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NATIONAL INNOVATION SYSTEM AND SME INNOVATIVENESS

A comparative study of Finland and Germany

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in International Business

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1 INTRODUCTION

1.1 European innovation leaders: Finland and Germany

Essentially, innovative performance of a country is an outcome of the overarching innovation system. It not only defines the innovativeness of individual actors such as firms and organisations, but also the entire system as such. The European Innovation Scoreboard (EIS), previously referred to as the Innovation Union Scoreboard, releases information on the comparative analysis of innovation performance in the EU countries. Intriguingly, it addresses the distinct strengths and weaknesses of each member states' national innovation systems. This helps countries spot the challenging areas that need to be tackled. The innovation scoreboard is crucial to examine, as it takes into account the significance of the national innovation systems. (European Commission 2016, EIS.) The results of the European Innovation Scoreboard in 2016 are demonstrated in figure 1.

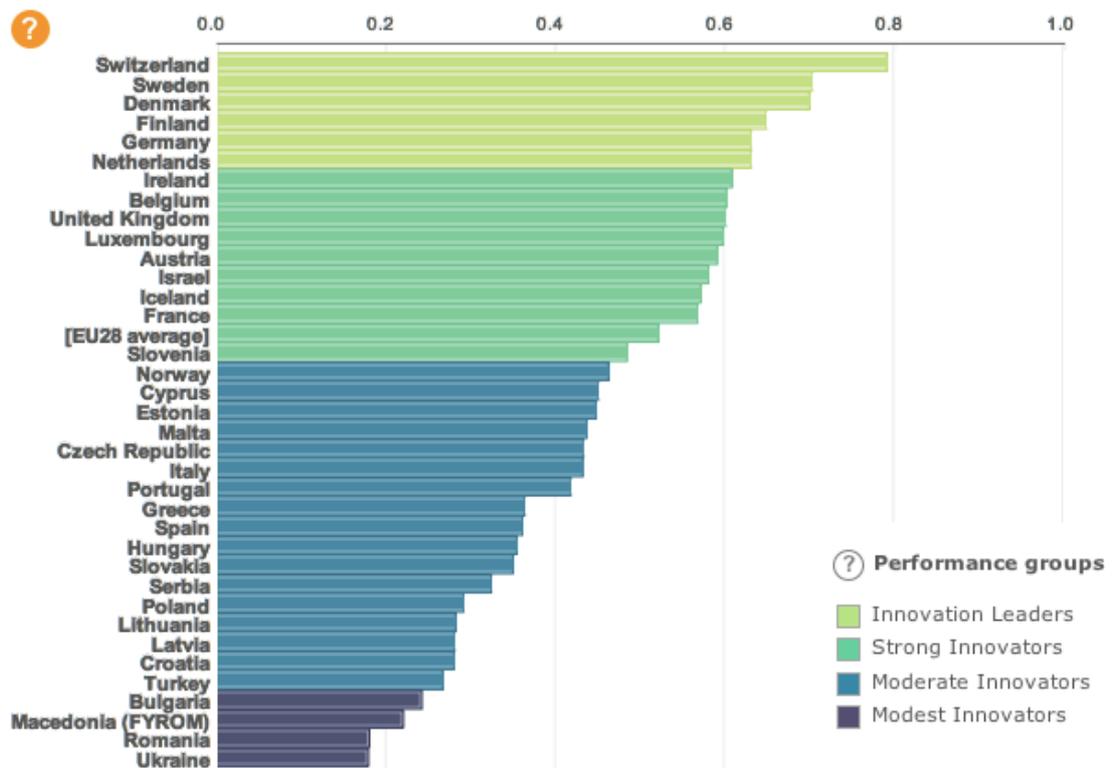


Figure 1 European Innovation Scoreboard (European Commission 2016, European Innovation Scoreboard Interactive Tool)

To address the research gap at stake, according to Piana et al. (2015, 19) there is limited research around the institutional interactions between cross-cultures and innovation performance in Europe. Thus, this sort of research would enable an understanding of a nations innovation dynamics (Piana et al. 2015, 19). For this study, attention is drawn to the **Finnish and German national innovation systems**. There are several reasons for the selection of these two countries. Firstly, as figure 1 above demonstrates, Germany and Finland are among the top four innovation performers. In other words, they belong to the ‘innovation leaders’ of Europe, which is quite a staggering result considering the extent of European member states existing. Finland and Germany lay extremely close to one another, thus Finland overtakes Germany with only a scant percentage: Finland scores 0,6494, whereas Germany attains a 0,63155 score. Most importantly, both countries are above the EU average index, which has been the case since 2008. (European Commission 2016, EIS interactive tool.)

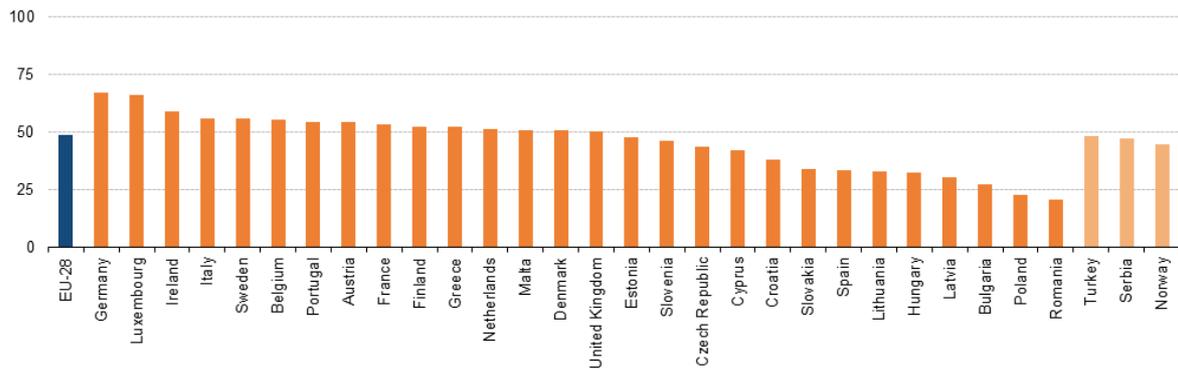
From a geographic and economic perspective, as Czarnitzki et al. (2007, 1) point out, a comparative assessment between Finland and Germany is judicious: Germany is the biggest economy within EU, conversely to Finland, which belongs to one of the smaller EU countries. Although they may notably differ in size, they are still both strong performers. One of Finland’s greatest assets in relation to its’ innovation system is the high level of networking and collaboration, which has been truly vital for a small country like Finland (Woiceshyn & Eriksson 2014, 21). This sort of approach has lead to Finland being often referred to as an innovation ‘hot spot’, and also positions well in international comparison on innovation (Kao 2009 110 & 112; Woiceshyn & Eriksson 2014, 21). Germany is often identified as a role model in terms of possessing one of the best national innovation systems in Europe (Enterprise and Industry, SBA Fact Sheet Germany 2013, 1). The national innovation system in Germany has its roots already from the 19th and 20th century. Clear aspects, which further developed the national innovation system in Germany, were for instance universities, fundamental research institutions, and the large and innovative industrial enterprises (e.g. Daimler). All of these matters have contributed vastly to the creation and success of the national innovation system prevailing in Germany. (Allen 2009, 375.) According to Meyer-Stamer & Wältring (2000, 6) Germany has managed to establish a hospitable environment due to several different counterparts and institutions simultaneously interacting with each other.

Another interesting remark related to figure 1 above is that the countries, which rank as innovation leaders, portray least differences across their performance with one another. This suggests that their high level of innovative performance can be attained with the help of a balanced national innovation system (European Commission, EIS 2016, 7). According to Nasierowski (2010, 42) **the assessment of National Innovation Systems** (NIS) can be considered as a starting point to the conversation around innovativeness. Research results indicate that the studies dealing with innovativeness, especially of in-

novative programmes and NIS, are crucial whilst shaping improvements for innovation policies and initiatives (Nasierowski 2010, 42). In other words, the innovative performance of a nation is not tied to the individual institutions, but rather to how these institutional actors interact and interlink with each other, as this is the foundation for a knowledge-facilitating system. Thereby, being able to comprehend these dynamic processes is one of the most focal topics in the research around NIS. (Samara et al. 2012, 624-625.) This study aims to assess national innovation systems from a dynamic perspective, where relationships and knowledge flows become integral to examine. The study suggests that an integrated and systemic approach to national innovation systems is an important element in fostering innovativeness, not only in the entire system, but also in the individual firms, including the **innovative SMEs**. Ultimately, the objective is to provide a rich understanding of the Finnish and German NIS, rather than generalize or measure any research outcomes.

1.2 Innovative small and medium sized enterprises: backbone of the European economy

The small and medium sized enterprises (SMEs) play a significant role in Europe, especially when reflecting matters from an innovativeness standpoint. In a European scale, SMEs dominate the economy: they account to 99% of all businesses. Additionally, SMEs are an integral part of the EU job creation, as they have enabled 85% of new jobs and established up to two-thirds of private sector employment. Therefore, the European Commission regards SMEs and entrepreneurship as important factors, which foster job creation and innovation. (European Commission 2016, Entrepreneurship and SMEs.) The statistical monitoring of Eurostat is worth examining more closely, as it illustrates key figures around EU level innovativeness. Figure 2 demonstrates the innovative enterprises in the European Union.



(*) The survey reference period covers the three years from 2010 to 2012.
Source: Eurostat (online data code: inn_cis8_type)

Figure 2 Share of innovative enterprises in the European Union, 2010-2012 (Eurostat 2016, Innovation Statistics)

The survey observes whether enterprises utilise knowledge from their external environment, or from their internal sources including market research. After the survey Eurostat can distinguish between innovative and non-innovative firms. (Nikolic et al. 2015, 199.) Although the survey does not explicitly focus on SMEs, the percentage of SMEs accounting in the EU is immense. Even as Nikolic et al. (2015, 199) addresses, although the enterprise structure is not the same in each EU member state, the majority of firms surveyed are SMEs. Based on Piana et al. (2015, 5) findings, the most innovative firms and clusters prevail within the Nordic, Anglo and Germanic regions. As figure 2 clearly indicates, Germany is the top performer when reflecting the share of innovative firms in the EU, ranking first. In Germany a profound 66.9% of enterprises remain innovative (2012-2012). Moreover, in Finland the proportion of innovative firms is relatively high as well (52,6%), which is above the EU average (48.9%). (Eurostat 2016, Innovation Statistics.)

In principle, literature identifies certain key characteristics, which contribute towards the level of innovativeness of SMEs. These factors reassert, why SMEs have been chosen as a dimension to be entailed in this study, conversely to larger firms. Even as research validates, there is not much basis on the idea that innovation grows in relation to firm size (Wagner & Hansen 2005, 840). One clear factor, which results in SMEs being more innovative, is their *external knowledge capabilities*. Ultimately, the knowledge creation and share of SMEs heavily relies on sources of external knowledge (De Mattos et al. 2013, 2; Moilanen et al. 2014 447; Svetina & Prodan 2008, 279-280), and is a crucial input to their innovative performance (Chun & Mun 2012, 419; Svetina & Prodan 2008, 279-280). Also, SMEs tend to be less bureaucratic and structured, which supports the view that SMEs have a positive correlation between speed and innovation (Kessler et al 2007, 3-5). Then again, in larger firms, knowledge shifts through functional inter-

actions, such as production, where most of the knowledge diffusion occurs in-house. In large firms knowledge transfers are often described as systematic in nature. (Svetina & Prodan 2008, 279-280.) As Kastelle & Steen (2010, 76) and Rogers (2004, 143) demonstrate, a *firm's network structure* can have immense influence on a firms' innovative capability. Based on literature, SMEs have indicated the most dynamic network structures: they are able to quickly share knowledge in their external environment (Rogers 2004, 143). Thus, SMEs have an extensive selection of external knowledge sources to choose from (Varis & Littunen 2012, 558). Thereby, SMEs seek for support and partnerships from their external environment, e.g. institutions and organisations, in order to foster innovations (Corral de Zubiequi et al. 2016, 82).

As Lehtoranta et al. (2012, 103) validate, public support is an integral dimension to enable growth and innovation in SMEs. The mechanics to enhance innovative efforts, through public support, can be in the form of establishing policy initiatives for instance. With the help of public support, a stronger innovation ecosystem can be built in nations. (Lehtoranta et al. 2012, 103.) The Finnish innovation systems can be considered as public-oriented, offering various support programmes and policies targeted towards SMEs (Lehtoranta et al. 2012, 104). Thus, the Finnish innovation policies are described as an integrated package of policy measures, which support the entire innovation process (Cees 2004, 206; Woiceshyn & Eriksson 2014, 24). According to the European Commission (Enterprise and Industry, SBA Fact Sheet Germany 2013; SBA Fact Sheet Germany 2014) German SMEs excel in innovativeness due to its well-functioning policy framework. As Meyer-Stamer & Wältring (2000, 21) note the public and private actors have established a number of policies and institutions that support SMEs Therefore, in this study, it is vital to address the external environment, e.g. the national innovation systems, in order to identify the distinct innovation policies, which have contributed towards SME innovativeness in Finland and Germany. It is particularly interesting considering the strong position of Finland and Germany in relation to not only its innovation system, but also the share of innovative firms prevailing.

1.3 Research objectives and research questions

Although this study has a clear focus on the on the national innovation system of Finland and Germany, also the small and medium sized enterprises play an essential role; as through the various components of the system, innovativeness can be boosted. Therefore, it is crucial to note that this study has a strong focus on innovative firms, rather than innovations in general. The reason for this sort of outline is, because only a small number of studies have managed to focus on the research of innovative firms (Resele 2015, 98). According to Resele (2015, 98) there is a lack of studies that would actually

provide a clear definition of what innovative firms stand for. Literature in general has failed to classify the differences between innovation and innovative firms (Resele 2015, 98).

Due to this sort of lack in research, not being able to classify the two differing concepts from one another, therefore also in this thesis, in some parts innovation and innovativeness are used interchangeably with one another, same goes for the terminology around national innovation system and innovation system. Nevertheless, in terms of this study, innovative firms are defined as companies that have generated in the company or market a novel or significantly improved product or process that enhances economic benefit to the entire system (Resele 2015, 98). This study will be carried out in a comparative approach, reflecting the German and Finnish national innovation systems, as well as their SME innovativeness. In principle, by examining the NIS in detail, it will also reveal the main SME innovation policies and institutions, which contribute towards innovativeness of these dynamic firms. Ultimately, as the main and central purpose of this study is to, *describe and compare the national innovation systems in Finland and Germany, in order to identify the innovation policies and activities contributing to SME innovativeness.*

Moreover, the first research question aims to provide a comprehensive understanding on the Finnish and German national innovation systems: the identification of its main actors is vital to address. It also entails the description of their functions. Thereby, the thesis will focus around the central question of,

- What are the key actors and their functions in the Finnish and German national innovation system?

Albeit Finland and Germany portray similar characteristics in relation to their innovation systems, they still reflect underlying differences too. One way of determining these similarities and differences, is taking a look at some of the key functions, also referred to as features, which account to an innovative country. Therefore, the second research question addresses,

- What is the comparative performance of the key functions in the two national innovation systems?

These functions mainly stem from well-known public institutions such as the Organization for Economic Cooperation and Development (OECD) and European Commission (EC). Within the OECD and EC documents these functions are commonly referred to as indicators of the NIS. By assessing these functions allows the researcher to make comparisons among the Finnish and German national innovation systems, simultaneously identifying the country-specific strengths and weaknesses of the system. As the Finnish and German NIS will be examined from a dynamic and interactive perspective, some of the functions that will be analysed include R&D expenditure, level of networking, human resources, entrepreneurship and knowledge flows. Lastly, the third research ques-

tion, which considers the key innovation policies and activities that enhance innovativeness of the small and medium sized enterprises. Essentially, innovation policies and activities are a vital component of the overall innovation system. Hence, the third research question addresses,

- What are the distinct innovation policies and activities that enhance SME innovativeness?

The exploration of the Finnish and German SME innovation policies plays a very central role in relation to the overall aim of the study. The idea is to identify some of the focal SME innovation policies prevailing in the Finnish and German NIS. Thus, the intention of the researcher is not to assess the functionality of these policies, or level innovativeness that has been produced, rather describe and compare them. Therefore, the research is mainly descriptive by nature. Also it is important to note that the study has a focus on the company's external factors (policies), and not internal features. In principle, the study has been carried out employing a qualitative content analysis approach, which will help examine and describe the two national innovation systems from an external perspective. The researcher aimed to contemplate the study from an 'outsider' perspective, in other words, provide an elaborate comparative study for foreign policy-makers, institutions and organizations. This in order to benchmark, or simply take it as a process of knowledge share on the existing innovation policies. Ultimately, also Germany and Finland could benefit from these sorts of comparative studies, in order to reflect their own institutional strengths and weaknesses. Thereby, the study aims to provide insight for different stakeholders.

In terms of the **structure of the study**, the thesis holds up to seven chapters. Firstly, *chapter 1* addresses the background and research gap of the study, in addition to the research questions, as has already been mentioned. Essentially, the theoretical approach in this study is extensive. Thus, theory has been grouped into two focal segments, institutional theories (*chapters 2*), and national innovation systems (*chapters 3*). *Chapter 4* evolves around the research approach and chosen methodology. In this study, document analysis has been a central means of analysing data, stemming from numerous general government and public reports. *Chapter 5* draws together the empirical dimension on the Finnish and German national innovation systems as well as SME innovation policies. Lastly, in *chapter 6 & 7*, the most essential key findings will be summarized and concluded.

2 OVERVIEW OF INSTITUTIONAL THEORIES

2.1 Defining the institutional environment

Before depicting the theory related to national innovation systems, it is crucial to understand the term institution, and more importantly, the institutional framework, in its broader meaning. Essentially, the national innovation system is always tied to a larger picture, namely the institutional environment, which it is embedded in. In this study, particularly the Finnish and German institutional settings are being reflected. The institutional environment residing in Finland and Germany helps explain some of the country specific differences and similarities in relation to their national innovation systems. Ultimately, the institutional framework of a country is always unique. Nevertheless, it needs to be borne in mind that the concept of *institutions* can portray varying meanings, and is not confined to a univocal definition (Groenewegen et al. 2010, 24; Seyoum 2009, 166; Yeager 1997, 2). Hence, the definition is always dependant on the context, and can be translated into inter alia a rule, norm, custom, routine or practice (Groenewegen et al. 2010, 24; Lundvall 1998, 409). The most common reference to institutions is “*the rules of the game in a society*” (North 1990, 3; Yeager 1997, 2).

Thereby, institutions are always economic, political, historical or social in nature (Kirdina 2014 311; Yeager 1997, 3). Particularly in this study, the role of economic institutions is most central to contemplate. According to Lundvall (1998, 409) institutions embody an even broader definition, as they also encompass the features of interactive learning and knowledge. Thereby, the concept of trust is tightly knit with institutions, which is a multidimensional feature (Lundvall 1998, 409-410; Wang et al. 2014, 380). The *institutional framework* encompasses all the rules, regulations and policies that generate interaction between actors of the society (Popov et al. 2016, 274). For instance, from a policy perspective, national policies have been key in diminishing disparities between regions (Rodriguez-Pose, 2013, 1035). The importance of institutions stems from a simple notion: all economic action evolves in an institutional environment (Gertler & Wolfe 2002, 2-3).

Another concept closely related to the institutional framework is innovation, as innovation has significant impact on societies. Innovation takes place in the entire institutional setting, thus, not just within the firms themselves. For this reason, it is key to understand the interrelationship and dynamics of the institutional environment, as it can either generate innovations, or on the other hand, restrain the whole innovation process. (Gertler & Wolfe 2002, 2-3.) The more societies invest in education and innovation in terms of institutions, the more positive influence it has on the economic development (Rodriguez-Pose, 2013, 1037). This is also a central view within the study: the more

countries invest in human capital and knowledge facilitation, the more innovative outcomes can be produced. This is also apparent in the Finnish and German national innovation system, the academia plays an integral role in terms of innovativeness and knowledge transfer in entire institutional set up. Essentially, the institutional environment can vary significantly within countries (Gertler & Wolfe 2002, 2-3.). As Leite et al. (2014, 491) note, institutions are one of the main determinants when examining the differing economic performances of nations. Thus, what can be determined is that in order for a society to establish knowledge and innovations, countries needs well-established and supportive networks, which do not only stem from both the private sector and public sector, but from the overall institutional framework. The coherent construction of institutions can mitigate instability within a nation. (Gertler & Wolfe 2002, 2-3.)

All in all, the paramount objective, which institutions aspire to achieve within the institutional framework, is to diminish uncertainty. In other words, institutions enhance stability within a society (Berggren et al. 2015, 70; Gertler 2010 12; Gertler & Wolfe 2002, 2-3; North 1990, 3; Peng 2006, 110). According to Svetina & Prodan (2008, 282) and Hilmersson & Jansson (2012, 96) today's firms are confronted with high levels of uncertainty, this is mainly due to the drastic and turbulent changes induced by markets, industry and technology, which companies need to adapt to. For this reason, the role of institutions cannot be marginalized, as they not only help firms, but also the entire society, to combat uncertainty. Ultimately, institutions can reduce uncertainty in two ways: whether through informal, relationship-based communication, or through formal exchange, where rules govern situations and usually a third-party enforcement is needed (Peng 2006, 119). In the next chapter, a more detailed description on the meaning of informal and formal institutions will be portrayed, as these also play a central role in the institutional environment of the Finnish and German NIS.

2.2 Formal and informal institutions in the institutional framework

According to Yeager (1997, 2-3) a nation's institutional framework can be divided into two different dimensions: formal institutions and informal institutions. Albeit, according to Efendic et al. (2011, 522) and Liebert (2010, 391) less empirical research exist on the linkage between the two institutional concepts, they still present clear definitions, which are essential to convey. Firstly, formal institutions can be acknowledged, which refer to the written rules of the society (Yeager 1997, 3). Formal institutions incorporate different laws, taxes, contracts, regulations and rules such as various policies and intellectual property rights (Estrin & Prevezer 2011, 44; Palthe 2014, 60; Peng 2006, 110; Redmond 2005, 665-666; Yeager 1997, 3). In contrast to informal institutions, which are the un-

written rules of the society (Sauerwald & Peng 2013, 854; Yeager 1997, 3). Nevertheless, an alternative way of presenting the differences between the informal and formal institutions, is to take a look at Scott's (1995, 35) three institutional pillars: 1) the regulatory (formal), 2) normative (informal) and 3) cognitive (informal) pillars. These three pillars form the building blocks for the overall institutional framework (Palthe 2014, 60 & 62). As Peng (2006, 110) clarifies, the regulatory pillar is the compelling force of the government. Governments can govern both individual and firm action, in a sense, that violating any of these laws, can confront penalties. (Peng 2006, 109-110.) It is important to highlight the significance of governments, since they are an important determinant when examining a country's overall innovativeness (Koschatzky 2000, 10; OECD 1999, 17).

The fundamental task of the government is to establish effective and robust policies, which enhance the entire nations level of producing innovations (Koschatzky 2000, 10). In fact, governments can set up policies, which put pressure towards market actors (e.g. firms) to come up with innovative solutions (OECD 1999, 17). It is also a reason why, for this study the selection of formal institutions has been outlined: it allows examining the Finnish and German innovation policies, which have been aimed towards SMEs. The exploration of such policies reveals the formal institutions behind the national innovation system, this in order to spur the innovativeness of SMEs. The examining of formal institutions remains intriguing, as the Finnish and German NIS offer distinctly different innovation policies.

Then again, in relation to the informal institutions, the cognitive and normative pillars are witnessed. These encompass all the norms, cultures, taken-for-granted values and beliefs and that are perceived in a society, and which end up influencing the behaviour of individuals and firms (Scott 1995, 35-37; Yeager 1997, 3). Essentially, norms resemble, how things should be performed and done (Scott 1995, 35-37). One concrete example of an informal trait in the German SME sector is the economic and social norm, which is often described as patriarchal: a strong corporate culture often takes place, where people within the company feel as being part of the family. (Berghoff 2006, 274.) The informal aspect is clearly demonstrated as a mutual, usually unwritten norm guiding and directing behaviour (Berghoff 2006, 274). It is important to bear in mind that economic and social norms vary substantially among countries and different cultures. Also, for this study, informal institutions will be for the most part left out. This is due to the limitations, which the thesis confronts the researcher with. In the opinion of the researcher, more studies linking the two fields, formal and informal institutions, are needed, as only then can studies be carried out in the most comprehensive manner, taking all dimensions into account.

As a last component in the discussion of formal and informal institutions, a different sort of institutional dimension can be witnessed, i.e. enforcement mechanics. In the case

of enforcement mechanisms, institutions may end up being extremely ineffective, unless they are not being enforced. For example, some nations can have antitrust laws, which inhibit firms from becoming monopolies. However, some institutions can be self-enforcing. This is due with the ethics taught to people, which act as a self-enforcing mechanism. In essence, enforcement is one of the most key factors when contemplating differences in economic performance. (Yeager 1997, 3.) Thereby, institutions impact the economic performance of nations, where the two dimensions have a clear linkage between one another. This is also what the theory on New Institutional Economics pinpoints.

2.3 The key dimensions of New Institutional Economics

In relation to the overarching institutional environment, various theories highlight the import relationship between institutions and economic performance of nations. The most central institutional theories are new institutionalism, also known as neo-institutionalism, and new institutional economics (NIE). Albeit new institutional economics shares similarities with neo-institutionalism, it still portrays some differences (Bastürk 2016, 14). *New institutionalism* views institutions from a more societal perspective, emphasising features such as regulations, culture, social interactions and belief systems. (Bresser & Millonig 2003, 223; Greenwood et al. 2008, 737; Harvey 2014, 31-33.) Then again, *New Institutional Economics (NIE)* heavily emphasizes the aspect of economics in relation to institutionalism (Bastürk 2016, 11; Yeager 1997, 2 & 10). In other words, new institutionalism can be viewed from a more economic and realistic point of view (Ankarloo 2002, 10; Schneider & Nega 2016 435; Yeager 1997, 2 & 10). Essentially, within NIE, effective institutions promote economic growth (Nugent 2008, 206; Schneider & Nega 2016, 436). According to NIE, the relations between economic actors construct a complex system, which previous institutional theories have not been able to cover fully (Tywoniak et al. 2007, 215).

Moreover, in neo-institutionalism, markets are perfectly competitive, i.e. they enter and exist markets seamlessly, products are uniform and perfect information amongst actors prevails (Bastürk 2016, 14; Intarakumnerd & Chaminade 2011, 243; Leite et al. 2014, 495). Conversely to new institutional economics, which highlights the aspect of “bounded rationality”, i.e. how actors make choices that stem from a number of information sources (Bastürk 2016, 14; Caballero & Soto-Onate 2015, 961; Dequech 2001, 912-913; Furubotn & Richter 2008, 16; Leite et al. 2014, 495; Orhan 2016, 203-204). Thereby, actors have differing access to information, and disparities in utilizing it (Bastürk 2016, 14). Another key pioneer, related to the theory on new institutional economics, is Timothy Yeager (1997), whom attempted to explain the dynamic growth of

nations through NIE. It is perhaps one of the shrewdest ways in explaining the differences in the standard of living, economic performance and technological advancements between countries. (Yeager 1997, 1-2.) Thus, figure 3 below demonstrates how institutions influence economic performance over time. Institutions impact the behavior of organizations, which eventually results in the process of so-called ‘creative destruction’ phase. (Yeager 1997, 10.)



Figure 3 How institutions impact economic performance (Yeager 1997, 11)

Creative destruction takes place when economies operate in highly turbulent and dynamic environments, and where new technologies are continuously generated. It is the competitive environment, which drives businesses to continually improve their products and services, and seek for technological advancements. In case they are unable to remain competitive, they are out of the business. It is crucial to point out that creative destruction does not happen in every economy. Hence, it only occurs in nations where a robust institutional framework is in place. In nature, economic organizations seek to maximise their profits, and can establish this in a number of ways. What one can quickly capture is that the key to success is a robust institutional framework; nation's need to create incentives, and on the other hand, constrain firm's activities, so that the only path for them is to maximise profits, i.e. enhance their economic performance. (Yeager 1997, 11-12.) All in all, institutions have a significant impact on nations, as they indicate both direct and indirect influence on growth and income rates (Bjornskov & Foss 2016, 303; Jütting 2003, 19; Lartey & Mengova 2016, 60). Thereby, institutions are considered to

have a crucial role in terms of the overall economic development in a nation (Williamson 2009, 371). As Yeager (1997, 12) pinpoints, a nation's institutional framework must be adaptively efficient, in other words, it needs to be set up as a robust framework for actors to operate efficiently in. This is very much in line with the national innovation systems approach. National innovation systems are based on the same thought: institutions impact the level of economic performance. Nevertheless, it also takes more aspects into consideration, namely the innovative level, which the entire system and its actors hold.

3 THE SIGNIFICANCE OF THE NATIONAL INNOVATION SYSTEM

3.1 How the Systems of Innovation as a concept emerged

After having described the theoretical foundations of institutions, it is also important to understand how the essence of the systems of innovation emerged, as it is based on institutional theories (Tödtling & Kaufmann 1999, 700). According to Moulaert & Hamdouch (2006, 11) the concept of innovation dynamics in economics, within the last 20-30 years, has gone through some major changes. Hence, overtime the focus has shifted to depict innovations from a systems approach, also known as SI approach, where innovation could be explained from a more dynamic standpoint (Resele 2015, 98). The systemic approach towards innovation incorporates important features that foster innovation including institutional, political, organizational, economic and social factors (Rotaba & Beaudry 2012, 3). Thus, the systems approach takes also into account more aspects such as knowledge, which in addition to internal strengths, also stems from the external environment. Thereby, the systems approach integrates both the internal and external potential for innovation (Steiner 2009, 14).

According to Tödtling & Kaufmann (1999, 700) there are distinct reasons why a more novel interpretation to the systems of innovation approach emerged, which are highlighted in figure 4.

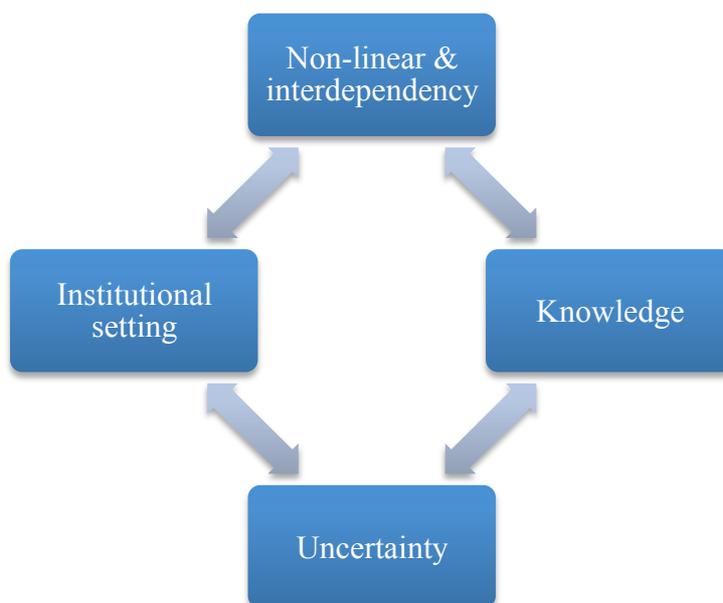


Figure 4 Determinants for the emergence of the Systems of Innovation (Tödtling & Kaufmann 1999, 700)

Firstly, the dimension of *non-linear & interdependency* is depicted. The traditional linear innovation model mainly focuses around the success and innovation processes of the individual firms. Within the linear model, the innovation process is tightly constrained to a certain pattern: firm's set up R&D activities, which followed to production, ending up to markets. In principle, the innovation process is described as very straightforward and pellucid, and does not take into account additional interdependencies. (Tödtling & Kaufmann 1999, 700.) According to Lundvall (1999, 61) one of the reasons why researchers began to interpret the systems of innovation in the first place was related to notion of realising that innovation was not a linear process, rather a process where several interactions took place. In addition to the several interactions, also various important actors were highlighted (Tödtling & Kaufmann 1999, 700). The system incorporated actors such as R&D units, customers and suppliers, shareholders, innovative firms, policy-makers and public authorities (Laukkanen & Patala 2014, 7; Tödtling & Kaufmann 1999, 700).

However, as research progressed, literature began to note also the importance of *knowledge* and *knowledge transfer* (Tödtling & Kaufmann 1999, 61), which forms the second dimension of figure 4 above. The former linear model approach construed knowledge as part of the R&D function, but the systems approach comprehends knowledge as part of the entire innovation process. In other words, knowledge can be accumulated and shared in different phases of the overall process. (Tödtling & Kaufmann 1999, 700.) According to Intarakumnerd & Chaminade (2011, 244) the SI approach definition also encompasses tacit knowledge, which can be public and/or specific, yet always costly. Thirdly, *uncertainty*, which is closely linked to the essence of institutional theory mentioned earlier. Thus, this aspect distinguishes significantly from the traditional linear approach model; as conversely, it takes into account the complex relationships and dynamics, which reside in the system. Essentially, institutions serve different functions in relation to the innovation process: 1) diminishing uncertainty (e.g. by setting regulations and standards), 2) controlling conflict amongst the various actors, and lastly 3) encouraging the overall innovation process (constructing incentives, e.g. economic grants, rewards, and patents, that further enhance innovativeness). (Tödtling & Kaufmann 1999, 700.)

As a fourth factor, the *institutional setting* of a nation is crucial when contemplating the overall innovation process. Thus, the institutional setting is a generator and enabler of innovations in the system. It is vital to point out that the institutional environment of each country is majorly dictated by their distinct 'governance model', which incorporates both the private and public sector actors. (Tödtling & Kaufmann 1999, 700-701.) Essentially, this sort of cohesive approach led to a more a systematic prospect on innovations, also known as the national innovation systems.

3.2 Introducing the National Innovation Systems

In conjunction with the systems of innovation, a distinct type of theory can be identified, namely the National Innovation System, which highlights the importance of national influence on innovation systems (Dodgson et al. 2008, 32). According to Groenewegen & Van der Steen (2006, 277) the literature on NIS is fairly novel, yet a continuously growing research area. Basically, the previously introduced institutional theories heavily emphasise the role of institutions, leaving out the dimension of innovations; NIS embraces both concepts. The first time that NIS was introduced was in the late 1980s and the concept has continued to develop ever since (Guan & Chen 2012, 102; Groenewegen & Van der Steen 2006, 277; Yoon & Hyun 2009, 2). Albeit the fact that NIS has no sole definition; it still encompasses common features that are shared across all definitions (Guan & Chen 2012, 102; Lundvall 1999, 62; Resele 2014, 52). Hence, well-known scholars such as Chris Freeman (1987), Bengt Ake Lundvall (1992), and Richard Nelson (1993) became the forerunners of the NIS approach (Gurova 2015, 146-147).

Nonetheless, it can be determined that literature on national innovation systems poses three key distinguishing features: 1) systematic nature, thus, NIS can be considered as a combination of components continuously interacting with each other, 2) institutional viewpoint, where both formal and informal institutions impact innovation development, 3) knowledge as a driver; the primary function of NIS (Gurova 2015, 146-147). Even as Guan & Chen (2012, 102) contemplate, a national innovation system is always an outcome of several interactions between the knowledge innovation process (KIP), and the overall innovation infrastructure. Ultimately, NIS can be determined as a set of measures implemented within the cooperation among private and public sectors to generate, transfer and disseminate new knowledge with the objective to boost innovation, and ultimately to develop the society in a sustainable manner (Resele 2015, 98).

As Freeman (1995, 11) and Groenewegen & Van der Steen (2006, 277) explicate, national innovation systems should be viewed from a more systemic approach to innovation, where the interplay between organizations, institutions and technologies, become increasingly influential in determining the rate of innovation diffusion. Not only are the inter-firm relationships important, but also the external linkages, such as science–technology bonds, which result in innovative success (Freeman 1995, 11). All in all, NIS is impacted by a number of factors, which convey its innovation performance such as knowledge infrastructure, institutional-set up, learning and innovation policies (Gregersen & Johnson 1996, 484). This further resonates with the view of national innovation systems being systematic in nature.

Another key element, which made NIS as a theory prominent and set apart from prior traditional institutional theories, was that the innovation system is always linked to a

specific country (Kaufmann & Tödting 2000, 30). This means that each national innovation system has distinct cross-cultural features. Moreover, this sort of thinking is justified, as nations differ to a great extent when contemplating their overarching system (Lundvall 1999, 61-62.) Moreover, also Nelson (1993) examines the underlying differences and key characteristics of various national innovation systems. Basically, nation specific policies and institutions have a significant bearing on innovation (Nelson, 1993, 1-540). From a policy perspective, particularly R&D expenditure is important to gauge. The assessment of R&D also in terms of this study is important to evaluate. All in all, extensive differences in national innovation systems prevail; thus, national institutions strongly influence the level of innovation in a country (Freeman 1995, 15).

To conclude, the evaluation of national innovation system ought to be comprehensive, as each country is defined by its own distinct institutional profile. Therefore, the national innovation systems prevailing in each country should be adjusted to strengths and weaknesses unique to the country; nations require different approaches, institutions and sets of policies. (Dodgson et al. 2008, 32-33.) A systematic approach will be also applied in terms of this study, covering more than one measure in the assessment phase.

3.3 Actors of NIS – from a systemic dynamic approach

A number of different organizations can be identified in the national innovation system. These organizations within NIS are commonly referred to as actors, players or agents of the system. (Resele 2014, 52.) It is worthy to note that the national innovation system definition embodies a dual approach to its actors of the system, both a narrow and broader vision. The narrow aspect includes actors that directly breed innovations such as innovative firms and research facilities. Then again, the broader definition entails all institutions influencing innovation like financial systems, learning and the regulatory system. It is thought that the broader notion leads to the successful economic performance of NIS, as it fosters innovative activities. (Pinto & Pereira 2013, 759.) According to Lundvall (1999, 61-62) the national innovation system is a powerful concept, as it comprises of a number of elements: not only knowledge creation, and basic actors like the firms and R&D units, but also universities, industry, and financial markets, which are an essential part of the emergence of NIS. This sort of view embraces the notion of a broader approach to NIS.

Another way of addressing the actors of NIS, and simultaneously embodying the broader approach, is to take a look at Samara et al. (2012, 627) structure in figure 7 below. In principle, the system is divided into different sectors, in order to classify the various innovation activities occurring within NIS. Essentially, major actors like governments, firms, academia, and research facilities carry out these activities. Consequent-

ly, the behaviour of an individual actor impacts all other actors of the system. (Samara et al. 2012, 627.) As one can quickly notice, the system as such is extremely broad, and covers a number of different actors. However, this sort of structure on NIS is vital to showcase, as it reveals the characteristic typical to national innovation systems: they are truly ambiguous and complex in nature. This is also the case for the Finnish and German national innovation systems, as they are multifaceted. Therefore, one study cannot simply examine all the different components related, thus, the study ought to be limited to only depict some of the dimensions.

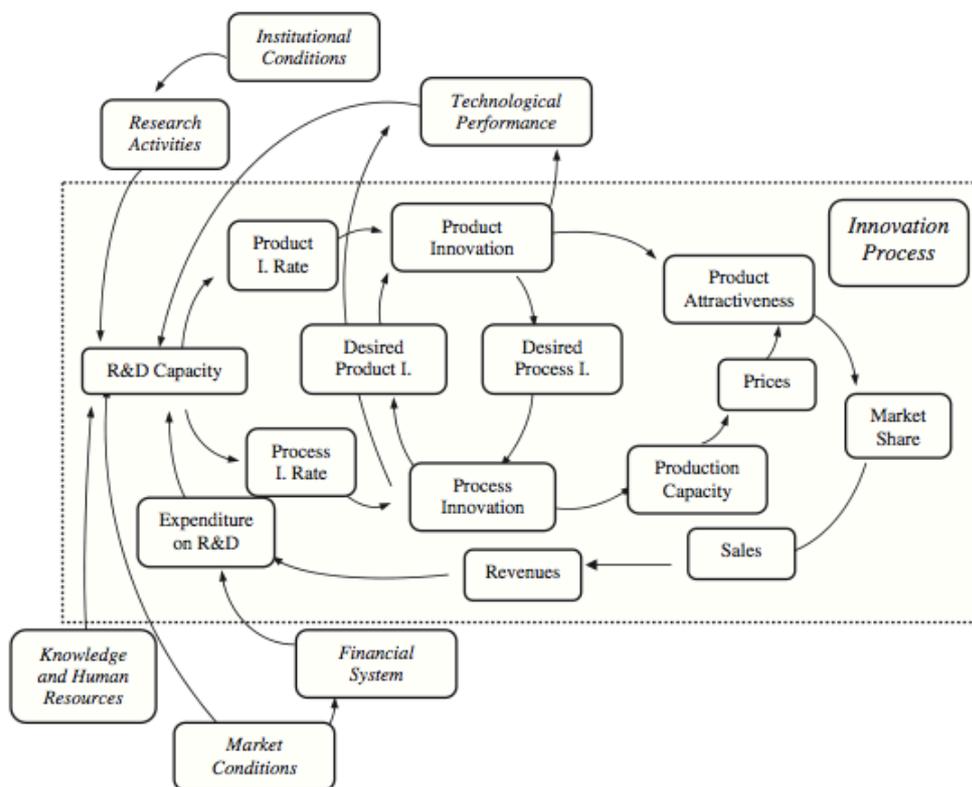


Figure 5 The generic structure of NIS (Samara et al. 2012, 627)

In the structure above, seven different subsystems can be identified: *knowledge, human resources, research activities, institutional conditions, innovation process, technological performance, financial system, and market conditions*. Out of these subsystems, particularly for this study, the first four components are most meaningful to portray. *Knowledge and human resources* as dimensions remain as extremely important, as they enhance the growth of NIS. These two components have a positive correlation with the innovation process; the level of education and academia are great examples of this. Also, *research activities* prove to be crucial: R&D expenditure is a central gauge of innovative input in the system. (Samara et al. 2012, 627-628.) Nonetheless, also *institutional condition* is portrayed: its goal is to assess the overall framework conditions of NIS.

(Samara et al. 2012, 628.) Hence, within the institutional setting Guan & Chen (2012, 102) and Dodgson (2009), highlight the importance of government intervention. In principle, governments enable incentives for innovative activities, which impact all the institutions and actors of NIS (academia, enterprises, etc.) and networks among them.

The *innovation process* contains all the interactional and causal-loops, which reflect the feedback mechanisms in the system. Moreover, within the innovation process, the most important innovations are process and product innovations. This is due to that fact that they gauge the national innovative performance in relation to a percentage of firms carrying out innovative activities. (Samara et al 2012, 628-630.) In general, NIS is often criticised for being too static and that it does not embrace the notion of dynamic innovation processes (Carayannis et al. 2012, 9). Nevertheless, in Samara's et al. (2012, 627) approach the dynamic structure is justified, as it clearly rejects the notion of linear innovation processes. All in all, the subsystems enable an ecosystem of complex interactions and networks, highlighting the systemic dynamic approach to NIS. (Samara et al. 2012, 627.) Essentially, these various actors contribute towards framework conditions in order for the innovation system to operate efficiently (Guan & Chen 2012, 102; Groenewegen & Van der Steen 2006, 278). As a result of multifaceted interaction between these institutions, innovations are cultivated (OECD 1997, 12). Considering the complexity of NIS, particularly from a Finnish and German standpoint, it is important to address, how to evaluate these systems, i.e. what sort of dimensions are being considered in its evaluation process. Several measures exist on how to evaluate the performance of national innovation systems, thus within this study the evaluation is carried out in a dynamic approach.

3.3.1 *How to evaluate the performance of NIS?*

As one can quickly grasp from the discussion based on national innovation systems, a nation's innovation performance is truly multifaceted and a complex phenomenon that stipulates more than a single criterion to describe it (Pan et al. 2010, 372). According to Bartels et al. (2012, 2) and Gurova (2015, 147) the importance of NIS in relation to economic performance has been widely recognised. In principle, some researchers claim that multi-factor performance measurement models are needed for the assessment of NIS. (Pan et al. 2010, 372.) For instance, according to Pan et al. (2010, 372) one way of measuring the performance is to gauge the conversion of inputs and resources to outputs. Nonetheless, this study argues that measuring the efficiency of NIS is more dynamic, and that the evaluation cannot be purely based on the statistics related to inputs and outputs. As Bartels et al. (2012, 2) point out, there are fairly few theoretical frameworks and models that analyse the dynamic nature of NIS. Adding on to this statement,

Groenewegen and Van der Steen (2006, 282) concur that the central challenge of national innovation systems is its dynamic nature and complexity. Therefore, not many frameworks exist that reveal the dynamicity of the system. Thus, one way of exploring this is through incremental innovation, knowledge and learning (Groenewegen and Van der Steen 2006, 282).

However, Pan et al. (2010, 372) bring out a valid point in the discussion of measuring inputs and outputs, as one effective measure is the aspect of R&D. Moreover, Bartels et al. (2012, 5) note that R&D and all resource capabilities have a positive correlation with innovation. Essentially, the degree of R&D and funding for science is one of the major features of an innovative country (Gurova 2015, 147). Therefore, R&D figures are not solely related to technology, in contrast, also the resource invested in human components, entailing research and development of staff and education. These are important factors impacting the performance of a nation's national innovation system, as human capital is one of the most significant resources that a nation possesses in terms of economic and technological advancement. Ultimately, the training and recruitment of creative talent, as well as the prevailing of energetic and risk-taking entrepreneurially oriented firms, all account to the efficiency of NIS – this promotes knowledge innovation. (Pan et al. 2010, 373.) For this reason, R&D expenditure and human resources figures will be portrayed in the comparative analysis phase of this study.

Another element worth highlighting in the evaluation of NIS is the analysis of the structure of networks. Within Bartels et al. (2012, 5) approach in the modelling of NIS, the dynamic relationships and networks have been construed. The network perspective is particularly important whilst gauging NIS from a dynamic standpoint. What theory accentuates is, that these economic agents have special, dynamic bonds amongst each other, which results in innovative and competitive economic performance, beneficial for the whole system. Particularly interesting relationships can be found in the dynamics of government-industry relations. (Bartels et al. 2012, 5-7.) Ultimately, according to Guan & Chen (2012, 103) by evaluating the innovation efficiency of NIS, one can identify the best practices of national innovation systems – a great tool for benchmarking.

Moreover, what this sort of assessment allows is to spot weaknesses in the system, which ultimately helps countries improve their efficiency. One of the most common ways to enhance innovation efficiency is by improving the existing innovation policies. (Guan & Chen 2012, 103.) Therefore, countries aspire to ameliorate their policy learning's from other nations, in other words, identifying the 'best practice' NIS countries. In principle, the entire innovation landscape is key whilst assessing innovation policies, as essentially the environment is one of the most important enablers for successful innovation policy-making. Within the innovation environment, especially governments pose to be one of the most powerful facilitators of effective innovation policy-making. (Guan &

Chen 2012, 103.) Government based policymaking and policies are an integral part of this study, also being reflecting in the comparative analysis phase.

Several studies conducted have proven that differences in innovation efficiency and performance prevail within nations. The reason for such differences stem from the institutional environment impacting the innovation process. Therefore, as Guan & Chen (2012, 103) point out, in order to obtain important information regarding innovation efficiency of a nations innovation system, a framework approach needs to be accommodated. It should act as an analytical tool to reflect the institutional environment, for instance to examine the existing innovation policies. Nevertheless, as Guan & Chen (2012, 103) note, simply assessing the conceptual structure of the NIS is not enough for a thorough analysis on the quality of innovation systems. In other words, in order to comprehend how to improve innovation performance, one needs to first construct a comparative analysis of national innovation systems. Hence, this sort of analysis can be carried out by deploying a framework based on best practice, and secondly by examining the framework, i.e. being able to identify country-specific differences within the two systems. (Guan & Chen 2012, 103.) The analytical framework deployed in this study is described next.

3.3.2 Analytical framework for the evaluation of NIS

For this study, an analytical framework for analysing NIS has been constructed. The researcher has designed the framework, by gathering literature and data from various NIS scholars. Nevertheless, the distinguishing element from previous frameworks has been the adaptation of a comparative one, as well as a clear SME focus, which prior frameworks have not managed to address comprehensively. Essentially, how has the framework been constructed? One of the most intelligible NIS frameworks existing, and which has also been deployed for the analysis phase, is Resele's framework approach (2014, 57). According to Resele (2014, 57) the framework is a combination of theory, documents, studies, statistics, expert interviews NIS actors, and surveys of innovative companies. In terms of a scientific approach, the framework can be considered trustworthy, and due its diversity, it is crucial to employ in this study. It is most apt for the assessment between the Finnish and German NIS, in other words, embracing a cross-country approach. The analytical framework is demonstrated in the figure 6.

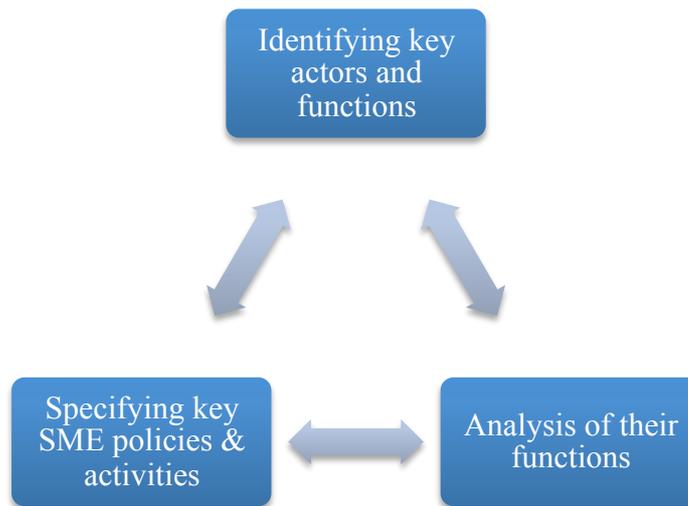


Figure 6 Analytical framework for the evaluation of NIS (Adapted from Bartels et al. 2012, 5, Chang & Shih 2004, 529, Guan & Chen 2012, 103, Samara et al. 2012, 627, Skiltere & Jesilevska 2013, 211, and Resele 2014, 57)

The first step within the framework is key towards the overall evaluation, namely defining the country specific profile of NIS: identifying the structural dimensions, such as the different key actors and their functions. Secondly, the key functions of the system are assessed; portraying what goes on in the NIS in terms of an innovation process standpoint, and how these functions interact with one another. (Resele 2014, 57.) This analysis phase is based on a network perspective; identifying if any special relationships within the system take place, an approach based on Bartels et al. (2012, 2) notion. Also, in the second phase, Chang's & Shih's (2004, 529) approach has been captured in the framework, as they specifically address the matter of a comparative study on innovation systems. Within their analytical framework, six key functions are being explored. Out of these functions, policy formulation, R&D collaboration, human resources and entrepreneurship are also being highlighted in this study. Ultimately, the framework interprets these functions in an interactional and dynamic manner. (Chang & Shih 2004, 529-530.) Also Samara's et al. (2012), in chapter 3.3, knowledge as a distinct subsystem, is assessed in the second phase.

It is vital to remark that Resele's initial approach to the framework highlighted also the system failures, but in order to capture this within the current setup, the strengths and weaknesses of NIS are acknowledged into the second step. It helps to determine the underlying differences, or on the other hand, similarities between the two systems. By taking into account both the strengths and weaknesses of the system; in this way the framework is broader in its approach. According to Skiltere & Jesilevska (2013, 211) the evaluation of the strengths and weaknesses of the national innovation system is crucial, especially in terms of successful innovation policy-making and in determining the innovative performance of the systems. As a last step, is to identify the specific innova-

tion policies that facilitate the innovativeness of small and medium sized firms. According to Intarakummerad & Chamindae (2011, 241) innovation policy refers to “*the public actions that influence innovation processes, in other words, the development and diffusion of innovation*”. As Schienstock & Hämäläinen (2001, 195) claim, the NIS approach as such is a rather loose conceptual framework in order to provide an adequate basis for developing innovation policies. Therefore, a comparative analysis on policies allows for successful assessment on benchmarking tools, i.e. policymakers are able to spot effective policies, which can be ‘borrowed’ to enhance another nations innovative performance (Schienstock & Hämäläinen 2001, 195-196).

Even as Lundvall & Borrás (1997, 63) refer to a process of ‘institutional learning and borrowing’, which means adapting economic institutions and policies, which have been proven to be successful in one country. Borrowing as such induces some challenges, as never is a foreign institution able to be fully transferred to different environment. Thus, it rather refers to a process of institutional learning (Lundvall & Borrás 1997, 63). The transfer and learning of policies is a process in which knowledge is shared across other countries, in order to enhance one’s own policy development (Malik & Cunningham 2006, 263). Distinguishing from Resele’s (2014, 57) framework approach, the last stage of the framework will especially evolve around a SME perspective, as it is key in determining, what sort policies and activities contribute towards the innovativeness of these dynamic firms. Essentially, the focus on SMEs has not been comprehensively researched nor considered in prior analytical frameworks of NIS, and therefore it is incorporated in the current framework.

Although the framework on NIS has gathered a lot of positive feedback, at the same time, it has also faced a lot of critique, which make the NIS approach somewhat lacking. One example is the fact that the NIS framework hasn’t managed to acknowledge the essence of SMEs and innovativeness, as explained earlier on. National innovation systems as a concept have been studied broadly, yet it is still faces challenges and topic areas, which have been untapped.

3.3.3 Critique on the National Innovation System approach

Although the national innovation system has received wide recognition, also critique can be recognized. Therefore, it is important to realise both the pros and cons, when depicting such significant theories. One of the major critiques related to the concept of NIS is that it incorporates almost everything, in other words, all the actors and relationships within the market (Lundvall 2007, 102; Resele 2014, 52). Thus, one must draw the line, and question what parts of the economy and system are relevant for the study. (Castellacci et al. 2005, 98; Lundvall 2007, 102.) Moreover, Carayannis et al. (2012, 9)

observe the same notion, stating that the systems approach is extensive, and poses no clear boundaries. As Carayannis et al. (2012, 9) determine in order to diminish the problem, the study should be outlined, e.g. to only examine innovation systems from a geographical or technological standpoint. Therefore, this particular study has also been delimited, namely to a comparative cross-country perspective. At the same, a comparative study makes sure it does not incorporate too much information (e.g. several countries), as assessments would be more difficult to carry out, incorporating too much within one study.

Another challenge within the national innovation system is how to link entrepreneurship with the system approach to innovations. Entrepreneurship is often acknowledged to be one of the key drivers of innovation, thus, when considering innovations from a systems approach, there is a great risk of neglecting the role on entrepreneurship and single agents in general. This is due to the structuralist approach, which the national innovation system poses, which easily undermines the crucial role of agents. (Lundvall 2007, 110.) In order to combat this challenge, the field of entrepreneurship has been encompassed in the comparative analysis phase (chapter 5). Also, theories have been carefully selected, reflecting NIS from a more dynamic standpoint. In conjunction with the analytical framework for the evaluation of NIS (chapter 3.3.2); albeit the framework conditions seem to be accurate, it should be borne in mind that due to the lack of coherent theoretical background on NIS, ultimately no unilateral and systematic way for the empirical comparisons of NIS among countries exists (Castellacci et al. 2005, 114-115; Guan & Chen 2012, 103). As Castellacci et al. (2005, 114-115) claim, neither advanced indicators nor data exist, in order to conduct systematic cross-country level empirical studies. Essentially, Resele (2014, 61) remarks, there is need for further research on how to analyse the functionality of national innovation systems. Ultimately, national innovation systems are highly complex and dynamic, which sets challenges in the analysis phase (Bartels et al. 2012, 6).

As a solution Carayannis et al. (2012, 9) suggest the characteristics of innovation systems ought to be quantified, in order to make better comparisons between the different systems, and to be able to assess their overall performance. Nevertheless, due to the complex nature of a systems approach, this is unfeasible. Up until now no solution for quantifying the characteristics of innovation systems has been developed. Therefore, the study at stake is a qualitative one of nature, which aims to explore and describe the Finnish and German innovation systems as such, and not gauge measures in terms of quantities. All in all, there are a multitude of challenges related to the evaluation of NIS. Thus, more advanced benchmarking tools are needed. Highly advanced indicators and data help produce more understanding around innovative activities of NIS, leading to more cross-country comparison studies. (Castellacci et al. 2005, 98.) This is also the key objective of this study, by using advanced indicators generated by the OECD and Euro-

pean Commission, more reliable assessments can be provided. After having examined the broad literature related national innovation systems, also sub-theories ought to be considered, as they are closely linked with NIS. They provide different insights to previous theories. Thereby, Porters framework is acknowledged as highly important to address.

3.4 Porters National Innovative Capacity Framework

In principle, the theory by Porter on Nation's innovative capacity is closely linked to theory on national innovation systems. Thus, it is important to convey Porter's contributions. One of the key drivers for the emergence of the national innovative capacity was that Porter and his fellow researchers became intrigued in the disparities in innovation intensity between advanced economies (Furman et al. 2002, 899). The framework initially derived from prior areas of research, such as national innovation systems (Furman et al. 2002, 900; Furman et al. 2000, 1). As Furman et al. (2000, 1) explicate, the national innovative capacity depends on a set of different features such as investments, policies and resources, which altogether determine the success of the innovative efforts in a country. For this reason, Porter's framework can to some extent be considered more apposite than the theory on NIS, as it has a clear focus on the *innovative* efforts and behaviour of a nation, not just innovation as such. As Stojanovska & Josifovska (2016, 26) state, the innovative capacity that a nation possesses is the compelling power in terms of the country's economic performance, i.e. the interlinked set of actors ultimately determine the success of a country's innovative efforts.

Within the theory of national innovative capacity, a specific framework can be identified. In principle, there are three elements that define the national innovative capacity: *common innovation infrastructure, the cluster-specific environment for innovation and the quality of linkages*. (Porter & Stern 2001, 29-30.) The framework is portrayed in figure 7.

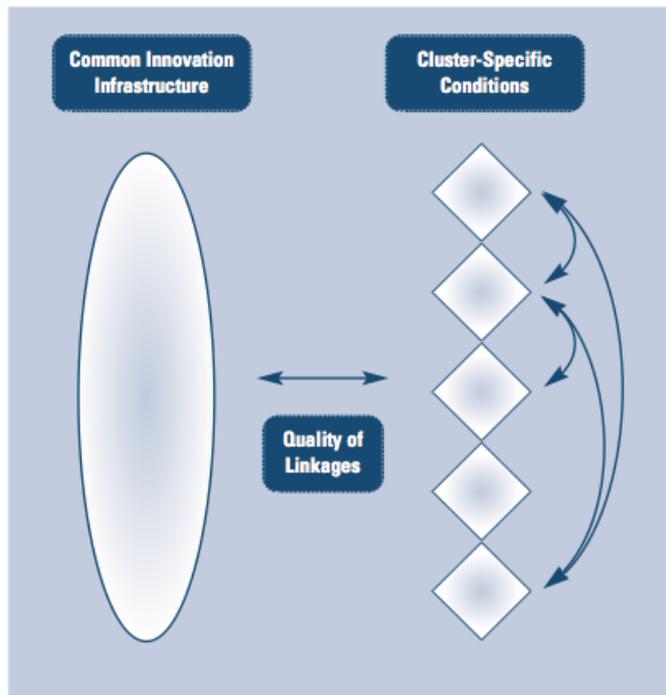


Figure 7 National Innovative Capacity (Porter & Stern 2002, 5)

The dimension of *common innovation infrastructure* at its simplest refers to the factors that enable and foster innovation throughout the entire economy. It incorporates different factors such as financial and human resources, innovation policies, and a nation's technological advancement, which all enhance the innovativeness of a nation. The theory highlights the importance of innovation policies, as they are a crucial attribute in the infrastructure. These policies can pose different objectives, but one of the most essential is the protection of intellectual property, i.e. patents, which safeguards innovations. Moreover, innovation policies can act as an incentive for firms to engage in innovative activities. (Porter & Stern 2001, 29-30.) Thus, as Furman et al. (2002, 900) state, one of the reasons why differences in the national innovative capacity between countries exists is closely related to the cross-country differences of innovation policy. In essence, the innovative performance depends on the accumulated stock of knowledge and policy choices, which have a strong impact on the overall innovativeness (Furman et al. 2000, 2). It can be determined that in order for a nation to possess innovativeness, a cohesive innovation infrastructure is vital. More importantly, a coherent innovation infrastructure constitutes of numerous effective innovation policies (Porter & Stern 2001, 29-30.)

The cluster-specific conditions as a dimension, is perhaps one of the distinguishing features Porter's framework compared to the NIS approach. Although national innovation systems also realises the importance of clusters, it does not take clusters into account as extensively as Porter's framework does. Porter determines that although the external environment poses opportunities for innovation, nevertheless, it is the compa-

nies themselves that introduce and commercialise new technology and innovations. Thereby, innovation and new technologies often occur in clusters. At its simplest, a cluster refers to a geographic locus of interlinked institutions and businesses that operate within a particular area of expertise. (Porter & Stern 2001, 29-30.) Lastly, *the quality of linkages*, which refers to the relationship between the innovation infrastructure and a nation's cluster is two-way: the innovation infrastructure provides essential resources for innovation, and firms within the clusters utilise this by commercialising innovations, which increases the innovative output of a nation as a whole (Furman et al. 2002, 907; Furman et al. 2000, 3; Porter & Stern 2001, 30). This special bond enhances the quality of linkages in the entire innovative ecosystem. The quality of linkages can be divided into two distinct groups, the informal and formal networks, which both play an essential role in fostering innovation. A great example of combining both informal and formal networking is universities, which acts as a bridge between technology and firms. (Porter & Stern 2001, 30.) In essence, without these vital linkages, technological advances may quickly spill to other countries (Furman et al. 2000, 3; Porter & Stern 2001, 30). If firms neglect the importance of these linkages, companies may lose valuable knowledge and innovative efforts quickly. (Porter & Stern 2001, 30.)

3.5 The Triple Helix model

Although the national innovation systems is an insightful way of portraying how various institutions generate and foster innovations within a nation, it should be noted that the NIS approach is still somewhat limited. This especially when considering, where innovations stem from, since according to the NIS approach incremental innovation mainly originates from inside the firm. (Etzkowitz & Leydesdorff 2000; Etzkowitz 2002b.) The incremental innovation processes descend from internal sources mainly through learning, as knowledge incrementally increases. On the other hand, discontinuous innovation can be comprehended to stem from external sources. (Etzkowitz 2002b, 1.) Such external sources, as Etzkowitz (2002b, 1) clarifies, are usually linked to universities, governments, and other significant institutions. In order for innovations to transcend and evolve outside the single firm, external relationships and institutions become increasingly important (Etzkowitz 2002b, 1).

As Etzkowitz & Carvalho de Mello (2003, 161) note, the triple helix is key to enhancing the innovation infrastructure in a knowledge-based economy. The triple helix model first emerged in 1995 by Etzkowitz and Leydesdorff, and has been adopted by many scholars since, especially in research fields such as innovation and knowledge-based economies (Ye et al. 2013, 2317). As Razak & Saad (2007, 215-216) pinpoint, the triple helix foundation is distinctively different in countries. Each country has dif-

ferent institutional needs, which need to be adjusted accordingly, thus, this is similar to the NIS approach. As Etzkowitz (2002b, 2) demonstrates, the triple helix model comprises of different reciprocal relationships, which ultimately enable innovation. The model comprises of three important components or also known as actors: universities, governments and industries. All of these have a mutual interaction and impact on innovations (Boja 2011, 38-29; Etzkowitz & Leydesdorff 2000, 111; Mac Gregor, Marques-Gou & Simon-Villar 2010, 174-175; Farinha & Ferreira 2013, 10; Peterka et al. 2012, 866.) The three components of the triple helix are presented in figure 8.

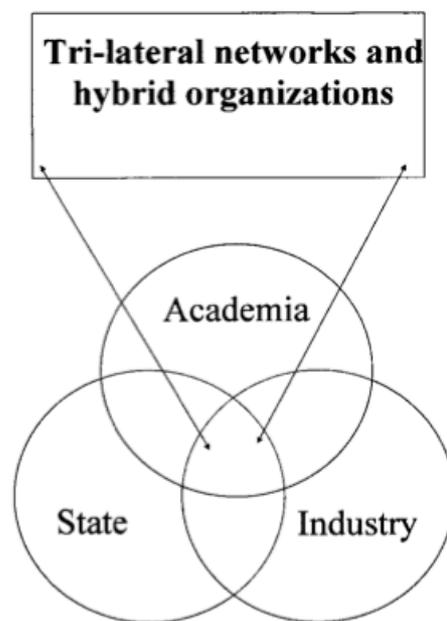


Figure 8 The Triple Helix Model of University – Industry – Government Relations (Etzkowitz & Leydesdorff 2000, 111)

Out of the three components, universities are recognized as an essential dimension in the transitioning towards a knowledge-based society (Etzkowitz 2002a, 7; Halilem 2010, 22; Ranga & Etzkowitz 2013, 5; Razak & Saad 2007, 212; Safiullin et al. 2014, 204). In terms of their specific functions, universities are one of the greatest facilitators of knowledge, particularly as they are extensive promoters of R&D and technology (Etzkowitz & Carvalho de Mello 2003, 161; Halilem 2010, 22; Razak & Saad 2007, 212; Safiullin et al. 2014, 204). According to Halilem (2010, 22) universities can also be characterized to possess an entrepreneurial role in the system. Particularly within technology innovation, entrepreneurially oriented universities play a significant part (Halilem 2010, 22). On the other hand, industry has a function of being the locus of production, whereas governments as institutions, which provide stable interactions among all actors (Etzkowitz & Carvalho de Mello 2003, 161). According to Peterka et

al. (2012, 866) the three institutional spheres are interlinked into a vortex connection, and the interactions among them take place in various phases within the innovation process. Nevertheless, Peterka et al. (2012, 866) remark that the mere formation of these relations between the academia, industry and government does not result in the attainment of innovation objectives: instead, two-thirds of such scenarios halt due to rigid organisational structures. Then again, Ranga & Etzkowitz (2013, 239) argue that the triple helix was constructed to work as a 'balanced configuration', where all three simultaneously promote innovativeness. The balanced configuration seems to be the best solution for innovative outcomes; it poses a favourable environment, where interactions and knowledge is created and transcended seamlessly between all three parties (Ranga & Etzkowitz 2013, 239).

In essence, the hybrid organizations (in figure 8) enable creative synergies, which are crucial for innovativeness. In other words, actors in hybrid organisations not only carry out their own tasks within the system, but also assist others when they are under-performing. This is key when contemplating innovative efforts in a society. (Ranga & Etzkowitz 2013, 239.) Also, these sorts of hybrid organizations resemble a dynamic approach to interaction (Etzkowitz 2002b, 2). Moreover, according to Brundin et al. (2008, 80) the objective of tri-lateral networks is to jointly realize the university spin-off firms, strategic alliances, governmental based research facilities, as well as trilateral initiatives for knowledge-based strategies, which all contribute to an innovative ecosystem. To conclude, the triple helix model emerged to better explain and address all three interdependent institutions into a triadic interactional framework. As a consequence, traditional economic development strategies such as the laissez faire model are slowly being substituted by a more knowledge-based strategy, where all three institutional dimensions continuously interplay with one another (Etzkowitz 2002b, 2).

3.6 Synthesis on the framework applied for this study

A number of theories and sub-theories on national innovation systems were presented in this chapter. Nevertheless, it is important to convey, how these theories have been employed in the study. Each theory represents an interesting point, which has been taken into account whilst assessing the Finnish and German national innovation systems, as well as their country specific SME innovation policies. The identification of *actors in NIS from a systemic dynamic approach* by Samara et al. (2012, 627-628) is of great importance in the study. As looking at the two distinct national innovation systems of Finland and Germany, it is essential to make careful selections on what sort of actors and functions ought to be assessed. As was already mentioned previously, in terms of assessing functions in a complex and extensive system like NIS, not everything can be

incorporated. Thereby, Samara et al. (2012) not only point out the vital actors needed for the study (governments, firms, academia, and research facilities), but also the vital functions that they carry out. The central functions analysed in this study are inter alia knowledge, human resources and research activities. Essentially, the systemic dynamic approach acts as a lens to contemplate the two NIS from mere inputs and outputs, focusing on more diverse functions from a dynamic standpoint. Especially networking, collaborations and the systems dynamicity are important factors whilst evaluating the Finnish and German NIS.

The *triple-helix model* supports the analysis phase in many ways. In the TH-model, in figure 8 (page 34) the central actors are presented. The model acts as a base for the study, i.e. examining these actors, and most importantly assessing the crucial role, which they play. According to the TH-model, the university is the most important facilitator of knowledge. Thus, academia is highlighted as one of the key actors in the Finnish and German system. Particularly the innovative cooperation and networking among academia and business within the Finnish and German NIS are central to contemplate. *Porter's framework* not only identifies the importance of functions in an innovative economy (e.g. human resources), but also the innovation policies that generate innovativeness in the overall infrastructure (Porter & Stern 2001, 29-30). As theory pinpoints, one of the reasons why cross-country differences in innovativeness take place is due to differences in innovation policy. In a cross-country study, the examining of innovation policies is justified, as it can reveal insights on the differences related to a systems' innovativeness. Both the triple helix and Porter's framework support the view that national innovation systems are dynamic and interactional in nature, rather than static and linear.

Lastly, the theories introduced in chapters 3.3.1-3.3.3 are most vital in the analysis stage. Particularly the first two chapters emphasise the key aspects for evaluating NIS: R&D, science base and human resources. According to literature, they are important factors of an innovative country (Bartels et al. 2012, 5; Gurova 2015, 147). Ultimately, it is the *analytical framework employed for the analysis of NIS* (chapter 3.3.2), which merges everything together. This is due to the fact that the (sub) theories on NIS have a number of dimensions in common: not only the point of view that the system is dynamic and complex in nature, but also the same functions for assessing innovativeness are being reiterated: human resources, R&D, networks, and knowledge, all account to an innovative NIS. In addition, innovation policies are noticed as an integral factor towards enhancing innovativeness. Altogether, these are the aspects, which the analytical framework combines into a coherent tool, which addresses the analysis stage most efficiently.

In order to respond to particularly the third research question on SMEs, it was seen logical to adapt the framework to include the SME point of view. At the same time, this

broadens current literature, as it entails the view on SME specific innovation policies. Another dimension, which theory has not managed to tackle comprehensively, is the relationship between *NIS – entrepreneurship* (pointed out in chapter 3.3.3). It is problematic considering how important entrepreneurship is regarding innovative efforts, not just within SMEs, but also in the entire system. Therefore, in order to combat the issue, also entrepreneurship will be reflected in the Finnish and German NIS. As Chang & Shih (2004, 529) argue, entrepreneurship should be a focal function assessed in relation to national innovation system studies. All in all, the theoretical foundation deployed in this study is significant: it lays the foundation for the qualitative content analysis process. With the help of theory, a detailed classification system was constructed, which aided in the key words searches that were made. In chapter 4 onwards, qualitative content analysis as a research approach will be presented more thoroughly.

4 RESEARCH DESIGN

4.1 Research approach

According to Eriksson & Kovalainen (2008, 6) deciding on the research topic and defining it into research questions is a vital dimension of the entire study. All the components of the study, i.e. the research design, data collection and analysis, depend on what sort of phenomenon or problem the study aims to address (Eriksson & Kovalainen 2008, 27). This study is qualitative in nature, as it aims to compare and provide a deep understanding of the Finnish and German national innovation systems, as well as the SME innovation policies. As a definition, *qualitative research* embraces the essence of various meanings, qualities and traits. Additionally, it emphasises characteristics related to people, cultures, situations and the ambiguous and complex interactions taking place. (Carson & Gilmore 2006, 66; Imms 2002, 3; Merriam 2014, 6; Tewksbury 2009 38-39) Qualitative data is often associated with texts and reports, which usually require a deep understanding of complexity and detail (Hox & Boeije 2005, 593; Saldana et al. 2011, 3-4). The Finnish and German NIS can be understood as truly complex in nature, where a qualitative research approach is justified.

As research suggests, qualitative research gives a thorough and deep understanding of social structures, organisations and processes (Tewksbury 2009, 39). Consequently, in order to receive a sufficient comprehension of the Finnish and German national innovation systems, in other words, what sort of actors, organisations, and interactions take place the qualitative approach is deployed. It is worthy to note that the qualitative study has been selected as a means of research, as the study has no fundamental hypotheses. Quite the opposite, the thesis' main objective is to interpret the topic as is, i.e. in its organic surrounding. The research outcomes of qualitative research are usually comprised of representations based on central findings from data. Analysis can be in the form of 1) documentations and reports based on observations (e.g. reflecting cultures), 2) new findings and insight on social structures, individuals and systems, 3) assessing the effectiveness of various policies and programs and lastly, 4) evaluating social justice and orders. (Saldana et al. 2011, 4.) In this specific study, the findings that are presented highlight the importance of understanding a system. Also, the study assesses the effectiveness of particularly SME innovation policies and programs, validating the need for qualitative research approach.

In relation to qualitative research, secondary data and document analysis, as research methods can be identified. As data collection and analysis has been carried out utilizing several documents, document analysis has been deployed as the main research method. *Secondary data* refers to data that has been initially compiled for a different purpose,

but has later on been reutilised for other research problems and questions (Hox & Boei-je 2005, 593; Heaton 2004, 1 & 16; Mishra 2008, 93; Sontakki 2010, 137). Vast amounts of data and research are available regarding the Finnish and German national innovation systems. Nonetheless, more thorough research evolving around the comparisons between the two systems is limited. Also, prior research has not fully addressed the relationship between NIS and SME innovativeness, which brings out new research questions, justifying the use of secondary data. *Document analysis* refers to organisational and institutional documents, including inter alia press releases, reports, survey data, interviews, public records, brochures, manuals, etc., which can be both printed or virtual (Bowen 2009, 27-29 & 32; Kohlbacher 2006, 3; Seitmaa-Hakkarainen 2014). Although document analysis can be used as a means to complement additional research methods, it can also be deployed as a stand-alone method, as in this study. All in all, document analysis follows a certain process of analysing the data: finding, selecting, appraising, and synthesising the documents chosen. Moreover, documents are organised into various themes and categories, this through content analysis. (Bowen 2009, 27-29 & 32.)

As Bowen (2009, 29) emphasises, as a research method, document analysis is applicable to studies, which aim to provide rich understandings and descriptions of a phenomenon, programme or event. Also, the assessment of documents is a way of structuring qualitative meanings of the text (Kohlbacher 2006, 12; Seitmaa-Hakkarainen 2014). As follows in this study, the objective is to provide an extensive and coherent understanding of the two national innovation systems, and give a thorough description on the SME innovation policies. As Bowen (2009, 29) remarks, document analysis is ideal specifically for cross-cultural studies, as it heavily relies on prior research, which may be the only realistic approach. Thereby, document analysis can be argued to be most apt for this study. Moreover, as Bowen (2009, 31) illustrates, document analysis has many positive elements: efficiency, availability, cost-effectiveness and coverage. Considering the extent of this study, i.e. involving a number of components (German innovation system, Finnish innovation system, German SME innovativeness, Finnish SME innovativeness), thus, document analysis can be considered as an efficient and cost-effective method to gain a deep understanding by scrutinising a vast amount of data. In terms of coverage, the selected documents provide a broad coverage of the research topic; they cover a long time span and broad institutional settings, which is key to successful document analysis (Bowen 2009, 31).

However, document analysis does induce some limitations. One of the main challenges is related to biased selectivity, i.e. the researcher has proven to select an incomplete collection of documents. For instance in an institutional context, the documents are highly likely to be linked with their distinct organisational policies and the agenda of the institutions own principals. Also, low retrievability can be witnessed as a blocker:

documents are not retrievable at all, or retrieving documents can be difficult. Unfortunately, this was also encountered a few times whilst proceeding with key word searches in the various databases, as some of the governmental documents were secured and blocked from the public. All in all, given the major advantages related to document analysis, efficiency and cost-effectiveness particularly, the positive elements tend to outweigh the potential limitations. (Bowen 2009, 31.)

To conclude, research design can be split into three larger domains: 1) causal research (cause-effect relationships), 2) descriptive (explores distinct features of a problem) and 3) exploratory (tackles research problems that lack in structure/level of comprehension). (Ghuri & Gronhaug 2010, 56-57.) Essentially, as this study is multifaceted in many ways, also the research design can be seen as broad: it embraces both descriptive and exploratory elements. Within the first research question on, what sorts of key actors prevail within the two NIS, the descriptive is more predominant, as the question simply aims to identify the actors in the local NIS. Then again, the second and third research questions, combine exploratory and descriptive features. This is mainly due to the fact that both questions have been researched on a country-level basis. Nevertheless, the comparative element is lacking, which in this case justifies an exploratory approach. The next chapter will give a thorough description of the data collection of this study.

4.2 Data collection

In this study, the analysed documents encompassed a wide variety including: reports, publications, webpages from the various institutions, brochures, etc. The initial search for data constituted of keyword searches within online databases of European Commission (EC), OECD, and the respective innovation research institutions of each country inter alia BMBF (Germany), BMBWi (Germany), Tekes (Finland), etc. These can be regarded as significant and major institutional bodies, which release a number of documents around innovation and innovation systems. Ultimately, the documents collected for this study are from internationally and globally reliable databases, which include experts and authors from a number of different nationalities, thus enhancing the reliability of the multiple data sources. In addition, key word searches were performed within Google search engine. This also provided a number of documents, which were assessed censoriously.

The main challenges were related to identification of the most relevant documents. Reports specifically around NIS and SME innovativeness were limited. Nevertheless, in order to combat this challenge, a distinct procedure for the selection of data was carried out. Firstly, the searches were conducted using key terms, inter alia “national innovation system Finland/innovation system Finland” and “national innovation system of Germa-

ny/innovation system of Germany”. Also, whilst searching for documents particularly from the SME dimension, key words such as “German SME innovation” and “Finnish SME innovation” were deployed. Within these documents, another round of key word searches could be made, in order to obtain more accurate information. Some of the reports were searched more vaguely, using simple key words such as “national innovation systems Europe”, since some of the documents entailed information around a number of EU countries, including Finland and Germany, or either one.

Also, more accurate key words searches within the documents were made using key words stemming from theory, such as networks, R&D, human resources, innovation performance. This provided a more narrowed approach to the final selection of documents. With some documents, a snowball-effect could be witnessed, leading to other relevant sources. This was particularly evident with documents related to SME innovation policies in Finland/Germany. In addition, some of the publications and reports were lengthy (up to even 300-400 pages), which meant they incorporated a lot of detail on the Finnish/German national innovation systems. Thus, in these cases the reports could be deployed for all sub research questions. Another criterion related to the relevance of these documents, was in conjunction with the time span. Even as Johnston (2014, 623) points out, the time span, i.e. when data has been collected, is a fundamental part of analysing data. In principle, national innovation systems and SME innovativeness can transform even within a short amount of time, thus, for the final selection of documents, it was crucial to select the most recent ones. The timeframe mainly constituted of reports from 2011–2016. However, a few reports were included, which did not fit the time span, as they were seen as crucial to the topics interfaced. In order to ameliorate the reliability and credibility of the study, a number of data sources were applied. Firstly, the usage of multiple data sources gives a more holistic and broader understanding of the study. Secondly, having collected data from European, Finnish and German databases, reduces the risks related to biased information.

The various document sources are portrayed in table 1. As it can be noticed, the data sources are divided depending on whether they were employed in the analysis of Germany, Finland, or both countries. This deemed a straightforward way to examine the different data sources and at the same time to ensure that both countries receive sufficient attention.

Table 1 Data sources, source name and number of documents

FINLAND			GERMANY		
Source Type	Source name	No. Of Documents	Source Type	Source name	No. Of Documents
webpage	Aaltoes	1	webpage	BMBF	1
webpage	DFHK	1	webpage	EC	1
webpage	Tekes	3	Report	EC	6
webpage	Vigo-program	1	Report	KfW	1
Report	EC	3	Report	OECD	1
Report	Tekes	5	Report	ISI	1
Report	OECD	1	Publication	DIW	4
Report	MEE	3	Publication	KfW	1
Report	MEC	1	Publication	EC	1
Report	VTT	1	Publication	OECD	1
Report	Sitra	1	Publication	BMBF	1
Report	Australian Business Foundation	1	Research paper	KfW	2
Publication	RIC	1	Research study	BMWI	1
Publication	EC	1	Brochure	BMWI	4
Publication	Tekes	4	Newspaper ad	BMWI	2
Intotal		28	Intotal		28

FINLAND & GERMANY		
Source Type	Source name	No. Of Documents
webpage	EC	1
webpage	OECD	2
Report	EC	2
Publication	EC	1
Intotal		6

Documents intotal	62
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As the table above reflects, the data encompassed the following: regarding Finland: 6 webpages, 16 reports and 6 publications and regarding Germany: 2 webpages, 9 reports, 8 publications, 2 research papers, 1 research study, 5 brochures, 2 online newspaper advertisements/announcements. Data used for both countries included: 3 webpages, 2 reports and 1 publication. Hence, the data comprised of 62 documents (Germany 28, Finland 28, combined 6). The various data sources are described in detail within Appendix 1. Appendix 2 provides a list of the abbreviations. As Schreier (2014, 175) notes, it is important to highlight the full scope and diversity of data sources, which have been used in the study. Basically, the several data sources complement each other, providing an even larger holistic understanding of the research questions, increasing the reliability and credibility of the study. However, given the amount of data sources, it

should be noted that during the course of searching, selecting and analysing data, severe criticism was encountered in the overall process. Over the entire timeframe of data collection and analysis, the researcher paid attention to the details of these documents, i.e. the authors, and intentions of each document. In the next chapter, a more thorough explanation of content analysis will be provided.

4.3 Data analysis in the form of content analysis

In terms of this study, the data was assessed with the help of qualitative content analysis. According to Hsieh & Shannon (2005, 1277) content analysis is a commonly used research method and technique for evaluating and analyzing qualitative research. It has been a growing field of scholarly interest in the past two decades as it has strength in examining complex business phenomena (Duriau et al. 2007, 5). It can be comprehended as a method to analyze documents (Elo & Kyngäs 2007, 108). Moreover, as Neuen-dorf (2002, 1) and Schreier (2014, 171) describes, content analysis is often characterized as *systematic*, and is applicable to many research areas in life. Thus, qualitative content analysis can be described as *polysemic*, which means that various texts and transcripts can be interpreted in several different ways, depending on the audience. Content analysis is a way of organising texts into themes and focal ideas. Hence, a key characteristic to qualitative content analysis is that it aims to *identify the most likely meaning* to its readers. The main asset of content analysis lies within its strength to *analyse large volumes of data* from multiple textual sources. (Macnamara 2005, 2 & 5.)

In order to give a comprehensive understanding of the Finnish and German NIS, and SME innovativeness, the need for detailed content analysis is accentuated. This is mainly due to the fact that texts can be interpreted in an ambiguous manner, and qualitative content analysis as a method aspires to make a more concise and understandable interpretation and meaning to the study. As Macnamara (2005, 5) addresses, the analysis phase very much depends on the individual researchers findings and construction of readings, which induces both challenges and opportunities. Some researchers claim that the analysis phase can inflict unreliability as it involves only one conclusive interpretation (Macnamara 2005, 5). Then again, some researchers state that in order to *comprehend texts and their deeper meanings*, qualitative content analysis is a prerequisite, which in this study seems to be the case (Duriau et al. 2007, 6-7; Macnamara 2005, 5).

Furthermore, for this study, additional advantages in relation to qualitative content analysis can be acknowledged. Firstly, data is *unobtrusive*, which means documents are not influenced by the researcher. This is a clear strength of the research method. (Berg 2004, 287; Bowen 2009, 31.) An additional advantage of content analysis is that it is a way to study *processes that have occurred over long time periods* (Berg 2004, 287-

In addition, as Berg (2004, 269-270) remarks, content analysis is carried out with either a latent or manifest approach. Essentially, the *manifest approach* concentrates on the numeric and countable features, whereas the *latent approach* takes the analysis even further, i.e. interpretation. Ultimately, through a latent content approach a deeper structural meaning can be perceived. (Berg 2004, 269-270.) In fact, for all of the research questions, some numeric data has been conveyed within data collection. Nevertheless, whilst depicting the research questions and particularly the objective of the study, it becomes obvious that qualitative interpretations become most vital. Hence, the latent approach has been deployed. Moreover, two additional approaches can be identified, which are closely linked to content analysis: inductive and deductive approach. *Inductive content analysis* is employed as a means, when prior studies examining the topic do not exist, or it is fragmented in general. Then again, *deductive content analysis* refers to an approach, where the analysis and its structure are initiated based on prior knowledge. Ultimately, knowledge is not fragmented, conversely to the inductive approach. (Elo & Kyngäs 2008, 107.) This study can be considered as deductive and theory-driven. Essentially, the theoretical framework constructed, and the respective key themes emerging from theory, lay the foundation for analysis. The theoretical framework is significant, as it acts as a means to organize and analyse the data.

Nevertheless, it needs to be borne in mind that both the deductive and inductive approach face the same *analysis process of data*: preparation, organizing and reporting (Elo & Kyngäs 2008, 107). Also, Bowen (2009, 32) identifies similar steps within the content analysis process, more specifically around document analysis, which includes: skimming (superficial examining of documents), reading (more thorough examining) and interpretation. However, the most profound steps lie within Seitamaa-Hakkarainen's (2014) approach: 1) Transmuting the data into a textual format, 2) Constructing a classification system, 3) Identifying the unit of analysis and segmentation, and lastly 4) Coding and reporting the data. These are also the steps, which have been encountered in the content analysis process of this study. Step one has already been covered, as the various data sources were already presented in a written form, and thus transcribing the data into text was not necessary. As a consequence, in the next chapters, the three remaining phases of the content analysis process will be described (classification system, segmenting, coding/reporting).

4.3.1 Constructing a classification system

In this study, a classification system was constructed, in order to categorise and identify the key themes, which arose from theory. The classification system is an integral part of the entire study, as it makes sure theory is in line with data, allowing the researcher to

make more precise analysis (Seitemaa-Hakkarainen 2014). Hence, the classification system is presented below in table 2.

Table 2 Classification system

Research question	Sub research questions	Analytical Framework on NIS	Theoretical Background	Key Themes
Describe and compare the national innovation systems in Germany and Finland, in order to identify the innovation policies and activities contributing to SME innovativeness	What are the key actors and functions in the Finnish and German innovation systems?	1. identification of actors and their functions	NIS theory, Triple Helix, Institutional theory	Innovation system (IS), Actor (A), Function (F), Institution (IN), Government (G), University (U), Industry (IND), Business (B), Research Facility (RF)
	What is the comparative performance of the key functions in the two NIS?	2. Analysis of their functions	NIS theory, Triple Helix	Knowledge, (K), Network (N), Cooperation (C), R&D (RD), Research (R), Science Base (SC), Human resources (HR), Entrepreneurship (E) Strength (S), Weakness (W), Innovation performance (IPE), Innovation Process (IP), Dynamic (D)
	What are the distinct innovation policies that enhance SME innovativeness?	3. Specifying SME innovation policies and activities	NIS theory, Porters Framework, innovative SMEs (chapter 1.2), Institutional theory	Innovation (I), Innovation policy (IP), Innovative firm (IF), Innovative SME (ISME), Innovation activity, Funding (F), (IA), Tekes (T), Young Innovative Companies (YIC), Aalto (A) German: KMU, (KMU), innovative (INV), ZIM (Z), innovation aktivität (IAT)

With the help of building a classification system, the researcher can make sure that the theory and research questions are interlinked, at the same time ensuring that all of the dimensions are meaningful for the analysis phase (Seitemaa-Hakkarainen 2014). As Schreier (2012, 58) notes, the classification system ought to be constructed in a careful manner. As Seitemaa-Hakkarainen (2014) address, the classification system and coding scheme are always tied to the purpose of study, which needs to be as specific as possible. Thereby, the classification system can be constructed in relation to themes deriving from the research question and theory, or on the other hand, it can be produced at the same time as the data analysis proceeds. Ultimately, there is no uniform way to carry out a classification system, as it always unique, depending on the nature of the study. Thus, it may be necessary to process the data in multiple rounds in order to extract the relevant chunks of information and to pick up on the most relevant themes. In the process of the analysis, new classes may appear. Essentially, the most important aspect within qualitative content analysis is that a linkage between the theoretical framework

and data must always exist, in order to complement each other, and the study at stake. (Seitemaa-Hakkarainen 2014.)

When breaking down the concept of national innovation system into smaller subcategories, essential themes transpire. It was relevant to take into consideration the analytical framework for the evaluation of NIS (in chapter 3.3.2), as it interlinks and embraces the key theories that were presented earlier in the study. Thus, the analytical framework is an important tool for the data analysis process. As one can note, the analytical framework (column 3) is not only in line with the theoretical background (column 4), but also with the sub research questions (column 2). Thus, all of these dimensions mutually reinforce each other. The classification system was continuously re-examined and altered. Most of the themes were simple to identify, having a strong linkage with theory, yet some themes emerged during the analysis process of data. All in all, with the help of a classification system, the analysis phase could be considered more visible and coherent. In relation to the first two sub research question on, “what are the key actors and functions in the Finnish and German NIS?”, and “what is the comparative performance of the key functions in the two NIS?”, the themes were most straightforward. Hence, these themes had the strongest linkage between the theories present. Especially theories on national innovation systems and the triple helix model reflect the key themes related to the actors and the key functions of NIS. In the third sub research question, which evolves around the SME specific innovation policies and activities, the key themes emerged mainly from theories on innovative SMEs, Porter’s framework, and NIS.

For the third sub research question, also German reports were assessed, which meant that some of the coded themes needed to be translated into German. It was vital to translate the coded themes into German, as the researcher could make more accurate analysis. Moreover, the third sub research question distinguishes somewhat from the first two sub questions, as central themes emerged also during the process of analysis. Within the reports for the third research question, key themes arose as the researcher read through the reports numerous times. The more the researcher explicated the reports on SME innovation policies, the more profound themes transpired from the data analysis process. Overall, a broad selection of themes occurs in the classification system, which is mainly due to the extensive theoretical framework applied in the study. Nevertheless, the researcher intended to select the most relevant themes transcending from theory and the data analysis process. The careful selection of themes made the analysis process more lucid. Out of the remaining steps, the segmentation, coding and reporting phases are important to address.

4.3.2 *Segmentation, coding and reporting*

An important step within the qualitative content analysis process is its *segmentation* phase. As Seittemaa-Hakkarainen (2014) establish, reliable analysis is based on the fact that data is always segmented. In principle, data can be segmented based on a number of attributes: external structures (pauses, phrases, breaks) or semantic features based on conveying meanings, where a conceptual framework is key within the unit of analysis/key themes (Seittemaa-Hakkarainen 2014). More specifically, the unit of analysis can be defined as phrases, sentences, chapters, words, ideas, themes or concepts (Berg 2004, 273; Seittemaa-Hakkarainen 2014). As Berg (2004, 271-272) highlights, defining the unit of analysis can turn out to be a complex matter, as it can be carried out in different levels. As follows within this study, the segmentation process is based on semantic meanings, as the idea was to create a holistic and descriptive understanding of the study. Thus, as the research concentrates on document analysis in the form of texts, the most straightforward way was to identify the key themes based on the prevailing words and themes. The key themes were presented in the classification system above (table 2).

As a third component in the content analysis process, *coding* can be identified. In its simplest, coding is a process of comparing the data, in other words, seeking for conceptual similarities within the documents (Schreier 2014, 178; Seittemaa-Hakkarainen 2014). Essentially codes usually derive from the research questions and themes (Miles & Huberman 1984, 54). Hence, the process of coding the data can proceed for example by taking notes of the texts, i.e. memos, which ultimately are defined as the interpretations of the documents (Seittemaa-Hakkarainen 2014). In relation to this study, codes were appointed to documents, which derived from key themes. Most documents entailed a word that was directly linked to the key themes, thus the coding process was straightforward. In some cases, the word or theme present in the document embraced some dimension of the selected units of analysis, or indicated alike meanings, which were addressed to the respective codes accordingly. For instance, a key theme derived from literature “university”, nevertheless, the researcher quickly identified similar meanings within the documents, i.e. “educational system, tertiary education, secondary education, top talent”, where all of these conveyed similar meanings, and were allocated to respective key units of analysis. Also, another example on the key theme for “innovation”, posed to convey meanings such as “innovation behaviour” and “innovation leader” in the documents. In these cases, alike meanings could be coded under the key theme of “innovation”. Thereby, coding was a continuous process of careful analysis.

Some of the documents were relatively lengthy (300-400 pages), and contained information on more than the Finnish/German case countries (e.g. information on all European innovation systems). In the circumstances, where documents were extremely lengthy, the researcher made the coding process more cost and time-effective by elec-

tronically identifying keyword searches for “Germany” and “Finland” within the document itself. This allowed the researcher to find the relevant chapters and sentences, which depicted the case countries, and where the coding process could be carried out most efficiently. Then again, some of the documents that were not as lengthy (approx. 5-30 pages) were coded by hand, i.e. taking notes and memos (printed documents). A concrete example of the coding process can be found in the Appendix 3, where the attached coding sample has been coded based on the classification system presented earlier. Basically, by taking notes and memos, the researcher was able to identify linkages, differences and similarities within the texts. Also, during the coding process, central findings or aspects, which could potentially need further elaboration, were taken into consideration. Some of the documents embodied multiple codes, which occurred in the classification system. Moreover, a group of documents sampled in the data collection stage were eventually dismissed as irrelevant in relation to the key units of analysis.

Within *reporting* the data, the segmented and coded data acts as a basis for the analysis phase (Seitemaa-Hakkarainen 2014). It should be borne in mind that within this study, the data was analysed and reported in a qualitative manner, where frequencies were not demonstrated. Therefore, the reporting phase was based on the researchers objective to provide a rich and elaborate interpretation, as well as to contemplate the findings based on a confluence of theory and data. The careful selection and evaluation of data was a way to report the data as visibly and holistically as possible. It is crucial to portray the importance of trustworthiness related to this study and qualitative content analysis. A discussion on trustworthiness will be presented next.

4.4 Establishing trustworthiness within qualitative content analysis

The evaluation of qualitative research is an essential process within the entire study. In essence, trustworthiness is the most key attribute, whilst evaluating content analysis. Trustworthiness in relation to qualitative content analysis is commonly linked with terminology such as *credibility*, *conformability*, *dependability*, *transferability* and *authenticity*, which are also important to elaborate within this chapter (Elo et al. 2014, 1; Guba 1981, 80). Trustworthiness can be encountered in each stage of the analysis process: 1) Preparation, 2) Organization and 3) Reporting the research results. Each phase embodies the five characteristics related to establishing trustworthiness within the study. (Elo et al. 2014, 1.) In terms of the *preparation phase* for qualitative content analysis, particularly within data collection, **credibility** can be highlighted. Credibility is associated with how aptly the data aligns with the intent of the research and how acquainted the researcher is with the research area. Additionally, credibility can be associated with the researchers self-awareness, i.e. what are her/his own skills in relation to the study. (Elo

et al. 2014, 3.) Thus, Guba (1981, 80–81) notes that credibility is associated with internal validity, i.e. the truthfulness of research results, which should be conveyed realistically.

The researcher underwent a profound thought process on how to collect data most suitably. Ultimately, given the vast topic area – two extensive national innovation systems, in addition to a cross-country SME reflection – qualitative content analysis seemed to be most efficient to cover such large topic fields. Thus, the researcher collected data from databases and company websites, which have been established as trustworthy. The identification of well-known institutions (e.g. OECD & EC) around innovation systems, further spurred the researcher to carry out a qualitative analysis. Even as Shenton (2004, 73) underlines, a quality criterion in terms of credibility is to adopt most appropriate and well-recognised research methods. Also, considering the timeframe national innovation systems have existed for a long time. Thus, in order to provide the most comprehensive approach, secondary data was considered most reliable. Moreover, research on NIS and SME innovativeness is rather fragmented, which further encouraged the researcher to conduct a qualitative content analysis. Especially institutions such as OECD and the European Commission provide great interactive tools to conduct comparative assessments between case countries. Consequently, the analysis phase was based on the select reports and publications.

Then again, in relation to self-awareness, credibility could be achieved. The researcher has spent almost six years living in Germany, which means she is very much familiar with not only the language, but also the culture prevailing in Germany. This helped the data collection process, i.e. understanding the research tools, sources, and culture-specific terminology. Moreover, transparency and credibility (familiarity) with the research topic were attained: the researcher has conducted her bachelor thesis on the German NIS and German SME innovativeness, where she possesses prior knowledge and expertise. On the other hand, a challenge related to this study, are the potential biased views. As this study is comparative in nature, the researcher needs to be extremely careful in order to avoid biased interpretations affecting the study as well as the research outcomes.

For instance, the researcher could have assumptions on, whether the two NIS are very similar or different to one another. The researcher needs to restrain him/herself from such prejudice thoughts. Also, another risk is related to reiterating the research results, which stemmed from the researchers bachelors thesis. In order to eschew from bias behaviour, the researcher collected a new data set, which ensured that data would not be out-dated, and would not stem from the previous study. Moreover, the research problem and sub research questions were formed in a way that would discard any bias constructions. As Shenton (2004, 73) establishes, in order to ensure credibility and trustworthiness, the background, qualifications and experience of the researcher are im-

portant criteria whilst proceeding with qualitative content analysis. Next, trustworthiness in relation to the organization phase will be examined.

4.4.1 Trustworthiness in the organization phase

Then again, in relation to the *organization phase* of content analysis, particularly **conformability** as a key feature can be portrayed. In essence, conformability refers to how accurately and precisely does the data reflect the actual findings, i.e. results are not drawn by the researcher. In the organization phase, it is crucial to elaborate how the categories have been created. By describing this phase, the overall trustworthiness of the study can be ameliorated. (Elo et al. 2014, 5.) In order to address the matter of conformability, the researcher intended to make the research findings as transparent as possible. Interpretations were not based on the researchers own assumptions. Throughout the analysis process, the researcher made several check-up rounds, going back to the data, before making any final conclusions on the findings that were revealed. In addition, the findings were not solely based on data, it was a blend of data and theory that enabled a suitable approach to the organization phase, and ensured a reliable coding process. Ultimately, the interpretations and findings of this study are interlinked with the selected documents and thorough literature review – this clearly enhances the conformability perspective.

Indeed the field of objectivity becomes intriguing in the dimension of conformability, as it reflects the neutrality of the researcher, i.e. dismissing ones own motivations and biases (Elo et al. 2014, 2 & 6; Guba 1981, 80–81). Although the researcher indicates interest in the German – Finnish composition due to her background, nevertheless, the analysis process has been carried out in an objective manner, in order to restrain the researchers own biases regarding the phenomenon. Essentially, the use of content analysis and secondary data is justified in this sort of circumstance; the researcher is detached from the documents, as other parties have already produced them. However, it is clear that the researcher must objectively review and assess the documents, which has also been the case for this study. One measure, which was used to improve objectivity was an even division among the documentation between Germany and Finland; both countries needed to represent an even number of documents. Lastly, trustworthiness in the reporting phase will be clarified.

4.4.2 *Trustworthiness in the reporting phase*

The remaining features of dependability, transferability and authenticity are witnessed in the reporting phase. **Dependability** is also known as the stability of data, particularly over time. Furthermore, dependability as a measure is high within a study, if fellow researchers can comprehend the decision trails of the original researcher. (Elo et al. 2014, 4 & 7; Miles & Josefowicz-Simbeni 2010, 422.) Firstly, in conjunction with this study, the researcher has aimed to ensure that results have been reported in a systematic manner, which resonates with the dependability dimension. The systematic manner can be illustrated in a way in which the researcher has indicated clear linkages between theory, data and results in the reporting phase. As Elo et al. (2014, 7) accentuate, in order to achieve dependability researchers should be able to provide rich, comprehensive and vivid descriptions, which emphasise the core themes occurring in the data. In this study, the researcher adopted a framework approach to NIS, which stemmed from literature; thus, at the same time it had a clear connection to data, and highlighted the most focal themes. This enabled the researcher to make rich and comprehensive descriptions on the Finnish and German national innovation systems, as well as their innovative SME performance. The framework approach took all of these matters into account, and ultimately led to a systematic manner to carry out a comparative study.

Transferability is associated with external validity, i.e. how can the findings be rationalised, generalized and more importantly, transferred to different contexts (Elo et al. 2014, 2; Guba 1981, 79; Shenton 2004, 63). Ultimately, based on research, it is up to the readers' own judgment whether results are transferable to other settings. A researcher can enhance trustworthiness by asking: can fellow researchers assess the transferability regarding the results (i.e. are the data and data collection described in detail)? (Elo et al. 2014, 2.) In this study, by giving a thorough description of the Finnish and German innovation systems, increased transferability. In addition, the theoretical framework was not only applied to one case country (Finland), but also to the German landscape, which already as such (a comparative approach) improves transferability. In the introduction it was brought up, whether other nations could benchmark from the successful SME innovation policies prevailing in Finland and Germany. Nevertheless, this sort of thinking induces challenges, i.e. whether results around successful SME innovation policies could be transferred to other countries, as settings vary to a great extent. Ultimately, the institutional environment is truly unique and vulnerable to continuous change and development over time. Also, the cultural traits are distinctly different in each country, even on a European scale, which sets its own challenges for transferability.

The last dimension, **authenticity**, refers to the extent in which the researcher is able to indicate a set of realities. Out of all five traits, the authenticity feature is the most recent one, and was only added to the list of trustworthiness in 1994. (Elo et al. 2014, 2-

3.) In addition, Bowen (2009, 38) emphasises additional characteristics related to the field of authenticity, particularly within document analysis, where authenticity refers to the usefulness of these documents. In other words, comprehending the initial purpose of the documents: the setting in which the document was produced, and the intended readers, which the document aims to target (Bowen 2009, 38). Ultimately, this can induce distinct challenges in the reporting phase, as researchers subjectively assess the documents.

For this study, the authenticity component was acknowledged to a great extent, albeit at the same time, it could be perceived as challenging. Before selecting each document, the researcher ensured the trustworthiness by checking the author's title and field of expertise, in addition to which institution published the document (e.g. EC, OECD, BMWi, Tekes, etc.), thus, answering the question, is the institution reliable and well known? All the documents, of which the researcher was not fully assured, were left out. This is as Bowen (2009, 38) suggests: the analysis process of documents ought to be as rigorous and lucid as possible. Nevertheless, the trickiest part was identifying the initial intent of the document. Although researchers claim to target a specific audience and have a certain purpose for the document, it can never be fully clarified, whether authors' subjective motives and biases have interfered in the process of producing the document. Thereby, even if the document intends to reach a specific audience and purpose, the outcomes may be different.

As a concluding remark on trustworthiness, it needs to be borne in mind that qualitative research rarely proves any actual results, but at its best successful qualitative research can only suggest convincingly (Saldana et al. 2011, 136). Even as Tewksbury (2009, 52) demonstrates, qualitative research is commonly exploratory, which simply means, it pursues to reveal social structures and systems, which have not been previously examined comprehensively. For this reason, the study has not drawn too pivotal conclusions regarding the Finnish and German NIS, but rather adopts a descriptive and informative approach. All in all, the assessment of one's own research can be a difficult. Nevertheless, rationally demonstrating and reasoning decisions for the use of the selected data can facilitate the overall evaluation process significantly.

5 INTRODUCING THE FINNISH AND GERMAN NATIONAL INNOVATION SYSTEMS

5.1 Actors and their functions in the Finnish innovation system

Finland is a sparsely inhabited country with 5.5 million citizens, which accounts for 1.07% of the entire EU population. Thus, in terms of land mass it is the 8th biggest country within the EU. Finland has been the first country to imbibe the national innovation system strategy, especially within S&T policies (science and technology) in the early 1990s. It is worthy to note that Finland possesses one of the world's highest R&D intensities, thus further indicating its excellence in the scientific and technological fields. Moreover, the country is acknowledged to have a number of hot-spot clusters in key technologies such as environment, energy, materials, ICT, food and agriculture. (Halme et al. 2016, 16-18; Naumanen & Hyvönen 2015, 13.) Over the years, the country has transformed into a reputedly competitive and knowledge-intensive economy, mainly thanks to its fundamental networking capabilities (Kuusisto et al. 2015, 14-15; Schienstock & Hämäläinen 2001, 32-28). In the early 1990s it began to take up changes in the policy field, and embraced novel concepts such as knowledge, know-how, and national innovation systems (Kuusisto et al. 2015, 14-15).

As Roos et al. (2005, 8) highlight, a key learning from the Finnish NIS is its highly developed and well-coordinated system: it has strong linkages especially between government and industry. Consequently, also strong R&D linkages can be found between the academia, government, and businesses (Haukka 2005, 15; Roos et al. 2005, 7). These are also important dimensions in the light of both the triple helix model and theories on NIS. The Finnish national innovation system and its key actors are illustrated in figure 10.

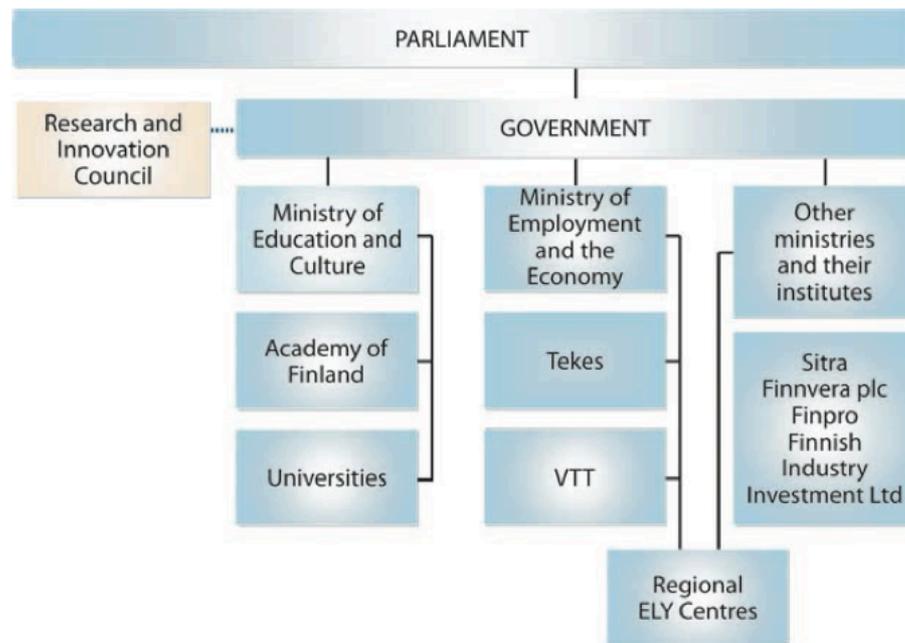


Figure 10 Finland's national innovation system (Wallin et al. 2012, 30)

Ultimately, the Finnish national innovation system is split into four operational levels, whereby the Parliament and government dictate the highest level (Halme et al. 2016, 19). Finland constitutes of a dual model, which encompasses both polytechnics and universities: 26 polytechnics and 14 universities. It also incorporates up to 12 public research organizations. (Halme 2016, 21; Ministry of Education and Employment and Economy 2009, 243-244.) Table 3 conveys the most key actors and their functions more clearly.

Table 3 Actors and their functions in the Finnish NIS

Institutional Actor	Function
Research and Innovation Council (RIC)	Is led by the Prime Minister: advising the Government and Ministries in vital matters such as innovation and research, especially in their exploitation and evaluation. The council is responsible for the Finnish national innovation system in its entirety. (Halme et al. 2016, 19; Naumanen & Hyvönen 2015, 8; Török 2012, 48.)
Ministry of employment and economy (MEE)	MEE is mainly in charge of innovation: its budgeting and policy-making (Halme et al. 2016, 20; Naumanen & Hyvönen 2015, 8).
Ministry of Education and Culture (MEC)	MEC is also responsible for science and innovation policy. (Halme et al. 2016, 20.)
Academy of Finland	The Academy of Finland coordinates research and allocates funding to cutting-edge scientific research. (Halme et al. 2016, 20; Ministry of Education and Culture 2013, Evaluation of the Academy of Finland, 10; Naumanen & Hyvönen 2015, 8.)
Tekes	Its' key functions are coordinating and funding research, innovation and industrial R&D, and is the most important publicly funded institution. It also promotes cooperation between large enterprises and SMEs and public and private sector. (Halme et al. 2016, 20; Haukka 2005, 15; Hyytinen et al. 2012, 10-11; Ministry of Employment and the Economy 2012, Evaluation of Tekes, 51-52; Naumanen & Hyvönen 2015, 8).
Sitra	Also known as the Finnish Innovation Fund Sitra, acts as a public fund and is governed directly by the Parliament. Sitra enables funds for research projects and technology transfer, particularly for SMEs and start-ups. (Halme et al. 2016, 20; Naumanen & Hyvönen 2015, 9; Roos et al. 2005, 7.)

Other important actors in the Finnish innovation system can be noted, whilst contemplating SME innovativeness particularly. Firstly, *Finpro*, which aids Finnish SMEs in their international efforts, spurring foreign direct investment and boosting tourism. (Halme et al. 2016, 21; Naumanen & Hyvönen 2015, 8.) Another important institution is the *Technical Research Centre of Finland, VTT*, i.e. the leading research and Technology Company in relation to all Nordic nations. In essence, VTT is responsible for expert services for domestic and international partners, in both public and private sectors. Moreover, it is an important institution, as it bridges the gap between the academia and businesses. Thereby, it is a crucial institutional body promoting interaction and

knowledge flows within the entire Finnish innovation system. (Naumanen & Hyvönen 2015, 8; Numminen 1996, 14.)

5.2 Actors and their functions in the German innovation system

As mentioned already in the beginning of this study, both Finland and Germany are described as driving innovation leaders in Europe; thus, they can be portrayed as possessing exemplary innovation systems. In essence, it is no wonder that Germany is often identified as a role model, possessing one of the best national innovation systems (Enterprise and Industry, SBA Fact Sheet Germany 2013, 1). Germany has 81.2 million inhabitants, which makes it the largest country in Europe. Opposite to Finland, which has a rather moderate population. All in all, Germany has the largest innovation system in Europe (Sofka & Sprutacz 2016, 13; Ruecker et al. 2015, 105.) In Germany the most important sectors for the economy lie within manufacturing, which accounts for a total of 43.4% total gross value added (in 2013) (Sofka & Sprutacz 2016, 14). Similar to Finland, in Germany most of the research and innovation activities are undertaken by public research institutes, industry, businesses and the academia (Ruecker et al. 2015, 115). The key institutional actors and functions are illustrated in figure 11.

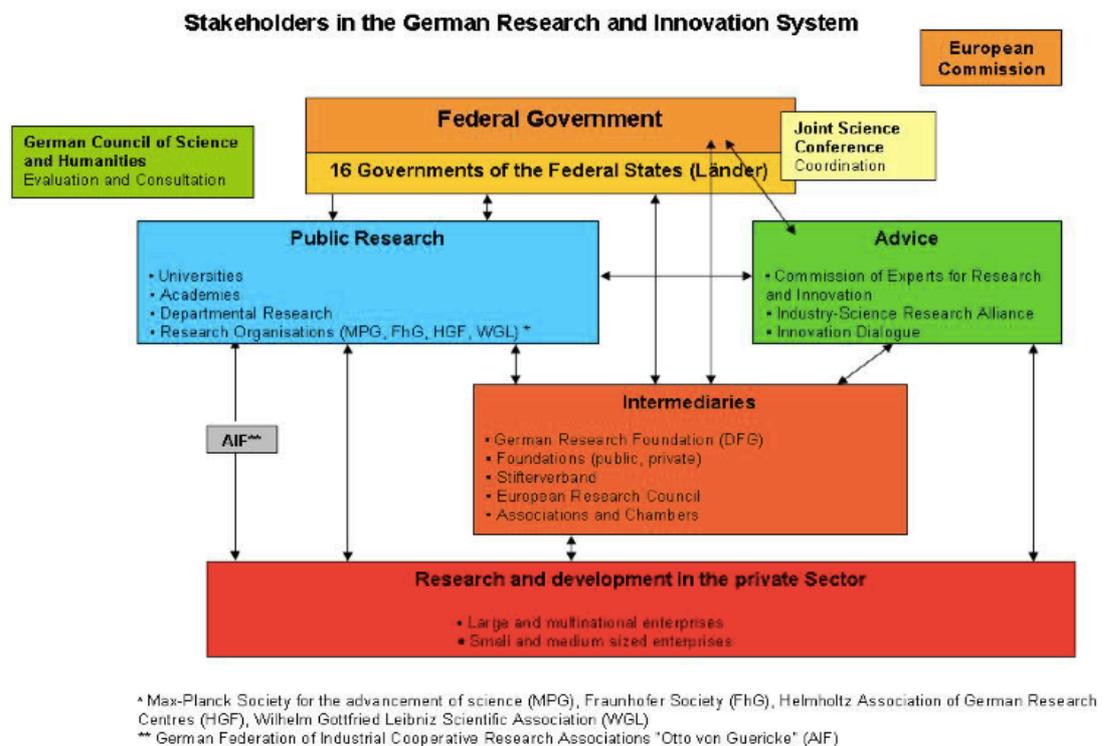


Figure 11 Germany's national innovation system (Ruecker et al. 2015, 105-116)

Whilst taking a look at the structure of Germany's innovation system, it can be remarked that it is distinctly different in comparison to Finland's. The German NIS is extremely complex, with a number of different institutional layers. The highest level in the German system is the Federal Government and 16 Governments of the Federal States, also known as 'Länder' in German (ISI et al. 2008, 2-3; Ruecker et al. 2015, 105-116; Sofka & Sprutacz 2016, 15.) Thereby, R&I (research and innovation) is a mutual responsibility of the Federal Government and the 16 Federal states. Furthermore, Länder play a vital role in the system, as they facilitate knowledge flows between industry and science, and support various innovation programmes. (Sofka & Sprutacz 2016, 16.)

In relation to its public research sphere, Germany has 108 universities and 210 universities of applied sciences, which is quite staggering. The Finnish NIS comprises of three Ministries, whereas the German NIS has six different ministries. (Ruecker et al. 2015, 105-116.) In addition, the German NIS has a wide scope of non-university public research institutes, which are portrayed in the table 4.

Table 4 Actors and their functions in the German NIS

Institutional Actor	Function
Federal Ministry of Education and Research (BMBF)	The central task is to promote education, research and science within the innovation system (Ruecker et al. 2015, 107; Sofka & Sprutacz 2016, 16).
Federal Ministry of Economy and Technology (BMWt)	The main objective of the Ministry is to boost and enhance the social market economy, as well as maintain innovativeness in the long run, i.e. innovation policy-making (Ruecker et al. 2015, 108; Sofka & Sprutacz 2016, 16).
Max-Planck-Society (MPG)	The most successful research organisation in Germany's innovation system, which mainly focuses on basic research within innovative fields for example biological-medical and social sciences. Altogether the MPG has 82 institutes. (Ruecker et al. 2015, 108 & 116-117.)
Fraunhofer Society (FhG)	Encompasses up to 67 institutes and is the largest organization for applied research in the entire Europe. It covers research fields such as health, communication and the environment. (Ruecker et al. 2015, 108 & 117.)
Helmholtz Association (HGF)	The organization aims to pursue long-term research. It holds up to 18 institutes from various fields for instance technical, biological and natural sciences. (Ruecker et al. 2015, 108 & 117.)
Stiftverband	Also characterized as a business community initiative, promoting long-term enhancement of the German research landscape. It also gives recommendations for enterprises and policy-makers. (Ruecker et al. 2015, 108.)

The multitude of research institutes is a unique feature in the German system. However, due to the limitations of this study, and the great extent of Germany's system, not all institutional actors and research institutes have been addressed. Hence, only the most crucial ones in relation to innovation are illustrated. As Sofka & Sprutacz (2016, 17) acknowledge particularly the MPG, FhG, HGF and Leibniz Association (in table 4 above) are important facilitators of research and knowledge, and are all unique components of the German national innovation system. In terms of important organisations around SMEs innovativeness, especially the *EXIST-programme* is well established in Germany. The programme has been launched by BMWt, which is targeted towards university-based start-ups. The main goal of the programme is to enhance the entrepreneurial environment at research institutes as well as universities. In addition, the EXIST facilitates technology and knowledge transfer. (Ruecker et al. 2015, 137.)

5.3 Comparison of the Finnish and German innovation systems

In order to comprehend the features characteristic to the Finnish and German NIS, it is important to look at the systems from a comparative standpoint, using the same measures for assessment. In table 5, some of the central measures for examining an innovation system have been gathered.

Table 5 Finnish and German NIS in comparison

Measure	Finland	Germany
Size	-population: 5.5 Million	-population: 81.2 Million
GDP (2014)	-€205b (above EU average)	-€2,915.6b (above EU average)
R&D structure (2014)	-private sector more dominant, yet figures have been constantly dropping	-private sector R&D more dominant: two thirds R&D funded by private sector
Largest R&D investments (2014)	-manufacturing, ICT, forestry, metal, chemical	-Manufacturing, automotive, chemical industries, electrical and optical machinery and pharmaceutical
EU ranking of innovation system	-identified as a 'innovation leader' (ranks fourth, European Innovation Scoreboard 2016)	-identified as a 'innovation leader' (ranks fifth, European Innovation Scoreboard 2016) → largest innovation system in EU
Unique features of the innovation system	-Region plays a strong role in boosting entrepreneurship	-several R&D centres for businesses exist, 800 publicly funded research institutes
Layers in the innovation system	-four layers	-multiple
R&I responsibility	-R&I policy and strategy: Finnish government & Research and Innovation Policy Council (RIC) -a mix of national and local administration, regions also have a high level of autonomy (in regional policies)	-R&I policy and strategy: shared by the Federal Government & the governments of the 16 German states ('Länder') - research is also conducted in universities, businesses, and non-university institutes
Central R&I strategy	-National R&I strategy by the Government & RIC: improve competitiveness, reform knowledge & education, foster clean solutions, promote welfare & digitalisation of working	-high-tech strategy (HTS) established by Federal Government: covers education, innovation, research and technology transfer

Main challenges in the innovation system	<p>-productivity halted (exports declined) → impact of global recession</p> <p>-dramatic decline both in public & private R&D investments</p> <p>-needs to enhance quality of research and science, and increase the internationalisation of R&I activities</p>	<p>-declining trends in human resources → lack of skilled personnel and a large shift in career choices of secondary school students</p> <p>-declining innovation activity and investment in SMEs</p> <p>-restricted availability of venture capital → limits growth in high-tech, knowledge intensive sectors and entrepreneurs</p>
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As table 5 indicates, although the Finnish and German systems portray similarities (e.g. strong private sector R&D investments, both countries characterised as innovation leaders in the EIS ranking 2016, etc.), they still demonstrate clear differences. For instance, the German NIS is more complex in nature, i.e. the system comprises of multiple actors and layers. Also, the central R&I strategies and responsibilities differ, as well as the challenges, which the Finnish and German NIS encounter, distinguish vastly. Ultimately, even though both innovation systems are regarded as top performers in the EU, they still indicate certain issues that need to be tackled in order to boost competitiveness and innovativeness in the economy. The various functions, which will be addressed next in chapter 5.4, give indication on, how the Finnish and German NIS performs. At the same time, this sort of analysis allows to examine the system specific strengths and weaknesses in comparison to each other.

5.4 Analysis of key functions: Science base, R&D and entrepreneurship

In the analytical framework of evaluating NIS, the second step is to analyse the functions of these actors, in other words, how they promote and facilitate innovativeness in the overall system. Since the innovation system here is viewed from a system dynamic perspective, several aspects become interesting. Hence, figures 12-13 portray some the key functions in the Finnish and German innovation system (Finland red, Germany black). Firstly, the science base, R&D and innovation, and entrepreneurship standpoint are being depicted, as they are all important facilitators of knowledge in the entire system.

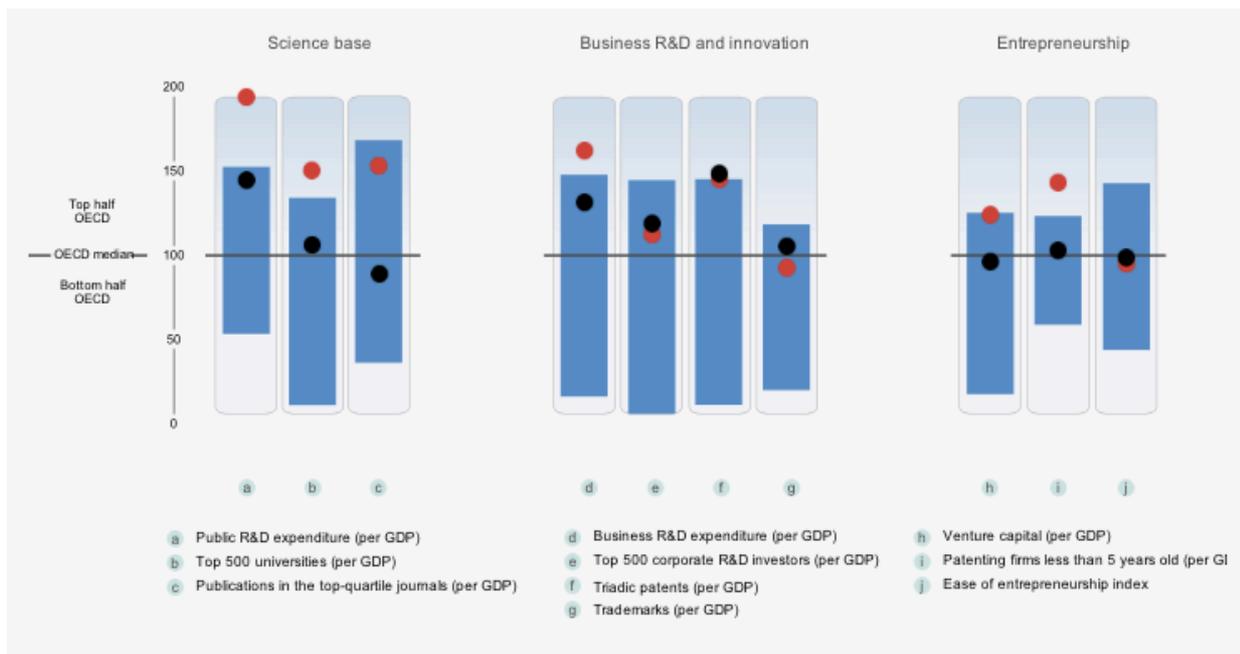


Figure 12 Finnish and German National Innovation Systems: Science base, Business R&D, Entrepreneurship (OECD 2016)

Firstly, portraying the dimension of *science base*, Finland dominates in all of the indicators above. In essence, Finland has a strong science base, as well as a high public sector spending on R&D. In addition, universities are highly ranked in the system. (OECD, Science and Innovation: Finland 2012, 290.) As Naumanen & Hyvönen (2015, 42) address, knowledge facilitation within the Finnish national innovation system is comparatively strong, especially in international comparison. Particularly the measure of ‘Public R&D expenditure’ (indicator a) is striking in Finland. According to Tekes (2015, 11) public R&D funding is extremely vital in Finland, as it compensates for market failures and encourages firms to boost their R&D investments. On the other hand, Halme et al. (2016, 60) stress that the Finnish science base is at risk of fading unless the Finnish academia and research institutes make new strategic choices focusing on their strengths and cooperation. Also, it needs more academic top-level researchers, which currently remains low (Halme et al. 2016, 60). Nevertheless, also Germany performs well in the science base sphere, as it is above the OECD average in two out of three measures. Similar to Finland, the country has high public R&D expenditure, in addition to a highly regarded academia. In order to further promote the field of science base, more than a 20% increase from last year in funding measures has taken place for university research, thanks to the innovation institution BMBF. Also, R&D funding by the government and states has been raised from 3% to 5% a year by towards inter alia the Fraunhofer Society, the Helmholtz Association, and the Max-Planck Society, which are important organisations in the knowledge facilitation process. (OECD, Science and Innovation: Germany 2012, 298.)

Then again, taking a look at the dimension of *business R&D and innovation*, both countries are above the OECD in almost all sections. Conversely to the previous dimension, here Germany excels in most measures. Essentially, Germany supports the innovation process in a number of different ways with its effective institutional set up, which resonates with the strong innovation performance (OECD, Science and Innovation: Germany 2012, 298). However, both public and business R&D is higher in Finland (indicators a & d) – it is truly no wonder Finland is considered to possess one of the highest R&D expenditures in Europe. Finland ranks first within EU in Business R&D, and second in Public R&D, whereas Germany ranks fourth in both measures. This can also be exemplified within GERD (Gross Domestic Expenditure on R&D) in the figure 13, which takes into account both private and public R&D spending.

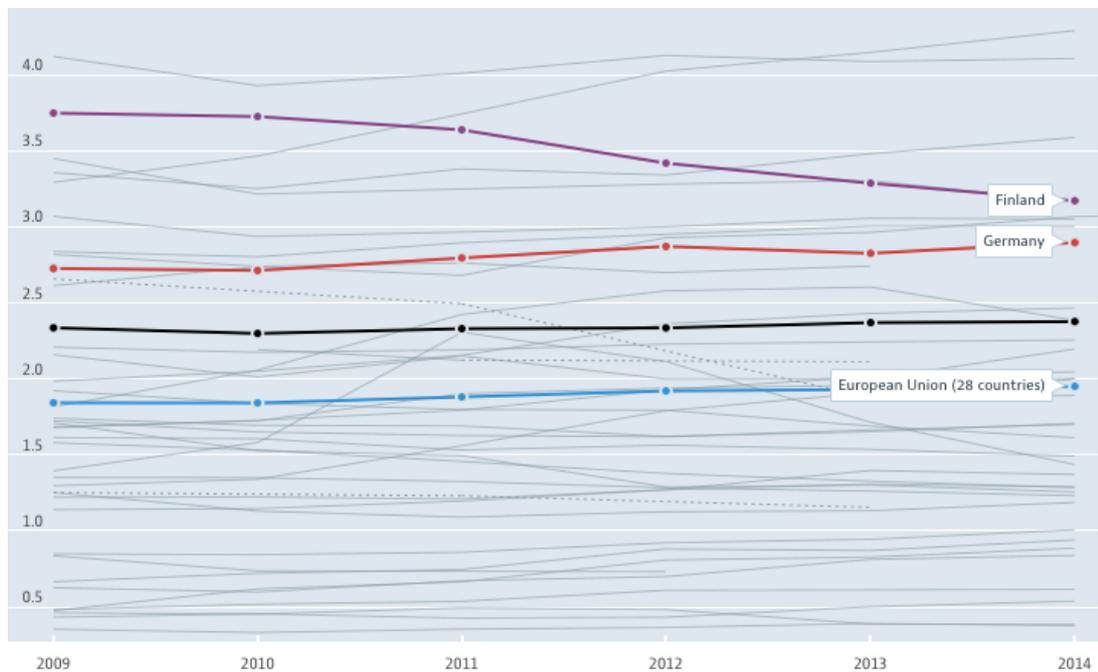


Figure 13 Gross domestic spending R&D: Finland and Germany (OECD 2016)

Clearly, Finland dominates this arena, by having a higher R&D intensity. However, the gap between the two has narrowed down, and Germany is beginning to catch up. In Finland, both R&D figures have dropped down during the timeframe 2007–2012, whereas at the same time, these figures have increased in Germany. One reason for the decline in Finland’s public R&D is the government’s budget deficit, which is not expected to grow in the near future. (European Commission, Research and Innovation performance in the EU 2014, 101-104, 121-124, 110 & 130.) Also, in terms of business R&D expenditure in Finland, the figures have decreased mainly due to the major restructurings that occurred in the electronics sector. In 2012 most R&D investments fo-

cused on Nokia, thus making the nations economic situation more vulnerable than it may appear. Then again, in Germany R&D has increased due to the substantial expansion of budgets in public R&D. Although Germany has almost reached its 3% national target in R&D intensity, there is a strong variation between the German 16 Federal States (Länder) and their R&D intensities. Another weakness in Germany's R&D is the low level of expenditure in high-tech fields including ICT, which is one of Finland's S&T specialisation strengths. Germany invests heavily in the automobile segments, which accounts for almost one-third of the entire German business R&D spending. (European Commission, Research and Innovation performance in the EU 2014, 101-104, 121-124, 110 &130.)

5.4.1 Entrepreneurship

In addition, the dimension of *entrepreneurship* is significant, particularly when reflecting the aim of the study on SMEs. Ultimately, Finland performs stronger than Germany in two out of three fields. This has a lot to do with the fact that Finland has had a growing culture of entrepreneurship. Due to the various programmes like the VIGO accelerator, young firms not only receive adequate financing, but also the innovative expertise, which they need. (OECD, Science and Innovation: Finland 2012, 290.) Within the entire EU and in terms of entrepreneurship, Finland belongs to the top five best performers (European Commission 2016, EIS, 23). Although Germany's entrepreneurship performance is in line with the EU average, it still remains one of the innovation systems weakest spots. In Germany, the main obstacles have been related to limited access to finance, especially regarding various SME innovation programmes. The lack of such support is a direct obstacle to innovation. (OECD 2014 Deutschland 30; OECD, Science and Innovation: Germany 2012, 298.) Also, the rapidly ageing population is becoming more dominant, which is diminishing the pool of young people. Moreover, already established enterprises offer a more attractive career option in contrast to the risky start-up life. (European Commission, Enterprise and Industry, SBA Fact Sheet Germany 2014, 8.) This sort of non-entrepreneurial attitude can be socially embedded in the culture, and ultimately deteriorates entrepreneurial initiative.

However, also the policy frontier faces challenges, as it lacks the promotion of a more broad-based entrepreneurial programme approach. German policy-makers aim to tackle this weakness, and encourage entrepreneurial and SME dynamism by various policies. (European Commission, Enterprise and Industry, SBA Fact Sheet Germany 2014, 8; OECD 2014 Deutschland, 30-31; Sofka & Sprutacz 2016, 7.) Most of these policies are targeted towards schools and academia, entrepreneurs, and businesses, in order to spur an innovative and entrepreneurial mind-set. These programmes include

EXIST, Young Digital Economy, and the network of successful female entrepreneurs. (European Commission, Enterprise and Industry, SBA Fact Sheet Germany 2014, 8; OECD 2014 Deutschland, 30-31.) All in all, on a EU scale, Germany places seventh in entrepreneurship (European Commission 2016, EIS, 23). Then again, providing support for entrepreneurs and their innovative efforts is strong in Finland, and the country provides a significant amount of funding to support start-ups (9.9%) (Török 2012, 13). One of the key reasons for the success has been its governmental policy measures and broad-based support, which Germany would also need. Another contributor to success has been the persistent role of academia, such as the Aalto University, which encourages positive entrepreneurial attitudes. A strong entrepreneurial academia is currently lacking in Germany, yet continuously improving with the help of new policies. (European Commission, Enterprise and Industry, SBA Fact Sheet Germany 2014, 8; Halme, K. et al. 2014, 13; SBA Fact Sheet Finland 2014, 6.)

5.4.2 Knowledge flows and human resources

Continuing the analysis of functions, as the analytical framework of NIS declares, the human resources and knowledge approach is important (figure 14). In this section, the focus will only be on the dimension of knowledge flows, commercialisation and human resources, as they are most crucial. As the data reflects, there are vast differences between the two systems, especially in the field of *knowledge flows and commercialisation*. Although knowledge facilitation can be considered fairly strong within the Finnish and German system at a EU level, from an OECD standpoint, they do not perform as strongly.

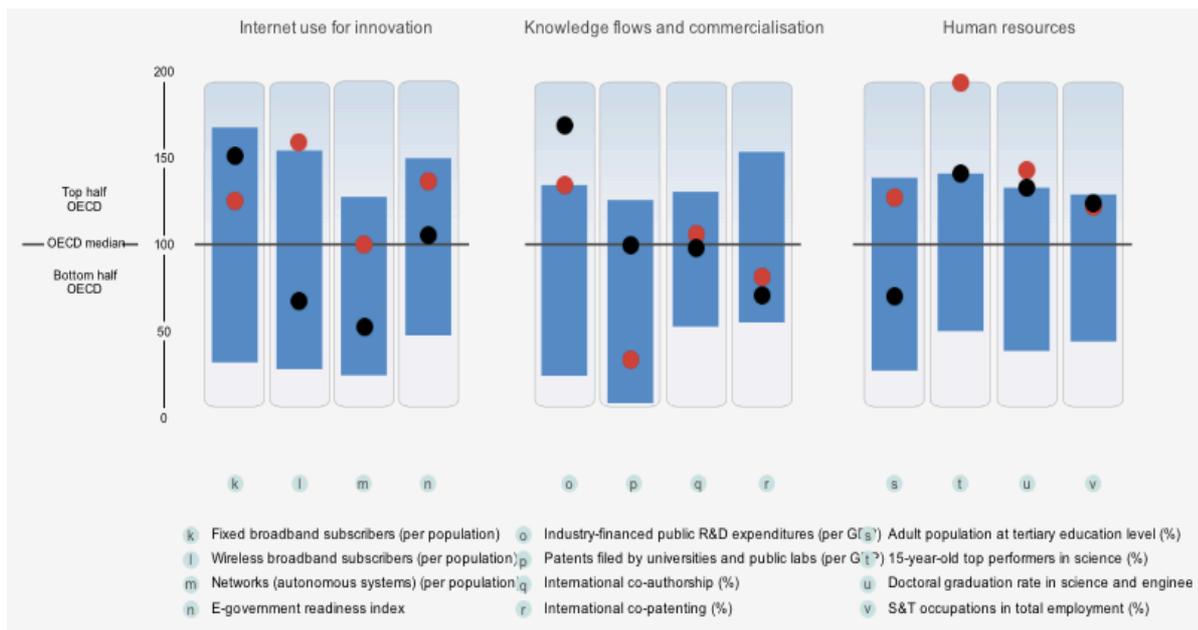


Figure 14 Finnish and German National Innovation Systems: knowledge flows and human resources (OECD 2016)

In the first two measures of knowledge flows and commercialisation (o & p indicators), Germany is clearly ahead of Finland. Important factors, which have contributed to the country's success, are the initiatives aimed towards enhancing cooperation between business and science. Some of the most reputable initiatives are inter alia Excellence Clusters, the EUROSTARS, and the German Centres for Health Research Initiative. (OECD Science and Innovation: Germany 2012, 298.) Although Germany poses a lot of innovative and knowledge-intensive sectors, i.e. high-tech industries, they haven't been exploited yet. Thereby, the institutions BMBF and BMWi are taking steps to better enhance knowledge and innovation activities. For instance, BMBF has introduced the High-Tech Strategy (HTS), which addresses this matter. It is the overarching foundation for German innovation, and is the first policy initiative that includes all the key stakeholders: Länder, Industry, and Science Council. This sort of collaborative initiative better directs innovation activities. Nevertheless, in order to improve the knowledge-intensity field, more structural reforms around research, education and the innovation system are needed. (European Commission, Research and Innovation performance in the EU 2014, 121-124, 128; ISI 2008 5-6; OECD 2014 Deutschland, 30; Török 2012, 4.)

On the other hand, in Finland, although knowledge sharing and facilitation has been thought to be successful, it still confronts challenges that it needs to tackle. For instance, one of the new policy measures aims to enhance research and innovation internationalisation with the help of joint programmes such as 'the new Team Finland'. Another alarming feature is Finland's decline in the number of national and international patent

applications. Essentially, what this addresses is the importance of international markets for a small country like Finland. (Halme et al. 2016, 8 & 14-15 & 80.) Also, the field of *human resources* addresses pellucid differences between the two countries, and is an area where Finland leads Germany in almost all four indicators. In Finland, a number of educational reforms have taken place to enable a viable educational system (OECD, Science and Innovation: Finland 2012, 290). According to Halme et al. (2012, 76) and European Commission (EIS 2016, 19) human resources is a major strength in Finland. The country has a high quality of primary education and higher education, where it ranks in the top four on the WEF Global Competitiveness Index 2015. Moreover, human resources in especially science and technology facilitate innovation to a great extent. The proportion of professionals in terms of total employment accounts to 40%, which is fairly high, the OECD average being 30%. Although Finnish universities are highly acknowledged, on an international ranking they reach mid-level rankings in international university comparisons. (Halme et al. 2016, 13 & 290.)

In terms of Germany, although the human resources field is not as strong as Finland's, it is still above the OECD average in most measures. Nevertheless, it faces more challenges than Finland. Germany has confronted a lot of difficulty replacing its retiring skilled researchers and engineers; also the training of these skilled workers is bound to change, which induces glitches. Consequently, as the population ages rapidly, a large share of these skilled employees retires, which will decrease these indicators even more. In conjunction with the indicator "s" (human resources dimension, figure 14), Germany is strikingly below the OECD average. This has a lot to do due with the fact that dropout rates in universities remain high. In addition, European Commission (EIS 2016, 19) points out that Germany performs well in doctoral education, but tertiary and upper secondary-level education is underperforming. Nevertheless, Germany is currently implementing policy changes in order to balance the educational preferences, thus aiming to make the university education more attractive. (Sofka & Sprutacz 2016, 7 & 98.)

5.4.3 *Networking & innovation cooperation*

Innovative ideas are established thanks to *networking and innovation cooperation*. Thus, the innovation cooperation between businesses, academia and research institutes is portrayed in figure 15. Once again, although both countries are above the EU average, Finland has managed to excel in this field, demonstrating greater performance. Thereby, Finland can be named as a top-performer, and lands first place in the ranking. (Numminen 1996, 27; Tekes 2015, The impact of Tekes and innovation activities, 11.)

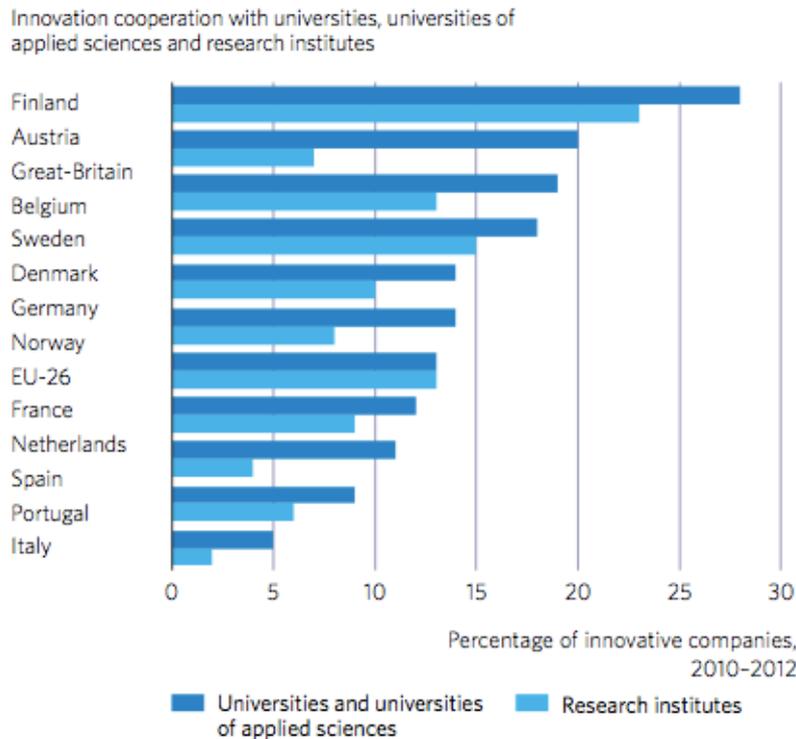


Figure 15 Innovation cooperation (Eurostat 2015, Community Innovation Survey)

According to Roos et al. (2005, 10) the networking aspect is highly developed in Finland, as already in the mid-1990s up to 40% of innovative firms reported that they collaborated among the academia and public research institutes. Basically, a few focal institutional actors can be identified that have enabled innovative cooperation in Finland. Firstly, *Sitra*, which has an important ability to network seamlessly with important decision-makers. The ability to convince these decision-makers in terms of taking on new initiatives, such as structural changes, is key to facilitating innovations and new solutions for organisations. (Ministry of Education and Ministry of Employment and the Economy 2009, 25-26.) Second, *Tekes* can be highlighted as a central institution regarding innovation cooperation and networking, especially between the academia, industry and research institutes in Finland. This is also key to the theory on the triple helix, which highlights the cooperative efforts between the three institutional actors. Tekes is the most notable funding body regarding academia - industry R&D linkages. (Naumanen & Hyvönen 2015, 42-43; Numminen 1996, 29; Roos et al. 2005, 11.) During 2008–2013, in total 135 spin-off firms were established from ideas stemming from the collaboration of universities and research institutes, and 52 from university of applied science ideas. (Naumanen & Hyvönen 2015, 44.) Ultimately, competitive advantages are being created when research institutes, SMEs and large enterprises cooperate with one another. (Tekes 2015, The impact of Tekes and innovation activities, 11-12.) However, the innovation cooperation and networking, especially between private and public sector is at risk of fading, due to the extensive cuts in the public R&D funding. As the

amount of various programmes supporting knowledge transfer and cooperative projects decreases, the incentives and resources available for innovative collaboration diminishes (Halme et al. 2016, 82.)

Then again, in Germany the proportion of innovative enterprises collaborating with the academia is 14.3%, which is just above the EU average (13%). Although the number may be higher than its neighbouring country, i.e. France (8.5%) and Italy (2.9%), it still remains notably lower than the innovation leader counterparts: Finland 26.1% and Sweden 17.6%. Basically, 93% of German universities would like to cooperate with businesses to a greater extent, based on survey results from the Stifterverband, one of the most important innovation facilitating research institutes in the German NIS. The underlying reason, why German universities would like to increase their cooperation with firms is because they see opportunities in relation to funding. However, a lot of challenges are confronted as academia – business cooperation induces obstacles related to time, project costs, and risks in general, which needs to be tackled by the right kind of policy measures. On the other hand, the upward trend in public and private R&D expenditure may result in more innovative collaborations and projects in the future, which is positive for the entire German NIS. Another strength in the innovation cooperation efforts within the system is the collaboration around technology: 153 innovation and business incubator systems prevail in Germany. These centres merge together more than 5.800 firms and 46.000 employees. Thus, the centres have been truly successful: they have outsourced over 17.400 enterprises. (Sofka & Sprutacz 2016, 85 & 89-90.)

5.4.4 Comparison of the Finnish and German key features

As witnessed above, in relation to the key features that have been assessed, both countries constitute of a viable national innovation system. Nevertheless, they still indicate distinct strengths and weaknesses in the various areas. A comparative table (table 6) is crucial, in order to highlight these similarities and/or differences.

Table 6 Finnish and German key features in comparison

Function	Finland		Germany	
	Strength	Weakness	Strength	Weakness
R&D	-strong R&D: both public & private (ranks first in business R&D, second in public R&D in the EU)	-R&D figures dropping alarmingly: government budget deficit & restructurings in electronics sector	-ranks fourth in public & private R&D in the EU -R&D figures increasing → upswing especially in public R&D	-vast differences in R&D intensity among Germany's 16 Federal States
Entrepreneurship	-strong entrepreneurial culture (e.g. Aaltoes) -broad based support policies and programmes	-ensure policies remain effective and that entrepreneurial culture retains a strong positions	-more policies have been introduced to spur entrepreneurship	-lack of entrepreneurial culture -lack of adequate policies and broad based support targeted towards entrepreneurs
Knowledge flows	-strong linkages among actors in the system, especially between government–industry -aims to address the challenge of innovation internationalisation: new policies, e.g. 'the new Team Finland'	-lack of innovation and research internalisation -notable decline in patents, both domestic and international	-strong cooperation amongst actors, especially between business–science -robust policies fostering innovativeness (e.g. High-Tech strategy)	-more structural reforms and policies are needed to enhance innovative activities within the German NIS
Human resources	-high quality of education in all levels -human resources in science and technology generate innovation largely	-In international comparisons, Finnish universities reach mid-level rankings	-high quality of education -new policies aimed to decrease university drop out rates, e.g. balance preferences	-tertiary and upper-secondary level education performs weaker in Germany -high level of university drop outs
Networking	-fundamental networking capabilities, particularly between business – academia, and business –research institutes	-the cuts in public R&D challenge the networking and cooperation potential, especially in the	-the increases in private & public R&D may improve the level of networking and collaborations	-level of networking among business – academia notably lower than in Finland (slightly above EU)

	-viable institutions facilitating networking & innovativeness: Sitra & Tekes	private – public sphere	-several innovation and business incubator centres, as well as technology parks exist	average)
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The functions above analyse national innovation systems from a dynamic standpoint: the level of interactions, networking, R&D, etc. Ultimately, these features change on a constant basis, which makes the assessment of the Finnish and German NIS challenging. These functions encounter continuous fluctuation, which is characteristic for a complex and changing NIS, regardless of the nation. Therefore, it needs to be borne in mind that even if Finland for instance has the highest R&D investments in Europe at the moment, this may change vastly in the upcoming years. In the current framework of functions, Finland and Germany face certain challenges, which they need tackle. The same can be argued for both countries: viable (innovation) policies are key, in order to enhance and sustain innovativeness and competitiveness in the nation. For both countries, effective policies can diminish the level uncertainty and boost the performance of not only individual firms and institutions, but also the overall system. Within the analytical framework for evaluating the Finnish and German NIS, SMEs innovation policies play an integral dimension. Thus, before examining the innovation specific policies in detail, it is crucial to contemplate the current situation in relation to the Finnish and German SMEs in relation to their innovative efforts.

5.5 Innovative Finnish and German SMEs

As previously stated, SMEs act as significant contributors to the innovation ecosystem. Therefore, the policy initiatives aimed at SMEs are important to view, as they facilitate innovative behaviour. The Small Business Act for Europe (SBA) fact sheet is one of the most relevant and apt measures to reflect the performance of SMEs from a country perspective. The SBA is EU's policy initiative to support SMEs. It constitutes of 10 policy principles ranging from entrepreneurship and access to finance to internationalisation. In addition, it targets to improve the understanding of the most common trends and national policies impacting the performance of SMEs. Out of the SBA measures, attention is paid to specifically '*innovation and skills*' as it is a key component to the aim of this study. In principle, regarding the skills and innovation sector, Germany outperforms Finland. This is illustrated in figure 16 and figure 17.

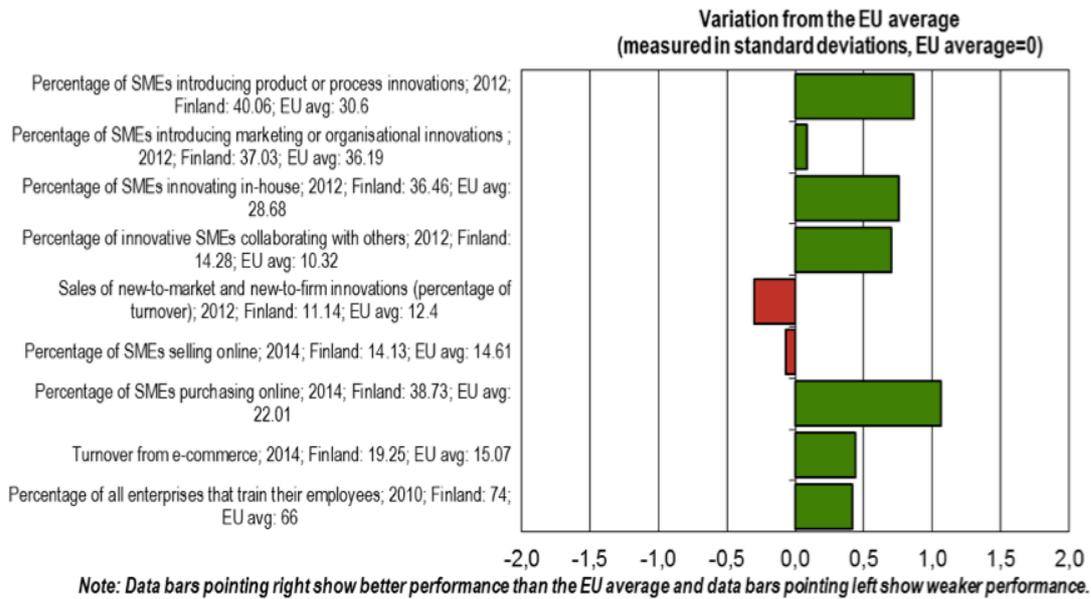


Figure 16 Skills and innovation in Finland (European Commission, Enterprise and Industry, SBA Fact Sheet Finland 2015, 12)

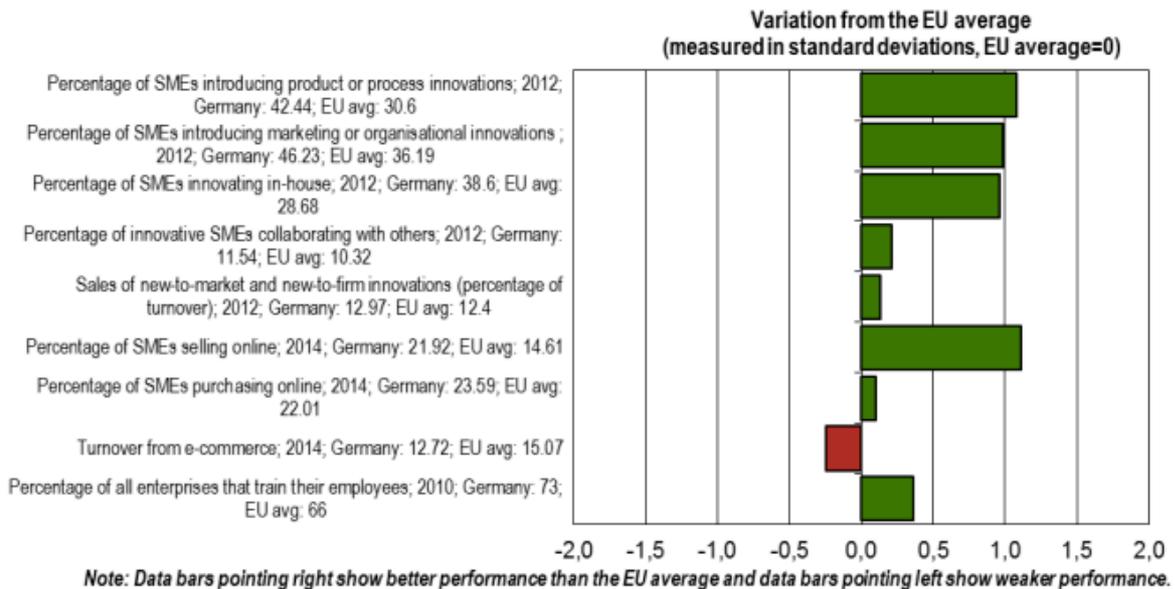


Figure 17 Skills and innovation in Germany (European Commission, Enterprise and Industry, SBA Fact Sheet Germany 2015, 14)

German SMEs are notably more innovative than its EU counterparts (Tchouvakhina & Schwartz 2013, 2). Nevertheless, Finland also performs well above the EU average, belonging to the top five best performing EU countries. Over the entire SBA timeframe since 2008, Finland's SME innovation performance has retained a stabilised position. Essentially, the stabilisation can be considered as a form of achievement for the Finnish SMEs, as during the time period, the overall performance of EU declined. There are a

number of reasons, why the Finnish SMEs attained a stabilised position, but mainly it was due to the persistent and considerable policy effort frontier. (European Commission, Enterprise and Industry, SBA Fact Sheet Finland 2015, 12.) Finland has managed to comprehensively address its SBA measures in the area of ‘skills and innovation’. (European Commission, Enterprise and Industry, SBA Fact Sheet Finland 2015, 15.)

Then again, the success of German SMEs during the crisis of 2008–2014 is truly unique on a EU scale. If Finland managed to retain a stabilised position, Germany excelled. Consequently, SMEs soared from 1 870 000 in 2008 to nearly 2.2 million in 2014. Across all the different sectors the total value added was approximated to be around 16%. What have been the positive factors contributing towards Germany’s strong SME innovative performance? Similar to Finland, one of the key contributors has been the extensive policy frontier. Due to the precisely engineered and innovation-hospitable SME policies, Germany has managed to build and maintain an innovation-friendly environment. (European Commission, Enterprise and Industry, SBA Fact Sheet 2015, 1-4 & 13-14.) Moreover, one of its core strengths in the SME innovative performance lies within strong business R&D, in which many German businesses are world leaders in their specific niche market (European Commission, Research and Innovation Performance in Germany 2013, 3). Another factor, which contributes to the high level of German SME innovativeness, is the ‘Central Innovation Programme (ZIM)’, a specific innovation policy, which has been very successful in terms of assisting SMEs (The European Commission, Enterprise and Industry, SBA fact sheet 2013, 13-14).

Nevertheless, based on statistics, this success story of German SMEs will potentially only continue for the next few years, as some of the innovation fields have encountered gradual erosion. (European Commission, Enterprise and Industry, SBA Fact Sheet Germany 2015, 1 & 14.) Reasons for the downward trend are not fully clear. At least low sales expectations and a general pessimistic economic outlook have decreased the number of innovation activities of SMEs substantially. (Abel-Koch et al. 2015, 50.) Basically, other member states are beginning to catch up, and have been able to improve their performance significantly. Germany needs to address the field of entrepreneurship within its policymaking, as it is deteriorating the future of SMEs. (European Commission, Enterprise and Industry, SBA Fact Sheet Germany 2015, 1 & 14.) Consequently, as a third step in the analytical framework of NIS, the key policies and activities ought to be specified, which have enabled the innovative behavior of these firms. Next, the Finnish landscape of SME policies will be examined, following by the German SME innovation policies.

5.5.1 *Fundamental SME innovation policies in Finland*

The Finnish innovation system regards SMEs as a vital component of the economy. Thereby, a number of innovation policies and activities have been targeted towards them. According to the survey conducted by the Policy Report ‘Evaluation of the Finnish National Innovation System’, the actors involved in the system, including SMEs themselves, were asked to identify the most important institutional bodies of the system. The Finnish SMEs highlighted the importance of Tekes and Universities as the most important actors of the system. (Ministry of Education and Ministry of Employment and the Economy 2009, 35-36.) As the SBA fact sheet validates, through out the years, Tekes has been an extremely vital institution in terms of the Finnish SME innovation policy-making (European Commission, Enterprise and Industry, SBA Fact Sheet Finland 2014, 12). Essentially, Tekes plays a central role in promoting cooperation between academia, industry, and large enterprises and can be comprehended as a ‘network creator’ (Halme et al. 2015, 61; Naumanen & Hyvönen 2015, 42-44; Valovirta et al. 2014, 37.)

Consequently, Tekes has launched the *Young Innovative Companies –programme (YIC)*, which has been vital for SME innovativeness. The programme provides essential funding, mainly for firms that have been operating for a couple of years, and already possess some customers. The main objective of the Young Innovative Companies is to speed the international growth of the most talented SMEs. (Halme et al. 2016, 74; European Commission, Research and Innovation Performance in Finland 2013, 7; Naumanen & Hyvönen 2015, 8; The Evidence Network Measuring Innovation Impact 2013, 10.) In figure 18, the most important Finnish SME innovation policies are demonstrated, including the YIC programme.

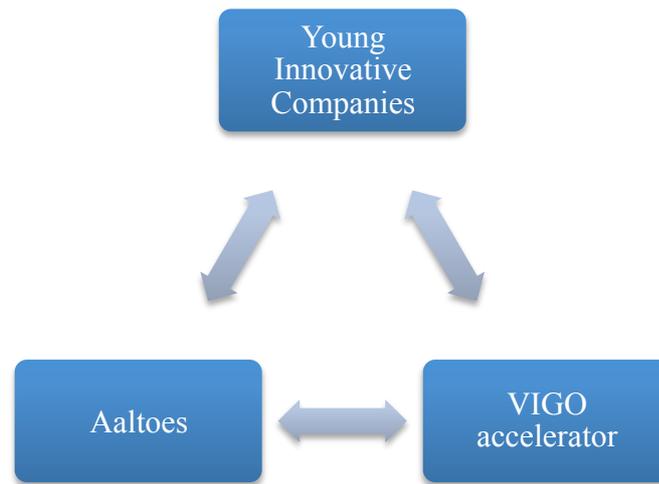


Figure 18 Central SME innovation policies and activities in the Finnish innovation system

One important precondition for the YIC funding is that these firms must display strong efforts in relation to innovation (Tekes 2016, Young Innovative Company Funding). Based on external assessments the results indicate that the programme has been very successful and seems promising for the future. A key attribute in the programme has been the inclusive approach for developing participant firms: in addition to financing, it offers non-financial guidance such as mentoring. (Halme et al. 2016, 75.) Ultimately, both the aspect of finance and non-financial features are crucial for the innovative performance of these young firms. The programme has led to an increase of innovative Finnish SMEs in relation to revenue, employees, business and knowledge linkages as well as the international customer base (The Evidence Network Measuring Innovation Impact 2013, 10-11; see Appendix 4).

Thus, *the VIGO accelerator* was launched in 2009 and was set up by the Finnish Ministry of Employment and Economy. The overall aim of the programme is to complement the innovation system by bridging gaps between early phase technology enterprises and international venture financing. With the help of VIGO, companies can receive access to both public and private funding. (Halme et al. 2016, 75; European Commission, Research and Innovation Performance in Finland 2013, 7; Naumanen & Hyvönen 2015, 53; VIGO-Program 2016.) Based on external evaluations, the VIGO programme has been of great importance, and has successfully attained its goals (Halme et al. 2016, 75). Lastly, the *Aaltoes*, also known as the Aalto Entrepreneurship Society, is distinguished. The core reason, why Aaltoes was founded in the first place (in 2009) was that these students realised that the entrepreneurial culture in Finland had distinct flaws: Finnish universities did not support students or researchers, who were inspired to start their own firms and internationalise. (Aaltoes 2016; Halme et al. 2016, 75-76; Naumanen & Hyvönen 2015, 53-54.)

Aaltoes organizes a number of pitching events, workshops, and other events where both students and researchers can experiment together and look for potential co-founders. One of the perhaps most well-known and widely recognized pitching events held by Aaltoes is Slush. Slush has expanded from a 300-person event to one of the largest events of its kind in the whole world. For instance in 2014 the event had over 14 000 participants and over 3 500 firms. Over 750 investors visited the event to meet these start-ups, which is a great means of collaboration and networking. The organization inspires students, and sparks them on their way of becoming entrepreneurs – truly crucial whilst reflecting the innovative efforts and entrepreneurial mind-set of Finland. (Aaltoes 2016; Halme et al. 2016, 75-76; Naumanen & Hyvönen 2015, 53-54.) As Török (2012, 7) contemplates Aalto University as such could be an exemplary educational institution other member states could learn from. It has been a key dimension in fostering innovativeness and entrepreneurial attitudes between academia, business and research institutes (Török 2012, 7).

5.5.2 Central SME innovation policies in Germany

Similarly to Finland, also Germany demonstrates effective SME innovation policies. According to Heike et al. (2013, 1) the German government and 16 Federal states support SMEs with a wide range of policies and programs that boost their innovativeness. In other words, the transfer of knowledge, i.e. intensifying their R&D activities, has been one of the key activities established. (Heike et al. 2013, 1; Ruecker et al. 2015, 138.) Nevertheless, what are the most important SME innovation policies prevailing in Germany? According to the survey conducted by the German Institute for Economic Research (DIW Berlin) on ‘how SMEs evaluated the efficiency of funding, R&D and innovation programmes’, the Central Innovation Programme and KMU-innovativ were noted as the most focal policies (figure 19) (Heike et al. 2013, 1 & 12-13). Hence, *ZIM (Zentrales Innovationsprogramm Mittelstand, also known as the Central Innovation Programme)*, which has a very central role in enhancing the viability of German SMEs. BMWi has established the programme, and the central objective of ZIM is to increase transparency and diminish administrative costs (European Commission 2012, Central Innovation Programme SME; Török 2012, 27).

Moreover, other objectives of ZIM include promoting the competitiveness and innovativeness of the German SMEs (BMWi 2014, Bundesministerium für Wirtschaft und Energie, 7; European Commission 2012, Central Innovation Programme SME; Török 2012, 27; Sofka & Sprutacz 2016, 46). Based on research, ZIM is the most important instrument targeted towards SMEs in order to strengthen innovative capabilities (Belitz et al. 2012, 3; BMWi 2016, Future of the German Mittelstand, 15-16; Heike et al. 2013,

14; Sofka & Sprutacz 2016, 46). Hence, ZIM is defined as a nation-wide funding programme, where the central aim is to establish various research collaborations between SMEs and businesses. Moreover, it is crucial to keep in mind that ZIM is not tied to a specific sector; in contrast, it is available to all technologies and sectors (BMW 2015, Central Innovation Programme for SMEs, 6; European Commission 2015, Policies in support of high-growth innovative enterprises, 14; Sofka & Sprutacz 2016, 46).

This adds to the programmes diversity and flexibility. As SMEs receive grants of various sizes, it is up to the enterprises themselves whether they prefer to conduct the projects and research on their own or in collaboration with others. For this purpose, three different routes exist: ZIM-SOLO (funding for single firm projects), ZIM-KOOP (joint R&D projects with more than one stakeholder), and ZIM-NEMO (the networks of innovative SMEs) (Heike et al. 2013, 6; BMW 2011 Building on SMEs, 8). ZIM is an important programme fostering SME knowledge exchange: collaboration and learning from experts, and other companies. Basically, SMEs participating in the programme can learn how other firms manage their innovation processes, in other words the programme transmits vital skills and know-how. This sort of learning fosters SMEs innovative behaviour and success. (Török 2012, 9.) Since 2008, ZIM has funded up to 29, 000 projects. One of the major strengths of the programme is its flexibility in grant applications. (Sofka & Sprutacz 2016, 46.) Hereby, the positive effects of ZIM are viewed as priceless. Although ZIM is recognized as the number one innovation policy for SMEs in terms of funding, this aspect still remains as one of the main obstacle to innovation in the SME sector. Albeit Germany constitutes a generally innovation hospitable environment, it still induces challenges in the field of financing, which it needs to address more comprehensively. (Zimmermann 2016, 2; Zimmermann 2014, 2.)

The evaluation reports highlight another central innovation programme, the *KMU-innovativ* (*Kleine und Mittlere Unternehmen*; small and medium sized firms-innovative), which is a technology-specific programme (Heike et al. 2013, 3 & 15-16; Sofka & Sprutacz 2016, 46). Basically, *KMU-innovativ* has been established to simplify the access to BMBF's traditional programs. Up to 70% of SME project costs can be granted for financing within the *KMU-innovativ*. (Heike et al. 2013, 3 & 15-16; Sofka & Sprutacz 2016, 46.) Moreover, the program is accessible in nine different technology fields. The *KMU-innovativ* functions are also diverse, as it does not only offer funding, but also guidance and expertise. (Belitz et al. 2012, 57; BMBF 2016 *Innovativer Mittelstand*; BMBF, *KMU-innovativ* 2016, 2.) Similar to ZIM, this policy measure also captures the essence of providing both formal institutional aid (funding), as well as informal help (guidance, expert support), which can be considered key to success in policy-making. All in all, there is much evidence that the funding programs initiated by BMW and BMBF have had a significant impact on improved quality of R&D and innovation

activities in German SMEs (European Commission, Research and Innovation Performance in Germany 2013, 6; Heike et al. 2013, 3 & 15-16.)

5.5.3 Comparison of the Finnish and German SME innovation policies

As the last step in the assessment of SME innovation policies of Finland and Germany, is the comparative dimension. As can be noted, the Finnish and German NIS provides a variety of different policies targeted towards the innovative SMEs. Although the Finnish and German SMEs demonstrate innovative success, they still face certain challenges, whether in the form of funding or internationalisation, which hinder their innovative efforts. Therefore, in order to ensure and enable the innovative performance of these dynamic firms, sufficient policies are needed. Within the Finnish and German innovation ecosystem, particularly Tekes and ZIM were highlighted. Intriguingly, it is interesting to note that Germany and Finland have established collaborative efforts in relation to their SME innovation policies. Hence, Tekes and ZIM have established the possibility for SMEs to engage in joint projects between Finland and Germany. Within these projects, SMEs can target any area they prefer in order to generate innovative and competitive services, processes and products. (Tekes 2015, Finnish-German Call for Joint Projects for SMEs; BMBF 2016, Bekanntmachung; BMBF 2015, Bekanntmachung; DFHK 2016, Suomalais-saksalainen haku pk-yritysten yhteisprojekteille.) This is a great example of what two effective institutions combined can produce: a collaborative approach to knowledge sharing. This is a dimension, which should also be strengthened among other European countries: promoting knowledge share, and generating cross-country innovative projects, which potentially leads to an impact in innovativeness of SMEs on a European scale.

As Török (2012, 13-14) states, from a Finnish and German perspective, innovation policies are mainly based on similar tools and initiatives. They share similar innovation policy strategies, such as offering SME support programmes and establishing new forms of knowledge transfer. Similar principles and actions take place at a European level. Nevertheless, some differences can be pointed out: Finland demonstrates a truly integrated and collaborative model, where different tools and activities are linked to each other. In the system, private firms and governments in fact demand foresight studies, whose results may impact the country's policy-making. (Török 2012, 13-14.) A challenge, which the Finnish system needs to address in its policy initiatives for SMEs, is the access to finance. Especially regarding the internationalisation of growth companies, the lack of funding remains an obstacle. For a small country like Finland, innovation internationalisation is extremely vital, as it boosts productivity and increases knowledge share. It is also one reason, why in the recent years, innovation policy has

shifted more towards growth enterprises and start-ups. (Halme et al. 2016, 77.) On the other hand, as Belitz & Lejpras (2014, 13-14) note, Germany ought to implement a more systematic approach to its SME policy-making. The German system has tried to imbibe a more systemic approach, and has adopted evaluations as part of its policy scheme. Thereby, foresight studies impact on how innovation policies and programmes change overtime, which accentuates their importance also in the future.

Other challenges, which the German SMEs face, are related to the bureaucratic burden and access to finance, which have been recently taken as major points to act upon in policy efforts (since 2015). Some of these actions include the new law enacted by the Federal government to diminish the bureaucratic burden for SMEs. Ultimately, it can be argued that also the German innovation system aims to follow a more systematic approach, and has addressed a number of issues, which the SMEs are currently tackling with; this with the help of setting up efficient policies and laws. Then again, a distinctly positive feature, which has been highlighted in the German SME policy frontier, is its innovative approach to policy-making. For instance, with ZIM the element of both funding and expertise are combined into a coherent policy. Expertise can for example be in the form of vouchers for professional consulting. This is an example of a dedicated policy instrument for the German SMEs as it provides support in many ways. All in all, despite the recent policy actions taken to support German SMEs, a major downward trend in SME innovation has taken place. (Sofka & Sprutacz 2016, 17 & 45-47.)

This downward trend, as Sofka & Sprutacz (2016, 96) state, needs major attention and a comprehension of the cause and effect relationships, in order to redefine and adjust the innovation policies aimed for SMEs. Hence, as with other challenges, which the Finnish or German SMEs face in relation to their innovative efforts, can at least to some extent be diminished with the help of effective policies. In order to set up viable policies, nations need foresight studies and evaluations, which is the basis for continuous assessment. Although policies are usually unique and country-specific, other countries may benefit significantly from benchmarking around successful innovation policies. Even for Finland and Germany, some policies and institutions have proven to be more successful than others (ZIM & Tekes). The knowledge share around successful innovation policies among countries may potentially increase the level of institutional learning and efficiency of NIS – a desired element, as countries strive for a more knowledge-intensive economy.

6 CONCLUSIONS

6.1 Theoretical implications

The theoretical framework used in this study has been fundamental, particularly regarding the analysis phase. The thesis incorporated a profound amount of theory, which was due to the fact that the research questions encompassed many different components related to national innovation systems. This justifies the need for a comprehensive approach to theory, in order to underline the key themes within data analysis. As a consequence, out of all the theories, the NIS approach has been most essential. Based on literature *the analytical framework for evaluating NIS* was deployed, which also took into account the SME field. According to the opinion of the researcher, an area, which prior frameworks have not been able to address. Hence, the framework embraced three distinct stages: 1) Identifying key actors and functions, 2) Analysing their functions, and 3) Specifying central SME innovation policies and activities. In principle, the analytical framework helped explain the innovation systems from a *systemic dynamic approach*. The systematic dynamic approach contemplated the German and Finnish innovation system from mere R&D figures, also taking into account the collaborative and networking features, which are vital whilst depicting complex innovation systems.

In relation to analytical framework, it can be argued that the current framework broadens existing literature. Also, it provides a different point of view in which NIS should be portrayed, taking into account the importance of SMEs. Albeit this was not the initial objective of the study, i.e. to test theory, nevertheless, the applicability of the framework was seen important and was tested. Nevertheless, the framework as such is by no means perfect and poses challenges. In order to determine whether it is an efficient tool for comparative studies, further research is required, and an extensive amount of testing on its practicality is needed. The initial framework from Resele's (2014) theory lacks in its comparative approach, and therefore testing is needed to verify whether the adapted framework suits for other similar studies. Also, the transferability of the framework may differ to a great extent within countries. Consequently, from a theoretical standpoint, no radical and abrupt conclusions can be made on its effectiveness. What this sort discussion highlights is that more theoretical contributions in the field of comparative tools for evaluating NIS are needed. In addition, these tools should be adapted to also consider the SME landscape and innovativeness. Clearly, the two dimensions have an impact on each other, however, the absence of theory combining these two elements, is lacking.

Also, the *Triple-Helix model* developed by Etzkowitz has been significant. The triple helix emphasises the three utmost important actors of NIS: government, academia and

industry. In fact, especially in the comparative analysis phase, it became clear that both countries highlight the importance of all three actors. What was surprising for the researcher was the amount of significance that was laid upon the academia of the two systems; indeed they are considered as one of the most vital facilitators of knowledge. The academia is a feature, which the triple helix also considers most integral to a knowledge facilitating system. The researcher quickly grasped that there was a clear linkage between theory and data present. Basically, the TH-model complements with other theories related to NIS: all theoretical foundations have a strong belief in the strength of networks, interactions and linkages between its actors. The quality of linkages was also highlighted in *Porter's national innovative capacity framework*, which was also witnessed in the data analysis phase of Germany and Finland. Nevertheless, although the triple helix comprehends that the institutional needs vary within each country, it still doesn't provide any clear tool to actually gauge on the efficiency of NIS. Also, a similar challenge related to the analytical framework of NIS: the triple helix does not take into account culture specific traits, which poses challenges for a comparative study.

Another remark, which the researcher made, was the *lack of literature on the linkage between entrepreneurship – NIS*. Although it was already highlighted as a key issue in chapter 3.3.3 “Critique on the NIS approach”, indeed theory has not managed to embody this field inclusively. It became particularly apparent, as data in return, has captured the essence of NIS and entrepreneurship. The lack of literature around such a central theme concerns the researcher, as entrepreneurship plays an important role in the entire innovation system, especially regarding promoting innovativeness, i.e. the entrepreneurial attitudes and behaviour. If literature were able to acknowledge the linkage between the two, also more accurate conclusions within the analysis phase could have potentially been made. In relation to the *external knowledge capabilities of SMEs* (introduction), the researcher argues that this study has a clear indication that SMEs truly need external aid in order to facilitate innovative outcomes. However, the researcher does not neglect the fact that internal innovation capabilities are essential too, but by no means can the external factors be dismissed. Thereby, a clear linkage between data and theory exists. If firms are being restrained from receiving access to finance and innovation projects, innovative behaviour can potentially be hindered. Therefore, SMEs need to engage in the external opportunities posed by the environment, in order to leverage their innovation potential. On the other hand, the external environment needs to enable policies and activities for SMEs to engage in. It is a mutual and reinforcing system.

All in all, although literature has come a long way from studying innovation systems from a linear approach, it still addresses the need for more theoretical contributions (e.g. examining the systems complexity, interactivity, and from a comparative standpoint). Tools ought to be developed so that they examine the impact of NIS on SME innovativeness, as till now it mainly focuses around SME innovations as inputs and outputs.

Therefore, whether a more exact theoretical framework had existed, more applicable and accurate results could have been potentially illustrated. Ultimately, the current framework deployed has proven to be reasonable, yet at the same time, it doesn't consider cultural and historical elements as comprehensively (e.g. informal institutions) as it should, leaving out important elements, which are needed for a comparative study.

6.2 Managerial implications

The purpose of this study was to examine the Finnish and German national innovation systems, more precisely, in a comparative manner, in order to identify their distinct national characteristics and SME policies. The objective of the study was to give a holistic view of the two NIS, especially from an institutional perspective. Although NIS as a field of literature has received wide recognition, at the same time, it has been confronted by a lot of critique. Critics' argue that national innovation systems have already been researched in developed countries, and that developing countries would require more research. Nevertheless, the researcher disagrees with sort of thinking in many aspects. In the opinion of the researcher, the current state of research has not managed to encompass the field of NIS comprehensively within developed countries. For instance, the dimension of national innovation systems and their influence on SMEs has not been addressed adequately. Also, fewer studies have managed to study NIS from the innovative capacity that it holds.

In the light of this study, decision-makers from other national innovation systems (e.g. in Europe) could benefit from these sort of comparative assessments. Ultimately, SMEs are the cornerstone of Europe's economic market and viability, not only in relation to job creation, but also in terms of generating novel innovations and innovative behaviour. Thus, this type of resilient performance promotes competitive advantages for nations and increases productivity. Therefore, comparative studies around developed economies should not be dismissed. They provide essential insight for other nations, both the developed and developing ones. If countries shared their successful innovation policies and programmes, as a consequence, other countries could benchmark and imbibe similar innovation strategies. This type of knowledge share between countries could potentially promote knowledge transfer not only within domestic borders, but also outside the country, which in fact, could potentially be fundamental for innovativeness globally. Not only would policy-makers benefit from comprehensive studies on NIS, but also SMEs themselves. Basically, all actors within the system could utilise research results on, which policies and activities are beneficial. Ideally SMEs would be able to search and find information on what sort of innovation programmes and activities exist, which they could tap into.

In relation to cross-country collaboration, as pointed out earlier, Finland and Germany have managed to establish cooperation by combining their institutional strengths around SMEs, i.e. the collaboration between ZIM and Tekes. The cooperation between the two institutions is a great example of what two strong innovation leaders can produce. In principle, by joining country specific institutional strengths, enhances not only knowledge share among policy-makers, but also among the SMEs themselves, which is reciprocally beneficial. More importantly, it contributes towards SMEs internationalization efforts, in which particularly Finland has been struggling. Perhaps the core problem, which European countries encounter, is that each nation aims at being top-performers in relation to competitiveness and innovativeness; they do not always realise the advantages related to knowledge share. Essentially, a lot of studies focus on the figures and numbers resonating the resilient performance, but in order to understand the institutional environment carefully, more comprehensive approaches are needed, as then policymakers can benefit in adopting new policy initiatives. All in all, comparative studies and benchmarking are an integral part of effective policy-making.

6.3 Limitations and suggestions for future research

The study poses some limitations. Most of the limitations can be associated with assessing national innovation systems, especially in terms of its innovative capacity. Ultimately, no exact formula exists for measuring the functionality of the national innovation system, which clearly addresses the need for further development. It is for certain that the innovation system as such has an impact on the innovative performance of SMEs, however, to what extent exactly, are still unknown. Another feature in conjunction with assessing NIS is the comparative element, a challenge, which has not been fully tackled yet. Nevertheless, what today's research does provide are the numerous conventional indicators available such as R&D expenditure figures, number of patents, innovation cooperation, etc., which provide great insight for evaluating national innovation systems. However, they can only be deployed as a means of giving an approximate picture of NIS. None of these indicators actually take into consideration NIS comprehensively as entirety, where all indicators would be accumulated into one single tool. For instance, the linkage between national innovation systems and SMEs is under researched. Although there are studies, which examine SME innovation policies, they do not address the notion, how this in return affects the innovative behaviour of firms.

Additional limitations include the ambiguity of national innovation systems, which is especially apparent in the analysis phase. It is an extensive system, which encompasses several actors and institutions, not to mention knowledge flows and interactions. Thus, sufficient conclusions from such large systems can be difficult to draw, as it incorpo-

rates multiple components. There is also a lack of similar methodologies for analysing NIS among different countries. This holds particularly true in relation to a comparative analysis, where the lack of a similar structure of NIS can be difficult to liken. Some scholars and nations prefer to deploy an 'all-inclusive' means of analysis, where the system is assessed from all of its inputs and outputs. In contrast to scholars whom prefer to focus solely on distinct aspects, such as knowledge flows.

Even within this study, for the researcher to be able to imply that the Finnish and German national innovation system can be used as a means of benchmark for other EU countries: this statements doesn't take into account that a 'one size-fits-all' may not work for other member states. Therefore, national innovation systems are always unique and individual. What works in one country, may not translate to others. Due to the dynamic nature of NIS, where things change on a constant basis, success is not guaranteed for the longer run. Even though Finland and Germany may resemble strong innovation systems now, this might change in the nearby future drastically. Basically, the national innovation system role models can alter very quickly. Another limitation is related to the data available on national innovation systems, from a global versus EU perspective. Essentially, most analysis on NIS was carried out on either the basis of European Commission or the OECD tools, which as such can already induce biased views. The OECD includes 35 member states and the EU 28 members. Then again, considering how many countries exist world wide, is it reliable to talk about truly global measurement tools? Another issue related to this is that most data does not bridge the two, European Commission and OECD, which can potentially give rather one-sided results.

In the opinion of the researcher, although the OECD and EC organizations prove to be trustworthy and significant in the light of NIS, thus more studies on bridging the two fields EU – Global interface are needed, to give a more inclusive picture on national innovation systems. Consequently, this would potentially enhance the analysis amongst different countries, whether they would stem from the EU, or not. The current data available already governs the direction of comparative studies to be carried out on either a EU level basis, or OECD basis, which in the long run is not ideal. Nevertheless, the reason for choosing OECD and EC as comparative tools for assessing NIS was one way of diminishing biases from a Finland and Germany standpoint. The researcher did not want to deploy country-specific tools, this to avoid biases. Obviously, this links towards the suggestions for future research. It goes without saying that more efforts are needed to formulate a comprehensive framework approach for analysing NIS, as only then researchers are able to carry out reliable comparative assessments. Otherwise, benchmarking on the best practices of national innovation systems may be dubious. Also, foresight studies and evaluations are critical to continue employing as a means of continuous assessment of policies. Nevertheless, more future research is needed on, how concretely nations can benchmark on the successful innovation policies of others: countries need

clear strategies and guidance on how the innovation policies can be leveraged in the best possible way. Thus, another field of future research can be associated with the dimension of formal and informal institutions. Although this study had a stronger focus on formal institutions (policies), some of the informal institutions (entrepreneurial attitudes) were also captured. However, more research is needed in the field of both formal and informal institutions, and their reciprocal impact on one another, as well as the impact on the entire innovation system. Ultimately, the analysis of informal institutions may provide answers for the effectiveness/ineffectiveness of formal institutions, and vice versa.

Furthermore, this study focused more on the institutional perspective; also socio-cultural, political and judicial dimensions should be captured in comparative assessments, to provide reliable outcomes. However, the reason for having selected the institutional sphere as a point of view was mainly due to the fact that it was recognized as more urgent to depict. Lastly, prospects for future research can be found in the field of innovations versus innovativeness. As till date, there is still no exact distinction between the two. Essentially, if researchers were able to provide more clear and coherent tools on measuring either one, also the analysis phase would potentially be more consistent. This would allow more diverse approaches to assess national innovation systems, as today most research focuses on innovations as numbers, i.e. patents and R&D, whereas more dynamic features could be introduced. This sort of change in research needs to be commenced from literature. Thereafter, institutions like the OECD and European Commission could tap into this, and provide more versatile data on national innovation systems.

7 SUMMARY

The purpose of the study was to give an overview of the German and Finnish national innovation system, in order to identify the innovation policies that contribute towards the innovativeness of SMEs. Therefore, the study was conducted in a comparative manner, so that the country specific differences versus similarities could be showcased. Ultimately, as the main and central purpose of this study was to, *describe and compare the national innovation systems in Finland and Germany, in order to identify the innovation policies and activities contributing towards SME innovativeness*. This having said, the study has explicated matters from an external standpoint, as prior research has focused around firms' internal strengths. In terms of the external features, especially (formal) innovation policies and activities facilitating innovativeness of firms become fascinating. It was vital to incorporate the notion of SMEs within the study, as in the opinion of the researcher this dimension has been neglected in prior NIS studies.

Quite frankly, even as statistics and data validate, it can be acknowledged that both Finland and Germany portray strong and robust national innovation systems. Ultimately, their institutional environment enables a landscape beneficial for innovative success. At least from a European point of view, Finland and Germany are top-performers, and can be accounted as the 'innovation leaders'. This is particularly interesting considering the significant differences in relation to their size: Germany constitutes of the biggest population and economic force in EU (over 80 Mill.), whereas Finland remains one of the smaller countries (over 5 Mill). Despite both countries belonging to the EU, their institutional profile and innovation systems differ vastly. For instance, Germany comprises of multiple layers and actors, whereas Finland has only four operational layers. However, although the layers of the system may differ distinctly, still both innovation systems share the common notion of being complex and ambiguous in nature, comprising of different linkages and networks; this sets its own challenges for a comparative assessment.

Due to the complexity of national innovation systems, it was important to assess NIS from a dynamic standpoint, with the help of key functions including R&D, knowledge flows, entrepreneurship, human resources and networking. In most functions, Finland turned out to be slightly more effective. This is also in line with the figure 1 presented in the beginning of the study (European Innovation Scoreboard 2016 country ranking), where Finland overtakes Germany. However, in the single SBA indicator on SME 'innovation and skills', Germany outperforms Finland. It can be acknowledged that it is extremely difficult to state, which country performs better in terms of overall innovativeness: both nations pose varying strengths and weaknesses, which either reinforce or hinder their innovative capacity. Also, it is important to bear in mind that this was never the initial intent of the study, to argue, which system performs better. Nevertheless, this

sort of comparison becomes inevitable to some extent. The idea was to give a comprehensive and descriptive understanding of the two national innovation systems.

It is for certain that the Finnish national innovation system encompasses a number of factors, which depicts its outstanding performance, and has led to it being one of the most competitive systems in the EU. Noteworthy to mention are its major investments in public and private R&D (facilitating knowledge transfer), an entrepreneurially oriented mind-set (particularly through the Aalto University), the robust innovation institutions (e.g. Tekes and its various innovation policies), as well as its overall systematic approach to SME policy-making. However, Finland needs to ensure the effectiveness of its system and policies also in the nearby future, as based on the statistics, the level of R&D expenditure will drop significantly. Consequently, it will have an enduring impact on the knowledge flows and innovativeness. Therefore, the prospects related to Finland's innovation system ought to be considered with caution.

Then again, Germany's success, especially in the SME innovation sector has features worth highlighting. ZIM as a central and key programme has established positive outcomes in terms of boosting innovation. These types of diverse programmes like the Central Innovation Programme truly demonstrate the great strength that resides in Germany: a robust and well-outlined policy, which allows SMEs to engage in innovative projects. The Central Innovation Programme has been set up in order to increase transparency and diminish administrative costs, i.e. reducing uncertainties, which are the paramount objective institutions aspire to achieve. Nevertheless, at the same, Germany faces extreme challenges in the SME field, not only with the administrative burden, but also in relation to entrepreneurship, which has influenced the decline of SMEs. In terms of entrepreneurship, the attitudes and social stigma, i.e. the fear of failure, needs to be addressed, not only by establishing effective institutions, but also the society as whole has to act towards diminishing this, as it can be truly detrimental to SME innovativeness and young entrepreneurs.

In principle, both Finland and Germany have managed to construct efficient innovation policies. The vital component towards successful policy-making is not purely based on the funding element, but also the expertise, knowledge and guidance, which these policies provide. It is a combination of both, the formal (funding) and informal (knowledge share), which has potentially contributed towards the Finnish and German SMEs innovative performance (e.g. in the case of ZIM and Tekes). These sort of well-engineered policies assist SMEs in their innovative efforts, which is an area that other EU members could benchmark on. The only issue, which is difficult point to out is, how much these policies have yielded innovativeness (quantitative measure). This sort of evaluation would require an extensive amount of testing, but would be truly beneficial in terms of benchmarking and best practices knowledge share. All in all, the national innovation systems of Finland and Germany have components, which rest of the EU

member states could imbibe from: the overall coherent construction of institutions and policies, extensive investments in both public and private R&D, investments in human resources, and the strong bonds between its different actors (e.g. networking & knowledge share). Although the countries face weaknesses, they still enable an overall favourable business-environment. This sort of institutional set up is essential to maintain in the future, as more EU members states are beginning to catch up swiftly. Thereby, Finland and Germany need to retain, if not enhance, their strengths within the innovation system.

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APPENDICES

APPENDIX 1

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APPENDIX 2 ABBREVIATIONS FOR THE VARIOUS SOURCES

Abbreviation	Full name
Aaltoes	Aalto Entrepreneurship Society
DFHK	Deutsch-Finnische Handelskammer
EC	European Commission
OECD	Organisation for Economic Co-operation and Development
Tekes	Teknologian Kehittämiskeskus
MEE	Ministry of Employment and Economy
MEC	Ministry of Education and Culture
VTT	Technical Research Centre Finland
RIC	Research and Innovation Council
BMBF	Federal Ministry of Education and Research
BMWI	Federal Ministry of Economy and Technology
KfW	KfW Bankengruppe
ISI	Fraunhofer Institute for Systems and Innovation Research
DIW	Deutsches Institut für Wirtschaftsforschung

APPENDIX 3 SAMPLE CODING

I innovation

3.7 Skills & innovation

Percentage of SMEs introducing product or process innovations, 2012. Finland 40.06, EU avg 30.6

Percentage of SMEs introducing marketing or organisational innovations, 2012, Finland 37.03, EU avg 36.19

Percentage of SMEs innovating in-house, 2012, Finland 36.46, EU avg 28.68

Percentage of innovative SMEs collaborating with others, 2012, Finland 14.28, EU avg 10.32

Sales of new-to-market and new-to-firm innovations (percentage of turnover), 2012, Finland 11.14, EU avg 12.4

Percentage of SMEs selling online, 2014, Finland 14.13, EU avg 14.61

Percentage of SMEs purchasing online, 2014, Finland 38.73, EU avg 22.01

Turnover from e-commerce, 2014, Finland 19.25, EU avg 15.07

Percentage of all enterprises that train their employees, 2010, Finland 74, EU avg 66

Variation from the EU average
(measured in standard deviations, EU average=0)

Metric	Finland	EU avg	Variation (SD)
Percentage of SMEs introducing product or process innovations, 2012	40.06	30.6	~0.9
Percentage of SMEs introducing marketing or organisational innovations, 2012	37.03	36.19	~0.1
Percentage of SMEs innovating in-house, 2012	36.46	28.68	~0.8
Percentage of innovative SMEs collaborating with others, 2012	14.28	10.32	~0.4
Sales of new-to-market and new-to-firm innovations (percentage of turnover), 2012	11.14	12.4	~-0.3
Percentage of SMEs selling online, 2014	14.13	14.61	~-0.1
Percentage of SMEs purchasing online, 2014	38.73	22.01	~1.0
Turnover from e-commerce, 2014	19.25	15.07	~0.4
Percentage of all enterprises that train their employees, 2010	74	66	~0.8

Note: Data bars pointing right show better performance than the EU average and data bars pointing left show weaker performance

Finland performs well above the EU average in this area. It boasts a large number of SMEs which are involved in various forms of innovation. This is in line with the country's overall position as an 'innovation leader' on the EU's 'Innovation scoreboard'. Compared to last year, there have been slight improvements in some of the innovation-related indicators. Over the entire SBA period since 2008, Finland's performance in terms of SME participation in innovation-related activities has stabilised around the same high level. This also holds for Finnish SMEs' uptake of IT since 2008. This stabilisation is an achievement, considering that at the same time overall EU performance deteriorated.

This performance was helped by the considerable policy efforts focused on this area since 2008. During this period, Tekes, the most important innovation-financing organisation, steadily moved its focus towards financing more SMEs. In its 2011 strategy, Tekes earmarked one third of its funding for new growth-oriented companies and another third for established companies with less than 500 employees. This was a dedicated shift to support SMEs, although SMEs already accounted for two thirds of all funding in 2011 (up from around 55% in 2004). Since then this share has dropped slightly (53% in 2014). Another important and successful measure was the specific Instrument for Young Innovative Companies, launched in 2008.

In the reference period, Tekes complemented these programmes with several other 'campaigns', directed at SMEs especially. These are more short-term than multi-annual programmes, focus on different themes and target different sectors. In addition, a financing instrument, 'Tekes support programme for innovation activities in small and medium-sized enterprises', was introduced at the beginning of 2015. Funding is granted to SMEs for innovation activities, e.g. to help SMEs strengthen and protect their intellectual property rights, transfer highly qualified personnel from large companies or research organisations on a temporary basis and provide innovation advisory and support services. The programme is valid until 31 December 2020. The maximum budget for the programme is EUR 250 million and consists of loans and grants to assist SMEs in various ways across several sectors. Overall, Finland has fully addressed the SBA agenda in this area.

ISME innovative SME

IA innovation-activity

IP policy

T Tekes

YIC young innovative companies

APPENDIX 4 IMPACT OF THE YOUNG INNOVATIVE COMPANIES
(NIY) PROGRAM IN FINLAND (Tekes & The Evidence Net
work 2013, 11)

Performance Measure	Performance since Engagement with NIY Program	Percentage of Companies Attributing Positive Impact to the NIY Program
Annual Revenues	61% of companies increased revenues by 100% or more	90
Export Revenues	44% of companies have export revenues greater than €500,000	97
Increase in International Customers	52% acquired 10 or more international customers; 81% acquired 3 or more	96
Increase in Employment	34% increased by more than 100%; 77% increased by 25% or more	93