representation in the core is Malmö, which has 14 firms in the core, 8 in the semi-periphery, and 15 in the periphery. Malmö is the center of the business cluster in which most of the firms are located. Karlshamn is the area with the second highest number of firms with 5 in the core, 3 in the semi-periphery, and 4 in the periphery. Belkinge Institute of Technology is also located in Karlshamn and that institute is an important source of knowledge for actors in the industry, as a sizeable number of employees in the network were educated there. Helsingborg has 1 firm in the core, 3 in the semi-periphery, and one in the periphery. Kristianstad has 1 firm in the core and 1 firm in the periphery. Lund, Ronneby, Eslöv, Klippan, and Höllviken all have 1 firm located in the periphery. Table 8 and figure 6 will be used to answer the final research questions of this paper.

### *5.3.2 Key strategic actors in GINs: the establishment of global networks through local actors*

The third and final research question of this paper is to investigate the relationship between regional dynamics and the propensity of SMEs to engage in GINS. The subsequent paragraphs of this chapter aim to answer that research question. Educational and support organizations are important in the network, as most of them are in the core and semi-periphery. Three firms in the network attempted to establish GINs with China (RF18, RF36, & RF51). RF18 and RF36 are in the semi-periphery of the network, whilst RF51 is in the core of the network. The only firm to successfully establish a linkage with China was RF18; it should also be noted that as of 2014, RF18 is the fourth most profitable firm developing video games in the Skåne region (Game City, 2015). RF18 is connected to both RF36 and RF51 through unpaid knowledge exchange (Informal friendship). Both RF36 and RF51 failed to establish GINs with China. It can be deduced that RF18 is the first firm in the network to create a linkage with China. They passed on their networking information to RF36 and RF51, who also attempted to break into the Chinese video game market; however, they may not have had the absorptive capacity to do so. That is why they failed to establish a successful linkage.

GF12 is one of the biggest international publishers in the industry. GF12 is linked to 6 firms in the network (RF10, RF11, RF12, RF15, RF48, & RF51); these linkages are through paid knowledge exchange. All the actors with these global linkages to GF12 are located in the core of the network. Through secondary analysis of the firms' websites, the first established GIN with GF12 was in

2005 with RF51. The first connection is based on press releases from the firms' websites either through the announcement of a formal partnership or the official release of a product which was produced via collaboration. All the firms who have contact with GF12 are also connected to each other via unpaid knowledge exchange (Informal Friendships). The first firm in the region to establish a formal contract with GF12 was RF51. In 2005, they pitched a concept for a video game to GF12 (signed official publishing deal in 2010) followed by, RF48 in 2013, and RF10, RF11, RF12, & RF15 in 2015. RF51 first got in contact with GF12 via a publishing arrangement under which RF51 was contracted to make a game for GF12. However, due to the lack of experience, the product was canceled. The collaboration remained, and GF12 partnered with the firm to develop assets for a game with some of GF12s internal teams. The next GIN with GF12 was in 2013 in which RF48 also collaborated with GF12 to develop assets for their video game. The General Manager of RF51 left the firm in 2013 to start up a new company (RF48). In the network, there are key strategic actors who act as gatekeepers to these GINs. RF51 is connected to RF12 and RF15 through friendship and RF48 is connected to RF10 and RF11 through friendship. Once a successful GIN is established, knowledge of it can flow through the network via buzz (friendship and labor mobility), which then allows other actors in the network to establish GINs with the global firm.

From the evidence provided a substantial amount of the GINs are accessed through key actors on the regional level. GINs flow through local buzz, which then allows actors, who are privy to the buzz to engage in global pipelines (GINs). RF15 originally got in contact with GF12 through a regional contact in which they wanted to engage in a collaborative partnership, but the deal was never finalized. However, that same firm was later approached by GF12; GF12 wanted to publish one of RF15s games on their own platform. On getting in touch with GF12, RF15 stated,

*"its been a while since I was in touch with GF12. I think I'll have to rekindle that contact again, which can be problematic because it's been like 2 or 3 years since there was any like actual communication. People move on, and you have no email address to anyone. But then, that's when the network comes in handy."*

(Source: Interview RF15).

Some of these key GINs are accessed via key strategic actors on the regional level. These key strategic actors, generally engage in first contact in several different ways. In the case of RF15, they reached out to GF12 and pitched a project to them. Other key strategic actors worked in some of the biggest firms in the region, such as RF22 and RF52. Another important source of international

networking is international conferences. There has been regional support to firms in the network, in which local institutions offer financing for some of the firms in the network to attend these international conferences. There is also a major conference which is held annually in the region. Networking is generally exchanged via labor mobility, informal friendships, and conference attendance. The cluster is marked by high rates of labor turnover, which is conducive for firms in the network to go global. When an actor in the region enters a new firm, they are not just bringing their experience, but also their network. The presence of high-profile MNCs in the region is important; they have the absorptive capacity to form GINs, through which the networking information and contacts can then be passed onto these key strategic actors.

It can be argued that GINs would have been established with GF12 through other avenues, due to the importance of the firm in the industry. The illustration of another example of how GINs are established on the regional level, through local buzz, by key strategic actors further develops the argument. However, this example is not a key firm in the industry but they are a key firm in the network. GF23 is located in the United Kingdom and has linkages with 3 firms in the region, (RF10, RF26, & RF37) all of which are located in the core of the network. Both RF10 and RF26 acquire knowledge from RF37 (unpaid knowledge exchange). RF37 is the proximate source of the GIN with GF23. The CEO of GF23 acts as a business mentor to the CEO of RF26, and has a friendship based relationship with RF10. The GIN was first established by RF37. After the successful establishment of the first GIN linkage, the information of that connection was then passed through the network via local buzz. This local buzz then helped actors to engage in these global pipelines and GINs; however, on the regional level, they were accessed via key strategic actors.

When asked about how RF15 gets global contacts they said,

*“I mean there’s some sort of continuum between the festival and conferences. And the big thing with going to those is that everyone else is there and you can sort of meet people. Again, just like I know one person that can turn into me knowing two people and then, it sort of snowballs from there.”* (Source: Interview RF15).

The same firm also spoke of a mailing list that is used to exchange knowledge with each other in the industry. The list started in 2008 with 50 people, but as of 2017 it has over 400 people. The list is used to share sales numbers, information from platform holders (Global Firms), and international regulatory and legal advice. However, only certain actors in the network are privy to



this information. On sharing information of this mailing list RF15 said,

*“it,s reasonably secretive but it needs that to be to work, it also needs to be a bit restrictive with who gets on the list because you can’t add everyone, because then, that would stop working if I’m sending my email to 5,000 people, I might as well just post it publicly” and “some of it you can share, and some of it like by sharing it, you will break it, and it won’t exist for anyone anymore.”* (Source: Interview RF15).

RF18 was also asked how they engaged in GINs and their response was,

*“we wanted to get more in contact with our GF6 contact, so we contacted RF36 and asked them which GF6 contact they had, and they introduced us to some guys who.... I mean, things like that we can talk. Now, we think our translation company is doing not so good of a job and I’m thinking about asking other game developers which company they are using”* (Source: Interview RF18).

GIN contact details are spread through the network via local buzz by these key actors, who function as the “gatekeepers” to these international contacts. Actors in the region try to source information locally first; when that fails they go global. On going global RF18 said:

*“we can talk to people in the region and try get it right. I mean, we have a bigger local network now than we had before, and if we would need anything specific, I would ask them first”* (Source: Interview RF18).

Due to the lack of diversified organizational thickness in the region actors need to source information globally. GINs work in a twofold process. On the regional level, once a GIN network is established, it makes it easier for other actors in the network to engage in GINs with that same firm. Frequent interaction with the same global firm strengthens the GIN, as the global firm now has knowledge and experience of the regional infrastructure and institutional framework. Global firms may be more likely to engage in GINs on the regional level, based on the performance of past linkages with actors in the same region. As in the case of GF12, forming strategic alliances with both RF51 and RF48, which proved auspicious for GF12. Both firms are now official partners with GF12. Later, GF12 reached out to a small actor in the region (RF15) and asked them to publish a game on GF12’s platform. RF15 is a firm with only one employee; and the only link that they have, with GF12, which is one of the biggest firms in the industry, is the regional link. Past regional experience may have encouraged GF12 to get in contact with other firms in the region, which would not have happened without initial successful contact by RF51.

The regional reputation is also illustrated by the experience of actors in the region trying to engage

in GINs with China. One firm (RF18) successfully established a GIN with China in the network. However, other actors in the network were unable to engage in GINs with China. Local buzz of failed network linkages with China, on the regional level, may act as a barrier for firms trying to engage in GINs; as previously failed GINs may discourage actors from going global in that region, due to reputation of the region. Conversely, repeat established linkages may strengthen the GIN and the internationalization capacity of the region. The global firm may be more willing to engage in GINs with actors in the same region, due to positive past experiences. This will cause a snowball effect in which local buzz will encourage more actors in the region to try to establish GINs with the firm.

Table 9 includes all the GINs that regional actors (who were interviewed) in the network have established. It also shows their regional location and where in the network they lie: core, semi-periphery, and periphery. Most of the firms in the network are in Malmö, which also acts as the core of the network. Karlshamn also acts as an important location for the network, as it is host to 3 firms in the core of the network. Helsingborg has 1 firm each in the core, the semi-periphery, and the periphery. Kristianstad has 1 firm in the core, and Lund has 1 firm in the periphery.

*Table 9: Regional centrality of network and GINs*

<b>Location</b>	<b>Location</b>	<b>Network Location</b>	<b>No of GINs</b>
<b>RF10</b>	Malmö	Core	20
<b>RF13</b>	Malmö	Core	4
<b>RF15</b>	Malmö	Core	3
<b>RF18</b>	Malmö	Semi-Periphery	8
<b>RF26</b>	Malmö	Core	9
<b>RF30</b>	Malmö	Core	1
<b>RF35</b>	Malmö	Core	7

<b>RF37</b>	Malmö	Core	10
<b>RF42</b>	Malmö	Core	2
<b>RF51</b>	Malmö	Core	11
<b>RF5</b>	Karlshamn	Core	3
<b>RF11</b>	Karlshamn	Core	8
<b>RF48</b>	Karlshamn	Core	11
<b>RF12</b>	Helsingborg	Core	12
<b>RF28</b>	Helsingborg	Periphery	5
<b>RF36</b>	Helsingborg	Semi-Periphery	8
<b>RF21</b>	Kristianstad	Core	5
<b>RF19</b>	Lund	Periphery	5

*Source: Own survey*

Malmö and Karlshamn have the highest concentration of video game firms and are the regional locations with the most firms in the core of the network (Malmö 14 total and Karlshamn 5 total). Overall, total regional connectivity has a significant impact on the propensity of firms to engage in GINs. As the table 9 shows, some core firms have 1 or 2 GINs, whilst some semi-periphery firms, have 9 or 8 GINs, and one firm in the periphery has 5. The findings suggest that actors in the core of the network may not need to engage in GINs to the same extent as actors in the periphery. Actors in the core may benefit from local buzz; whereas peripheral actors, who are not privy to this local buzz, may have to access knowledge outside of the region via GINs. The structure of where actors lie in the network (core, semi-periphery, and periphery) has a significant impact on the propensity of SMEs to engage in GINs.

Regional connectivity with key strategic actors in the network also has an impact on the propensity of SMEs to engage in GINs. Two firms in the semi-periphery (RF18 and RF36) are somewhat

isolated from the network; however, they both have established 8 and 9 GINs respectively. They are also connected to each other through unpaid knowledge exchange. When being interviewed, they explained how they are somewhat more isolated than other firms in the network. RF18 acquires knowledge from 6 regional firms and RF36 acquires knowledge from 5 regional firms. They both only exchanged knowledge with 1 regional firm each. These firms are more secretive with their networking information. It should also be noted that during the interview RF36 did not want to go into detail about any of their global linkages. On the regional level, a lack of trust between actors can be hampering on firms trying to establish GINs. The GINs established by RF18 and RF36 are also not analogous to the other GINs shared by other firms in the region, as RF18 and RF36 both engage in strategic GINs pertinent to their business strategy. Firms in the region that are more connected showed repeat frequency with the same GINs; although, it was not always the case, as firms will establish GINs depending on their target market. They may also need to source knowledge from different sources than other firms in the core. The linkage will generally start with one firm and then diffuse through the network, depending on the level of trust. Actors in the core of the network engaged in homogenous GINs to an extent. However, as the firms move away from the core they start engaging in heterogeneous GINs and isolate themselves from regional knowledge exchange.

Three firms attempted to establish GINS with China (RF18, RF36, & RF51). RF18 and RF36 are located in the semi-periphery of the network, with RF51 being located in the core. Except for RF51, these two firms (RF18 & RF36) share a common GIN; they are also more isolated from the core of the network. In the previous example discussed in this chapter, regarding RF10, RF11, RF12, RF15, RF48, & RF51 engaging in GINs with GF12, all firms were located in the core of the network. The other example was GINs established by RF10, RF26, and RF37 with GF23; which are also all located in the core of the network. Firms in the core demonstrate homogenous GINs which may be attributed to the diffusion of local buzz in the network. As firms move away from the core the types of GINs become more heterogeneous. This is because they experience less contact from regional actors in the core.

The firms' locations within the network and how connected they were with key strategic actors in the network had the biggest impacts on the propensity for SMEs to engage in GINs on the regional level. Due to a lack of local buzz which is facilitated by regional connectivity, firms in the periphery of the network may have more of a need to establish GINs. Regional connectivity with key strategic actors also had a significant impact on the propensity for firms to engage in GINs, as global

networking is passed through the network by these key strategic actors. However, it should also be noted that firms in the semi-periphery and periphery, whilst lacking local buzz, at times engaged in GINs via these key strategic actors in the network. Network connectivity and regional connectivity with key strategic actors in the network are not mutually exclusive.

## 6 Conclusion

The final chapter of this paper addresses the initial aims of the study. Following the aims of the study, a summary of the main findings that were discussed in chapter 4 are presented. The chapter concludes with a section on the limitations of the research and how it can be further developed and expanded upon.

### 6.1 Research aims and summary of the findings

This study set out to understand three main research questions which are: (1) to investigate the extent of combinatorial knowledge exchange and the spatial geography in which the exchange occurred, (2) to understand the drivers and dynamics which facilitated these processes, (3) and to assess the impact of regional dynamics and industrial knowledge bases on the propensity of SMEs to engage in GINs. The literature on GINs is still somewhat embryonic; however, the literature identifies both regional dynamics and the knowledge base of an industry to be contingent factors in how firms engage in GINs. Very little is understood regarding how firms (not industries) dominated by different knowledge bases engage in GINs, which knowledge they acquire through regional networks, and which knowledge they acquire through global networks and what determines the decision of firms to engage local or globally. For sourcing knowledge related to innovation.

The study has shown that the industrial knowledge base of an industry is not static, as the literature suggests. Instead, the industrial knowledge base is dynamic and evolves over the lifecycle of the industry. Furthermore, the heterogeneity of firms in an industrial knowledge base means that the type of knowledge needed will differ by firm, as will the spatial proximities in which this knowledge is exchanged. Industry evolution in the video game industry has been engendered by innovation and technological change, which has impacted both the knowledge needed by firms and the spatial proximities in which that knowledge is exchanged. In the formative years of the video game industry, there was a dominant knowledge base (engineering), in which knowledge was exchanged regionally; this is consistent with the literature. However, industry evolution changed both the dominant knowledge base and spatial trajectory of knowledge exchange. Firms in the network sourced from of plethora of knowledge varieties over different spatial proximities; the type of

pertinent knowledge needed by the firm was sometimes contingent on their target market.

The industry network had a high frequency of linkages with all the biggest video game markets (USA, Japan, U.K, & Germany) in the industry except for China, where distance in institutional proximity acted as a barrier for firms engaging in GINs with China. The findings suggest that 70% of knowledge is exchanged on the regional level, 2% on the national level, and 28% on the global level. Unexpectedly, there seemed to be little to no impact on the exchange of tacit knowledge over distant geographical proximities, as 34% of all engineering knowledge and 29% of all artistic knowledge was sourced globally.

Further analysis of tacit knowledge exchange in the network can further expound on how it was exchanged over distant spatial proximities. Whilst tacit knowledge was exchanged globally, it was done via face to face interaction. A significant proportion of actors in the network engaged in GINs through conferences (regional & international) and regional contacts. Regional support organizations played a pivotal role in facilitating these global interactions, as some firms in the network availed of regional grants, which financed entry and travel expenses to these international conferences; this further strengthened the region's role in firms' engagement in GINs. However, not all tacit knowledge was exchanged through face to face interaction, as a significant amount of tacit knowledge exchange included the licensing of engineering products. Technological change and innovation has also augmented how tacit knowledge can be exchanged via codification. During the initial lifecycle of the video game industry tacit knowledge was exchanged locally as there was a significant demand for engineering knowledge which at the time was difficult to exchange via distant spatial proximities. However, developments in computer science have allowed industry experts to develop video game engines via tacit knowledge. The video game engine can be used by actors who license the software. The engine is developed using tacit knowledge inputs, but the final product can be used by licensees via codified instructions. Actors can benefit from the tacit knowledge input that was used to create the product regardless of geographical proximity. Technological change and innovation has also changed the dynamics of how once tacit dimensions of knowledge may be codified to an extent. The lack of regional linkages with actors on the national level departed from the literature, as industries with a symbolic or synthetic knowledge base are thought to exchange knowledge regionally and nationally. Although national firms are highly influential in the video game industry, they unexpectedly lacked representation of knowledge exchange with the network. When knowledge cannot be accessed on the regional level, actors went global to access that knowledge with little attempt to ascertain that knowledge nationally. It is

unclear why the national level is underrepresented in the network, and a sound analysis cannot be deduced from the information presented in the interviews.

This study also aimed to understand why firms engage in GINs. It was found that firms in the region engaged in GINs for several reasons: to be competitive on the global market, to gain knowledge relevant to the firms' target market, to break into strategic markets, and to source knowledge that was unavailable at the regional level due to the organizational variety of the region. The level of industry internationalization meant that for firms to be competitive and strategic, they had to source knowledge globally from key strategic actors in the region. The level of global interaction with regional actors is a good barometer for measuring the level of innovativeness of the network. Considering both the age and size of the firms, they are engaged with key strategic global firms operating in the biggest markets of industry; the network characteristics somewhat depart from what would be expected from SMEs. Firms in the region also had to engage in GINs due to a lack of specialized knowledge at the regional level. The Skåne region is identified as being organizationally thick and specialized. The lack of industry diversification on the regional level mean that regional actors must seek knowledge outside of the region. This could also explain the lack of network integration with actors on the national level. The knowledge that cannot be sourced regionally may also be unavailable nationally, which is why firms in the region sought global as opposed to national knowledge exchange. The linkages in the network consists of more unpaid knowledge exchange at the regional level, which is consistent with the literature; these informal linkages are facilitated by a level of trust on the regional level. All other exchanges, such as paid knowledge acquisition, paid knowledge exchange, and unpaid knowledge acquisition, were spilt roughly 50% between the regional and global level.

Whilst it has been understood that the industrial knowledge base and regional dynamics influence the propensity of SMEs to engage in GINs, the findings from this study also suggest that both the market type and strategy of the firm have an influence on the types and geography of knowledge sourcing. Firms in the network that targeted different markets of the video game industry demonstrated the tendency to source a particular knowledge type. Firms in the educational video game market: RF5, RF10, & RF37, sourced roughly 40% of all scientific knowledge in the network, whereas firms that targeted the console and indie market: RF11, RF26, RF35, RF12, RF48, & RF51 sourced roughly 85% of all artistic and 35% of all engineering knowledge in the network. Furthermore, these different types of markets affect the geography of these knowledge exchanges. In developing games for the console market, the primary goal of the developers was to make a



product for the global market; this means that knowledge would need to be sourced globally to retain competitiveness in the global market. This is evident from the following data, in which the 6 firms previously mentioned accounted for roughly 44% of all GINs in the network. The findings also suggest that firms don't engage in GINs exclusively for the international market; RF10 who targets the domestic market, has established more GINs (20) than any other firm in the network. Firms that target the domestic market seek out global knowledge to retain market competitiveness on the domestic level, which is contingent on their market strategy.

The final aim of this paper was to explore the influence of regional dynamics on the propensity of SMEs to engage in GINs. The findings suggest that the propensity of SMEs to engage in GINs is contingent on: access to conferences (regional and international), the presence of key strategic actors in the region, and the firms' location within the regional network. Key strategic actors are identified as actors in the region that have access to international contacts, which they may pass onto other actors in the region. Some firms in the core of the network were engaged in a low level of GINs whilst, other firms in the semi-periphery and periphery of the network were engaged in a high level of GINs. Firms in the core of the network have less of a need to establish GINs, as they have access to local buzz; firms in the peripheral regions of the network who are not privy to this local buzz, may have to source knowledge globally to augment their knowledge requirements. The structure of where actors lie in the regional network has significant impact on the propensity of SMEs to engage in GINs. Firms that are more closely linked were found to have analogous GINs; however, the further away from the core firms are, the more heterogeneous their GINs become. The evidence also suggests that the regional reputation may have an impact on both regional and global firms' ability to establish successful GINs. Once a firm established a successful GIN, they also created a regional linkage. The firm which initially engaged in the GIN may pass on their networking information through local buzz to other firms in the region. In the case of the global firm, with a linkage to both the region and the firm, they may seek out other firms in the region based on propitious performance of previous successful GINs in the region. This will create a snowball effect, in which the more a firm engages in the GIN, the stronger the ties will be, on both the regional and firm level. Conversely, negative regional experience may have an adverse impact on the likelihood of firms attempting to establish GINs with a specific region. Firms which agglomerate around the core of the network display more GIN homogeneity because too much local buzz may influence the types of GINs with which they engage, to an extent. Some firms in the network have unsuccessfully attempted to establish GINs with firms in China, which then acted as

a deterrent for regional firms to attempt to establish similar GINs, based on negative local buzz. The only firm that established a successful GIN with China was a firm located in the semi-periphery of the network. Based on the heterogeneity of firms that rest in the core, semi-periphery, and periphery; too much local buzz or not enough can negatively impact the network. Firms in the core of the network may be less inclined to take risks when engaging in GINs, as they may be exposed to too much local buzz. Firms in the semi-periphery may have enough local buzz to engage in GINs, but also may not be influenced too much by the impact local buzz has on the spatial trajectory of these GINs; therefore, they may engage in more diversified GINs than firms in the core. Firms in the periphery of the network may not have enough access to local buzz to engage in strategic GINs. Their global networks consisted of what was necessary to compete in the industry.

The regional dynamics that had an impact on how SMEs engaged in GINs were the level of regional industry diversification or lack thereof and how connected and integrated firms in the region were with each other. The specific regional location of SMEs had little impact on how often they engaged in GINs; however, their level of integration in network had significant impact on how they engaged in GINs. The network consists of key strategic actors who act as gatekeepers to global networks and they may pass on these global networks via local buzz, but only to firms in the network that are exposed to local buzz. The closer to the core firms were, the more homogenous their GINs were, to an extent. As firms in the network move away from the core their GINs become more heterogeneous. Too much integration at the core of the network can be hampering to the engagement of GINs as the pool of GINs may lack diversification which could lead to path exhaustion. Too little integration between firms in the network can also be hampering as there is not enough local buzz being exchanged to facilitate these GINs. A level of moderate network integration may be the most conducive environment for diversified GINs, as actors in the region can access GINs through local buzz but also not be negatively impacted by too much local buzz.

The contribution of this thesis is both theoretical and methodological. As I will discuss next; the thesis contributes to the current debate on the geography of innovation networks related to the industrial knowledge base epistemology. It explores the validity of some of the main findings in the existing literature on industrial knowledge bases and their geographies, it provides alternative explanations to their somehow differing patterns, such as the role of the market, the strategy of the firm and the structure of the network. By bringing in the network structure, I am able to discuss

how the position of the firms in the regional network affects their propensity to engage in GINs. Methodologically, the paper combines social network analysis with interview and survey data and is the result of intensive data gathering work. It should be also noted that I learnt to use social network analysis for the purpose of this thesis. The result is a complete new set of data on the geography of knowledge networks with promising new venues of research.

## 6.2 Future Research

As previously stated little is understood about how SMEs engage in GINs. It is understood that both the industrial knowledge base and regional variety have an impact on how firms may engage in these GINs. The heterogeneity of an industrial knowledge base, firms in an industrial knowledge base, and regional variety must be considered when analyzing how SMEs engage in these GINs. This study was pertinent to SMEs with a symbolic/synthetic industrial knowledge base operating in an organizationally thick and specialized region (Skåne). The research can be developed in two ways. First, by analyzing firms with different industrial knowledge bases operating in an organizationally thick and specialized region or by analyzing firms with a similar industrial knowledge base operating in a different regional variety (organizationally thick and diversified and organizationally thin). Analyzing industries with a heterogeneous knowledge base in the same regional variety can further expound on the regional impact of firms engaging in GINs from the perspective of their industrial knowledge base. Analyzing industries with a homogenous knowledge base in the same regional variety can expound on the heterogeneity of firms operating under an industrial knowledge base.

Further studies on the influence regional dynamics and industrial knowledge bases have on how firms engage in GINs can further develop the literature, allowing studies involving different regional varieties and knowledge bases to be cross referenced in order to develop and strengthen newly formulated theoretical conceptualizations. The literature on GINs is quite contemporary compared to the other conceptualizations delineated in this paper. Further research is needed to develop sound theories. This paper aimed to contribute to our understanding of the impact of regional variety and industrial knowledge bases have on SMEs engaging in GINs. As stated in chapter two of this paper, the generalizability of these results in different industries and regional variety may be controversial, as they are pertinent to industries with a symbolic/synthetic knowledge base operating in an organizationally thick and specialized RIS. Further research on

industries with different knowledge bases operating in different regional varieties would build upon a growing body of work, in which results from different regional varieties and industrial knowledge bases may be benchmarked and cross referenced with each other to further develop the literature and enhance our understanding of the interplay between how regional dynamics and the industrial knowledge base of a firm impacts the role on how firms engage in GINs.

# References

- Alexander, B., 2013. Design of a socio-technical change management process: a critical realist perspective. INEER ICEER Conference.
- Archer, M., Decoteau, C., Gorski, P., Little, D., Porpora, D., Rutzou, T., Smith, C., Steinmetz, G. and Vandenberghe, F., 2016. What is Critical Realism? Perspectives, (38,2), pp. 4-9.
- Asheim, B.T., Boschma, R. and Cooke, P., 2011. Constructing regional advantage: Platform policies based on related variety and differentiated knowledge bases. *Regional studies*, 45(7), pp.893-904.
- Asheim, B.T. and Coenen, L., 2005. Knowledge bases and regional innovation systems: Comparing Nordic clusters. *Research policy*, 34(8), pp.1173-1190.
- Asheim, B., Coenen, L., Moodysson, J. and Vang, J., 2005. Regional innovation system policy: A knowledge-based approach. CIRCLE (Centre for Innovation, Research and Competence in the Learning Economy) Working Paper, 13.
- Asheim, B., Coenen, L. and Vang, J., 2007. Face-to-face, buzz, and knowledge bases: sociospatial implications for learning, innovation, and innovation policy. *Environment and Planning C: Government and Policy*, 25(5), pp.655-670.
- Aslesen, H.W., Chaminade, C., Herstad, S. and Trippel, M. *Forthcoming*, Global Innovation networks. State of the art and the way ahead
- Aslesen, H.W. and Freel, M., 2012. Industrial knowledge bases as drivers of open innovation?. *Industry and Innovation*, 19(7), pp.563-584.
- Asheim, B. T. & Gertler, M. 2005. The geography of innovation: Regional innovation systems, in: J. Fagerberg, D. Mowery & R. Nelson (Eds) *The Oxford Handbook of Innovation*, pp. 291–317 (Oxford: Oxford University Press)
- Asheim, B. and Hansen, H.K., 2009. Knowledge bases, talents, and contexts: On the usefulness of the creative class approach in Sweden. *Economic Geography*, 85(4), pp.425-442.

Barnard, H. and Chaminade, C., 2017. Global Innovation Networks: towards a taxonomy. Submitted to Research Policy.

Bathelt, H., Malmberg, A. and Maskell, P., 2004. Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in human geography*, 28(1), pp.31-56.

Bhaskar, R., 2014. Roy Bhaskar Interview. Youtube, [Video Online] Google, Available Online:  
<https://www.youtube.com/watch?v=TO4FaaVy0Is&index=8&list=FLyLUUVfc8zIGSAad9uSVTxw> [Accessed 2 May 2017]

Boschma, R., 2005. Proximity and innovation: a critical assessment. *Regional studies*, 39(1), pp.61-74.

Boschma, R. and Martin, R., 2010. The aims and scope of evolutionary economic geography. *The handbook of evolutionary economic geography*, pp.3-39.

Carter, B. and New, C. eds., 2005. *Making realism work: Realist social theory and empirical research*. Routledge.

Chaminade, C. and Asheim, B., 2014. Global innovation networks, regional variety and its impact on the innovativeness of firms and regions: The IT and new media industry in Sweden in a global comparative perspective. Marianne and Marcus Wallenberg Foundation [Project Report]

Chaminade, C. and Plechero, M., 2015. Do regions make a difference? Regional innovation systems and global innovation networks in the ICT industry. *European Planning Studies*, 23(2), pp.215-237.

Chaminade, C. and Plechero, M., 2015. The role of geographical proximity in the international knowledge flows of European firms: an overview of different knowledge transfer mechanisms (No. 2015/30). Lund University, CIRCLE-Center for Innovation, Research and Competences in the Learning Economy.

Chaminade, C., Zabala, J.M. and Treccani, A., 2010. The Swedish national innovation system and its relevance for the emergence of global innovation networks. CIRCLE Electronic WP series, Paper, (2010/09).

Clark, G.L., 1998. Stylized facts and close dialogue: methodology in economic geography. *Annals of the association of American Geographers*, 88(1), pp.73-87.

Cooke, P., 2002. Regional innovation systems: general findings and some new evidence from biotechnology clusters. *The Journal of Technology Transfer*, 27(1), pp.133-145.

Cooke, P., Uranga, M.G. and Etxebarria, G., 1997. Regional innovation systems: Institutional and organisational dimensions. *Research policy*, 26(4-5), pp.475-491.

Cowan, R., David, P.A. and Foray, D., 2000. The explicit economics of knowledge codification and tacitness. *Industrial and corporate change*, 9(2), pp.211-253.

Dataspelsbranschen., 2016. Swedish Game Developer Index 2016. Available Online: [http://www.dataspelsbranschen.se/media/154926/gamedeveloperindex\\_2016.pdf](http://www.dataspelsbranschen.se/media/154926/gamedeveloperindex_2016.pdf) [Accessed May 2017]

Denzin, N.K., 1973. *The research act: A theoretical introduction to sociological methods*. Transaction publishers.

Downes, L., 2010. Capcom's Inafune On Western Development. [a]list Frontline Marketing. 28 June 2010 [Online]. Available Online: <http://www.alistdaily.com/media/capcoms-inafune-on-western-development/> [Accessed 20 May 2017]

Drennan, J., 2003. Cognitive interviewing: verbal data in the design and pretesting of questionnaires. *Journal of advanced nursing*, 42(1), pp.57-63.

Easton, G., 2010. Critical realism in case study research. *Industrial marketing management*, 39(1), pp.118-128.

European Commission., 2017. Regional Innovation Monitor Plus. Available Online: <https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/base-profile/south-sweden> [Accessed 20 May 2017]

Friedman, T.L., 2005. It's a flat world, after all. *The New York Times*, 3, pp.33-37.

- Game City., 2015. Game City Survey. Available Online: <http://www.gamecity.se/survey2015/> [Accessed 20 May 2017]
- Jick, T.D., 1979. Mixing qualitative and quantitative methods: Triangulation in action. *Administrative science quarterly*, 24(4), pp.602-611.
- Gertler, M.S., 2003. Tacit knowledge and the economic geography of context, or the undefinable tacitness of being (there). *Journal of economic geography*, 3(1), pp.75-99.
- Goffin, K. and Koners, U., 2011. Tacit knowledge, lessons learnt, and new product development. *Journal of Product Innovation Management*, 28(2), pp.300-318.
- Grillitsch, M. and Nilsson, M., 2015. Innovation in peripheral regions: Do collaborations compensate for a lack of local knowledge spillovers?. *The Annals of Regional Science*, 54(1), pp.299-321.
- Grillitsch, M. and Trippl, M., 2013. Combining knowledge from different sources, channels and geographical scales. *European Planning Studies*, 22(11), pp.2305-2325.
- Haythornthwaite, C., 1996. Social network analysis: An approach and technique for the study of information exchange. *Library & information science research*, 18(4), pp.323-342.
- Johnson, B., Lorenz, E. and Lundvall, B.Å., 2002. Why all this fuss about codified and tacit knowledge?. *Industrial and corporate change*, 11(2), pp.245-262.
- Lundvall, B.Å., 2010. Scope, style, and theme of research on knowledge and learning societies. *Journal of the Knowledge Economy*, 1(1), pp.18-23.
- Manniche, J., 2012. Combinatorial knowledge dynamics: On the usefulness of the differentiated knowledge bases model. *European Planning Studies*, 20(11), pp.1823-1841.
- Martin, R., 2012. Measuring knowledge bases in Swedish regions. *European Planning Studies*, 20(9), pp.1569-1582.
- Martin, R., 2013. Differentiated knowledge bases and the nature of innovation networks. *European Planning Studies*, 21(9), pp.1418-1436.



Martin, R. and Moodysson, J., 2011. Innovation in symbolic industries: The geography and organization of knowledge sourcing. *European Planning Studies*, 19(7), pp.1183-1203.

Martin, R. and Moodysson, J., 2013. Comparing knowledge bases: on the geography and organization of knowledge sourcing in the regional innovation system of Scania, Sweden. *European Urban and Regional Studies*, 20(2), pp.170-187.

Modell, S., 2009. In defence of triangulation: a critical realist approach to mixed methods research in management accounting. *Management Accounting Research*, 20(3), pp.208-221.

Moodysson, J., 2008. Principles and practices of knowledge creation: On the organization of “buzz” and “pipelines” in life science communities. *Economic Geography*, 84(4), pp.449-469.

Newzoo., 2016. The Global Games Market Races \$99.6 Billion in 2016, Mobile Generating 37%. Available Online: <https://newzoo.com/insights/articles/global-games-market-reaches-99-6-billion-2016-mobile-generating-37/> [Accessed 20 May 2017]

Newzoo., 2017. THE GLOBAL GAMES MARKET WILL REACH \$108.9 BILLION IN 2017 WITH MOBILE TAKING 42% Available Online: <https://newzoo.com/insights/articles/the-global-games-market-will-reach-108-9-billion-in-2017-with-mobile-taking-42/> [Accessed 20 May 2017]

Pilat, D., Backer, K., Basri, E. and Box, S., 2008. The development of global innovation networks and the diffusion of knowledge, OECD-World Bank Forum

Pitcher, J., 2013. Keiji Inafune says Japanese developers need to learn from overseas devs. Polygon. 3 April 2013 [Online]. Available at:

<https://www.polygon.com/2013/4/3/4181120/keiji-inafune-says-japanese-developers-need-to-learn-from-overseas> [Accessed 20 May 2017]

Plechero, M. and Chaminade, C., 2013. The influence of micro-characteristics in different modes of globalization of innovation: A comparative study of Indian (Pune) and Chinese (Beijing) firms. *Industry and Innovation*, 20(7), pp.661-682.

Plunkett, L., 2012. Every Game Studio That's Closed Down Since 2006. The Kotaku, 16 January 2012 [Online]. Available at: <http://kotaku.com/5876693/every-game-studio-thats-closed-down-since-2006> [Accessed 20 May 2017]

Polanyi, M., 1966. The logic of tacit inference. *Philosophy*, 41(155), pp.1-18.

Schoenberger, E., 1991. THE CORPORATE INTERVIEW AS A RESEARCH METHOD IN ECONOMIC GEOGRAPHY\*. *The Professional Geographer*, 43(2), pp.180-189.

Scott, A.J., 1997. The cultural economy of cities. *International journal of urban and regional research*, 21(2), pp.323-339.

Skåne., 2017. Skåne developing with innovation arenas and clusters. Available Online: <http://www.skane.com/en/skane-developing-with-innovation-arenas-and-clusters> [Accessed 20 May 2017]

Smith, J.H., Tosca, S.P. and Egenfeldt-Nielsen, S., 2008. Understanding Video Games.

Ter Wal, A.L. and Boschma, R.A., 2009. Applying social network analysis in economic geography: framing some key analytic issues. *The Annals of Regional Science*, 43(3), pp.739-756.

Tödting, F. and Tripl, M., 2005. One size fits all?: Towards a differentiated regional innovation policy approach. *Research policy*, 34(8), pp.1203-1219.

Tripl, M., Tödting, F. and Lengauer, L., 2009. Knowledge sourcing beyond buzz and pipelines: evidence from the Vienna software sector. *Economic Geography*, 85(4), pp.443-462.

Van de Vrande, V., De Jong, J.P., Vanhaverbeke, W. and De Rochemont, M., 2009. Open innovation in SMEs: Trends, motives and management challenges. *Technovation*, 29(6), pp.423-437.

# Appendix

## Appendix A – Network Survey (Online Survey)

Type of partners	M	Type/Type of linkage	Knowledge	Location*	Importance
Game Companies	Binary Peak AB				
	Blast Door Interactive AB				
	CANWZ in Sweden AB				
	Casen Crowd				
	Coastalbyte AB				
	Cockroack (Sleeping Machine AB)				
	DeadShark Triplepunch AB				
	DeadToast Entertainment				
	Defrost Games				
	Divine Robot AB				
	Forgotten Key AB				
	Frictional Games AB				
	Frogsong Studios AB				
	Gatling Goat Studios AB				
	Grapefrukt (webbfarbror AB)				
	GreyLight Entertainment				
	Haunted House AB				
	Illusion Labs AB				
	Imperial Game Studio AB				
	JE Software				
	King				
	Leripa AB				
	Localize Direct				
	Mediocre AB				
	Midnight Hub				
	Mjainir Games *				
	Monsuta AB				
	Nemoria Entertainment AB				
	Newnorth Technology				
	Nodbrim Interactive AB				
	Noumenon Games AB				
	Number Twenty Five Entertainment				
	Odd Comet Games AB				
Ozma Speldesign AB					
Pixelbite AB					
Planeto AB					

	Polyregular Studios AB				
	Primary Hive				
	ProCloud Media Invest AB				
	Redgrim AB				
	Redikod AB				
	REGN				
	Royal Hand Studios				
	Saguru AB				
	Simogo AB				
	Star Vault AB				
	Station Interactive AB				
	Stormhatt Studios				
	SwedishGame development AB				
	Tarsier Studios AB				
	Ubisoft Entertainment				
	VisionPunk				
	Wordexia				
Education Organisations	Blekinge Institute of Technology				
	Lund University (LU)				
	Malmö Högskola (MH)				
	Malmö Yrkehögskola (MY)				
	The Game Assembly (TGA)				
Support Organisations	Game City				
	Media Evolution (ME)				
	Nordic Game (NG)				
	Gameport				
	Malmö Incubator (MINC)				
	Malmö Startups				
	Diversi				
	Dataspelsbranschen / Swedish Games				
	International Game Developer's Association (IGDA)				
Major platform owners, virtual reality (VR) platforms	Activision Blizzard				
	Apple				
	Bandai Namco				
	Electronic Arts				
	Facebook				
	Google				

and publishers	HTC Vive				
	Konami				
	Microsoft				
	Nintendo				
	Oculus				
	Paradox Interactive				
	Sony				
	Square-Enix				
	StarVR				
	Take Two				
	Ubisoft				
	Valve Corporation				
Additional Comments					

*Source: Own Survey*

**Global innovation networks, regional variety and its impact on the innovativeness of firms and regions:  
The IT and new media industry in Sweden in a global comparative perspective**



This questionnaire is a part of an ongoing research project that aims to understand how and why firms in different regions around the world use global networks (GINs) to innovate. The project focuses on the IT and new media industry in four locations: Scania in Sweden, Oslo in Norway, Bangalore in India and Beijing in China. Our main interest is in innovation processes and knowledge sources related to innovation.

All information gathered during this interview will be treated confidentially, i.e. it will not be possible for anyone to identify your firm. Moreover, no individual firm or organization will be mentioned in any publications based on these interviews. If such a need should arise, we will ask for your permission.

Interviewer \_\_\_\_\_

Date of the interview \_\_\_\_\_

Name of firm \_\_\_\_\_

Address of firm \_\_\_\_\_

Firm number (anonymous) \_\_\_\_\_

Name of respondent \_\_\_\_\_

Function of the respondent

- |  |  |
|--|--|
| <input type="checkbox"/> CEO   | <input type="checkbox"/> head of commercial / marketing department |
| <input type="checkbox"/> entrepreneur                                  | <input type="checkbox"/> other _____                               |
| <input type="checkbox"/> head of technical department / R&D department |  |

Contact details

phone \_\_\_\_\_

email \_\_\_\_\_

Version: 2016-01

**INTERVIEWER**

The interview is divided into four main blocks. The first is concerned with the company's innovation activity. The second part deals with how external knowledge is acquired. The third one is on the regional ecosystem, including the role of formal and informal rules, established practices and perceptions present in the society on the regional level. Finally the last one is related to the background information of the firm.

If your unit is part of an enterprise group, please answer all subsequent questions in relation to this unit in NORWAY/SWEDEN/CHINA/INDIA only. (Please select the one that applies)

**INTERVIEWER**

We will start by asking some questions on the innovation activities of your company.

**PART 1. INNOVATION ACTIVITIES**

1. Does the firm have employees (full-time equivalents) that are occupied with the development of new products /services/ solutions most of the time?  
 No  
 Yes, how many in 2014? \_\_\_\_\_ %
  
2. Do you have employees with foreign background who are of the strategic importance for innovation activities? If yes, how do they contribute to innovation activities?

**INTERVIEWER**

Give the interviewer **Chart № 1** for the educational background of employees.

3. In the following chart you will find different educational backgrounds. Could you please indicate what is the dominant profile(s) of the employees occupied with the development of new products /services/ solutions most of the time? Please indicate the share (%) of the following fields (adding up to 100%).  

a) Natural sciences	→	%
b) Engineering, technical studies	→	%
c) Artistic studies	→	%
d) Management studies	→	%
e) Marketing studies	→	%
f) Other _____	→	%

4. Do you have an R&D department?

No

Yes, how many employees in the R&D department as a percentage of total staff? \_\_\_\_%

5. Could you describe a **typical innovation in your firm**?

INTERVIEWER

If typical innovation is an example of a product, please follow up on the process – the activities behind development of the product



**INTERVIEWER**

Give the interviewee **Chart № 2** on types and levels of innovation.

6. During the **last three years**, did your unit introduce any of the following innovations? If yes, could you please indicate how novel they were **with respect to the typical innovations in your industry as whole – globally?**

Introduced innovation	Below average	Average	Above average	Cutting edge – new to the world
<b>P1. Innovation in goods</b>				
<b>P2. Innovation in services.</b>				
<b>PR. Innovation in processes</b>				
<b>O1. New management practices</b>				
<b>O2. New business models</b>				
<b>Other types of innovation? _____</b>				

7. Do you have any IPR such as industrial design, copyright, trademark, patent on the innovations you introduced in the last three years?

PART 2. KNOWLEDGE LINKAGES

INTERVIEWER

In the next section we would like to understand how your company acquires **knowledge relevant for innovation** from other units within your company and from other organizations and individuals/networks of individuals externally and where those organizations, individuals/networks of individuals are located.

INTERVIEWER

Give the interviewers **Chart № 3** on types of knowledge

8. Please look at Chart 3 which distinguishes between different forms of knowledge. Could you please estimate the importance from 1 to 5 of different forms of knowledge you need for typical innovation in your company described above? 1 – not important at all, 5 – very important.

Scientific knowledge	→	1 2 3 4 5
Engineering knowledge	→	1 2 3 4 5
Artistic knowledge	→	1 2 3 4 5
Managerial knowledge	→	1 2 3 4 5
Market knowledge	→	1 2 3 4 5
Other _____	→	1 2 3 4 5

Total 100%

INTERVIEWER

Use **Chart № 4** on types of knowledge as a check list for yourself regarding the types of knowledge linkages that can be relevant. Do not give it to interviewee. Ask each type of knowledge one by one – if knowledge is used in innovation processes and where does it come from.

In the case in which the interviewee indicates one of the sources marked with an asterisk, please proceed to question 9b.

9. a. We would like to understand how your firm acquires the different forms of knowledge indicated in the previous question. Please indicate the most important sources of **scientific knowledge/engineering knowledge/artistic/managerial/market knowledge**. If a partner is a local subsidiary of a multinational company, please indicate. (Do you use scientific knowledge while developing innovation? If yes, where do you acquire it from?)

b. Could you please indicate the type of partner and the specific location (city, not country)

Knowledge	Type/Type of linkage	Name*	Type of partners *	Location*	Subsidiary Yes/No
Scientific					
Engineering					
Artistic					
Managerial					
Market					

\* only in case of sourcing using linkages marked with \*

**PART 3. THE ROLE OF THE REGIONAL SYSTEM OF INNOVATION**

**INTERVIEWER**

In the coming part we want to understand the availability and quality of the regional eco-system in terms of innovation and how it influenced your decision to source knowledge internationally.

First, give the interviewee **Chart № 5** with the figure explaining the rationale behind this part. Second, give **Chart № 6** with a list of organizations in the region as well as the scale means from 1 to 5.

**Innovation Processes**

10. We would like to know how useful are other organizations in the region for your innovation processes, both directly – as partners – and indirectly – for example providing infrastructure, training, funding, etc. For each form of organization, please indicate their importance directly or indirectly using a scale from 1-5, being 1 not important at all and 5 very important.

<b>Organizations</b>	<b>Directly</b>	<b>Indirectly</b>
Other firms in IT & new media industry	1 2 3 4 5	
Other firms in different but related industries		
Universities and research centers		
Customers		
Suppliers		
Competitors		
Government		
Consultants		
Intermediaries (tech. transfer offices, industrial associations)		
Venture capital, business angels		
Other organization (pls. specify) _____		

11. a. Are you aware of any **policy initiatives in your region** that support innovation? (the interviewer could provide a list of policy initiatives and ask the interviewee if he/she is aware of them)

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- b. If yes, which policy initiatives supporting innovation has your firm used in the last three years?

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- c. Specify for the above mentioned policy initiative HOW you benefit from them? (multiple options valid). Mark with a cross (X)

1. Access to market knowledge	
2. Access to technological knowledge	
3. Sharing knowledge with suppliers, customers or competitors	
4. Sharing knowledge with universities	
5. Training, upskilling	
6. Access to funding	

**INTERVIEWER**

Give the interviewee **Chart № 7** with a list of institutional factors. We would like to know if those factors have influenced in a positive or negative way innovation in the firm (hampering, neutral, enabling).

12. The chart provides you with a list of other factors affecting the quality of the innovation environment in your region. We would like to know if those factors have influenced in a positive or negative way innovation in your firm (hampering, neutral, enabling). Insert a cross (X) in the option that applies

<b>Institutions</b>	<b>Hampering</b>	<b>Neutral</b>	<b>Enabling</b>
Regulations			
International standards			
Societal values towards innovation			
Societal acceptance of failure			
Willingness of other firms in the region to exchange knowledge related to innovation (culture of collaboration)			
Level of trust among different actors in the region			
Regional actors having a joint vision for the development of the region			

13. In the case in which the responses were **enabling or hampering**. Do you have any concrete example?

Internationalization Processes

14. Have the availability and quality of the organizations in your region influenced in any way your **decision to acquire or not knowledge internationally**? If so, can you give an example?

15. a. Are you aware of any policy initiatives in your region that **support internationalization in any step** of the development of innovation – from acquiring knowledge to commercialization?

- b. If yes, which policy initiatives supporting internationalization has your firm used in the last three years?

16. Have any of the institutional **factors (regulations, norms)** mentioned before influenced your decision to **acquire or not knowledge internationally**? If so when? Can you give an example?

17. Has any **other factor – not necessarily in your region** – affected your decision to **acquire or not knowledge internationally**? For example, difficulties finding partners, cultural differences, reputation of the host region, etc.



PART 4. COMPANY BACKGROUND

INTERVIEWER

Finally, we would like to check that the information we have from your company is correct

18. Are you

- A standalone company
- The headquarters of an MNC
- A subsidiary of an MNC with head office located in \_\_\_\_\_

19. Year of establishment of this unit \_\_\_\_\_

- a. In case of merger or acquisition, indicate also the year in which the most recent merger or acquisition took place \_\_\_\_\_

20. Which percentage of your sales goes to the following markets

a. Domestic \_\_\_\_\_ %

International \_\_\_\_\_ %

Total 100%

- b. In case of international %, which are the most important markets?

21. How many employees (full-time equivalents) are working in your firm? \_\_\_\_\_

*Appendix C – Node Locations*

<b>Node Name</b>	<b>Location</b>	<b>Node Name</b>	<b>Location</b>	<b>Node Name</b>	<b>Location</b>
RF1	Regional	RF17	Regional	RF33	Regional
RF2	Regional	RF18	Regional	RF34	Regional
RF3	Regional	RF19	Regional	RF35	Regional
RF4	Regional	RF20	Regional	RF36	Regional
RF5	Regional	RF21	Regional	RF37	Regional
RF6	Regional	RF22	Regional	RF38	Regional
RF7	Regional	RF23	Regional	RF39	Regional
RF8	Regional	RF24	Regional	RF40	Regional
RF9	Regional	RF25	Regional	RF41	Regional
RF10	Regional	RF26	Regional	RF42	Regional
RF11	Regional	RF27	Regional	RF43	Regional
RF12	Regional	RF28	Regional	RF44	Regional
RF13	Regional	RF29	Regional	RF45	Regional
RF14	Regional	RF30	Regional	RF46	Regional
RF15	Regional	RF31	Regional	RF47	Regional
RF16	Regional	RF32	Regional	RF48	Regional

RF49	Regional	SO3	Regional	GF2	USA
RF50	Regional	SO4	Regional	GF3	Japan
RF51	Regional	SO5	Regional	GF4	USA
RF52	Regional	SO6	Regional	GF5	USA
RF53	Regional	SO7	Regional	GF6	USA
RF54	Regional	SO8	Regional	GF7	USA
RF55	Regional	SO9	Regional	GF8	Japan
RF56	Regional	NF1	National	GF9	USA
RF57	Regional	NF2	National	GF10	Japan
RF58	Regional	NF3	National	GF11	USA
RF59	Regional	NF4	National	GF12	Japan
RF60	Regional	NF5	National	GF13	Japan
RF61	Regional	NF6	National	GF14	USA
EO1	Regional	NF7	National	GF15	France
EO2	Regional	NF8	National	GF16	USA
EO3	Regional	NF9	National	GF17	USA
EO4	Regional	NF10	National	GF18	Indonesia
EO5	Regional	NF11	National	GF19	UK
SO1	Regional	NF12	National	GF20	Ireland
SO2	Regional	GF1	USA	GF21	Germany

GF22	USA	GF42	USA	GF62	Denmark
GF23	UK	GF43	USA	GF63	UK
GF24	Germany	GF44	UK	GF64	USA
GF25	Spain	GF45	USA	GF65	UK
GF26	Cyprus	GF46	USA		
GF27	Germany	GF47	USA		
GF28	Finland	GF48	USA		
GF29	Germany	GF49	France		
GF30	USA	GF50	Germany		
GF31	UK	GF51	Japan		
GF32	USA	GF52	South Korea		
GF33	USA	GF53	China		
GF34	USA	GF54	Denmark		
GF35	USA	GF55	USA		
GF36	Ireland	GF56	Denmark		
GF37	Canada	GF57	UK		
GF38	USA	GF58	UK		
GF39	USA	GF59	Norway		
GF40	USA	GF60	UK		
GF41	USA	GF61	UK		

Source: Own Survey

*Appendix D – Regional Node Location*

<b>Node Name</b>	<b>Location</b>	<b>Node Name</b>	<b>Location</b>	<b>Node Name</b>	<b>Location</b>	<b>Node Name</b>	<b>Location</b>
RF1	Malmö	RF17	Malmö	RF33	Karlshamn	RF49	Malmö
RF2	Malmö	RF18	Malmö	RF34	Helsingborg	RF50	Malmö
RF3	Malmö	RF19	Lund	RF35	Malmö	RF51	Malmö
RF4	Malmö	RF20	Höllviken	RF36	Helsingborg	RF52	Malmö
RF5	Karlshamn	RF21	Kristianstad	RF37	Malmö	RF53	Malmö
RF6	Malmö	RF22	Malmö	RF38	Malmö	RF54	Klippan
RF7	Karlshamn	RF23	Malmö	RF39	Malmö	RF55	Karlshamn
RF8	Malmö	RF24	Helsingborg	RF40	Malmö	RF56	Malmö
RF9	Malmö	RF25	Malmö	RF41	Karlshamn	RF57	Eslöv
RF10	Malmö	RF26	Malmö	RF42	Malmö	RF58	Kristianstad
RF11	Karlshamn	RF27	Malmö	RF43	Malmö	RF59	Malmö
RF12	Helsingborg	RF28	Helsingborg	RF44	Karlshamn	RF60	Malmö
RF13	Malmö	RF29	Karlshamn	RF45	Malmö	RF61	Malmö
RF14	Karlshamn	RF30	Malmö	RF46	Malmö		
RF15	Malmö	RF31	Ronneby	RF47	Malmö		
RF16	Karlshamn	RF32	Karlshamn	RF48	Karlshamn		

*Source: Own Survey*

*Appendix E – Network Node Location*

<b>Node Name</b>	<b>Location</b>	<b>Node Name</b>	<b>Location</b>	<b>Node Name</b>	<b>Location</b>	<b>Node Name</b>	<b>Location</b>
RF1	Periphery	RF17	Periphery	RF33	S-Periphery	RF49	Core
RF2	Periphery	RF18	S-Periphery	RF34	S-Periphery	RF50	Periphery
RF3	Core	RF19	Periphery	RF35	Core	RF51	Core
RF4	S-Periphery	RF20	Periphery	RF36	S-Periphery	RF52	S-P
RF5	Core	RF21	Core	RF37	Core	RF53	Periphery
RF6	S-Periphery	RF22	Core	RF38	Periphery	RF54	Periphery
RF7	S-Periphery	RF23	Periphery	RF39	Periphery	RF55	Periphery
RF8	S-Periphery	RF24	S-Periphery	RF40	Periphery	RF56	Periphery
RF9	Periphery	RF25	Core	RF41	Core	RF57	Periphery
RF10	Core	RF26	Core	RF42	Core	RF58	Periphery
RF11	Core	RF27	Periphery	RF43	S-Periphery	RF59	S-P
RF12	Core	RF28	Periphery	RF44	Periphery	RF60	Periphery
RF13	Core	RF29	Periphery	RF45	Periphery	RF61	Periphery
RF14	S-Periphery	RF30	Core	RF46	Core		
RF15	Core	RF31	Periphery	RF47	S-Periphery		
RF16	Periphery	RF32	Core	RF48	Core		

*Source: Own Survey*

