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Technology Transfer and Innovation Strategy (T2IS): Innovation Network Model as an Instrument for Internationalization of SMEs

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SUMMARY

Small and medium-sized enterprises (SMEs) are vital to the health and vibrancy of the European economy, and researchers need to understand the factors that underlie the international process of SMEs. One of the most widely identified antecedents to the internationalization of SMEs is networking capacity. However, despite widespread attention, the theoretical and empirical status of the relationships between technology transfer, innovation strategy, network and SMEs internationalization remains uncertain. Some researchers note that claims regarding a direct positive relationship between network capacity with internationalization fail to adequately account for the variables that mediate this relationship.

The purpose of this thesis is to increase the understanding of how the combination of technology transfer and innovation strategy has become a key element for ensuring the development and growth of SMEs since has enhanced their ability to be part of networks and has facilitated their access to international markets. The central research question of this thesis asks: *How do technology transfer and innovation strategy (T2IS) facilitate the SMEs internationalization process?*

Collectively, the five chapters contribute to explain the SMEs internationalization process by more precisely explaining the relationships between technology transfer, innovation strategy, networking capacity and SMEs internationalization. The thesis, therefore, highlights and confirm that SMEs can balance their limited resources with careful participation in networks. Indeed most SMEs need to be part of networks to get their innovations and develop special competence on technology transfer and rapidly access to international markets. Although there exists a well-developed tradition of industrial network research there is a lack of analysis of systematic and empirical models of network relating to the technology transfer and innovation strategy in the context of SMEs'internationalization.

Based on the research framework on theoretical insights from technology transfer's topic and its extensive concepts of innovation, network and internationalization, the thesis examines how the internationalization process is facilitated by SMEs' networking capacity. The findings allowed us to address an empirical study created to develop a systematic conceptual model of an Innovation Network (IN) and propositions regarding the access of SMEs to international markets. The IN model can be an easy-to-follow innovation model for SMEs when adopting a knowledge-transfer, innovation strategy and networking approach. This helps to make certain the important drivers and approaches for the innovative network capacity and internationalization performance of SMEs. These findings have critical implications for practitioners in enhancing their firms in international performance. More specifically, the thesis analyzes how SMEs' membership in networks or clusters stimulates the concrete collaboration with High Education Institutions (HEIs) or Public Research Institutions (PRIs), Governments and other businesses and contribute to acquire and absorb innovation via different channels of external knowledge influencing SMEs' behaviours at the international level.

SMEs are encouraged to concentrate on developing network partnerships that promote innovation breadth. The IN model guides SME practitioners who agree that both networking and innovation investments will boost the internationalization of their SMEs. Due to potential networking and innovation costs and threats for SMEs, the potential risks of overextending limited resources and expertise for practitioners and policymakers are recognized. A clearer understanding of how large-scale SMEs can build their innovation networks and how to build or participate in optimal network structures can therefore be of great benefit to theory, policy and practice.

SUMARIO

Las pequeñas y medianas empresas (PYME) son vitales para la salud y la vitalidad de la economía europea, y los investigadores deben comprender los factores que subyacen al proceso de internacionalización de las PYME. Uno de los antecedentes más identificados de esa internacionalización de las PYME es la capacidad de creación de redes. Sin embargo, a pesar de la atención generalizada, el análisis teórico y empírico de las relaciones entre la transferencia de tecnología, la estrategia de innovación, la creación de redes y la internacionalización de las PYME sigue siendo relativamente escaso. Algunos investigadores señalan que las afirmaciones relativas a una relación positiva directa entre la capacidad de formar parte de una red de colaboración con la internacionalización no tienen en cuenta adecuadamente las variables que median esta relación.

El objetivo de esta tesis es aumentar la comprensión de cómo la combinación de la transferencia de tecnología y la estrategia de innovación se ha convertido en un elemento clave para garantizar el desarrollo y el crecimiento de las PYME, ya que ha mejorado su capacidad de formar parte de redes cooperativas y ha facilitado su acceso a los mercados internacionales. La pregunta central de investigación de esta tesis es: *¿Cómo la transferencia de tecnología y la estrategia de innovación facilitan el proceso de internacionalización de las PYME?*

En conjunto, los capítulos contribuyen a explicar el proceso de internacionalización de las PYME explicando con mayor precisión las relaciones entre la transferencia de tecnología, la estrategia de innovación, la capacidad de creación de redes y la internacionalización de las PYME. Por lo tanto, la tesis destaca y confirma que las PYME pueden equilibrar sus limitados recursos con una participación cuidadosa en redes colaborativas. De hecho, la mayoría de las PYME deben formar parte de esas redes para obtener sus innovaciones y desarrollar una competencia especial en materia de transferencia de tecnología y de acceso rápido a los mercados internacionales.

Aunque existe una tradición bien desarrollada de investigación en redes industriales, no existe un análisis de los modelos sistemáticos y empíricos de la red en relación con la estrategia de transferencia de tecnología e innovación en el contexto de la internacionalización de las PYME.

Basándose en el marco de investigación sobre los conocimientos teóricos de la transferencia de tecnología y sus amplios conceptos de innovación, redes e internacionalización, la tesis examina cómo se facilita el proceso de internacionalización por la capacidad de redes de las PYME. Los resultados permiten abordar un estudio empírico creado para desarrollar un modelo conceptual sistemático de una red de innovación y propuestas relativas al acceso de las PYME a los mercados internacionales: el modelo IN (Innovation Network). Este puede ser un modelo de innovación fácil de seguir para las PYME al adoptar un enfoque de transferencia de conocimiento, estrategia de innovación y creación de redes. Además, posibilita identificar los factores y enfoques más relevantes para desarrollar la capacidad de red innovadora y el rendimiento de la internacionalización de las PYME. Estos hallazgos tienen implicaciones críticas para los profesionales en la mejora de sus empresas en el desempeño internacional. Más concretamente, la tesis analiza cómo la pertenencia de las PYME a redes o clusters estimula la colaboración concreta con universidades (IED) o instituciones públicas de investigación (PRI), gobiernos y otras empresas y contribuye a adquirir y absorber la innovación a través de diferentes canales de conocimiento externo que influyen en los comportamientos de las PYME a nivel internacional.

Los resultados de la tesis alientan a las PYME a concentrarse en el desarrollo de redes colaborativas que promuevan la amplitud de la innovación. El modelo IN (Innovation Network) guía a los profesionales de las PYME a realizar inversiones tanto en redes colaborativas/clusters como en innovación para impulsar la internacionalización de sus PYME. No obstante, debido a los posibles costos de creación de redes e innovación y las amenazas para las PYME, es necesario tener en cuenta los riesgos potenciales de sobreextender los recursos limitados, muy especialmente para aquellos encargados de formular políticas de fomento de la innovación, el desarrollo y la internacionalización de las PYME.

La tesis que se presenta tiene como objetivo una comprensión más clara y proponer un modelo de IN para las PYME para que estas puedan crear sus redes de innovación, que estas facilitan su internacionalización y cómo construir o participar en estructuras de red óptimas puede ser de gran beneficio para la teoría, la política y la práctica.

Statement of original authorship

The work contained in this thesis has not been previously submitted for a degree or diploma at any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signed: 

Dated: Padua, 20.04.2021

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Serena Mancini

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Abbreviations

CCI - Cultural and Creative Industries
CEF – Connecting Europe Facility
CERN - European Council for Nuclear Research
CIP - Competitiveness and Innovation Framework Program
DIHs - Digital Innovation Hubs
EAFRD - European Agricultural Fund for Rural Development
ECSC - European Coal and Steel Community
EDIDP - European Defence Industrial Development Programme
EDP - Entrepreneurial Discovery Process
EFSI - European Fund for Strategic Investments
EIP - Entrepreneurship and Innovation Program
EIP - European Innovation Partnerships
EIS - European Innovation Scoreboard
EPO - European Patent Office
ERNs – European Reference Networks
EU - European Union
EURADA - European Association of Development Agencies
FDI - Foreign Direct Investment
FP7 - Seventh Framework Program
GDP - Gross domestic product
HEIs - High Education Institutions
HPC - European High-Performance Computing
ICT - Information and Communication Technologies
ICT-PSP - Information Communication Technologies Policy Support Program
IEE - Intelligent Energy Europe Program
IET - International Entrepreneurship Theory
IJVs – International Joint Ventures
IN - Innovation Network
KBV - Knowledge-based view
KET - Key Enabling Technologies
KIT - Knowledge, Innovation and Technology
LE - Large Enterprise
MFF - Multiannual Financial Framework
MNC - Multinational Corporation
NFBS - Non-financial business sector
NGOs - Non-Governmental Organizations
OECD - Organisation for Economic Co-operation and Development

OL - Organizational Learning
PRIs - Public Research Institutions
PTD - Potential Technological Distance
RDA - Resource Dependence Approach
RIS - Regional Innovation Scoreboard
RIS3 - Research and Innovation Strategies for Smart Specialization
RTD - Research and Technological Development
SMEs - Small and medium-sized enterprises
SNA - Social Network Theory
T2IS - Technology Transfer and Innovation Strategy
TCA - Transaction Cost Approach
TFEU - Treaty on the Functioning of the European Union
TH -Triple Helix
TT - Technology Transfer
URCs - University Research Centres

Chapter 1 INTRODUCTION

This thesis aims to address an empirical study created to develop a systematic conceptual model of an innovation network and propositions regarding the access of small and medium-sized enterprises (SMEs) to international markets. This model examines the scientific knowledge of relationships between governments, university and industry, specifically SMEs and it can be an easy-to-follow innovation model for SMEs when adopting a knowledge-transfer, innovation strategy and networking approach. Specifically, the objective of the PhD project is to propose a model of an innovation network, testing it to Italian and Spanish cluster cases and contributing to a better understanding of the level and structure of internationalisation of European SMEs. As a consequence, the thesis proposes a way on how to improve (1) the networking and internationalization of SMEs that can be enhanced through (2) the application of an innovative model to traditional pathways. While all of these factors will be elaborated on throughout the next sections, we will begin by contextualising the background of the thesis and by explaining the applied methods and research design and we will conclude by summarizing the structure of the thesis.

1.1 Background

Small and medium-sized enterprises (SMEs) are affected by the globalization of the markets and the increasing competition force them to act at the international level (Williamson, 1985). The introduction of international collaborative approaches has appeared as one solution for small businesses to address their constraints. The introduction of multinational collaborative methods is one solution for small businesses to address their constraints.

Various aspects of their business especially the process of internationalization, have paid a great deal of attention to academics and entrepreneurs by playing an active role in international markets over the last few years. However, the process of internationalization requires a level of investment and assets that small and medium-sized enterprises do not normally have. The size, age and experience of SMEs influence their willingness and ability to internationalize. Smaller firms are less internationalized than larger ones as well as exports and imports tend to increase as SMEs grow more mature. Few European SMEs do business internationally, either within or outside the European Union (EU). According to a study conducted in 2018, 25% of EU-based SMEs have been engaged in exports (inside and outside Europe) over the previous three years. Only 13% of EU-based SMEs have discussed development markets outside the EU, have rapidly extended their businesses to international markets and used international diversification as a significant route by which to realize their potential growth. (Pangarkar, 2008).

For the last few decades, researchers have been exploring current assumptions and creating new international market theories to understand when and how SMEs are internationalizing. Internationalization theories have described the various mechanisms of internationalization that take place as businesses spread across national boundaries. Various investigations have explored the range of internationalization with the finding that most of these mechanisms do not clarify the internationalization actions of different firms, but this does not mean that they are not at all helpful. Indeed, the majority of these approaches claimed that the success of SMEs against larger competitors can be determined by their ability to make efficient use of internal and external networks and to create useful collaborations (Noteboom, 1994; Chesbrough, 2003; Narula, 2004). Smaller companies need to be internationalized and simultaneously opened up to work with internal and external partners such as suppliers, customers or even universities (OECD, 2008). The advantages of internationalization come not only from exports but from all forms of international activity.

Networks broaden the ability of individual SMEs to internationalize and continue to be a critical component of such assistance. Networks seem a relevant source of competitive advantage and an effective way to assist SMEs in internationalizing more rapidly due to information benefits (Zamberi Ahmad, 2014), and they allow SMEs to develop more chances of internationalizing successfully (Torkkeli, Puumalainen, Saarenketo and Kuivalainen, 2012). Furthermore, Chetty and Agndal's (2007) research emphasizes that the network can be viewed as a dominant component of SMEs' social capital, which is efficacious for firms' internationalization, for instance, the more interactions a firm has with its partners, the more resources their partners would devote. Achrol (1997) also agrees with the efficacy role of a network and emphasizes the importance of commitment, trust and social norms when building long-term stable partnerships. In consequence, the acquired information would create business chances for SMEs (Chetty and Agndal, 2007; Torkkeli et al.,2012).

SMEs need networks to get their innovation and special commercial competency and to realize rapid growth. SMEs can compensate for their limited resources with a careful utilization of networks. Network relationships are not "free" however they need specific managerial capabilities. Indeed network capacity of SMEs can improve their competitiveness by easing cooperation among small groups of companies. By getting together, they can improve performance, increase their visibility and enhance their internationalisation strategy and performance.

Growth-oriented SMEs are increasingly establishing different kinds of cooperative arrangements with other companies and organization (Jarillo, 1989) to share business risks, managing their innovation and market growth processes (Castells, 1996). In the early stages of growth, SMEs need to establish relationships with companies and opinion leaders who have high visibility in the field (Larson, 1991; Lia and Welsch, 2002). According to Lechner and Dowling (2003), these relationships create a network that helps an SME to overcome the liability of newness (Elfring and Hulsink, 2003).

Some networks are critical in several stages of the life cycle. For technology-driven firms, it is also important to participate in the so-called knowledge, innovation and technology (KIT) networks (Lechner and Dowling, 2003; Nonaka and Teece, 2001). These networks provide the company with new knowledge or access to the new knowledge creation process (Lechner and Dowling, 2003; Cohen and Levinthal, 1990).

There are also two types of networks: support network and collaboration network (EC, 2007, p 24-5). Support networks aim to be operated by the government (e.g. commercial offices abroad) or by major business groups. They have a vital role to play in promoting some kind of internationalization as they have access to information that can be accessed explicitly by SMEs. In this position, they cover one of the areas of greatest demand and need for SMEs (EC, 2007, p 24-5). Cooperation networks focus on promoting direct cooperation between companies (EC, 2007, p 24-5). Clusters, business networks and export consortia will play an important role in enabling SMEs to achieve a more foreign perspective. In particular, export consortia have a special role to play by serving groups of firms collaborating on an export growth initiative. Within a narrow niche, they are always successful from the outset in foreign markets and membership in a cluster enhances their export potential (EC, 2011 (2), p 13).

SMEs housed in clusters and business networks benefit from interactions, business interactions and formal and informal expertise flowing within clusters and business networks, as well as from tailored services supported by cluster and network associations. Such benefits promote, for example, the establishment of relationships abroad so that SMEs can have better access to global supply chains, establish strategic alliances with research organizations in counterpart clusters or networks, extend their business operations abroad, including public procurement, and receive relevant services, skills and personalized technical advice (EC, 2011 (2), p 13). European Member States should identify clusters and network associations as effective facilitators and include them in market support schemes aimed at facilitating the internationalization of SMEs (EC, 2011 (2), p 13).

Nevertheless, many studies demonstrate that, even if there is evidence of mutual benefits, most SMEs are reluctant to collaborate. This fact encourages the labour of this dissertation: explaining the internationalization process of SMEs more efficiently and came up with an Innovation Network model as an instrument of internationalization based on the most important international entrepreneurship theories. Although there exists a well-developed tradition of industrial network research there is a lack of analysis of systematic and empirical models of network relating to the technology transfer and innovation strategy in the context of SMEs'internationalization.

Based on our research framework on theoretical insights from technology transfer's topic and its extensive concepts of innovation, network and internationalization, we examine how the internationalization process is facilitated by SMEs' networking capacity. Our findings allowed us to address an empirical study created to develop a systematic conceptual model of an innovation network and propositions regarding the access of SMEs to international markets. This helps to emphasize the important drivers and approaches for the innovative network capacity and internationalization performance of SMEs. These findings have critical implications for entrepreneurs in enhancing their firms in international performance. More specifically, we analyze how SMEs' membership in networks or clusters stimulates the concrete collaboration with High Education Institutions (HEIs) or Public Research Institutions (PRIs), Governments and other businesses and contribute to acquire and absorb innovation via different channels of external knowledge influencing SMEs' behaviours at the international level.

1.2 Problem discussion

SMEs internationalization has gained growing research attention over the last few decades as a result of increasing numbers of SMEs from both developed and emerging markets augmenting their international presence, powered by globalisation (Gjellerup, 2000). However, given the rapidly evolving business world, traditional ideas on how companies internationalize (Forsgren, 2002), prior research on the internationalization of SMEs businesses has not been able to completely capture this phenomenon, which is a theoretical weakness.

Consequently, there are both empirical and theoretical research problems to be handled in this thesis.

Empirical questions are raised regarding the conditions for entry to foreign markets for SMEs. They also have a different range of tools and expertise on the type of business that SMEs represent than larger firms.

In addition, traditional theoretical perspectives have been established in the 1960s, 1970s and 1980s, so it has been debated whether they are getting out of date because few changes have been made to adapt them to the new global business climate (AxinnandMatthyssens, 2002). As a result, questions are raised as to whether current hypotheses are relevant when examining the processes of internationalization of SMEs.

Compared to traditional theoretical approaches, the current theorizing on smaller companies focuses primarily on the newest projects of smaller, rapidly internationalizing firms. They are mostly high tech and run by a powerful entrepreneur. With this research emphasis, the international entrepreneurial viewpoint neglects the smaller, medium-sized, already globally developed medium-sized or low-tech small and medium-sized enterprises most frequently studied in other thesis.

When looking for an acceptable theoretical framework, it can be seen that it is difficult to find a single theoretical perspective that alone can grasp the processes of internationalization of SMEs (Coviello and McAuley,1999; Elo, 2005; Rialp and Rialp, 2001). Of the remaining three conventional perspectives, the economic outlook, with its dominance of Multinational Corporation (MNC) and Foreign Direct Investment (FDI) analysis, mainly offers static models that are inadequate to capture internationalization processes. Instead, the behavioural and relational viewpoints are chosen to capture a more holistic view of the international expansion of firms (Johanson and Vahlne, 2006). They are acceptable because they see the world as a deciding factor in the foreign actions of the organization. In addition, both country-specific and relationship-specific internationalization problems of firms are illustrated. Even so, they can be questioned in terms of their applicability to SME studies in an internationalization process sense.

As stated above, the traditional internationalization perspectives have paid less attention to smaller firms increasingly entering the global market, which is problematic since smaller firms are not "smaller versions of big businesses …Smaller businesses deal with unique size-related issues as well, and they behave differently in their analysis of, and interaction with the environment" (Schuman and Seeger, 1986, in Coviello and McAuley, 1999, p. 228). When applying extant theory on SMEs, mixed results are seen. For example, Gankema et al. (2000) showed internationalization process models to be valid for SMEs. Thus, even if shown useful for SME research (McAuley, 2010), the extant theories need to be further validated for SMEs. Supportive notions of current theories are also recognized for internationalized small and medium-sized companies (Child and Rodrigues, 2005; Jansson and OSZE, 2012) and MNCs (Buckley et al., 2007). Elango and Pattniak (2007) say that considering that companies are in the early stages of internationalization, the Uppsala model may still be a very useful analysis method. There are also mixed outcomes of studies on the internationalization of SMEs, and calls for theoretical advances and/or new models of internationalization of SMEs should be pursued (Child and Rodrigues, 2005; Fillis, 2001; Johanson and Vahlne, 2003; Meyer and Gelbuda, 2006).

1.3 Research gap and research questions

The objectives relate to the economic development and government policies need to increase the competitiveness of SMEs, where competitiveness is understood as the qualities of a location that enable firms to succeed in national and global markets. We see that SMEs can balance their limited resources with careful participation in networks. Indeed, most SMEs need to be part of networks to get their innovations and develop special competence in technology transfer and rapidly access international markets.

Although there exists a well-developed tradition of industrial network research there is a *research gap* of analysis of systematic and empirical models of network relating to the technology transfer and innovation strategy in the context of SMEs' internationalization. This only justifies the need for a better model as an instrument of internationalization that can be used to assess innovation and productivity of SMEs, as the key drivers that support both aspects of this ambition. Such a model can be beneficial as it can aid in better decision making as well as the selection of the right approach for local economic development, and the subsequent selection of the most favourable mechanisms for internationalization. This research aims to increase the understanding of how the combination of technology transfer and innovation strategy has become key elements for ensuring the development and growth of SMEs since has enhanced their ability to be part of networks and has facilitated their access to international markets proposing a systematic conceptual model of an innovation network. Through this model, we want to explain how concrete collaboration between Governments, Universities and Businesses (actors) facilitate membership in networks or clusters via different channels of external knowledge (variables) stimulating SMEs' engagement into international ecosystems.

More specifically, this study will analyse the theoretical framework of the technology transfer's topic and its extensive concepts of innovation, network and internationalization of SMEs to provide answers to a specific *research question:* how the internationalization process is facilitated by SMEs' networking capacity. Our findings allowed us to address an empirical study created to develop a systematic conceptual model of an innovation network and propositions regarding the access of SMEs to international markets. This model can be an easy-to-follow innovation model for SMEs when adopting a knowledge-transfer, innovation strategy and networking approach. This helps to make certain that the important drivers and approaches for the innovative network capacity and internationalization performance of SMEs. These findings have critical implications for entrepreneurs in enhancing their firms in international performance. More specifically, we analyse how SMEs' membership in networks or clusters stimulates the concrete collaboration with High Education Institutions (HEIs) or Public Research Institutions (PRIs), Governments and other businesses and contribute to acquire and absorb innovation via different channels of external knowledge influencing SMEs' behaviours at the international level.

1.4 Data collection and research methods

This paragraph aims to describe the data collection and research methodologies that were encountered during the data collection process.

The *data collection methodology* adopted for this thesis began with the identification of the problem and literature review, which then led to the recognition of research gaps as well as the research questions. The initial research question has emerged from action research and case studies which have revealed gaps of adequate mapping of the modelling framework on SMEs. Therefore, the initial research question has been "whether a methodology describing how to construct a customised modelling method may be built and what other factors may (positively) influence such an endeavour" (Camarinha-Matos, 2004 p.72). The research question has started in the larger context of other recent achievements in the SMEs domain, which has been revealed by a critical literature review.

Data collection, in the form of peer-reviewed journal articles, were obtained through systematically identifying a sample of research evidence that has Technology transfer as their primary focus according to the sampling approach adopted from David and Han (2004) as well as Newbert (2007) and based on three steps:

- Step 1: An initial search using the keywords (firm/s, enterprise/es, company/ies, SMEs, innovation strategy, network and internationalization) was performed by identifying relevant abstracts and titles on the following databases: ScienceDirect, Scopus, Compustat, Google Scholar, Eurostat, OECD and EPO. The search only includes studies that directly and explicitly integrate concepts and theories from Technology transfer, Network, International Business and Entrepreneurship theories. Selection criteria were formulated following the aims of this study to identify appropriate journal articles for inclusion in the dataset. They comprise:

- Published papers in peer-reviewed journals
- Quantitative as well as qualitative or conceptual studies
- Papers for which the explicitly stated main focus, theme, study objective or dependent variable related to firm internationalization

However, rather than restricting the search to journals with the highest impact in their fields, we have included all published and accessible journal articles in which the primary focus is on Technology Transfer and SMEs Internationalization process.

- Step 2: the selection criteria were then applied to the 380 articles identified in the database search by probing their abstracts for first-level inclusion.
- Step 3: 340 articles were then reviewed for final inclusion by reading the full articles. This full review also involved manual coding of the articles' texts. Potentially suitable, cross-referenced papers, not included in the original database search results, were also identified and subjected to full content review. This culminated in 330 articles being included in the final sample representing 35 journals, mostly in Entrepreneurship (30%), International Entrepreneurship (17%) and International Business journals (15%). The rest are found in Management (10%), Technology Transfer (8%), Small Business Economics (12%) or other (8%) journals. These results suggest that the chosen dissertation topic is relevant across the wider field of management. Publication dates varied from 1817 to 2018, with a greater number of them published in the last decade (64%). A large amount of research in the last decade underscores the increasing prominence of the technology transfer debate connected to SMEs

internationalization process. However, it should be noted that the analyses were based on published journal articles that are available on electronic databases and accessible via the internet. Under-representation of journal articles published before 1998 in the sample may therefore be caused by many of them not being converted into an electronic format and therefore being unavailable for inclusion.

A combination of *research methodologies* was utilized, and these were dependent on each other to obtain the outcome of the research.

a. Research Purpose

According to the constructs identified in the literature review, the theoretical framework developed in this thesis aims to propose a conceptual systematic conceptual model: Innovation Network - IN model. More specifically, the IN model shows how the combination of technology transfer and innovation strategy has become key elements for facilitating networking and internationalization capacity of SMEs since very few studies might have been done to comprehend the phenomenon.

The systematic search of the literature, review of technology transfer, innovation strategy, network and internationalization definitions, qualitative data processing into quantitative data and data acquisition by focus group discussions, questionnaire and analysis were mixed. More specifically, we have developed this thesis taking into account three fundamental categories of purpose: exploratory, descriptive and explanatory (Masum and Fernandez, 2008).

- **Exploratory:** the exploratory research purpose started from the assumptions that very few studies have been completed (Yin, 2003) and developed to understand the phenomenon of interest. For this reason, we have built a preliminary painting to give a comprehensive overview of the matter (Sekaran, 1992). The exploratory studies helped us to formulate hypotheses and suggested feasibility since they “are thus important for obtaining a good grasp of the phenomena of interest and for advancing knowledge through good theory building" (Sekaran, 1992). In this chapter, we have been focused on 'what' questions.

- **Descriptive:** the descriptive research purpose has been used to explain the relevant aspects of the phenomenon of interest (Sekaran, 1992) of a certain group in organizations. In this chapter, we have also been focused on 'how' and 'who' questions.
- **Explanatory:** the explanatory research purpose is based on previous theories and knowledge to point out the patterns related to the phenomenon of interest and to answer the research questions (Yin, 2003). It involved formulating hypotheses and testing them empirically to identify potential relationships between the elements related to the phenomenon of interest. In this chapter, we have been used theory and focused on 'why' questions.

Generally, only one of these three categories of research is utilised as the dominant purpose. However, since the purpose of the thesis is to benefit a higher knowledge of the networking and internationalization aptitude of SMEs combined with technology transfer and innovation strategy, we have applied mainly an explanatory purpose and to some extent exploratory and descriptive.

a. Research approach

Based on our practical experience and review of definitions the possible research question has been revealed. To confirm the importance and validity of this question, the desk research, case studies and reports, focus group discussions and observations (Quinn, 2002) of SMEs and University experts in public organizations, associations and conferences were applied as a qualitative research approach in all part of this theoretical framework. This research approach has permitted to have a complete and detailed description of the subject through the application of reasoning (Masum and Fernandez, 2008) and to understand the phenomenon. This approach was helpful to look at theories and construct a systematic conceptual model to link the theories and practices and to fulfil the objectives of the study.

a. *Research strategy*

The systematic search of the literature review of technology transfer, innovation strategy, network and internationalization definitions and focus group discussions were used as a research strategy. On one hand, the review of definitions and our practical experience was revealed the possible research investigation; on the other hand, the qualitative research approach based on the focus group discussions was applied in all parts of the chapter to confirm the significance and validity of our questions as well as to verify discovered links between technology transfer and innovation strategy and SMEs' networking capacity which facilitates the access to international markets.

- **Systematic search of the literature**: According to Booth, Papaioannou, and Sutton (2012) who argue that every review has to be more or less systematic. In this thesis, the systematic search approach (Grant and Booth, 2009) was chosen to collect data using different kinds of typologies and taxonomies of technology transfer, innovation strategy, network and internationalization. We decided to use this approach because the reviewing literature allows identifying the connection between ideas and practices as well as synthesizing and gaining a new perspective (cited in Randolph, 2009).
- **Definitions**: The total systematic search is the product of previous draft desk researches conducted to outline and precise the keywords as well as the criteria for inclusion and exclusion of literature.

  These analytical approaches try to understand the complex process under investigation (e.g. the network dynamic). Only a third of the studies use quantitative approaches. These include mail, telephone, self-administered and combined surveys. The sources of information have been data from a commercial database (e.g. Leximancer), published reports and scientific papers. Manual coding was first applied to the sample to identify several variables. The result was recorded on an Excel spreadsheet to show the sample articles': reference details, study themes and research questions, theoretical framework/s, level/s of analysis, research target/s, pertinent findings.

To minimise researcher bias, the electronic text analytics software Leximancer was used in conjunction with manual coding as the primary qualitative analysis tool (Smith and Humphreys, 2006). Recent research papers reveal that Leximancer is increasingly used as a semantic mapping tool in qualitative research designs (Cretchley, Gallois, Chenery and Smith, 2010; Dann, 2010; Liesch, Håkanson, McGaughey, Middleton and Cretchley, 2011; Hansson, Carey and Kjartansson, 2010; Campbell, Pitt, Parent and Berthon, 2011; Hewett, Watson, Gallois, Ward and Leggett, 2009; Cretchley, Rooney and Gallois, 2010; Rooney et al., 2010). Such increased popularity stems from Leximancer having been validated as appropriate knowledge discovery, a qualitative research tool (Smith and Humphreys, 2006). All articles under review have contributed to the literature on Technology Transfer. Accordingly, the over-connected concepts directly associated with the overarching literature themes of Technology Transfer were iteratively removed until a stable map was consistently generated. The sources of information have been data from statistical offices (national, Eurostat, OECD, EPO, etc.), companies' annual financial reports, experts' opinions, published reports and scientific papers, commercial databases (e.g., Scopus and Compustat). The following inclusion criteria have been used for the evaluation of this study – 1) literature assessment reporting technology transfer typology(ies) or taxonomy(ies), 2) literature overview reporting innovation strategy typology(ies) or taxonomy(ies); 3) literature evaluation reporting network; 4) literature assessment reporting internationalization; the publication language – English.

The final step in the analysis of the academic literature involved addressing the study aims by interpreting the emergent themes and concepts inductively derived using Leximancer extraction by manually reviewing the actual text underlying them (Crofts and Bisman, 2010).

Each study indicates the state of the technology transfer and innovation strategy in the respective European member states with regards to

SMEs' membership in networks or clusters and its art of internationalization capacity. We conducted a thematic analysis of these empirical studies to identify patterns and categories by theme summarising all the views and theories collected. Using different words, we analysed the completed reports to identify patterns, differences, inhibitors to internationalisation, and first-rate practices.

- **Focus group discussions**: According to Gill, Stewart, Treasure, and Chadwick (2008) approach, the focus group discussions were applied for generating information on collective views and meanings that lie in the back of the perspectives. They were used as a qualitative research method to confirm the significance and validity of authors' questions and the observed links between technology transfer, innovation strategy and, network and internationalization.

  The broad strategy in this study was to conduct an original survey among firms and universities and it was decided that the survey should be based on interviews with key informants in the firms and universities. Moreover, because experiments with administering questionnaires proved unsatisfactory, it became necessary data acquisition during focus group discussions. At the same time, an important aim was to undertake a study that would permit significant quantitative analysis, and not merely a small number of case studies, to eliminate subjectivity as much as possible. Therefore, the data for this research were collected through face-to-face semi-structured focus group discussions with individuals from 64 representatives of entities cover 12 different thematic areas in the health and life sciences fields (52 SMEs, 4 universities and 8 research centres) during October 2016 - July 2017. This focus group discussions format was appropriate to be used as a general guide to provide standardization for the data to be collected. It also had the advantage of allowing for focused questioning formally and providing some flexibility to adapt to the wide variety of circumstances in the firms. In this way, it has been possible to prevent the strained atmosphere that could be created by strictly designed questions with pre-determined multiple-choice answers, which could lead to the loss of important issues. Attendees to focus group discussions, mostly responded very well to a relaxed, conversational interview format. They were willing to share their information. For instance, the attendees revealed stories about several technology acquisition implementations in the lifetime of their firms. The minimum time for a focus group happened to be 4 hours. The focus group discussions were always complemented by a visit to production sites and laboratories accompanied by a director of the firms. These moments happened to be an invaluable opportunity to confirm some of the information given by the main attendees or at least to double-check some important information gathered. In addition to interviewing representatives from companies, focus group discussions were completed with representatives of key knowledge production institutions and science departments of universities or of national research centres, and officials of ministries with responsibility for science and technology, such as directors of the technology development centres where some firms in the sample are located. These focus group discussions and thus personal contacts were especially helpful in building relationships based on trust with the managers of the companies in the sample. Our knowing the professors and managers with whom the firms probably are engaged in a project, readily paved the way for a trust relationship with the companies. Moreover, in cases of research projects conducted with universities or research institutes, these auxiliary meetings were sources of valuable information regarding the details of specific projects and the actual role of the firm in those projects.

The questions in the main focus group discussions were developed according to the analytical framework discussed previously. The questions covered the following information:

1. **General historical background information about the firm**, where questions related to the past and present of the firm were raised. These

questions aimed to pick on the year the firm started its activities, the number of employees at the start and present, size, range of products previously and at present, amount of sales at the start and present, type of customers at the start and present, rate of growth since the beginning, and identification of change of technology projects.

2. **Link-specific information on technology acquisition and capabilities in the firm** draws on measures of technological capability accumulation, details about the main process technology currently in use and other and secondary process technologies that have been transferred previously.

3. **Firm interactions elaborate knowledge links from the domestic and foreign communities** moved from the inherent complexity of socio-economic interactions which underlie the generation and exploitation of new technological knowledge. In this perspective, basic steps in the analysis of demand-driven innovation dynamics have involved the identification of the main issues and gaps in the economic literature, and the elaboration of a comprehensive model drawing upon appreciative theorizing. In addition, they were beneficial in producing a wealthy understanding of participants' experiences and beliefs (Morgan, 1998 noted in Gill, Stewart, Treasure, and Chadwick, 2008). In this case, the focus group discussions have produced the advantage to use fewer resources (time and money) and the authors have built upon every single response to produce information (Office of Quality Improvement, 2007). Content evaluation of qualitative data acquired from the focus group discussions was analysed using manual content analysis. We have turned process data coding in numerous rounds independently to make sure the validity of findings. The resulted were discussed and presented through consensus.

Moreover, to deepen and give value to our previous research, a questionnaire has been circulated among the network of the Centre for Knowledge and Technology Transfer of Charles University (Prague, Czech Republic) between

December 2019 and February 2020. Individuals from 23 entities (5 HEIs, 6 SMEs, 1 Representative of working life, 5 Intermediaries which represent enterprises, 1 Intermediary which represents education, training or youth organization, 3 Organizations active in the field of education, training and youth and 2 Public bodies) from Czech Republic, Slovakia, Switzerland, Spain, Greece, Italy, Portugal, the United Kingdom, Croatia, the Netherlands and the United States of America were involved in this questionnaire. We used the past study to derive survey items in the design of the questionnaire to deal with and of the variables of our research model. The draft questionnaire was also analysed by an economic policy panel of the public sector and industry experts. This procedure allowed minor adjustments to existing items for respondents to properly perceive them consistently and to guarantee their validity. The research model items established redundancy, after which some questions were removed. (see Appendix A).

1.5 Structure of the thesis

Chapter 1 is the introduction to the research. It will highlight the objectives of the research as well as introduce the research questions shaped from the gaps identified in the literature review. The main important components of the methodology adopted for the research will also be explained.

Chapter 2 consists of the literature review divided into five separate sections, namely, technology transfer, innovation strategy, network and networking, project management and internationalization process. The section on technology transfer contains definitions and model analysis based on qualitative and quantitative approaches. The important model of technology transfer is also presented, as are the key factors of technology transfer success are discussed along with determinants and proxies to help improve the internationalization of SMEs. The following section on innovation strategy focuses on appropriate definitions for innovation strategy as well as the main conceptualization of types of innovation in this area. Literature has identified that some definitions focus on process and products, while the other deals with models and frameworks as well as mechanisms that have also been identified from the literature. The section on network and networking presents the various definitions and forms of network and networking as well as some of the major types of network. Also, theories of SMEs networking are presented according to the type of approach, practical or theoretical. Finally, the last section on the internationalization process analyzes the main definitions as well as theories and models of the SMEs'internationalization process. An in-depth analysis of the genesis of this phenomenon has been also developed including a classification of the motivation to internationalize SMEs in proactive and reactive or pushes and pulls.

Chapter 3 deals with the analysis of the European Union Research and Innovation policy for SMEs. In order to map economic and financial instruments within the European Innovation Policy, a framework and a protocol are proposed. The framework will detect where Innovation Policy is located within a complex system of innovation. To accomplish this goal, each instrument is analysed to understand if it influences innovation.

Chapter 4 provides details of the model that will be developed. The chapter is divided into four sections. Section two presents the research methodology as well as section three presents a conceptual framework and characteristics of the model and examines its role in the implementation of SMEs networking and internationalization. Section four analyses case studies of clusters from Italy and Spain and applies the model to these clusters. Finally, section five summarizes the findings in light of relevant literature underling the potentiality of the model for SMEs.

Chapter 5 will consist of conclusions. It will include findings and will elaborate on the most important lessons to be learnt from this research as well as the theoretical and practical implications. Limitations in this thesis are reported as well as future research directions that would advance the SMEs internationalisation process and empirical studies.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

This chapter aims to present a review of the literature related to *Technology Transfer*'s topic and its connected models and theories. The theoretical background will focus on the extensive concepts of Technology Transfer, Innovation Strategy, Network and Internationalization process to determine a formal definition and to understand their overall landscape. A more in-depth literature review of the concepts of Technology Transfer, Innovation Strategy and Networking pretends to be a reflection on the methodologies and approaches used. We intend that future solutions can be adapted to the actual context and challenges of the university-industry-government link to determine and demonstrate the gaps in knowledge and to prepare this research.

The theoretical interpretation of the technology transfer process can cover a variety of very interesting disciplines that are recognized as a source of economic growth and development. Technology transfer processes were always analyzed considering the knowledge as a base factor of the process. There are two currents of thoughts: the neoclassical models such as a *linear model of innovation* which considered the knowledge as an exogenous element and the innovative models which underlined the importance of a linear and step-by-step development divided in space and time. With the acceleration of social networks and with the new models of sociology and technology, knowledge and people are brought together considering that the main motivation for technology development is the networks of people and technology assumes growing importance in the technology transfer processes. Even considering knowledge and people as factors of the technical method, the models unnoticed not solely the interactions between the technological amendment and natural resources however conjointly a full vary of additional adaptations/transformations, that square measure a miscellaneous of the technological amendment, redesigning and substitution.

Many theoretical frameworks seek to describe the innovation analysis as considered in terms of time. The new theories point out that the innovation processes based on skills and knowledge evolve (trial-and-error, problem-solving process) and that the technology transfer process is dynamic arguing that knowledge, people and their social network evolve and change over time [Figueiredo, 2008].

The literature review is a process of development that is composed of six key steps, as underlined by Machi and McEvoy (2016). The first and second steps include deciding on the problem statements and the methods and tools required to address the problem. This is discussed in the research description and structure in Chapter 1. Step three involves the collection and compilation of the relevant literature. In this step, the most relevant journals and databases are identified and searched for key terms. In step four the literature is surveyed to discover the evidence and build an argument. The final two steps involve drawing conclusions and communicating those conclusions.

2.2 Technology Transfer. Definition

The classic literature underlines that the technology transfer is considered by several authors as almost impossible (Bozeman, 2000; Zhao and Reisman, 1992), due to the awkwardness of defining "technology‟, establishing boundaries in this dynamic process and measuring its impact on individuals, firms or countries. However, the definition of "technology‟ is not clear (Bozeman, 2000). The technology was usually considered a tool (Bozeman, 2000). Sahal (1981, 1982, in Bozeman, 2000) describes technology as a „configuration‟, stressing the idea that transfer of technology is not just about the product but also about its use and application.

Technology is a term with origins in the Greek technologia, techné art, skill + -o- + -logia –logy and means a manner of accomplishing a task especially using technical processes, methods, or knowledge. Technology transfer indicates the action of transferring knowledge, skills, technologies, methods, and facilities among industries, universities, governments and other institutions (Intarakumnerd and Goto, 2018) to allow that scientific and technological growth is accessible to a huge range of users. They can then develop and utilize the technology in new products, processes, applications, materials or services. The Technology Transfer process has an important role not only for universities and research centres but also for SMEs and economic growth (Dority, 2003). A general definition of technology transfer can be constructed by looking at the Latin origins of the word ‘transfer’. Albors, Sweeney, and Hidalgo (2005) state that in Latin, “trans means over, or across the border, and ferre means to carry”: the word trans suggests that during the process of carrying, a border is passed meanwhile the concept of carrying refers to something, which is done strongly, on purpose.

The idea of technology transfer - the transfer of the results of research from universities to the economic sector - is stated to have had its origins in a report developed, to the President in 1945 through Vannevar Bush entitled “Science—The Endless Frontier.” Having witnessed the importance of university research to the national protection for its role within the successful Manhattan Project, he applied this experience to a recognition of the value of university research as a vehicle for reinforcing the economy by growing the pool of know-how for use by enterprises via the guide of basic science by the federal government. The report stimulated great and increasing funding of research by the federal government leading to the established order of several research-orientated governmental agencies, e.g. the National Institutes of Health, the National Science Foundation, the Office of Naval Research, and, ultimately, to the acceptance of the investment of simple research as an important activity of the federal government (Bremer, 1998).

Although technology transfer is not a new business phenomenon, the literature on technology transfer agrees that is difficult to have a specific and univocal definition due to the complexity of the intrinsic process (Robinson 1991; Spivey et al. 1997). The definitions depend on how the user considers technology and in which kind of context (Chen 1996; Bozeman 2000).

Major theorists have contributed to giving a basic definition of technology transfer, but each has established a role, a definition and a taxonomy that reflect their point of view. The definitions depend on how the user considers technology and in which kind of context (Chen 1996; Bozeman 2000): technology transfer can be connected in various fields because has a multidisciplinary nature. It can happen in each area and control of information (Reisman, 2005). Zhao and Reisman (1992) state this has prompted the advancement of various definitions following the control and the reason for the examination.

The word technology transfer can be used to indicate a process of transition from one unit to another (Souder et al. 1990; Ramanathan 1994). Ramanathan (1994) underlines that the transfer creates a successful impact if the transferee (receiving unit) takes advantage of the technology transferred. This process of transition includes physical resources, know-how, and technical knowledge (Bozeman, 2000). Based on the analysis of Osman-Gani (1999) technology transfer in other cases seems to be utilized to relocating and exchanging of personnel. It has likewise been utilized to show the transfer of technology from the academy to the industry or from an application to a division (Philips 2002). The economist's Arrow (1969) and Dosi (1988) analyzed the different applications of technology transfer grounding on properties of generic knowledge to focus on variables that relate to product design. From the sociological perspective, Rogers and Shoemaker (1971) and Rogers (2003) characterized technology transfer as a method for dispersion for inventive thoughts. This hypothesis created confusion because many researchers, and even practitioners, consider the technology transfer and technology diffusion as interchangeable words. The literature on the diffusion of technology transfer suggests that the technology transfer should be considered as a passive spreading of technological knowledge related to a specific innovation of interest. However, technology transfer, quite the opposite, is a proactive process to disseminate or acquire knowledge, experience and related items (Hameri 1996) but not a free (Autio and Laamanen 1995).

According to the extent of this research, technology transfer is depicted as the procedure by which technology, learning, additionally data created in one association, one field, or for one article is connected in another association, field, or for another item (Winebrake, 1992). Similarly, technology transfer can be considered as a functioning procedure between nations, organizations, or people. In general, technology transfer may be defined as the transfer of the research results from research institutions to the public (Bremer, 1998). It can likewise be characterized as the procedure of transferring the aftereffects of academic research from research institutions to different associations in methods for permitting with the end goal of further advancement and commercialization" (Carlsson and Fridh, 2002) and as an interactive procedure among elements over an all-inclusive timeframe (Gibson and Smilor, 1991). In this way, technology transfer is also defined as part of product, process or personnel (Chen, 1996). Indeed, there is usually an agreement (Sung and Gibson, 2000; Sung and Hyon, 1998) because technology transfer requires generally a human effort and collaboration between at least two people or useful units who are diverse for auxiliary, social, and hierarchical methodologies.

Technology transfer can be connected in various fields because has a multidisciplinary nature. It can happen in each area and control of information (Reisman, 2005). Major theorists have contributed to giving a basic definition of knowledge, but each has established a role, a definition and a taxonomy that reflect their point of view. Zhao and Reisman (1992) state this has prompted the advancement of various definitions following the control and the reason for the examination. The outcomes before 1990 did not think about the horizontal and vertical dimensions of the transfer. Actually, given the interdependency among horizontal and vertical parts, the commitment of technology transfer can once in a while be secluded (Reddy and Zhao, 1990).

In a worldwide setting, Bessant and Rush (1993) and Cumming and Teng (2003) point out that technology transfer can move through various channels (Glass and Saggi, 1999). Ordering the literature on technology, its procedure of transfer and its international degree, would be unfruitful (Bozeman, 2000) however broad attributes can be followed. In a basic definition, technology transfer can be portrayed as the procedure through which associations obtain technology from an outer source.

Göktepe (2004) has recognized five technology transfer instruments, to be specific, new businesses, authorizing, gatherings, distributions, and RandD understandings. He states that when technology streams from a specific stage to the following the change isn't smooth yet is generally influenced by holes, for example, recognizing a potential application and when how this can be transformed into an attractive item and that such holes can break the progression of the transfer. A framework that could take all of this into consideration can limit holes and boost the productivity of the stream. This procedure could be dynamic yet unpredictable and its prosperity is affected by different elements starting from a wide range of sources (Kumar, Kumar and Persaud 1999; Walter, 2000). Hoffman and Girvan (1990) underline that in developing countries, technology transfer should be seen regarding accomplishing three centre destinations: (i) the presentation of new methods by methods for the venture of new plants; (ii) the improvement of existing procedures, and (iii) the age of new information. It is brought up that industrialization is the principal way for financial development and improvement by numerous countries.

However, its prosperity wards on the accessibility of the required technology and the capability to use technology effectively (Shariff and Haq, 1979). "Transfer of Technology" is considered as a sane path in numerous countries since it contributes to a fast-technological advancement. Consequently, in developed and developing countries, technology transfer has become a subject of impressive research activity. Technology transfer is a process in which a technology produced in one spot is adjusted and used or diffused in different spots. Autio and Laamanen (1995) state that technology transfer can be deciphered as a functioning process since it is exceeding the natural limits of some units such as nations, industries, firms, or even people.

2.3 The different Models of Technology Transfer. A review.

The main objective of this section is to look at a part of the prevalent models of the current Technology Transfer (TT) that have been created throughout the years to support transferees and transferors to understand this procedure better.

The TT process has been examined using diverse techniques. Some TT models were created after World War II to regulate the implementation of TT activities and their commercialization. They are classified in conventional TT models, appropriability models, dissemination models, knowledge utilization models, and communication models. Just later since the mid-1970s, considering the troubles and complexities looked at by managers of technology transfer projects, researchers, experts have been acquainted with new models to encourage the implementation of technology transfer projects. Both qualitative and quantitative models have been proposed. From one perspective, the qualitative model regularly has as its goal the outline of activities associated with overseeing TT and the elicitation of components and issues that can impact the achievement as well as the adequacy of TT. Then again, quantitative models aim at quantifying and analyzing parameters of significance in TT minimizing goal incongruence between the transferors and transferees of technology (Jagoda, 2007).

In the late 1980s and mid-1990s, the principles of the organization development movement have been caught up TT models (French and Bell, 1995). Amid the 1980s examinations on TT brought up the significance of the specific technology being moved in a bigger set of financial advancement (Hope, 1983). During the 1990s new methodologies underline that learning at the organizational level is a key factor in encouraging technology transfer (Figuereido, 2001). Key strategic management experts outfitted and further added to the improvement of TT models based on the knowledge-based view (KBV) and organizational learning (OL) perspectives. These points of view have demonstrated comparative segments, for example, results, procedures, hindrances and facilitators (Daghfous, 2004) and have invigorated the extension of TT models.

2.3.1 The TT models after World War II

a. **The Appropriability Model:** the development of this model goes back to 1945-1950s. It underlines that thanks to their quality technologies offer themselves (Gibson and Slimor, 1991). The importance of the nature of research and competitive market weight are featured on this model in stimulating the use of research results (Tenkasi and Mohrman, 1995). According to this model, the TT process pursues when technology has discovered users or has been recognized by the market. The model expects that after the advancement of a specific technology by scientists and their accessibility through different types of communications (for example specialized papers and logical articles), the market will consequently draw in the new technology (Devine et al., 1987). Gibson and Slimor (1991), in their three-level TT model, distinguished the technology improvement as a first and dynamic dimension contrasted with inactive technology processes associated with communication tools such as research reports, journal articles, and computer tapes. This appropriability strategy views TT as the result of a programmed procedure that started with logical and scientific research and afterwards moves to development, financing, and marketing. [One] need not be worried about linkages in the technology commercialization process (Kozmetsky, 1990). Be that as it may, throughout the year's Devine et al. (1987) and Gibson and Slimor (1991) have proven that quality technologies don't more often than not sell well themselves.

b. **The Dissemination Model:** Rogers (1983) and Rogers and Kincaid (1982) formulated the Dissemination model between the 1960-1970s. The utilized method underlines the value of technology and innovation to be diffused or disseminated to potential users by the experts (Williams and Gibson, 1990). It supposes that an expert transfers specialized knowledge to a willing user. Williams, Gibson, and Slimor (1990;1991) point out that a new technology transfer from an expert to a non-expert once the connections are fixed. This model presents a second level that includes the expert's primary responsibility to select technology and ensure the technology is available to a receptor. As Gibson and Slimor (1991) state a receptor can appreciate and potentially utilize the technology. However, this model has a unilateral communication characteristic because it doesn't include the involvement of users (Devine et al., 1987; Gibson and Slimor, 1991).

c. **The Knowledge Utilization Model:** Gibson and Slimor (1991) built up this model in the late 1980s. It notably affects TT literature (Szakonyi, 1990; Zacchea, 1992). The importance of their approach lies in the role of interpersonal communication between technology developers/researchers and technology users and on the organizational obstacles or intermediaries of TT. This approach based on knowledge represents an evolutive advance that focuses on how to organize knowledge to effective use of technology users (Backer, 1991). Gibson and Slimor (1991) outline their model as a technology application level. This level included the profitable use of technology in the market place as well as other application such as intra-firm processes. Although this approach acquired appreciations for the level of complexities of the TT, Dimancescu, and Botkin (1986) have underlined that it experiences a straight predisposition. This model reduces the complex nature of the transfer process to sequentially requested stages (Gibson and Slimor, 1991; Sung and Gibson, 2000). Be that as it may, the dissemination and knowledge utilization models still experience the ill effects of direct inclination because these sort of TT models have impediments as far as their application in transferring technology across organizational barriers (Tenkasi and Mohrman, 1995; Gibson and Slimor, 1991).

d. **The Communication Model:** Williams and Gibson (1990) and Doheny-Farina (1992) have replaced the previous three models with this model. It considers TT as a communication and information flow process with communication understood to be concerned with the full exchange and sharing of meanings. Technology is perceived as an ongoing process that includes a nonlinear interactive process of exchanging ideas among people included (Williams and Gibson, 1990). Coherently with this approach Gibson and Slimor (1991) and Irwin and Moore (1991) consider the communication model as an extension of the network communication paradigm. The communication model, which consists of characteristics such as nonlinear communication, interactive, interpersonal/organizational communication, helps to explain the lack of the previous TT strategies based on one-way unidirectional communication, and dissemination/diffusion models (Irwin and Moore, 1991). A nonlinear interactive communication approach is developed to overcome the obstacles of communication between developer and user of technology (Doheny Farina, 1992; Dobrin, 1989). It supposes that there is “a body of information, of objective facts, just lying there waiting to be communicated” (Dobrin, 1989). The validity of the mentioned hypothesis is referred to as knowledge as an object that exists independently, valid, complete and has universal applicability (Tenkasi and Mohrman, 1995). The technology developer oversees transferring knowledge through appropriate actions for the user. Tenkasi and Mohrman (1995) underline that the adoption of knowledge is simply because the users fail to understand. Although the communication model demonstrates its complexities in the technology transfer process, Tenkasi and Mohrman (1995) highpoint how it cannot provide explanations on the complexities of knowledge transferred through collaborative learning of knowledge. Zhoa and Reisman (1992) and Figuereido (2001) point out that this view is coherent with the earlier studies on TT which underline the importance of strategic alliances/IJVs and learning at the organizational level of the common management analysts.

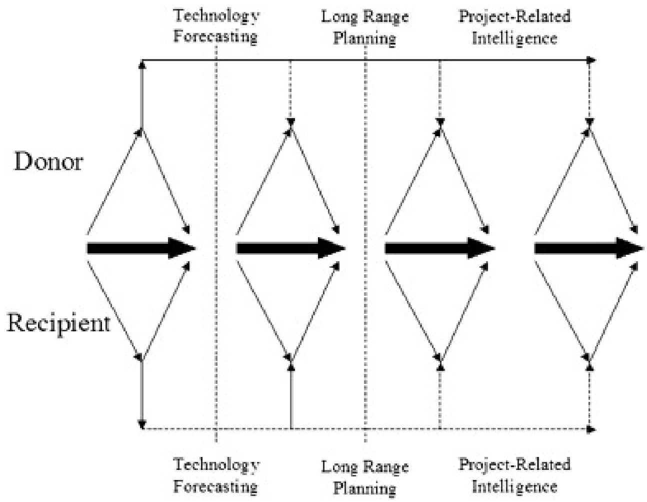
2.3.2 The TT models since early 1970s to 1990s: Qualitative and Quantitative

Since the early 1970s managers of technology transfer projects, researchers, consultants, and practitioners of technology transfer have introduced TT models that have facilitated the successful implementation of technology transfer projects. Qualitative models have been proposed as well as quantitative models. Jagoda (2007) underlines that Qualitative models often have as their objective the delineation of activities involved in managing TT and the elicitation of factors that can access the success and/or capability of TT. Quantitative models go for measuring parameters of importance in TT and investigating them to limit objective incongruence between transferors and transferees of TT. In this paragraph, emphasis will be given to the qualitative TT models.

2.3.2.1 Qualitative TT models

a. The **Bar-Zakay Model**: Bar-Zakay (1971) developed this TT model considering a project management method. He separated the TT procedure into the Search, Adaptation, Implementation, and Maintenance steps and portrayed the activities, milestones, and choice (Figure 1). The upper portion of the figure depicts the activities and prerequisites of the transferor (referred to as the "donor" by Bar-Zakay) and the lower a large portion of that of the transferee or the "recipient." The activities to be done are determined in detail in this model and the significance of both the transferor and transferee securing abilities to embrace technological forecasting, long-range planning, and gathering of project-related intelligence is underscored. The model uses the term "donor" for the transferor giving the feeling that the owner of technology is giving without end an important resource out of selfless reasons! This is not the case and the utilization of such terms must be maintained a strategic distance from.

Figure 1. The Bar-Zakay model of Technology Transfer



Source: Jagoda (2007)

The Bar-Zakay model likewise experiences another detriment. Jagoda (2007) points out that "The model has limited relevance today since many of the activities, terms, and ideas expressed reflected the setting of the late 1960s to early 1970s when buyers of technology were mainly passive recipients who depended greatly on aid programs for the purchase of technology. It was also an era when government controls were instrumental in determining the rate, direction, and scope of technology flows."

The exercises that can be gained from the Bar-Zakay model are the accompanying:

- There is a requirement for an extensive examination of the whole TT process from "look" directly through to "post-execution" exercises.
- A process approach must be received in arranging and executing TT projects

- It is essential to have achievements and choice focuses on the goal that exercises can be fortified, botches revised, or even the undertaking ended anytime.

b. The Behrman and Wallender Model: Behrman and Wallender (1976) have proposed a seven-step process for international technology transfer that might be increasingly important to worldwide partnerships. The seven steps are:

- Manufacturing proposal and planning to land at choices regarding the area and setting up a business case including asset appraisals.
- Deciding the product design technologies be exchanged.
- Specifying details of the plant to be designed to produce the product and different perspectives identified with construction and infrastructure advancement.
- Plant development and generation start-up.
- Adapting the procedure and product if necessary and fortifying production systems to suit neighbourhood conditions.
- Improving the product technology transferred utilizing local skills.
- Providing external support to fortify the connection between the transferor and transferee.

One of the shortcomings of this model is that, during the initial three steps, the transferor builds up the technology transfer project with a poor contribution of the transferee along these lines strengthening reliance. Notwithstanding, in the fifth and sixth steps there is an impressive degree for the transferee to absorb and improve both product and process technology. This means that technology transfer does not stop with the beginning of production except if there is a system to encourage osmosis the project cannot be considered to have conveyed.

The lessons that can be gained from this model are the accompanying:

- There is a requirement for the transferee to be included right from the earliest starting point in the planning and implementation of a TT project.

- A technology transfer project does not finish with the beginning of production.

- Unless express measures are set up to guarantee the assimilation of the transferred technology, the technology transfer cannot be said to have been effective.

c. **The Dahlman and Westphal Model**: during the 1980s, it started the industrialization process in the Far East. Dahlman and Westphal (1981) was involved in this new historical phase and proposed a nine-stage process model as pursues:

- Carry out pre-investment feasibility to accumulate information and complete technical and economic analysis to set up project suitability.

- Carry out a feasibility study after a preliminary identification of technologies.

- Carry out basic engineering studies that include the readiness of procedure flow diagrams, layouts, material and energy balances and other structure determinations of the plant and apparatus and the core technology to be transferred.

- Carry out a detailed engineering study that includes the preparation of a detailed civil engineering plan for the office, including development and establishment specifications and recognizable proof of the peripheral technology expected to make the transfer successful.

- Carry out the selection of providers for equipment and subcontracting services to gather the plant and machinery and plan for the co-ordination of the work among different parties.

- Prepare and execute a training and education plan, in consultation with the providers of technology, for the workers who might be employed in the technology transfer project.

- Construct the plant.

- Commence operations.

- Develop inconvenience shooting skills and set up courses of action to take care of the design and operational issues as they emerge, particularly during the early years of activity.

This model might be viewed as an improvement of the Behrman and Wallender model with an emphasis on transferee involvement at all stages of the TT project. Its significant shortcoming is that it assumes that the transferee will have access to high-level engineering skills. This may not be valid in many developing countries. It additionally gives very little attention to negotiation and post-implementation assimilation activities.

The lessons that can be gained from this model are the accompanying:

- A TT project is best examined utilizing a consecutive perspective.

- A TT project should be initiated after a feasibility study since such projects often require substantial commitments.

- Transferees need to create sound engineering and project management skills without which the TT procedure cannot be managed effectively.

d. Schlie, Radnor, and Wad Model: Schlie et al. (1987) propose a straightforward, conventional model that outlines seven elements that can impact the implementation and success of any TT project. These seven elements are listed below.

- The transferor, which is the unit selling the technology to the beneficiary.

- The transferee, which is the unit purchasing the technology.

- The technology that is being transferred.

- The transfer mechanism has been exchanged to transfer the chosen technology.

- The transferor condition, which is the arrangement of conditions, in which the transferor is working. Qualities of the transferor condition that can impact the adequacy of the transfer procedure include, among others, financial status, business orientation, and working policies.

- The transferee condition is the quick arrangement of conditions under which the transferee is working. Attributes of the transferee condition that can impact the absorptive capacity of the transferee include physical and organizational infrastructure, skills availability, the responsibility to the transfer project, technological and business orientation economic status.

- The greater condition is that encompassing both the transferor and the transferee. There might be layers of this condition that are sub-regional, regional, and global. Even if the immediate working condition of the transferor and the transferee are ideal for the technology transfer, if the layers of the greater condition are not supportive, then cross-border and international technology transfer could be unfavourably influenced. Factors in the greater condition such as political relationships between countries, exchange rates, investment climates, trade negotiations, the balance of trade, relative technological levels, and the status of intellectual property protection regimes could impact the achievement of a TT project.

The seven components of this model are valid even in the present business setting. How that they show themselves can anyway change with time. The shortcoming of this model is that it offers no rules regarding what a transferee ought to do.

The lessons that can be gained from this model are the accompanying:

- The numerous progressions that have occurred and are occurring in the worldwide business setting today have made it basic for managers of technology to increase good insights into the transferee condition, transferor condition, and the more prominent condition when developing a TT project.

- The choice of the technology transfer mechanism system ought to be founded on a modern comprehension of the other six components.

e. **Lee et al. Model**: the longitudinal model of technology transfer is based on a study of developing and industrializing countries. Lee et al. (1988) state that "a transferee firm needs to set up strategies to have the capacity to experience the stages of acquisition, assimilation, and improvement". As the firm advances technologically, it needs to adopt proper actions of transfer, depending on the level of the life cycle of the technology. They likewise note that the mechanisms chosen by the transferor to transfer technology will connect to the newness of the technology, its strategic importance to the transferor firm, and the degree of intellectual property protection required.

f. **The Keller and Chinta Model**: Keller and Chinta (1990) argue that successful technology transfer would be controlled by the degree to which the transferor and transferee deal with the political, lawful, social, cultural, economic, and technological boundaries that block transfer and reinforce activities that encourage it. The encouraging activities allude to the willingness of the partners to adapt their respective strategic and operational postures to guarantee a "win-win" result.

g. **The UNIDO Model (1996)**, recommends that, in the manufacturing sector, when the requirement for a TT project is set up, evaluation, negotiation, contract execution, and technology adaptation and absorption should be pursued consecutively to guarantee adequacy.

h. **The Durrani et al. Model (1998)**, have proposed a conventional model consisting of five steps:

- Establishing commercial necessities
- Identifying technology solutions
- Classifying technology solutions
- Establishing sources from where the technology could be procured
- Finalizing the technology-acquisition decision

The major lesson of this model is that it focuses on the importance of building up the requirement for a technology transfer project and for identifying multiple sources of technology for empowering a better choice of the transferor.

i. **Bozeman (2000)** has proposed a casual effectiveness model of technology transfer. The model underlines the importance of technology transfer from universities and government laboratories to industry. In this model, the key elements of the transfer process are:

- The transfer specialist (the transferor)
- The transfer system
- The transfer object (the content and type of the technology being transferred)
- The transfer beneficiary (the transferee)
- The demand environment (market and non-market factors vis-à-vis the requirement for the technology).

This model additionally focuses on the significance of setting up the requirement for a technology transfer project and for identifying multiple sources of technology. Six "out-the-door" measures are proposed. These are market impact, economic development, political advantages, opportunity expenses, and growth of scientific knowledge and human capital as a result of the transfer. The importance of affect appraisal is a valuable lesson that this model confers.

2.3.2.2 Quantitative TT models

The literature is meagre with regards to quantitative models of technology transfer. A list of significant models is described as follows:

a. Sharif and Haq (1980) elaborated on a quantitative model. This model proposes the concept of potential technological distance (PTD) between a transferor and transferee. It contends that when the PTD is either excessively extraordinary or excessively little between the transferor and transferee, the adequacy of the transfer is low. It recommends that when a transferee first searches for a potential transferor it is essential to look for one with an "ideal" PTD. From a practical perspective, a potential transferor at the firm level may not be eager to effortlessly disclose data that could empower an appraisal of the PTD. The best estimation of the model is that it attracts attention regarding the requirement for joining the idea of a PTD in choosing transferor.

b. Raz et al. (1983) have introduced a model of technological "catch-up" that indicates how a technology head, through technology transfer, can help the rate of technological development of a technology follower. The model looks at three steps of development of a technology follower specifically, the moderate beginning step with high technological capability gap, the faster-learning step with the diminishing gap, and they get up to speed phase when the technological gap is very small or shut. They contend that this kind of analysis would empower technology leaders to grow clear approaches, based on considerations of competitiveness, security, and other related issues when going into technology transfer agreements.

c. The econometric model of Klein and Lim (1997) considered the technology gap between the general apparatus and electrical and electronic enterprises of Korea and Japan. Their discoveries propose that technology transfer from leaders can have a crucial role in upgrading the technological levels of follower firms. Their analysis likewise demonstrates that the adherents should enhance transfer by autonomously setting up measures to adjust and confine the technology transferred from the leader. This model hence accentuates, based on empirical evidence, the requirement for post-implementation activities that encourage assimilation and modification of the transferred technology. It likewise unmistakably portrays the requirement for a firm, as it develops technologically, to connect its technology transfer activities with internal RandD.

An examination of the models of technology transfer demonstrates that there are a few important lessons that they pass on. These are summarized below.

- It is essential to consume comprehensive analytical effort in building up the requirement for a technology transfer project before the initiation of a TT project.

- A TT project should not be initiated without a careful feasibility study since such projects regularly require substantial asset duties.

- A process approach must be embraced in arranging and executing TT projects and to guarantee effective technology transfer there is a need to extensively analyze the whole procedure from “technology search” directly through to “post-implementation” activities.

- The numerous progressions that have occurred and are occurring in the global business setting today have made it essential for managers of technology to increase knowledge into the transferee environment, transferor environment, and the greater environment when arranging and actualizing a TT project.

- Multiple sources of technology must be distinguished to empower a decent decision of transferor.

- Partners in TT projects need to create abilities to utilize formal, logical and analytical methodologies that can create information for better technology transfer planning.

- It is essential to have achievements and choice focuses so that activities can be fortified, mistakes corrected, or even the project ended anytime.

- As a transferee firm advances technologically, it needs to choose proper systems of transfer, depending on the phase of the life cycle of the technology and its technological capability profile.

- A technology transfer project does not finish with the initiation of production. Except if express measures are set up to guarantee assimilation of the transferred technology the technology transfer cannot be said to have been fruitful.

- The success of a technology transfer project would be established by the degree to which the transferor and transferee manage the obstacles that impede transfer and initiatives that facilitate it.

In any case, what may likewise be noted is that no model attempts to catch these significant contemplations. A diverse model would be exceptionally helpful to managers of technology transfer projects if it displays this insight in a process-oriented approach. This model can address a significant number of issues looked at by firms during the implementation phase of technology transfer. The following part will initially introduce an outline of regular issues looked at by SMEs in planning and implementing technology transfer and then propose a process model called “the Life-cycle Approach for Planning and Implementing Technology Transfer” that endeavours to join the intelligence of the models discussed. The adoption of this process model will allow SMEs to manage the common issues they face in planning and implementing TT projects.

2.4 TT models after 1990s

A review of the literature on TT researchers shows that they have attempted to develop a new technology transfer model. The models listed below have been developed after the 1990s. They underline 1) the importance of communication TT, 2) the key elements which influence TT and KT, and 3) the TT processes in IJV (Gibson and Slimor, 1991; Sung and Gibson, 2000; Rebentich and Ferretti, 1995) underling the limits that emerge from the traditional TT models in terms of the application in contemporary high-tech industries.

a. **Gibson and Slimor's Model**: The model describes TT from the viewpoint of technology researchers and users who state that it is divided into three levels: Level I (Technology Development), Level II (Technology Acceptance), and Level III (Technology Application). The hidden hypotheses of this model are the organization and communication theories (Gibson and Slimor, 1991). It clarifies the dimensions of technology transfer involvements and coordinates the activities engaged with the traditional models. Technology Development is considered as the most significant level where the transfer process is viewed as passive because the emphasis is on the quality of research and competitivity of the market in achieving technology transfer (Gibson and Slimor, 1991). Technology Acceptance level demonstrates more involvement of TT which is disseminated to individual users (Gibson and Slimor, 1991). The technology application level is the most involved level of TT because it includes the commercialization of the technology's use in the marketplace and other application such as intra-firm processes where the key elements are the interpersonal communication between technology developers and users, and the organizational barriers and intermediaries of TT (Gibson and Slimor, 1991).

b. **Sung and Gibson's Model**: As an extension and improvement to the three levels involvement model of TT (Gibson and Slimor, 1991), this model gives plausible explanations with regards to the dimensions and factors influencing knowledge and TT by describing knowledge and TT in four levels of involvements. These levels are classified by Sung and Gibson (2000): Level I (Knowledge and Technology), Level II (Sharing), Level III (Implementation), and Level IV (Commercialization). At the first level, research is developed by technology developers into knowledge and make accessible of their finding through research publication, videotapes, teleconference, news, etc…. TT at this level is considered a passive process that involves all participants (Sung and Gibson, 2000). At the second level, technology developers and users share best practice of technology transfer occurs when knowledge and technology are transferred across the personal, functional, or organizational level and are accepted by users (Sung and Gibson, 2000). At the third level, the achievement is controlled by the opportune and proficiency of knowledge and technology transfer, and the client's assets capacity to actualize. Finally, at the last level, knowledge and technology are commercially used. The commercialization level is constructed on the creation and implementation levels with the help of market strength.

c. **Rebentisch and Ferretti’s Model**: Rebentisch and Ferretti (1995) propose an incorporated model of the TT process developed from the knowledge of two IJVs. The model addresses the issues on 1) how much exertion is required to transfer different types of technologies, and 2) what impact the organization’s existing competencies might have on that process. This model refers to TT as “the transfer of the embodied knowledge assets between organizations”. The TT procedure in this model consists of four classifications that incorporate 1) Transfer Scope, 2) Transfer Method, 3) Knowledge Architecture, and 4) Organizational Adaptive Ability. The purpose of transfer depends on how much data is exemplified in the technology and what kind of technologies a firm seeks to acquire from the source. Because of this model, the transfer scope consists of four kinds of technologies: General knowledge, Specific knowledge, Hardware, and Behaviours. This model classifies the transfer approaches in the TT procedure as 1) Impersonal communication, 2) Personal communication, 3) Group interaction, and 4) Physical relocation. Knowledge architecture is characterized as “a characterization of the structure and artefacts into which knowledge has been embodied in the organization and describes the way organization stores and processes information” (Rebentisch and Ferretti, 1995). Knowledge architecture has four pivotal components that impact TT process 1) technology hardware, 2) experience base, 3) strategies, and 4) association control structures. These components relate to the level of technology’s complexity and compatibility with the current organization, the expenses, and degree of progress engaged in implementing it, and the possibility of experiencing any opposition

(Rebentisch and Ferretti, 1995). Organizational adaptive ability is "the adoption of the organization's ability to utilize its resources to make adaptations either to itself or to new technology" (Rebentisch and Ferretti, 1995). Organizational adaptive ability comprises staffing and production adaptability. This model, which is created dependent on two IJVs, nevertheless, basically offers the theoretical experiences of TT procedure of equipment or embodied technology (explicit knowledge) where no speculation testing and observational examination have been directed. Since this model is created from the transferring partner's perspective thus it experiences an inalienable direct predisposition in which the relationship and logical elements of JVs have not been considered.

d. **Other Related Theoretical Foundations of Technology Transfer:** From a review of literature, the other relevant theories which are found which are observed to be identified with TT are the international trade (IT) theory, foreign direct investment (FDI) theory, KBV perspective, and OL perspective. The international trade theories, which comprise of the classical trade theory (Ricardo, 1817), the factor proportion theory (Hecksher and Ohlin, 1933), and the product life cycle theory (Vernon, 1971; Wells, 1968, 1969), are identified with TT studies as they give clarifications on how trades between countries contribute to the progression of productions or goods and services which have brought along the technology implanted in them. The foreign direct investment theories are identified with TT studies as they give clarifications on how FDIs by MNCs become the principal channel for intra-firm technology transfer; where technology is transferred to MNCs' auxiliary or offshoots in the host countries. FDI theories comprise of the market imperfection theory (Hymer, 1960, 1970; Kindleberger, 1969; Caves, 1971), international production theory (Dunning, 1980), internationalization theory (Buckley, 1982, 1985; Buckley and Casson, 1976), and transaction cost theory (Williamson, 1975; Ouchi, 1980; Williamson and Ouchi, 1981). However, for this review, the significant theories underlying the current TT model are KBV and OL perspectives. The streams of literature on TT, KBV and

OL perspectives are quite similar along various dimensions, for instance, the results, procedures, barriers, and facilitators (Daghfous, 2004).

e. Knowledge-Based View Related Models

i. **Kogut and Zander's Model:** Kogut and Zander (1992) built up the foundation for the knowledge-based theory of the firm underlining the strategic importance of knowledge as a source of competitive advantage. The focus of their theory is that "what firms do better than markets is the creation and transfer of knowledge within the organization". Knowledge, which comprises of data and know-how, is not only held by individuals but at the same time is communicated in regularities by which members participate in a social community. Firms as social communities act as "a repository of capabilities" determined by the social knowledge embedded in enduring individual relationships structured by organizing principles (Kogut and Zander, 1992). The organizing principles relate to "the organizing knowledge that establishes the context of discourse and coordination among individuals with disparate expertise and that replicates the organization over time in correspondence to the changing expectations and identity of its members" (Kogut and Zander, 1996). Kogut and Zander (1993) assert that 1) firms are efficient means by which knowledge is created and transferred, 2) a common understanding is developed by individuals and groups in a firm through repeated interaction to transfer knowledge from ideas into production and markets, 3) what a firm does is not depending on the market's failure rather the efficiency in the process of transformation relative to other firms, and 4) the firm's limit is determined by the difference in knowledge and the capabilities between the creator and the users and not market failure.

ii. **Grant's Model**: Grant (1996a) has furthermore examined the theoretical positions of the knowledge-based view, which considers knowledge creation as "an individual activity rather than an organizational activity". The model is depicted as pursues: 1) Knowledge is a noteworthy beneficial asset in terms of its contribution to value-added 2) Knowledge Knowledge contains information, innovation, know-how, and skills. 3) Individuals are the basic administrators of knowledge creation and the key repositories of knowledge. 4) Most knowledge is subject to economies of scale and scope. Firms comprise different people with specialized knowledge and their role is to integrate knowledge to enable it to produce products and services. Specialized knowledge can be coordinated inside firms through four instruments 1) through guidelines that control the connections between individuals and directives which guide non-specialists, 2) through sequencing; a mechanism to organize production activities in a period designed succession with the end goal that each specialist's input occurs independently through being assigned a different availability, 3) through routines; where the signals and responses created by groups over time allow the complex cooperation people in a generally programmed manner, and 4) through group problem solving and decision making; a system used to perform irregular, complex, and significant tasks that require broad individual collaborations and communications. Common knowledge was significant as a method through which various people can communicate to integrate knowledge (Grant, 1996b).

iii. **Spender's Model**: Spender (1996) proposes a dynamic knowledge-based model for the firm. Knowledge is viewed as "a process or a competent goal-oriented activity rather than as an observable and transferable resource" (Spender, 1996). As knowledge is dynamic in nature, a firm is a natural system of knowledge production and application (Spender, 1996). A firm is a system of knowing action and not a system of applied abstract knowledge (Spender, 1996). Other supporters of this approach are Blacker (1995) and Orlikowski (2002). Blacker (1995) points out that the traditional approach to knowledge is "compartmentalized and static" and further recommends that it is progressively advantageous to talk about the process of knowing. Orlikowski (2002) proposes that the point of view which focuses on the knowledgeability of activity (perspective on knowing) that is on knowing might be an incentive from a point of view as opposed to knowledge.

iv. **Szulanski's Model**: Szulanski (1995) uses a different approach to knowledge transfer by adopting a communication metaphor in analyzing the intra-firm transfer of best practice in a way equivalent to the transmission of a message from a source to a beneficiary inside a given media or context (Timbrell et al., 2001). Szulanski (1996) proposes an intra-firm transfer of best practice model which views the intra-firm transfer of best practice as "an unfolding process" in which organizational steps are organized in four stages of processes: 1) initiation, 2) implementation, 3) increase, and 4) integration. Initiation is described as including all events that lead to the choice to transfer. A transfer initiates when both a need and the knowledge to address that need coincide inside the organization, perhaps unfamiliar. At the point when the need is found, it triggers a search for potential solutions; a search that leads to the discovery of prevalent knowledge (Szulanski, 1996). Implementation starts with the choice to move in which assets stream between the knowledge beneficiary and the source, the transfer-specific social ties between the source and the knowledge beneficiary are built up, and the transferred practice is typically adjusted with the objectives to suit the foreseen needs of the beneficiary to acquire problems experienced in a previous transfer of the same practice and to encourage the introduction of new knowledge less difficult to the beneficiary (Szulanski, 1996). Increase initiates when the beneficiary starts to utilize the transferred knowledge. At this level, the beneficiary's primary concern is to recognize and resolve unexpected issues that confine its capacity to coordinate or surpass the transfer performance execution (Szulanski, 1996). Integration starts when an acceptable outcome is accomplished by the beneficiary from the transferred knowledge and the transferred knowledge is change over into the firm's daily practice (Szulanski, 1996). Szulanski (1996) has investigated the origin of internal stickiness and identified four arrangements of variables that are probably going to have a huge effect on the difficulty of knowledge transfer: i) characteristics of the knowledge transferred, ii) the source, iii) the beneficiary, and iv) the context in which the transfer takes place. Central to Szulanski's (1996) model of intra-firm knowledge transfer, which builds on the previous TT literature (Leonard-Barton, 1990; Teece, 1977; Rogers, 1983), is the significance of examining all the four arrangements of variables simultaneously in an eclectic model.

f. Organization Learning Related Models

i. **Argyris and Schon's Model**: Argyris and Schon (1978) build up a three-fold typology of organizational learning: 1) single-loop, 2) double-loop, and 3) triple-loop learning. Single-loop learning is described as "the error-detection-and-correction process; where errors are detected and corrected to allow an organization to change its methods and rules to improve what is being done within existing programs or policies". As a result, the organization accomplishes its present objective more efficiently. In addition to the error-detection-and-correction, double-loop learning involves "change of the value of an organization's theory-in-use". This kind of learning happens when mistakes are identified and redressed in a manner that includes the adjustments in an organization's underlying norms, policies, and objective. Triple-loop or deutero learning is "learning how to learn"; where the organizational members' cognitive changes as a result of reflecting and inquiring into their past learning experiences. Triple-loop learning is likewise a procedure on how to execute single and double-loop learning (Argyris and Schön, 1978).

ii. **Mills and Friesen's Model**: The model clarifies that an organization learns through people in the organization. These people are contracted because of their specific skills or knowledge which might be increased through on the job training or formal training. Learning is an individual event, which benefits the organization totally through the people (Mills and Friesen, 1992). OL should include systemizing knowledge into its practices and procedures that are the re-utilization of knowledge. At the point when people do not utilize knowledge or resign, the knowledge will still stay with the organization which establishes OL. If an organization obtains or converges with other organization, OL occurs when the acquiring organization absorbs the acquired organization practices and procedures or include to its workforce the knowledge embodied in the acquired organization's processes (Mills and Friesen, 1992).

iii. **Nevis, DiBella and Gould's Model**: Nevis et al. (1995) propose a three-step model of OL: 1) knowledge procurement, 2) knowledge sharing, and 3) knowledge utilization. Knowledge procurement alludes to the advancement or creation of skills, experiences, and relationships. Knowledge sharing identifies with the dissemination of knowledge that has been learned. OL may occur in a planned or informal way. Knowledge and skill acquisition occur through acquisition as well as thorough knowledge sharing and utilization (Nevis et al., 1995).

iv. **Nonaka's Knowledge Spiral Model**: Nonaka (1994) proposes a model describing how organizational knowledge is created through different channels of collaboration between tacit and explicit knowledge. Nonaka (1994) recommends four modes of how knowledge is created through 1) socialization process (tacit to tacit knowledge creation), 2) externalization process (tacit to explicit knowledge creation), 3) blend process (explicit to explicit knowledge creation), and 4) internalization process (explicit to tacit knowledge creation).

v. Kim's Model: Kim (1993) proposes an integrative model describing the connection between individual learning and OL in which an organization learns through its members is influenced either straightforwardly or in a roundabout way by individual learning. This model describes OL as aggregate individual learning as well as includes the transfer mechanism among individual and OL; where individual learning becomes winds up implanted in an organization's memory and structure. In this sense, individual learning influences learning at the organizational level by its effect on the organization's shared models. This model underlines that the organization learns only through its members and learning does not rely upon a particular individual. However, individuals can learn without an organization. OL process is seen from two points of view: 1) the aggregate learning viewpoint, and 2) the intellectual result point of view. The aggregate learning perspective underlines how knowledge through individual learning moves toward organization shared knowledge, and the intellectual result perspective shows that knowledge obtained through individual learning can lead directly to a singular activity or indirectly to organizational activity through knowledge sharing (Kim, 1993).

vi. IJV Knowledge Management Model: the model of OL and KT in IJVs is based on input-process-output (Tiemessen et al.,1997) built upon Parkhe (1993) and Toyne (1989) approach. This model involves four basic components in OL and knowledge transfer in IJV: Structure, Conditions, Process, and Outcomes. Tiemessen et al. (1997) suggest three steps of inter-organizational learning in JV. The first step is to transfer process where two autonomous firms structure a JV, both firms transfer and contribute resources as far as their current supply of competencies. The transfer is described as the development of knowledge between the parent's firms, directly or indirectly, through activities such as buying technology, imitating technology used by the other JV's partner or modifying/changing the current advancements based on the partner's direction. Transfer means "to accept the partner's knowledge, to integrate knowledge into one's systems or changing one's resources to imitate knowledge" (Tiemessen et al., 1997). The second step is a transformation process where through joint activities these competencies are then transformed and upgraded to reflect the consolidated pool of knowledge and skills as well as new knowledge made from the partnership. Knowledge transformation corresponds to the extension of existing knowledge and the creation of new knowledge within the JV. Therefore, transformation is defined as the integration, application, and utilization of contributed knowledge, and the creation of new knowledge as a result of IJV activities. Collaborating with local partners is critical in guaranteeing appropriate and right adjustment, and opportunities to improve own capacities. Through the adjustment process, resource integration and partnering knowledge are made (Tiemessen et al., 1997). The third step is the reaping process where partners harvest knowledge and skills from IJV and bring them back to the parent firms. The gathering is depicted as "a process of retrieving knowledge that has already been created and tested from the IJV resources in which it resides and internalizing it into the parent firm so it can be retrieved back and used in other applications". The knowledge harvesting process is not quite the same as the transfer and transformation process because the process is more difficult and not straightforward (Tiemessen et al., 1997). Knowledge harvesting by the parent firms is dependent upon the top management's active role in JV and proper communication with the JV managers (Lyles, 1988).

The TT Triple Helix model: Etzkowitz and De Mello (2004) trace the origins of the Triple Helix model of innovation back to 1967, when Julius, Director of the Netherlands Central Organisation for Applied Scientific Research, introduced the concept of a "triangle". He stated: "all those responsible, in one way or another, for the all-important economic development of their countries, rack their brains to find the balance within the many complicated relationships in the modern eternal triangle of government, industry and science" (Ciapuscio, 1994, cited in Etzkowitz and De Mello, 2004). Etzkowitz and De

Mello (2004) go on to describe how Sábato later adopted this idea of the "triangle" and used it as a tool to diagnose the relationships of science, academia and industry in Latin America. They describe how he found out that there was almost total nonexistence of "triangles" in Latin American countries and that this could be a factor which was blocking economic development. He suggested that for progress to occur, it was necessary to create dynamic science and technology interactions that contribute to positive benefits for society. He believed in the need for a "progression of interactions concerned with the numerous and managed activities of three "vertices" of society: "government (G); the productive structure (E); including private and government-owned companies; and the science-technology infrastructure (I), including universities, public and private RandD centres" (Etzkowitz and De Mello, 2004). Sabato then hypothesised "a set of three types of the relationship among the elements of the triangle: intra-relations (within each vertex), inter-relations (within the vertices) and extra-relations (with the government directing the two other vertices)" (Etzkowitz and De Mello, 2004). According to Etzkowitz and De Mello (2004), this notion of progress was based on the government generating a process of strong interrelations among the three vertices. This idea was further developed by Etzkowitz and Leydesdorff (1995) who later named this process of interrelations as the Triple Helix model of innovation. According to Etzkowitz and Leydesdorff (1995), the Triple Helix model is a "spiral model of innovation, which can capture multiple reciprocal linkages at different stages of the capitalization of the knowledge". They argue that the Triple Helix model will be the key strategy of the national or multinational innovation agenda of the 21st century. This was echoed by Godin and Gingras (2000) who stated that in the past two decades the Canadian government had focused on the need to develop and promote stronger ties between universities and businesses through new policies and strategic programmes. The Triple Helix model repays the breaking points of the traditional linear methodology of innovation where theoretical and practical issues are investigated inside a different institutional field (namely, university and industry) underlining the impact of the transformational changes across institutional boundaries between university, government, and industry, which are viewed as the key players of technology transfer. Its focal point is that university, government, and industry that were differentiated from each other as a condition for the constitution of advancement have converged with each other to create a kind of institutional arrangement (Baber, 2001) for improving knowledge-based innovation. Universities play the role of business and become more entrepreneurial focused and act as experts (Etzkowitz, 2004). Industries are engaged in more research in new technology development through the foundation of research focuses. The government pushes collaborations among university and industry through planning and implementing innovation projects (Etzkowitz and Leydesdorff, 2001). Subsequently, networks are created among the three institutional spheres in common projects for pushing economic growth and knowledge-based innovation. This review significantly contributes to the existing TT literature by investigating the development of the previous TT models which include the traditional TT model, models created after the 1990s, other related hypothetical establishments underlying TT models.

2.4 Key factors of technology transfer success

The determinants of successful technology transfer are connected with the actors involved. In a transfer process, the ability to assimilate and re-utilize that technology can either upgrade or undermine the achievement of the transfer (Duan et al., 2010). His empirical outcomes (Cfr. Table 1) acquired from the examinations of technological partnership agreements among SMEs and research institutions demonstrate that Technology transfer in Triple Helix[1]

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[1] The Triple Helix model of innovation refers to a set of interactions between academia, industry and governments, to foster economic and social development (see The Triple Helix Concept. Stanford University Triple Helix Research Group. 11 July 2011 and Leydesdorff, Loet. "The Knowledge-Based Economy and Triple Helix Model". University of Amsterdam, Amsterdam Schoolf Communications Research). This framework was first theorized by Henry Etzkowitz and Loet Leydesdorff in the 1990s. The triple helix model of innovation, as theorized by Etzkowitz and Leydesdorff, is based on the interactions between the three following elements and their associated 'initial role': universities engaging in basic research, industries producing commercial goods and governments that are regulating markets. As interactions increase within this framework, each component evolves to adopt some characteristics of

cooperation is connected with: innovation strategy, network connectedness, project management, and internationalization process.

Table 1. Determinants of Technology Transfer and proxies

Proxy	**Determinants**	**National/ International TT**	**Sample**	**Author (year)**
Innovation Strategy	Investments	National level	SMEs-Public research institutions	Tushman and O'Reilly (1997)
	Financial performance	National level		Crespell and Hansen (2008)
	Network	International level		Coombs et al., 2003, Powell et al. (1996)
Network	Open Innovation	Regional level	Triple Helix collaboration	Chesbrough (2006)
	Knowledge			Vonortas (2009)
	Social capital			Lin (2008)

the other institution, which then gives rise to hybrid institutions. Bilateral interactions exist between university, industry and government.

	Knowledge, skills, tools, and techniques			Ohara (2005)
	Organizational capability			Adams et al. (2006)
Internationalization process	Market	International level	SMEs	Dunning (1995)
	Resources			Dunning (1995)
	Efficiency			Dunning (1995)

Likewise related to the actors involved in technology transfers, and as significant as an absorptive limit is a connectedness between the partners. As indicated by some authors (Gopalakrishnan and Santoro, 2004; Santoro and Bierly, 2006; Duan et al., 2010; Laroche and Amara, 2011), connectedness between partners assumes an important role in technology transfers. Environments that encourage interpersonal relationships can be conductors in the knowledge flow (Santoro and Bierly, 2006) since colleagues encourage the working arrangements between partners (Duan et al., 2010). As verified by Sherwood and Covin (2008), recognition among partners can encourage routines of knowledge-sharing, which prompts the common comprehension of techniques and practices and, consequently, promotes the acquisition of technology. The quality of these innovative capacities was likewise referred to as technological relatedness by Santoro and Bierly (2006). Due to limited resources and expertise, companies habitually cooperate with university research centres (URCs) to get to new technologies (Santoro and Bierly, 2006).

Similarly, connectedness between the actors of the Triple Helix is also expected. Indeed, Gkikas (2011) alludes to the importance of networking to the innovativeness of a firm. Given his research in other studies, he concludes that the innovativeness of a firm is positively connected with collaboration between Triple Helix actors.

2.5 Innovation Strategy

Innovation strategy plays a crucial role in determining the firm's innovative capacity and duty on innovation investments (Tushman and O'Reilly, 1997). De Jong and Brouwer (1999) points out that the innovation strategy is "a major directional and motivating instrument for developing innovative decisiveness". All things considered, the innovation strategy is an integrative piece of the mission, objectives, and budgets for development and has a positive effect on corporate financial performance (Zahra and Das, 1993; Markham, 1998). Many researchers affirmed the benefit of the positive effects of innovation strategy on innovation (Li and Atuahene-Gima, 2001; Verhees and Meulenberg, 2004; De Jong and Vermeulen, 2006). Along these lines, the planning and implementation of an innovation strategy is a key factor in deciding the dimension of innovativeness, which then drives the firm's financial performance (Crespell and Hansen, 2008).

To develop a precise definition of *Innovation strategy*, it is important to define the concept of *innovation*. Books, journal articles, and business magazine articles on innovation offer a variety of conceptualizations and definitions of *innovation*. The origin of the word "innovation" comes from the Latin words "innovatio" or "innovo.". Both words mean to "renew or to make something new" (Norrman 2008). The definition of innovation is highly varied because many different disciplines have focused on innovation from their specific perspective (Baregheh, Rowley and Sambrook, 2009). An early definition of innovation, from an economics point of view, was presented by Schumpeter. An innovation, by definition, "had a substantial economic impact. Innovation was something that profoundly changed the marketplace. The innovating organization was, thus, likely to become the new market leader and to gain an immense advantage over its competitors" (Schumpeter, 1943). West and

Anderson (1993) point out that "Innovation can be defined as the effective application of processes and products new to the organization and designed to benefit it and its stakeholders". Numerous other definitions additionally include the ideas of *new* and *novel*: *new* can be characterized as something that "breaks into" the market or society, while a *novel* is defined as a new but original, fresh, unique. Damanpour focuses on innovation at organizational dimension and proposes that innovation is, "the process that includes the generation, development, and implementation of new ideas and behaviours" (Damanpour, 1996). Freeman (1992) states the connection between innovation and invention that can be defined as a new idea, model or even physical or service product, whereas an innovation, from a financial point of view, is possibly achieved when the new idea or product achieves its first business progress. If the invention is a new idea that is made a reality, then the innovation is when the invention is applied and adds value. This idea extends the concept of the invention to innovation, as it is no longer only seen as something new or novel, but something new, novel and that provides a company with commercial success. Baregheh et al (2009), perfectionated the analysis with an alternative definition of innovation across different disciplines: it could be argued that the specific definition for innovation as a discipline is appropriate. In any case, they concluded that as business and academia become more inter and multi-disciplinary a generic and integrative meaning of innovation is required. Their definition of innovation according to the Community Innovation Survey (CIS)[2] is: "Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, to advance, compete and differentiate themselves successfully in their marketplace" (2009).

[22] The CIS is a survey of innovation activity in enterprises. The harmonised survey is designed to provide information on the innovativeness of sectors by type of enterprises, on the different types of innovation and on various aspects of the development of an innovation, such as the objectives, the sources of information, the public funding, the innovation expenditures etc. The CIS provides statistics broken down by countries, type of innovators, economic activities and size classes. https://ec.europa.eu/eurostat/web/microdata/community-innovation-survey

As a result, the role and importance of innovation strategy in SMEs have developed significantly (Hamel, 1996). The amount of money, time and effort concentrated on innovation strategy in both academic and business environments has expanded significantly.

Anderson, Potočnik, and Zhou (2014) state that innovation is a new and improved way of doing things, something novel and useful. Lafley and Charan (2008) define it as the conversion of a new idea into revenues and profits. Freeman (1992) states the connection between innovation and invention that can be defined as a new idea, model or even physical or service product, whereas an innovation, from a financial point of view, is possibly achieved when the new idea or product achieves its first business progress. If the invention is a new idea that is made a reality, then the innovation is when the invention is applied and adds value. This idea extends the concept of the invention to innovation, as it is no longer only seen as something new or novel, but something new, novel and that provides a company with commercial success. Baregheh et al (2009), perfectionated the analysis with an alternative definition of innovation across different disciplines: it could be argued that the specific definition for innovation as a discipline is appropriate. In any case, they concluded that as business and academia become more inter and multi-disciplinary a generic and integrative meaning of innovation is required. Recently Varadarajan (2018) has presented an overview of definitions and conceptualizations of types of innovation which are indicated in Table 2. Varadarajan (2018) discusses the literature and logical underpinnings of the various refinements and proposes a definition of innovation: “Innovation is the creation of value by using relevant knowledge and resources for the conversion of an idea into a new product, process, or practice or, improvements in an existing product, process, or practice”.

Table 2. Innovation and Innovation Types: An Overview of Definitions and Conceptualizations

Innovation "The implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (OECD, 2005, p. 46). **Process innovation** "The implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software" (OECD, 2005, p. 49). **Product innovation** The process of translating an idea into a customer value proposition that is commercially viable (Chandy and Tellis, 1998). "The introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user-friendliness or other functional characteristics" (OECD, 2005, p. 48). **Incremental product innovation** An innovation that offers new features, benefits, or improvements in existing technology. A new product that measures low on both the newness of technology and customer needs fulfilment dimensions. An innovation that is an adaptation, refinement, or enhancement of an existing product in existing markets (see Chandy and Tellis, 1998; Garcia and Calantone, 2002).

An innovation that is a refinement and extension of an established design that results in substantially lower price and/or greater functional benefits to users (Banbury and Mitchell, 1995).

Radical product innovation

A new product that incorporates a substantially different core technology and provides substantially higher customer benefits relative to previous products in the industry. A new product that measures high on both the newness of technology and customer need fulfillment dimensions (Chandy and Tellis,1998).

Market breakthrough product innovation

An innovation based on a core technology that is similar to the technology employed in an existing product that provides substantially higher customer benefits per unit of price paid. A new product that measures low on the newness of technology dimension and high on the customer need fulfillment dimension (Chandy and Tellis, 1998).

Technological breakthrough product innovation

An innovation based on a substantially different technology compared to the technology employed in an existing product, but does not provide superior customer benefits per unit of price paid. A new product that measures high on the newness of technology dimension and low on the customer need fulfillment dimension (Chandy and Tellis, 1998).

Business model and business model innovation

A business model is a specification of interdependent activities, processes, and structures that articulate the firm's organizing logic for value creation for its customers and value appropriation for itself and its partners (Sorescu et al., 2011).

A business model innovation is a change in one or more elements of a firm's current business model (content, structure, and governance) and their interdependencies, and thereby, a modification in the organizing logic for value creation and appropriation (Sorescu et al., 2011).

A business model comprises four elements: (1) customer value proposition, (2) resources - financial, human, and technological, (3) processes employed to convert inputs into finished products, and (4) profit formula that specifies the margins, asset velocity, and scale required to achieve an attractive return. The interdependencies between the elements of the business model require that each element of the model is congruent with the other elements (Christensen et al., 2016).

“A business model innovation is a new way of delivering and capturing value that changes the basis of competition” (Nidumolu et al., 2009, p. 60).

Exploitative innovation

Innovations that involve improvements in existing components and build on the existing technological trajectory (Benner and Tushman, 2002, p. 679).

Technological innovation activities aimed at improving a firm’s product offerings in existing product-markets (He and Wong, 2004, p. 483).

Exploratory innovation

Innovations that involve a shift to a different technological trajectory (Benner and Tushman, 2002, p. 679).

Technological innovation activities aimed at entering new product-market domains (He and Wong, 2004, p. 483).

Architectural innovation

An innovation that entails changes in the way in which the components of a product are linked together, while leaving the core design concepts (and thus the basic knowledge underlying the components) untouched (Henderson and Clark, 1990).

Reverse innovation

An innovation developed in an emerging market in response to the unique needs of and characteristics of customers in the market, and subsequently launched in relatively more developed markets (Immelt, Govindarajan, and Trimble, 2009).

Social innovation

“A novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals” (Phills et al., 2008, p. 39).

Sustainable innovation

"The implementation of a new product, process, or practice, or modification of an existing product, process, or practice by a firm that significantly reduces the impact of its activities on the natural environment" (Varadarajan, 2017, p. 17).

Sustainable product innovation

"The introduction of a new product or modification of an existing product by a firm whose environmental impact during the lifecycle of the product, spanning resource extraction, production, distribution, use, and post-use disposal, is significantly lower than existing products for which it is a substitute" (Varadarajan, 2017, p. 17).

Innovativeness

The capacity of a new innovation to create a paradigm shift in the science and technology and/or market structure of an industry (Garcia and Calantone, 2002).

New to: New to the world, new to the industry, new to scientific community, new to the market (place), new to the firm, and/or new to the customer (Garcia and Calantone, 2002).

New what: New technology, new product line, new product benefits/features, new product design, new process, new service, new competition, new customers, new customer need, new consumption patterns, new uses, new improvements/changes, new development skills, new marketing/sales/distribution skills, new managerial skills, new learning/experience/knowledge, and/or new quality/ benefits (Garcia and Calantone, 2002).

Product innovativeness

The degree of newness of a product to the firm, its uniqueness of superiority relative to existing products (Cooper, 2001).

The extent to which a product's technology, benefits, and features differ from other products in the same category (Lee and O'Connor, 2003).

Incrementally new product

A product that better satisfies an existing market need by using existing technologies or refinements of existing technologies (Urban et al., 1996).

Radically new product

A product that shifts the market structure, represents a new technology, requires consumer learning, and induces behavior change (Urban et al., 1996).

Source: Varadarajan, 2018

Building on the above, Varadarajan (2018) proposes the following definition of strategic innovation: “Innovation strategy is a firm’s relative emphasis on different types of innovations and the associated pattern of resource allocation, in alignment with its strategy at the corporate, business unit and functional levels”. Along this line, the planning and implementation of an innovation strategy is a key factor in deciding the dimension of innovativeness, which then drives a firm’s financial performance (Crespell and Hansen, 2008).

As a result, the role and importance of innovation strategy in SMEs have developed significantly (Hamel, 1996). However SMEs have limited resources at their disposal, this lack can be compensated by flexibility, agility, and innovativeness (Qian and Li, 2003; Acs and Yeung,1999). That is why SMEs’ performance in various contexts becomes a central issue when discussing the topic of innovation (Mazzarol and Reboud, 2008; Vermeulen et al. 2005; Wolff and Pett, 2006). The growth potential effect related to innovation strategy in SMEs comes from three input parameters: technology, RandD, and generation of competitive edge (Romano, 1999).

Coombs et al., 2003, Powell et al. (1996) point out that innovation strategy is conducted in inter-organizational networks. On the other hand, Chiesa and Manzini (1998) highlight that SMEs progressively moved toward becoming part of networks, in which resources, knowledge, and data circulate quickly and depend on coordinated efforts and partnerships. Knowledge diversity within a network is gainful because it produces positive externalities to multiple agents through knowledge spillovers, opening doors for innovation (Feldman and Audretsch, 1999, Kogut, 2000).

Gambardella (1992) states that to be part of a network, and to be able to effectively exploit the data that circulates in the network, has turned out to be significantly more profitable than having the option to produce new knowledge autonomously. Quinn (2000) underlines that to contend, collaboration inside a network of partners is becoming essential (Ritter and Gemünden, 2003), while Stabell and Fjeldstad (1998) presume that the estimation of the network increases with its normal size. Interacting with external partners permits a firm to access new knowledge, while network connections appear to advance innovative performance (Caloghirou et al., 2004). Granovetter (1973) stresses in terms of network functionality also especially the significance of weak ties, while Faems et al. (2005) feature the importance of diversity in external relationships to encourage innovation.

Network connections, next to intercompany connections concern linkages among companies and knowledge institutions and some researches have demonstrated the widespread use of university-industry partnerships (Schartinger et al., 2002, D'Este and Patel, 2007, Meyer-Krahmer and Schmoch, 1998, Perkmann and Walsh, 2007). If additionally a governmental body is involved in such a university-industry partnership, the term triple helix collaboration is utilized. Innovation inside networks is extensive as a result of the continued connection among institutions and commercial organizations of different sizes, capacities, and expertise (Omta and Van Rossum, 1999). Some authors highlight the importance of specific advantages of innovating within networks.

2.6 Network and Networking

Both terminologies concern the relationships of a business and are used interchangeably in previous literature (Chipika and Wilson, 2006; Leroy, 2012; Premaratne, 2002; Sawyerr et al., 2003; Scalera and Zazzaro, 2009; Zain and

Ng, 2006). *Network* refers to a set of elements or members that are connected (Casson and Giusta 2007). Connections or ties are the fundamental features of all networks (Casson and Giusta 2007). The connections are the results of relationships between the members. Besides, all members of a network are either directly or indirectly linked to each other (Casson and Giusta 2007). Thus, networks consist of a set of elements or members that are connected as a result of the relationships of the members. Seibert, Kraimer and Liden (2001) define a network as "the pattern of ties linking a defined set of persons or social actors". *Networking* refers to the process of building and engaging in networks. Table 3 below shows that these two concepts appear interchangeably and refer to the relationships of a business.

Table 3. Definitions of networks and networking

Authors	**Definition of Network**	**Authors**	**Definitions of Networking**
Zain and Ng (2006)	A network is the relationships between a firm's management team and employees with customers, suppliers, competitors, government, distributors, bankers, families, friends, or any other party that enables it to internationalize its business activities.	Lama and Shrestha (2011)	Networking is defined as the process of building long-term contacts with the motive to have access to information and resources.
Nieman (2006)	Networks can be defined as patterned, beneficial relationships between individuals, groups or organizations that are used to secure critical economic and non-	Scalera and Zazzaro (2009)	Networking can be formal and informal links that are created to allow its members to have cost-effective economic transactions.

	economic resources needed to start and manage a business.		
Halinen and Törnroos (1998)	Networks are structures of exchange relationships among business actors, firms as well as individuals - structures that emerge, evolve and dissolve over time in a continuous and interactive process.	Sawyerr et al. (2003)	Networking is the link between a business, its owner or its employees with other individuals or businesses, that involves exchanging of resources.
Das and Teng (2002)	Networks are relationships that create connections between two or more independent entities.	Chipika and Wilson (2006)	Networking is a set of connected sustained relationships, that involves cooperation and collaboration which is mutually beneficial to all members.
Premaratne (2002)	Networks are long-term contacts between small business owners and external actors (persons or organizations) to obtain information, moral supports and other resources.	Nieman (2006)	Networking can be defined as purposefully striving to make formal and informal contacts and to form relationships.

Source: Adapted from different authors (2019)

From these definitions it is evident that there are many relationships which a business can be a member of, therefore, the types of networks vary accordingly. Moreover, different criteria can be used to differentiate networks into various types. The classification of networking by different scholars is summarized in Table 4 below.

Table 4. Types of networks

Authors	**Classification of networks**	**Description of networks**
Möller and Halinen (1999)	Horizontal networks	Networks with competitors, research institutions, non-governmental- and governmental organizations (NGOs).
	Vertical networks	Networks with suppliers and customers
Littunen (2000)	Formal networks	Consist of networks with venture capitalists, banks, accountants, creditors, lawyers, and trade associations.
	Informal networks	Consist of personal relationships, families and business contacts
Ngoc and Nguyen (2009)	Official networks	Networks with government officials
	Managerial networks	Networks with top managers of supplier and customer firms.

	Social networks	Networks with friends and family, and with members of social associations and clubs.
Nieman and Nieuwenhuizen (2009) and Nieman (2006)	Personal networks	Networks with family and friends that are centred on the business owner
	Extended networks	Patterned networks that are formed with other organizations
	Social networks	Networks are created based on conformity to community ties or collective values.
Gellynck and Kühne (2010)	Horizontal network	Cooperation among firms that are primarily competitors.
	Vertical network	Cooperation among partners belonging to the same chain.
Leroy (2012)	Social networks	Networks are created as a result of the social interactions business owners have in their social life, such as networks with friends, family, relatives and social clubs.
	General business networks	Networks which businesses have with other businesses as well as with governmental and non-governmental

		organizations.
	Managerial networks	Networks which managers of a business have with suppliers, customers and similar businesses (competitors).

Source: N. T. Desta (2015)

Networks have been recognized as a significant factor in various researches on the innovation process. Ahuja (2000) and Burt (2004) have each shown that both the number and structure of connections in networks can improve innovation results. In trying to improve innovation results, effectively overseeing networks can directly lead to better outcomes for firms (Kastelle and Steen, 2010). While the advantages of managing networks are generally recognized (see Malerba and Vonortas (2009) for an overview), there are again open questions about how this knowledge can be applied in the case of SMEs. Chesbrough (2006) has demonstrated the importance of networks in open innovation. Firms accomplish and continue open innovation by utilizing a wide range of external actors and knowledge sources (Laursen and Salter, 2006; Lee et al., 2010; Lichtenthaler, 2009; Poot, Faems and Vanhaverbeke, 2009). Even though SMEs contribute significantly to open innovation, they are influenced by the open innovation process in a different way than large firms (Lichtenthaler, 2008). Findings suggest innovation in SMEs is becoming progressively open because of the absence of resources in developing and commercializing new products on their own and as a result, they are increasingly disposed or forced to collaborate with other organizations (van de Vrande et al., 2009). This suggests the immediate impacts of network connections may differ in the case of SMEs.

Networks give access to social resources that encourages exploration and exploitation activities of SMEs (Florin, Lubatkin and Schulze, 2003; March

1991). Social capital is in this manner dependent on networks but not equivalent. This is following Lin's (2008) hypothesis that network features are exogenous to social capital, but contrary to the view of Cooke and Wills, (1999, p. 224) who point out that "… social capital is the origin and expression of successful network interactions". We adopt Lin's interpretation that networks are exogenous to social capital here, leading us to utilize Nahapiet and Ghoshal's (1998, p. 243) definition of social capital as being the "(…) some of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit."

The importance of networks and social capital to innovation in SMEs is well documented (Ahuja, 2000; Lee et al., 2010; Rogers, 2004; Zeng, Xie and Tam, 2010). The advantages of both intra-firm (Tsai and Goshal, 1998) and inter-firm networks (Molina-Morales and Martinez-Fernandez, 2010) are obvious in that social network and related social capital variables were found to add to both product and process innovation in SMEs. Indeed innovation occurs in social networks of actors across multiple contacts (Shane and Venkataraman, 2000; Burt, 1992). Authors such as Sullivan, and Marvel (2011), Thorgren, Wincent, and Örtqvist (2009), Schilling, and Phelps (2007), as well as Rothwell (1991) all, support the idea that a more extensive territory and several network ties support innovation performance.

The foundation of networks holds a few advantages for SMEs (Robinson, 1982). SMEs typically need economies of scale in research, have less access to data, and other basic innovation resources (Mohannak, 2007). SMEs additionally have insufficient ability to exclusively manage the entire innovation process and are thusly encouraged to cooperate with other firms prompting potential pooling of resources and data (OECD, 2010b). Through establishing network relations, SMEs obtain advantages of large size without its related disadvantages (Nooteboom, 1994; Rothwell and Dodgson, 1994). Therefore, direct and indirect ties upgrade a firm's access to required contributions to the innovation process including skill accumulation through the combination of correlative skills and collective learning which occurs within networks (Pittaway et al., 2004).

Rosenbusch et al. (2011) challenge the supposition held by the network and social capital works of literature highlighting the importance of inter-firm collaboration and networking in innovation for SMEs. They argue that internal innovation projects lead to greater firm performance than innovation projects with external partners. They find that "the innovation projects that focus on external collaboration do not increase the performance of SMEs" (Rosenbusch et al., 2011, p. 13). They attribute this to the 'liability of smallness' and 'liability of newness' separately alluding to the predominance of greater innovation partners and absence of experience (Edwards, Delbridge and Munday, 2005). Granovetter's (1973) investigation of the strengths of weak ties has opened another line of inquiry into this relationship (Nahapiet and Ghoshal, 1998).

March (1991) utilizes this logic to argue that strong ties promote exploitation or the utilization of knowledge while weak ties are essential to new knowledge creation or exploration. Weak ties hamper complex data transfer and strong ties constrain data search in intra-organisational social networks. Ahuja (2000) argues strong ties empower trust (Coleman, 1988, 1990) but limit the diversity of new ideas, while weak ties provide data benefits (Burt, 1992; Granovetter, 1973) but inhibit trust. He concludes that there is no simple and optimal network structure as it is dependent upon the goals of the network members.

In addressing this issue, researchers utilized a contingency or dynamic perspective to establish optimal network structures at different phases of the innovation procedure (Fukugawa, 2006; Kleinbaum and Tushman, 2007; Pirolo and Presutti, 2010). These outcomes support that weaker ties should be emphasized during the exploration or idea generation phase while strong ties engagement is most proper for innovation implementation or exploitation. Concluding from the theoretical arguments and empirical results, we claim that larger diversity of network ties permits SMEs to draw on additional external resources, enabling them to open up their innovation effort and to innovate across a broader range of activities. We further contend that our measurement of innovation shows that we are taking at exploitation which will benefit most from stronger ties.

The network perspective holds collective social capital at the firm level to upgrade the probability of instrumental returns (Lin, 2008), increasing efficiency (Burt, 1992) and adequacy (Gabbay and Leenders, 1999). The focal point here is on the advantages, returns and social rents of social capital not at the individual level (Granovetter, 1973, 1974, 1982) but rather at the institutional or firm level, assuming the member's social capital to aggregate to the firm's collective social capital (Nohria and Ghoshal, 1997).

Networks spread risk, reduce innovation time and costs (Marinova and Phillimore, 2003) thus positively affecting long-term firm performance and exceeding the immediate collaboration costs (DeBresson and Amesse, 1991; Zhou, Wu and Luo, 2007). Besides network and social capital theories, various perspectives illustrate our theoretical understanding of the effect networks have on the firm performance of SMEs. The complex net of inter-organizational communication ways connects the firm with its technological environment and commercial centre (Rothwell and Zegveld, 1985), offering changes for and limitations on behaviour (Brass, Galaskiewics, Greve and Tsai, 2004).

Much emphasis has been set on the role of networks with external firms to benefit resource-poor SMEs, empowering them to survive competitive pressures from larger firms (Marinova and Phillimore, 2003). From suggestions, SMEs should seek strategies concentrating on the improvement of profitable networks with external resource holders to succeed (Lee et al., 2001). Such a view finds support in RBT (Penrose, 94 1959; Wernerfelt, 1984), which sees the creation and maintenance of networks as a mechanism in accessing scarce resources. Networks give access to external resources but also encourage the creation and exploitation of social capital which in itself is viewed as a source of competitive advantage (Barney, 1991; Florin et al., 2003; Nahapiet and Ghoshal, 1998). Similarly, in perceiving that a firm's resources may extend beyond the limits of the firm, the relational view regards inter-firm linkages as a source of "relational rents" and competitive advantage (Dyer and Sing, 1998, p. 661).

The mechanisms through which the performance advantages of networks convert into firm performance is not obvious from research results. While the connection between networks and performance appears obvious from the arguments above, Rodan (2010) has argued that innovativeness mediates the connection between network density, knowledge heterogeneity, and managerial performance. At the firm level, innovativeness has additionally been viewed as the mechanism that opens the performance benefits derived from social capital embedded in network structure and knowledge heterogeneity (Clifton, Keast, Pickernell and Senior, 2010).

Literature has documented the use of different theories on *Networking*. Premaratne (2002) notes that theories on Networking have been guided by several theoretical perspectives such as transaction cost (Coase, 1937; Williamson, 1985), resource dependence (Pfeffer and Salanick, 1978), relational exchange (Dwyer, Schurr and Oh, 1987) agency (Bergh, 1995; Fama, 1980), Social Network Approach (Aldrich and Zimmer, 1986; Birley, 1985; Birley and Cromie, 1988; Johannisson, 1987; Uzzi, 1997) and international business and marketing (Beije and Groenewegen, 1992). For our research, the three most relevant theories on networking are summarized in Table 5.

Table 5. Theories in the discussion of SMEs networking

AUTHOR	RANGE	KEY FACTORS OF THE THEORY	METHODOLOGY

COASE (1937); WILLIAMSON (1975, 1985, 1991)	Transaction Cost Approach (TCA)	The TCA theory is based on the notion that networking provides cost-efficient ways of undertaking transactions. Through networking, SMEs can distribute transaction costs amongst members, thereby reducing the cost that each business incurs.	Theoretical approach
PFEFFER AND SALANCIK (1978)	Resource Dependence Approach (RDA)	The RDA theory emphasises the notion that businesses may not have all the necessary human, physical and financial resources to overcome changes and influences from the external environment. Therefore, businesses have to depend on one another by creating networks to access the resources they lack to stay in competition as well as to grow their business.	Practical approach
ALDRICH AND ZIMMER (1986); BIRLEY (1985, 1990); BIRLEY AND CROMIE (1988); JOHANNISSON	Social Network Theory (SNA)	The SNA theory takes into account the social relationships which business owners come across in running their businesses, as well as the potential which such interactions have	Practical approach

(1987); UZZI (1997)	for the formation of networks.

Source: Desta, 2015

2.7 Internationalization process

The term *Internationalization* is ambiguous and definitions vary depending on the phenomenon they include. From a historical perspective, the internationalization of SMEs commenced with mankind's ability to travel across the seas and borders. Scholars and academics have attempted to outline internationalization on many activities with the use of many different perspectives and variables. Penrose's (1959) point of view on the subject specializes in the firm's core competencies and opportunities in the foreign environment. Welch and Luostarinen (1988) defined "internationalization as the process in which firms increase their involvements in international operations". By some scholars, internationalization is also described as "the process by which firms both increase their awareness of the direct and indirect influences of international transactions on their future and establish and conduct transactions with other countries" (Beamish, 1990). Later on, Calof and Beamish (1995) defined internationalization as "the process of adapting firms operations (strategy, structure, resource, etc.) to international environments".

Many literature in international business shows that export is the principal international business activity to gain access to new and larger markets. Traditionally, internationalization by exporting has been taken into consideration as a manner to increase the growth of firms.

Over the past decade, firms have been specializing in exclusive business activities as ways of internationalization and thinking about them to be important to gain competitive advantage. Partnerships with foreign companies, foreign investments and cross border networking have ended up more and more critical as methods of facilitating the alternate of technology and knowledge which allow SMEs to formulate strong international business strategies. Globalization, technological, political and financial changes are some of the main drivers for the growing internationalization of SMEs in today's world. Various theories of the internationalization process propose that certain types of SMEs internationalize by following the 'U-Model', expressing a careful and modern behaviour; whereas there are different types of SMEs that are considered as born globals and internationalize at an early degree of their establishment.

Going back through history we find a lot of theories that approach the internationalization process of SMEs in different ways. For a complete overview of the SMEs' internationalization process, we have summarized the main theories in Table 6.

Table 6. Theories and models of the SMEs' internationalization process

AUTHOR	RANGE	KEY FACTORS OF THE THEORY	METHODOLOGY
JOHANSON AND VAHLNE, 1977	Uppsala Internationalization Process Model	The basic assumption of the Uppsala Model is that market knowledge and market commitment affects both the commitment decisions and the way current decisions are performed—and this, in turn, changes market knowledge and commitment. The amount of knowledge of foreign markets and operations is	Theoretical approach

		influenced by the number of commitments of resources in foreign markets and vice versa	
JOHANSON AND MATTSSON, 1988	Network approach to internationalization	The emphasis of the network approach is in bringing the involved parties closer by using the information that the firm acquires by establishing close relationships with customers, suppliers, the industry, distributors, regulatory and public agencies as well as other market actors. Relationships are based on mutual trust, knowledge and commitment towards each other. Firm’s position in the local network determines its process of internationalization since that position determines their ability to mobilize their resources within the network.	Practical approach

MTIGWE, 2006	International Entrepreneurship Theory (IET)	International entrepreneurship theory argues that individual and firm entrepreneurial behaviour is the basis of foreign market entry. Technological advancements, cheap and easy ways to access information and better communication between the countries have helped SMEs to go abroad.	Empirical approach

Source: Masum and Fernandez, 2008

For a complete overview of the SMEs' internationalization process, we have developed an in-depth analysis of the genesis of this phenomenon. In general, motives to internationalize SMEs are classified as: proactive and reactive (Czinkota, 1982) or pushes and pulls (Bartlett, 1991), which includes the same groups of internationalization motives. Czinkota and Ronkainen (2001) state that: "proactive firms go international because they want to, while reactive ones go international because they have to". Before beginning with international activities, a person or thing, regardless of whether from outside or from inside, needs to start the company's international activities (Hollensen, 1998).

Proactive (pull) motives are inward firms' forces that take the company to the internationalization way, while reactive (push) internationalize motives are company reaction to the environment irritations. Proactive processes imply building a systematic international strategy. Reactive procedures are spontaneous company's reaction to the alterations in external ambience.

Internationalization stimulating factors exist if the company distinguishes business opportunities in foreign business sectors and has exceptional qualities, free operative capacity, the home market is limited, domestic competition presses and empowered by foreign subjects. This internationalization improvement is operational just to the degree that it is conveyed to the attention of the company's decision leaders (Miesenbock, 1988). From the points of initiation of internationalization and who triggers its realization, researchers (Johnston and Czinkota 1982; Leonidou, 1988) determine internal (firms) and external (environmental) motivations. Internal motives relate to inside performances of the company, while external motives are connected with the effect of the environment (domestic and foreign) on its international activity. Both procedures, internal and external should be solid sufficiently ready to trigger motivation in the decision making in the initialization of export (Cavusgil, 1984). As demonstrated by Dunning (1995) there are four different groups of procedures in internationalization: a) market seeking - access to new foreign business sectors, b) resource seeking - access to better and less expensive assets, c) efficiency-seeking - access to the assets which improve the level of company's efficiency, and d) strategic assets seeking - access to high technology and core competence improvement.

The process of SMEs' internationalization is additionally full of uncertainties and obstacles, high economic and political risks, requesting generous capacities and assets (Mariosole, Varum and Pisicttelo, 2013). In general, small and medium-sized companies, in contrast to the large ones, have an absence of managerial, financial, organizational and technological assets, which expands the possibility of failure of this process.

Given the importance of SMEs and their successful internationalization for national economies, it is of vital significance to the implementation of satisfactory institutional support policies. “Yet the most potent argument in favour of governmental support lies in the fact that SMEs play a key role in the stability and potential of any national economy. They need to be supported to acquire the capabilities needed to compete successfully in the international market” (European Commission, 2007). Therefore, the challenge of any government is to develop such a strategy and provide SMEs support mechanism that will eliminate the obstacles and give incentive for efficient internationalization helping them to incorporate their activities.

The public support is mainly in two directions, first, encouraging new firms to enter international markets, and second, animating exports of already exporting firms (Spence, 2003; Gorg and Strobl, 2008). This implies any fruitful approach to supporting internationalization, must take into consideration the barriers and drivers of this procedure. Removing barriers could produce results in short and medium timeframe while animating drivers of internationalization could create a platform for long term internationalization strategy (European Commission, 2007).

Facilitated and coordinated activities between government support agencies, business associations and banks and SMEs is the key mechanism for creating an effective support strategy. It implies a holistic approach to solving this issue and including as many stakeholders as possible. The support should be customized to SMEs with various degrees of export commitment. As most substantial support to SMEs internationalization process, the European Commission (2007) proposed those directions:

- *Individualized support*. Each firm has explicit characteristics, assets, and capacities. It should be screened independently and depends on its internationalization preparation, should propose programs for expanding the firm's overall international performances;

- *Financial support*. Since as the main barrier for SMEs effective internationalization is the absence of financial assets, the institutional support must create systems which will make relative this barrier (financial consulting, access to credits, financial instruments, trade insurance);

- *Networking*. Support of building networks is of essential significance since they assume key roles in, first, getting valid information system and second, setting up effective collaboration among firms;

- *Sector programs*. Besides general characteristics, each industrial branch has an explicit position in the worldwide market. Along these lines, the support should be adjusted to the qualities of the industry (high-tech SMEs faced different problems when entering into the global market than food processing companies).

Additionally, in SMEs' efforts to internationalize their business, they usually use aggregated positive experiences and follow certain examples that have been demonstrated as fruitful. This plan is an internationalization improvement strategy of the enterprise (Ruzzler and Konecnik, 2006). It depends on accessible assets, which can support or dissimulate this procedure.

The internationalization strategy is a basic piece of the general business strategy of the company since it is a consequence and extension of general firm strategy (Welch and Welch, 1996; Andersson, 2004). For understanding the essence of international strategy development it is important to comprehend the dimensions which are connected with this strategy. Ansoff (1957) established the so-called “Ansoff Matrix” of corporate development strategy focused on the company's products and markets. Luostarinen (1979) upgraded Ansoff's two-dimensional model of product-market, to incorporate the internationalization processes during the designing of the firm’s strategy. This so-called POM-Model consists of three levels of internationalization: first, product (P) – “what” firm operates (products, services); second, operation mode (O) – “how” firm operates (direct, indirect, branches, licensing), and third, market (M) – “where” firm operates (market and environments). In the last few decades, as a result of drastic political, economic and technological changes, SMEs rapidly reduce the time of their internationalization. Therefore researchers (Ruzzler and Konecnik, 2006) propose the time dimension as a fourth strategic dimension of internationalization.

2.8 The main hypothesis to be tested

The main hypothesis to be tested by the models are the following:

Hypothesis 1: There is a positive relationship between technology transfer, research, industrialization process, and the network.

Hypothesis 2: There is a positive relationship between technology transfer and inter-organizational networks. SMEs become part of networks, in which resources, knowledge, and information circulate rapidly and at low cost, and which strongly rely on collaborations and partnerships.

Hypothesis 3: There is a positive relationship between technology transfer, inter-firm collaboration and networking in innovation for SMEs. The internal innovation projects lead to greater firm performance than innovation projects with external partners.

Hypothesis 4: There is a positive relationship between the technology transfer and the SMEs' internationalization process because it is an integral part of the overall business strategy of the company and a consequence and extension of general firm strategy.

Hypothesis 5: There is a positive interaction between Governments and SMEs dimension. And they know the importance of the contribution that can be expected from competent cluster organisations supported by a cluster policy.

CHAPTER 3 EUROPEAN INNOVATION POLICY TO SUPPORT SMEs: RESEARCH AND INNOVATION IN SMEs

3.1 Introduction

The chapter aims to analyse the European Union (EU) innovation policy to support small and medium-sized enterprises (SMEs)[3]. Through its industrial policy, the EU has been striving to create conditions conducive to increasing industry growth and competitiveness since 1992.

The development of the workforce in the SME sector of the EU Member States was characterised by a decline caused by the recession in 2009 and a recovery from 2010 onwards, but this took effect very differently in the Member States. A renewed strong appetite for innovative industrial policy did not emerge until the effects of the credit crunch and the ensuing prolonged economic slowdown became manifest with dramatic consequences on the manufacturing industry in some EU countries. Nowadays, we observe a complete change of mood towards industrial policy intervention, as a result of a combination of factors such as fear of rapid de-industrialisation following the crisis, limited European growth, new opportunities and constraints related to climate change, competition from emerging economies where significant planning is taking place, etc.

[3] Szczepanski, M., A renewed industrial policy strategy, EPRS, European Parliament, November 2017.
European Commission, State of the Union 2017 – Industrial policy strategy: Investing in a smart, innovative and sustainable industry, September 2017.
European Commission, Industry in Europe – Facts and figures on competitiveness and innovation 2017, September 2017.
Parry M. and Sapała M., 2021-2027 multiannual financial framework and new own resources: Analysis of the Commission's proposal, EPRS, European Parliament, July 2018.

Overall, great expectations are placed on industrial policy, which is seen as a central tool for promoting economic transformation and sometimes even as a way of helping the Member States to recover from the global financial crisis. Today, EU policy aims to enable a successful transition towards digital, knowledge-based, decarbonised and more circular industry in Europe. To achieve this goal, the EU supports, coordinates and supplements Member State-level policies and actions, mainly in the areas of research and innovation, SMEs and digital technologies.

Since 2014, efforts have been made in several areas, including investment (mainly through the European Fund for Strategic Investment, which supports industrial modernisation); digitalisation (for example setting up several research partnerships, or a growing network of digital innovation hubs); financing (making it easier for industry and SMEs to access public markets and attract venture funds); greener industry (for example through the revised 2030 emission targets, or measures on clean mobility); standardisation (bringing together relevant stakeholders to collectively develop and update European standards); and skills (mobilising key stakeholders to close the skills gap and providing an adequate workforce for the modern industry). The European Parliament has called for ambitious policies in many of these areas.

In the future, EU spending on key areas relevant to industrial policy is expected to rise moderately. The European Commission is proposing to boost the share of EU spending on research, SMEs and key infrastructure, although not as much as Parliament has requested. In the coming years, policies are likely to focus on seeking fairer global competition, stimulating innovation, building digital capacities and increasing the sustainability of the European industry.

3.2 European Union Research and Innovation policy for SMEs

The word “innovation” lies increasingly at the core of the EU agenda. European institutions – both at the EU and national level – repeatedly state that sound innovation policy is key to recovering EU competitiveness, which lagged behind other areas of the world even before the financial crisis hit the world in 2008-09. The Lisbon strategy in 2000 already set very ambitious goals to unlock the potential for EU competitiveness. Indeed the European Union is challenged in the global arena by emerging economies when it comes to capturing and capitalising on knowledge and technology in the context of innovation.

At the same time, the innovation chain is becoming increasingly complex, open and internationalised; it includes and involves stakeholders representing the many different sectors and parts of society, and often businesses coming from different regions. The legal basis for the EU's general industrial policy is Article 173 of the Treaty on the Functioning of the European Union (TFEU), which states that 'the Union and the Member States shall ensure that the conditions necessary for the competitiveness of the Union's industry exist'.

The legal basis for EU policy on research and technological development (RTD) is provided by Articles 179 to 190 of the TFEU. The main instrument of the Union's RTD policy is the multiannual Framework Programme, which sets objectives, priorities and the financial package of support for a period of several years. The RTD Framework Programmes are adopted by the European Parliament and the Council, acting following the ordinary legislative procedures and after consulting the European Economic and Social Committee.

The innovation policy of the European Union for the Member States provides small and medium-sized enterprises (SMEs) with a wide range of programs to promote their research and development (RandD) and focuses, in particular, on the transfer of knowledge. In recent years, the programs have been streamlined and funding substantially increased as part of the second economic stimulus package. SMEs have profited from this: the number of research performing SMEs has grown; they have increased their RandD expenditure and intensified their knowledge exchange with universities and research centres. Technology-neutral government funding is to remain at the current level - around ten per cent of SMEs' RandD expenditure - thus providing more targeted support for knowledge transfer.

SMEs are key drivers of innovation because of their capacity to rapidly and effectively change new ideas into fruitful businesses. They fill in as important channels of information overflow bringing exploration results to the market. SMEs have a key task to carry out in technology and knowledge transfer processes, contributing to the market transfer of innovations coming from the research completed in universities, research bodies and research performing companies.

There is a growing entrepreneurial movement in Europe, particularly around technology-based entrepreneurship. Indeed, Europe is the global leader in many industrial sectors and technologies, particularly those with high value-added, greener production, and a low ecological footprint. It does well on markets encompassing more advanced, innovative and increasingly customised products and services.

While European industry strives to be at the forefront of new technologies, it must also respond to a need for greater resource efficiency and the imperative of promoting a sustainable, circular and low-carbon economy. This generates both new opportunities and new challenges. Currently, the EU industry is undergoing a transformation based on the ever-increasing role of new technologies such as robotics, the internet of things and artificial intelligence. The combination of these technologies and the reorganisation of labour means that the manufacturing process is gradually shifting towards the creation of smart factories based on innovative interactions between machines and humans, to produce more customised products of a higher quality. This industrial transformation offers unprecedented possibilities to understand and shape manufacturing performance, customer behaviour, and product development. It also has the potential to improve Europe's productivity, competitiveness and growth and create well-paid jobs in medium and high-tech manufacturing.

However, breakthroughs are necessary for several areas if this transformation is to come to fruition; these include wide implementation of digitalisation, including by SMEs, supported by substantial investment, continuous innovation efforts and the availability of a workforce with relevant skills and knowledge.

It is also a very lengthy process. Even though the main building blocks for this integrated vision already exist, the fusion of all the necessary technologies into coherent systems is still far away, and there are significant differences in levels of progress in the individual Member States. Furthermore, the EU industry is exposed to growing global competition. Global players, such as China, are focusing increasingly on advanced technologies and strategic value chains. Data from industry points to a gradual loss of global market and export share for European manufacturing, due to the robust growth of Chinese and other Asian manufacturers. While the technological complexity of manufacturing in Europe is still very high, the technological gap seems to be closing.

So far, EU innovation policy for SMEs has mainly focused on supporting the modernisation and development of the industry; ensuring fair competition; improving the business environment; increasing resource efficiency; enhancing standardisation; strengthening the single market; implementing regional development instruments that support innovation, skills and entrepreneurship; and enhancing access to industrial policy resources such as raw materials, skilled labour and finance. EU support is needed in areas such as building a legal framework to facilitate market entry and growth for businesses, encouraging the development of globally competitive strategic value chains, pooling resources for innovation and investment in industry, increasing the dissemination of technologies and making them accessible to European SMEs, and helping the workforce to acquire high-level skills.

Even though the very first attempts to support the industry through policy actions already started with the creation of the European Coal and Steel Community, it was not until the Treaty of Maastricht that a legal base for industrial policy was established. As a set out in Article 173 TFEU, the policy's goals are to (1) speed up the adjustment of the industry to structural changes; (2) encourage an environment favourable to the initiative and the development of undertakings throughout the Union, particularly small and medium-sized undertakings; (3) encourage an environment favourable to cooperation between undertakings; and (4) foster better exploitation of the industrial potential of innovation, research and technological development policies. In other words, the policy is aimed at securing framework conditions favourable to industrial competitiveness. This policy is cross-cutting, as it is embedded in several other EU policies, such as trade, the internal market, research and innovation, competition, the business environment, intellectual property rights, energy, employment, environmental protection and public health. It also has a sectoral dimension, as it can be implemented differently depending on the needs and characteristics of particular economic activities and products. While the EU establishes the framework conditions to boost industry competitiveness, primary responsibility remains at the national level. The Union's mandate is to support, coordinate or supplement the Member State-level policies and actions, but Article 173 excludes the harmonisation of national regulations or laws in this field.

SMEs assume a principal role in the innovativeness, economic development and, competitiveness in the European Union and are essential supporters of the European Union’s Gross domestic product (GDP) in addition to be key players of the European advancement scene. They exemplify a heterogeneous population of firms running from well-established companies to start-ups and research-backed spin-offs whose duties to the innovation framework are expensive and different. Their approach to innovation includes not only RandD based new products and services as well as improved processes and the adoption of new technologies and business models. Consequently, SMEs are often called the “backbone” of the European economy and their prosperity enabled the EU to accomplish the Lisbon strategy’s objectives about development and competitiveness They are described by dynamism, innovations, efficiency, and their little size considers for quicker decision-making and leadership process.

3.2.1 EU approach to boost Innovation policy

The OECD Bologna Charter on SME and Entrepreneurship Policies[4] embraced as a Declaration on 15 June 2000 on the Bologna Conference for Ministers Responsible for SMEs and Industry Ministers on "Enhancing the Competitiveness of SMEs in the Global Economy: Strategies and Policies" recognized the hugeness of SMEs for research, innovation and economic policy with regards to a globalized economy giving them the possibility to access to information, financing and networks. Thusly, one of the urgent objectives of the European Union (EU) is to build up a hardened position in the field of research and innovation and SMEs assume a significant role because:

- extent yield of the output of goods and services
- diminish income differences
- create a basin of specialized and semi-specialized workers as a reason for future industrial development
- provide opportunities for making technological methodologies
- provide a fertile field for entrepreneurs and managers.

The European innovation process was presented during the 1950s in Article 55 of the Treaty establishing the European Coal and Steel Community (ECSC)[5]. This article endorsed the High Authority to "encourage technical and economic

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[4] For more information about the OECD Bologna Charter, please refer to https://legalinstruments.oecd.org/public/doc/153/153.en.pdf (accessed 12 March 2015).

[5] Treaty Establishing the European Coal and Steel Community. Preamble. London: H.M.S.O., 1962, Art. 55.

research" in the area of coal and steel and gave financial and coordination actions such as the European Council for Nuclear Research (CERN) and Euratom (1957)[6]. Coincidentally, the first group of scientific and technical purposes is characterized in the first Framework Programme for Community Research with a Council Resolution of 25 July 1983[7]: European funds for a period of four years (1984-1987) were set up featuring the beginning of another period for the European innovation policy for a period of 30 years concentrated on the advancement of scientific and technological development.

In a general context of innovation policy, European policymakers executed express instruments that supported research and innovation on SMEs and improved business competitiveness within the EU and abroad progressing technological and knowledge progress. These instruments which have been executed in the EU policy agenda are constantly created and improved. They endeavour to address future global innovation challenges. Thusly, the Seventh Framework Program (FP7), the Competitiveness and Innovation Framework Program (CIP) and the current long-term financial programme Horizon 2020 for Research and Innovation express the EU leaders' view for the European Single Market in the 21st century[8].

The purpose of the FP7 (2007-2013) was to "contribute to the Union becoming the world's leading research area...[therefore]...require[ed]...[FP7] to be strongly focused on promoting and investing in the world-class state-of-the-art research, based primarily upon the principle of excellence in research"

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[6] Efron, Reuben, and Allan S. Nanes. "The Common Market and Euratom Treaties: Supranationality and The Integration of Europe." Int Comp Law Q International and Comparative Law Quarterly 6, no. 4, 1957, 670-84. doi:10.1093/iclqaj/6.4.670.

[7] European Commission. "EU Funds for Research and Innovation: An Overview." Accessed September 17, 2016. http://www.europarl.europa.eu/RegData/etudes/BRIE/2015/568327/EPRS_BRI(2015)568327_EN.pdf.

[8] European Commission. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Strategy for ICT R and D and Innovation in Europe: Raising the Game. Luxembourg: Office for Official Publications of the European Communities, 2009. And A Single Market for 21st Century Europe: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Luxembourg: Office for Official Publications of the European Communities, 2007.

(Official Journal of the European Union, 2006a). The FP7 consisted of five aggregates of programs: a) Cooperation; b) Ideas c) People; d) Capacities, and e) Euratom.

The CIP (2007-2013) was created to achieve the following goals (Official Journal of the European Union, 2006b): a) “to foster the competitiveness of enterprises, in particular, Small and Medium-sized Enterprises”; b) “to promote all forms of innovation, including eco-innovation”; c) “to accelerate the development of a sustainable, competitive, innovative and inclusion Information Society”; and d) “to promote energy efficiency and new and renewable energy sources in all sectors, including transport” (European Commission, 2008). The CIP included three programs: a) The Entrepreneurship and Innovation Program (EIP); b) The Information Communication Technologies Policy Support Program (ICT-PSP); and c) The Intelligent Energy Europe Program (IEE). Specifically, the points of the EIP were to help enterprises (especially SMEs), entrepreneurship, innovation (including eco-innovation) and industrial competitiveness (Official Journal of the European Union, 2006b). Actions of ICT (according to Article 26 of the source) enveloped the advancement of the single European information space and strengthening the internal market for ICT products and services and ICT-based products and services, the stimulation of innovation through a more adoption of investment in ICT and the development of a comprehensive data society and progressively proficient services in areas of public interest, and improvement of the quality of life (Official Journal of the European Union, 2006b).

In December 2008, the European Council called for the elaboration of a European Innovation Plan to contribute to the competitiveness of the EU’s industry and to strengthen the economic recovery. Since then, the European Commission has undertaken preparatory work on possible policy measures. Recent initiatives include:

- various preparatory policy documents, communications and staff working documents, in particular, the Communication “Reviewing Community innovation policy in a changing world ”;
- other policy papers covering specific areas, such as design for innovation, innovation in services, access to finance, the Lead Market Initiative and Key Enabling Technologies ;
- a business panel on future European innovation policy that provided a set of recommendations from a business perspective on priorities for future EU innovation policy;
- public consultation on the European Innovation Plan, which led to 215 responses from universities and research institutions, companies, governments, non-governmental organisations and individuals;
- a consultation on the review of European standardisation, coupled with the creation of an ad hoc working group (Express), which is due to close in May 2010; and
- ongoing work on the Community patent and the common patent litigation system, which will arguably lead to future policy measures – the estimated saving for EU companies would reach €289 million per year.

Overall, these policy documents point to the need to i) simplify and streamline EU funding programmes; ii) enhance cooperation between different levels of governance, including regional, national and EU research and innovation programmes; iii) strengthen the knowledge triangle, especially as regards education policies; (iv) focus on SMEs, which exhibit significant problems both in terms of awareness of existing support schemes and access to finance and v) focus innovation policy more towards emerging market needs and societal challenges, e.g. climate change and ageing.

In the 2014-2020 Multiannual Financial Framework (MFF), industrial policy is supported mainly under heading 1 'Smart and inclusive growth', which targets SMEs and innovation across its various programmes and objectives.

Horizon 2020: the EU's framework programme for research and innovation (€79.4 billion) provide several strands and instruments that serve industrial policy objectives. It is the financial instrument actualizing the Innovation Union and the chief innovation program expecting to stimulate research and innovation and to improve competitiveness at the European level, while the ninth framework program is being constructed. In this manner, it plans to empower the execution of the Europe 2020 strategy and other Union strategies, as well as the accomplishment of the European Research Area (ERA). Horizon 2020 programme is a political instrument "able to provide stability and growth, both in terms of funding as well as in terms of a political message". Support to innovative SMEs appreciates a high priority in Horizon 2020 as entrepreneurs and SMEs are considered as a principal main driving force behind the renewal of industries and for the creation of new and competitive jobs. The number one priority of the new Commission's agenda – generating jobs, growth, and investment – rightly alludes to the importance of not stifling innovation in SMEs, as the last create 85% of the net new jobs. Horizon 2020 covers the whole innovation chain from basic research to innovative products. The programme pays special consideration to gaps in funding for high-risk innovation; it creates business opportunities out of the responses to major societal challenges; it opposes productivity and innovation capacities; and, it encourages innovative companies to develop. As such, more money will be accessible for testing, prototyping, demonstration and pilot type activities, for business-driven RandD; for promoting entrepreneurship and risk-taking; and for shaping demand for innovative products and services. It has a political, social and economic impact on the common European market implementing general rules for the participation of SMEs, research centres and universities. This effect would reflect on the production process, the advancement of science, and even on employment levels. The programme covers significant "pillars" such as technology, education, industry, and society to encourage a competitive knowledge-based economy in the world. Therefore, the adoption of innovative strategies for Research and Innovation on SMEs is a key factor that makes both economic development and technological novelty. Indeed, SMEs are engaged with EU business development through a customized SME instrument (Dinges, Gassler et al. 2013). This segment of Horizon 2020 aims at finding "Europe's next innovation leader" and is "the main form of funding for activities close to the market that are supported under Horizon 2020". The SME Instrument has been created to cover all fields of science, technology, and innovation in a bottom-up approach inside a given societal challenge or enabling technology. It incorporates all steps from idea to market with continued support through a project idea on a market-oriented approach. The projects aim at identifying and attracting SMEs to help to fill the gap in funding for early-stage high-risk research and innovation, stimulate break-through innovations and increase private-sector commercialization of research outputs. The interim evaluation of Horizon 2020 and the high-level group chaired by Pascal Lamy found that the next framework programme for research and innovation would need to make it easier for citizens to understand the value of investments in research and innovation maximize the impact of investments by setting clearer targets and expected impact when addressing global challenges.

Health Programme: This work programme sets out the priorities and actions to be undertaken, including the allocation of resources, to implement the third Programme of the Union's action in the field of health (2014-2020) established under Regulation (EU) No 282/2014 (hereinafter referred to as 'the Programme Regulation')[9]for the year 2016. The 2016 work programme is also an important contribution – in the field of health – to the priorities of the Commission as outlined in the political guidelines of the President and the mission letter of the Commissioner responsible for Health and Food Safety. To boost economic growth and job creation, stimulate innovation and attract more

[9] Regulation (EU) No 282/2014 of the European Parliament and of the Council of 11 March 2014 on the establishment of a third Programme for the Union's action in the field of health (2014-2020) and repealing Decision No 1350/2007/EC http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOL_2014_086_R_0001_01&from=EN

investments, and contribute to the connected digital single market, the work programme contains activities on health innovation, focusing on Health Technology Assessment, e-health, and European Reference Networks (ERNs).
The Health Programme of the Union's action in the field of health (2014-2020) supports and adds value to the policies of Member States aimed at improving people’s health and reducing health inequalities by promoting health, encouraging innovation in health, increasing the sustainability of healthcare systems and protecting Union citizens from serious cross-border health threats.
Focusing on the key issues in terms of bringing added value and making a positive impact on delivering mutual benefits across the European Union, the EU Health Programme is built around the following four objectives: 1. Promoting health, preventing diseases and fostering supportive environments for healthy lifestyles taking into account the 'health in all policies' principle; 2. Protecting Union citizens from serious cross-border health threats; 3. Contributing to innovative, efficient and sustainable health systems, and 4. Facilitating access to better and safer healthcare for Union citizens.
From 2021, this programme has been substituted from the EU4Health Programme. EU4Health is the EU’s response to COVID-19, which has had a major impact on medical and healthcare staff, patients and health systems in Europe. By investing €5.1 billion, therefore becoming the largest health programme ever in monetary terms, EU4Health will provide funding to EU countries, health organisations and NGOs. EU4Health will: 1)boost EU’s preparedness for major cross border health threats by creating reserves of medical supplies for crises a reserve of healthcare staff and experts that can be mobilised to respond to crises across the EU increased surveillance of health threats; 2)strengthen health systems so that they can face epidemics as well as long-term challenges by stimulating disease prevention and health promotion in an ageing population digital transformation of health systems; 3) access to health care for vulnerable groups; 4) make medicines and medical devices available and affordable, advocate the prudent and efficient use of antimicrobials as well as promote medical and pharmaceutical innovation and greener manufacturing.

COSME: the EU's programme for SMEs (€2.3 billion) supports the industry through actions facilitating SME access to finance and markets inside and outside the EU and improving the framework conditions for the competitiveness and sustainability of EU enterprises.

Connecting Europe Facility: with an envelope of €19.1 billion, the CEF supports the general industrial framework by advancing work on the European transport network, further integrating European energy markets (which may lower prices) and investing in telecommunications and digital connectivity infrastructure.

European Fund for Strategic Investments: the (€21 billion) EFSI provides guarantees that mobilise additional private investment. Its involvement in areas such as infrastructure, research and innovation, renewable energy and energy efficiency, risk finance for SMEs and education, makes it an important instrument for modernising European industry.

EGNOS and Galileo: EU satellite navigation systems (€7.1 billion) and Copernicus, the European Earth Observation and Monitoring Programme (€4.3 billion), directly foster competitiveness, innovation and job creation in the European space industry, but are also designed to promote commercial applications and opportunities in other industrial sectors. Major support for the industry also comes from the European structural and investment funds (€454 billion). These funds focus on areas that are key to industrial competitiveness, such as research and innovation, digital technologies, low-carbon economy, supporting SMEs, and education and training. According to a 2015 study, more than half of the financial envelope will be allocated to initiatives directly or indirectly, helping to achieve EU industrial policy objectives.

Horizon Europe: to boost competitiveness, creating opportunities for employment and supporting advancement, Horizon Europe (2021-2027), which will succeed the recent Programme Horizon 2020 and will keep on concentrating on areas of research and innovation referred to high innovative enterprises or with a strong entrepreneurial inclination to enable and drive innovation. Following the experience of Horizon 2020, the new Framework Programme will keep on driving Europe's scientific excellence with a new mission-oriented approach. This will help define a new methodology to accomplish more extensive social and policy aims as well as economic goals. The Horizon Europe plans to:

- foster the EU's industrial competitiveness and its innovation performance, supporting business sector development
- strengthen EU science and technology through investments in talented people and cutting-edge research
- deliver on the EU's strategic needs and handle global challenges that influence the quality and nature of our daily lives.

Figure 2. Budget and Instruments

Source: European Commission (2017)

These programmes encourage also collaboration among European researchers and SMEs as well as their mobility and innovativeness promoting active participation in collaborative projects (Barajas and Huergo, 2010). The sponsorship was given by the EU to promote a few huge projects, which lead to economies of scale when driven adequately (Skakibara, 2002). This makes EU funding appealing for SMEs. Moreover, EU funded research projects undertakings give additionality, which means additional benefits/impacts, contrasted to national funding because of the standard of subsidiarity (Luukkonen, 2000). The calls enhance the practical use of the innovations, which increases the exploitation of the outcomes for SMEs, being another driver (Fisher et al., 2013). EU funded projects are a source of additional funding which targets accelerating innovation and competitiveness (Arnold et al., 2005). Moreover, these projects are adjusted to real financial and social issues and open up new scenes for research (Fisher et al., 2013). Besides, the calls launched address high level, interdisciplinary and complex research topics. Besides that, knowledge trade between various partners is empowered (Defazio, 2009). As Defazio et al. (2009) underline "the funding aims to enhance the research potential of participants through the benefits of collaboration".

Since mid-2014, several objectives have been achieved, including in the areas set out below.

Digitalisation: the EU has continued to implement its strategy for digitising the European industry. The European platform of national initiatives improves the sharing of best practices and ensures that measures are taken by Member States complement and reinforce each other. Public-private partnerships in research have been set up to build key digital technologies and integrate them in future digital industrial platforms, and promote their application in specific industrial sectors. The number of digital innovation hubs (DIHs) has been expanding, notably in eastern and central European countries, and the EU is linking them together in a pan-European network of DIHs. Furthermore, the European high-performance computing (HPC) joint undertaking has been launched to pool European and national resources to create HPC infrastructure and exascale supercomputers, to enable SMEs and industry to find innovative solutions, reduce costs and decrease time to market. The EU is promoting the development of technology and industrial capabilities in cybersecurity and industry should also benefit from the forthcoming removal of restrictions on the free flow of non-personal data.

Investment: the European Fund for Strategic Investment contributes to industry modernisation by triggering investment in SMEs, research, development and innovation, energy efficiency, energy, and digital transformation. As of April 2019, the total investment is expected to reach €392 billion. The Omnibus Regulation was adopted to simplify the process of combining EFSI resources with the European structural and investment funds for an even greater impact.

Financing: the capital markets union seeks to improve the availability of alternative sources of financing for European companies, including industrial firms. Notably, the EU has agreed on new prospectus rules to facilitate access to public markets, especially for SMEs, and on better financial support for small, growing and social enterprises with the adoption of legislation on European venture capital funds and European social entrepreneurship funds.

Single market for goods: the EU adopted a regulation on the mutual recognition of goods to boost product trade in the single market by improving communication between authorities and companies, facilitating the process for recognising that a product is already lawfully sold in another EU country and can, therefore, be allowed on EU markets, and reinforcing problem-solving mechanisms. Parliament and Council also reached an agreement on rules to make it harder to market unsafe products.

Energy: EU policies aim to assist industry with the transition to a low carbon economy and with decoupling economic growth from greenhouse gas emissions. In this respect, the Union has revised the 2030 emission targets for the energy and industry sectors under the EU emissions trading system. Furthermore, the co-legislators reached an agreement on common rules for the internal market for electricity, which may lower electricity prices for industrial use. Another major initiative was the revision of the Energy Efficiency Directive which aims to improve industrial competitiveness by keeping costs lower through better energy efficiency.

Standardisation and patents: the Joint Initiative on Standardisation brings together key European and national organisations, bodies and stakeholders, such as industry and SMEs, working on modernising and accelerating the delivery of standards by the end of 2019. The EU is trying to create a genuine unitary patent regime, protected by a unified patent court.

Skills: to address skills gaps that could hamper industrial growth, the blueprint for sectoral cooperation on skills was launched as part of the new skills agenda. It mobilises key stakeholders to deliver sector-specific skills solutions. Furthermore, the digital skills and jobs coalition is working on providing the industry with a labour force with digital expertise.

Circular economy: Parliament and Council have adopted new rules on how to manage waste (including extended producer responsibility). These will incentivise industry to design products that can be more easily recycled or reused, and stimulate industrial symbiosis – turning one industry's by-product into another's raw material. An EU plastics strategy seeks to transform the way plastics and plastics products are designed, produced, used and recycled. The EU has also examined the potential to increase the circular use of 27 critical raw materials.

Clean mobility and the automotive industry: the EU is introducing stringent CO2 emissions standards for cars and vans while supporting the deployment of alternative charging infrastructure and action to stimulate the development of autonomous driving, shared transport, and the development of sustainable batteries.

Trade: to protect the industry from unfair competition, the EU has adopted new and stringent rules on trade defence, including anti-dumping and anti-subsidy measures.

Defence industry: the EU has agreed on a new European Defence Industrial Development Programme (EDIDP), to boost innovation in the defence industry.

According to the Commission, the main programmes supporting European industry, such as Horizon 2020, CEF and COSME, received a high number of eligible submissions, exhausting the resources available (the first two also contributed to the creation of EFSI). Because of this, and as strongly advocated by the European Parliament, the envelope for the 'Competitiveness for growth and jobs' budget heading was increased during the mid-term revision of the 2014-2020 MFF by €875 million.

Looking to the long–term, EU investment in industry – particularly in digitalisation, research and innovation, crucial infrastructure and SMEs – is likely to increase slightly in the future. In its May 2018 communication on the multiannual financial framework for 2021 to 2027, the Commission proposed to increase the Horizon 2020 budget by 29%, the CEF by 19%, and COSME by 17%. It also proposed to increase funding for the single market programme by 9% and support digital transformation through the Digital Europe programme with a budget of €9.2 billion. Besides, the Commission proposed to reform its cohesion policy to concentrate funding on areas crucial for the industry, such as innovation, support for small businesses, digital technologies, industrial modernisation, and the shift towards a low-carbon, circular economy. This falls short of the European Parliament's demands: in its resolution of 14 November 2018, Parliament called for a 40% increase in the budget for research and innovation, doubling the budget for COSME, and an increase of 30 % for the CEF.

The Commission's May 2019 *Future of Europe paper* stresses that industry is increasingly affected by the growing use of technology and digitalisation and that a modern industrial policy should be built on the single market and focus on strategic value chains. The document also underlines the urgent need to take action should internal or external competitors distort the level playing field, and to develop new tools to address the distortive effects of foreign state ownership. In a 2017 reflection paper on globalisation, the Commission argued that industry's future depended on investment in new manufacturing technologies and related industrial data services. Importantly, the European Council Leaders' Agenda *Strategic Agenda 2019-2024*, released in May 2019, mentions the development of a new industrial strategy as a priority. Renewed interest in industrial policy is also expressed in the Franco-German manifesto of February 2019, which sets out a vision of how to help the industry face the challenges of globalisation. The document argues for increased support for innovation, the revision of the regulatory framework, and for new measures to defend and protect European companies, markets and technologies. As far as the policy outlook is concerned, under the current Treaties, the EU is to a certain extent able to address the need for industrial modernisation and increasing competitiveness. Even though the Member States have primary responsibility for their industrial policies, the Union will play an important role in the inevitable shift to digital, decarbonised and more circular industry in Europe. It will target its investments, research and innovation policies and the legal framework, such as environmental and product standards, towards achieving this transformation. New or updated legislation could be passed on:

Competition: the European Parliament has called on the Commission to assess the adequacy of market definitions and EU competition rules to take the evolution of global markets and the emergence of the role of major national players in third countries into account;

Public procurement: the European Parliament has called on the Commission to reflect on how public procurement could be deployed to trigger innovation systematically, particularly in the context of digitising industry. The Franco-Germann manifesto also calls for the strategic use of procurement;

Robotics and artificial intelligence: the European Parliament has called on the Commission to consider the creation of a designated agency to provide the necessary expertise to respond in a timely way to new opportunities and challenges arising in this promising field;

Low-carbon technologies: the European Parliament has asked the Commission to remove the remaining regulatory barriers to investment in risky 'first of a kind' projects.

Besides, initiatives could be taken in the following areas:

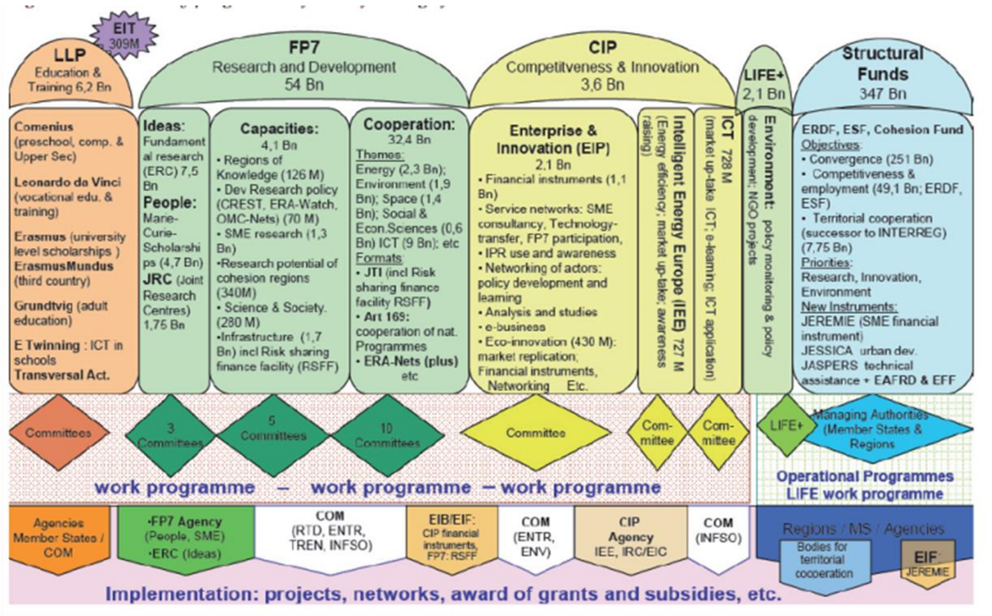
SMEs: the European Parliament has asked the Commission to consider launching an SME-specific initiative aimed at funding collaborative research access, digitalisation strategies and export market development;

Trade: the European Parliament has called for increased consistency between trade policy and industrial policy to avoid relocations and further deindustrialisation in the EU;

Industrial policy: the European Parliament has asked the Commission to develop, together with the Member States, an EU strategy and an action plan for a consistent and comprehensive industrial policy aimed at reindustrialisation, with targets, indicators, measures and time scales;

Climate policy: the European Parliament has called for the EU industrial strategy to include effective financing instruments and measures to help decrease carbon risk and tackle the risks of carbon leakage.

Figure 3. Community programmes for the funding of RandDandI



Source: European Commission (2020)

This EU 2020 strategy hints to create an ‘Innovation Union’ to improve framework conditions and access to finance for research and innovation to ensure that innovative ideas can be turned into products and services that create growth and jobs. The Innovation Union aims to create a genuine single European market for innovation, which would attract innovative companies and businesses. To achieve this, various measures have been proposed in the fields of patent protection, standardisation, public procurement and smart regulation. The Innovation Union also aims to stimulate private sector investment and proposes, among other things, to increase European venture capital investments. Within this context, as explained above, has emerged initiatives include actions to strengthen EU instruments to support innovation, to streamline administrative procedures to facilitate access to funding, particularly for SMEs and to promote the knowledge partnerships and the strengthening of links between education, business, research and innovation, including through the EIT, and finally to boost entrepreneurship by supporting young innovative companies.

These new flagship initiatives also deal with multi-level governance and announce the launch of joint ‘European Innovation Partnerships’ between the EU and national levels to speed up the development and deployment of the technologies needed to meet the challenges identified.

3.2.2 The new EU approach to the Innovation policy

The importance of innovation policy is widely recognised. It is also strongly linked to other EU policies, such as those on employment, competitiveness, environment, industry and energy. The role of innovation is to turn research results into new and better services and products to remain competitive in the global marketplace and improve the quality of life of Europe’s citizens. Europe spends 0.8% of GDP less than the US and 1.5% less than Japan every year on research and development (RandD). Besides, some brain drain effect occurs as our best researchers and innovators move to countries where conditions are more favourable. Although the EU market is the largest in the world, it remains fragmented and is not sufficiently innovation-friendly. Intending to change these trends, the EU has developed the concept of an ‘Innovation Union’, which aims to:

- Make Europe a world-class science performer;
- Remove obstacles to innovation — like expensive patenting, market fragmentation, slow standard-setting and skills shortages — which currently prevent ideas from getting quickly to market;
- Revolutionise the way the public and private sectors work together, notably through the implementation of Innovation Partnerships between the EU institutions, national and regional authorities and business.

As recently reported also by the OECD, “the organisation of innovative activities (technological as well as non-technological) across firm boundaries is clearly on the increase, with more balance between internal and external sources of innovation (...). Industries such as chemicals, pharmaceuticals and information and communication technology (ICT) typically show high levels of open innovation[10]”. Open innovation implies, inter alia, the use of internal and external RandD sources; openness to external business models, a variety of IP generators and collaborations (SMEs, academics, etc.), and proactive IP asset management. This is leading to an increase in the number of companies collaborating in innovative activities[11]. At the EU level, this new concept poses several challenges, such as clarifying the scope and enforcement of IPRs to reduce transaction costs in creating collaborative networks; coordinating and tailoring public support schemes to reflect the evolving nature of innovative endeavours; and removing barriers to the circulation and licensing of ideas across EU member states. The role of various measures such as patent protection, technology transfer, public procurement, smart regulation and standardisation is key in this respect because they attract innovative companies and businesses.[12]

In 2011, the Commission drew up a strategy to strengthen European standardisation (COM(2011)0315), in which it highlights the need to improve the method for setting standards and the use of standards in Europe to leverage European and international standards in the interests of the long-term competitiveness of European industry. Besides, European Innovation Partnerships (EIPs) have been designed to bring together public and private stakeholders at EU, national and regional levels to tackle major challenges in society and to help create jobs and growth by combining supply- and demand-side measures.

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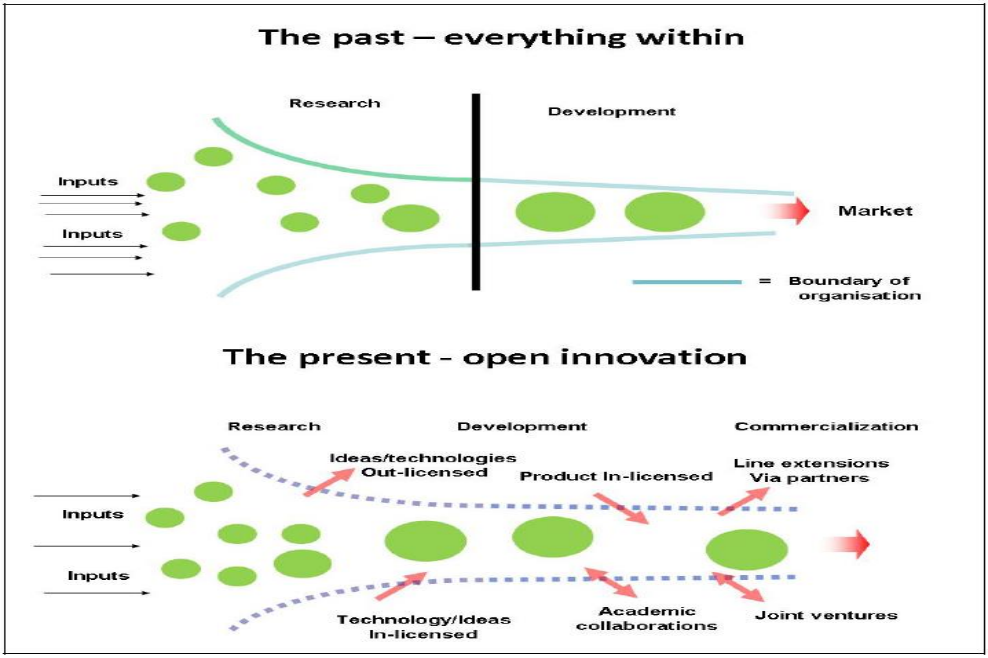
[10] See Open innovation http://www.oecd.org/dataoecd/22/44/41446671.pdf.
[11] OECD innovation strategy http://www.oecd.org/dataoecd/1/42/43381127.pdf
[12] See below, Sections 2, 3 and 4.

Figure 4. Traditional vs open innovation



Source: Chesbrough (2009) – quoted by Jackie Hunter, 5th meeting of the Task Force

The changing nature and scope of global innovation activities create very significant consequences for EU innovation policy, requiring a substantial review of the pillars of EU innovation policy, involving both the scope and the governance of innovation at the EU and national level. Several instruments have been introduced to measure and monitor the situation across the EU and the progress being made:

- A comprehensive Innovation Union Scoreboard based on 25 indicators and a European knowledge market for patents and licensing. The European Innovation Scoreboard (EIS) is a Commission instrument developed under the LisbonStrategy to provide a comparative assessment of the innovation performance of EU Member States;

- A Regional Innovation Scoreboard (RIS), which classifies the EU's regions into four innovation performance groups, similarly to the Innovation Union Scoreboard. There are 41 regions in the first group of 'innovation leaders', 58 regions in the second group of 'innovation followers', 39 regions are 'moderate innovators' and 52 regions are in the fourth group of 'modest innovators'. This provides more accurate mapping of innovation at the local level;

- The Innobarometer, an annual opinion poll conducted among businesses and the general public on attitudes and activities relating to innovation policy. The Innobarometer survey provides policy-relevant information which is not available from other sources.

The new EU approach to the Innovation policy could be summarised by saying that Parliament has adopted numerous resolutions which have further strengthened the EU's innovation policy. Some of the most recent are:

- Resolution of 22 May 2008 on 'The mid-term review of industrial policy: a contribution to the EU's Growth and Jobs Strategy[13]'. This resolution urged the Commission and the Member States to increase their efforts to reduce the administrative burden for enterprises. It also highlighted the importance of a transparent and simplified intellectual property rights policy;

- Resolution of 16 June 2010 on the EU 2020 strategy[14]. This resolution, while strongly supporting an industrial policy aimed at creating the best environment to maintain and develop a strong, competitive and diversified industrial base in Europe, also stressed that the Europe 2020

[13] OJ C 279 E, 19.11.2009, p. 65.
[14] OJ C 236 E, 12.8.2011, p. 57.

strategy should disclose the costs and benefits of converting to a sustainable, energy-efficient economy;

- Resolution of 11 November 2010 on European Innovation Partnerships within the Innovation Union flagship initiative[15];

- Resolution of 9 March 2011 on an Industrial Policy for the Globalised Era[16]. This resolution underlined the importance of a more comprehensive vision for European industry in 2020 as long-term regulatory predictability and stability are considered essential to attracting investment;

- Resolution of 12 May 2011 on Innovation Union: transforming Europe for a post-crisis world[17];

- Resolution of 27 September 2011 on the Green Paper: From challenges to opportunities: towards a common strategic framework for EU research and innovation funding[18];

- Resolution of 26 October 2011 on the Agenda for New Skills and Jobs. This resolution underlined the importance of developing closer cooperation between research institutes and industry and encouraging and providing support for industrial companies to invest in research and development[19];

- Resolution of 21 November 2013 on the proposal for a regulation of the European Parliament and the Council establishing Horizon 2020 — The Framework Programme for Research and Innovation (2014-2020)[20];

[15] OJ C 74 E, 13.3.2012, p. 11.
[16] OJ C 199 E, 7.7.2012, p. 131.
[17] OJ C 377 E, 7.12.2012, p. 108.
[18] OJ C 56 E, 26.2.2013, p. 1.
[19] OJ C 131 E, 8.5.2013, p. 87.
[20] OJ C 436, 24.11.2016, p. 284.

- Resolution of 6 July 2016 on synergies for innovation: the European Structural and Investment Funds, Horizon 2020 and other European innovation funds and EU programmes[21].

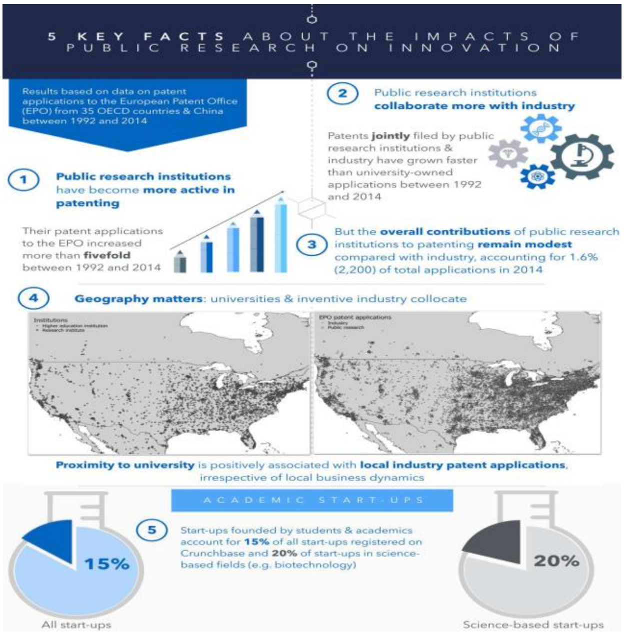
3.2.3 Role of High Education Institutions and Public Research Institutions in Europe for SMEs growth

The central role of knowledge creation in post-industrial economies and societies has given High Education Institutions (HEIs) and Public Research Institutions (PRIs) a pivotal role in society since they contribute to innovation and entrepreneurship via different channels of knowledge transfer (Borowiecki and Paunov, 2018), including university inventions, academic start-ups created by founders who are undergraduate students, doctoral students, or academic researchers, and informal science industry linkages (Breschi et al., 2019). Their ability to continuously bring new perspectives from different and unforeseeable angles make them crucial partners in the search for trendsetting and open innovation. Open innovation enhances the role of HEIs and PRIs. With the rise of open innovation (Chesbrough, 2003) the relationship between HEIs and PRIs and businesses has changed. Facing an accelerated pace and complexity of innovation, SMEs can no longer rely on their internal RandD processes alone but have to scan and absorb externally sourced relevant knowledge in a wide variety of disciplinary areas, sectors and institutions. SMEs explore innovation potential and partnerships with other companies, supplier firms and start-ups, in networks with a complex and constantly changing give-and-take of ideas, knowledge, IP, and market opportunities. Given the increasing complexity of technology development and acceleration of innovation cycles, SMEs have adopted new models of open innovation which include external partners even in core development processes. These open innovation approaches diversify and intensify partnerships between SMEs as well as between SMEs and HEIs and PRIs. This, in turn, leads to dense interactions with external partners as part of businesses' core innovation

[21] OJ C 101, 16.3.2018, p. 111.

processes. HEIs also proactively facilitate the co-creation of knowledge between partners through interface services, joint organisational structures and access to researchers and research infrastructures. HEIs are key partners in such external knowledge sourcing. They provide the most needed resource, namely competent graduates, while continuously producing new knowledge, including research-based systems and solutions to concrete innovation challenges. Just as vitally, HEIs are naturally disposed to scan knowledge frontiers and explore the next generation of technologies. They can thus identify new kinds of technological, societal and environmental problems which may define the future needs of users and markets. They are increasingly adept at looking for new, often interdisciplinary approaches to solving such problems, thus expanding horizons and showing the path toward future technologies.

Figure 5. Key facts about the impacts of public research on innovation



Source: OECD (2019), University-Industry Collaboration: New Evidence and Policy Options, OECD Publishing, Paris, https://doi.org/10.1787/e9c1e648-en

When universities and SMEs take part in collaborative research projects, they accomplish for a particular reason. Rather, the regional context in which HEIs and SMEs are involved, the profile of the HEIS and PRIs and its specific institutional approach are factors that accept a significant role in starting opportunities for university-business cooperation and in supporting their sustainability over time. HEIs and PRIs and their external partners are driven by a variety of reasons to include collaborative research projects, such as increasing their competitive advantage, testing and developing new and innovative products and services. In order to fully benefit from such dense collaborative networks of open innovation, SMEs need some enabling conditions, however, which are listed in Table 7 below:

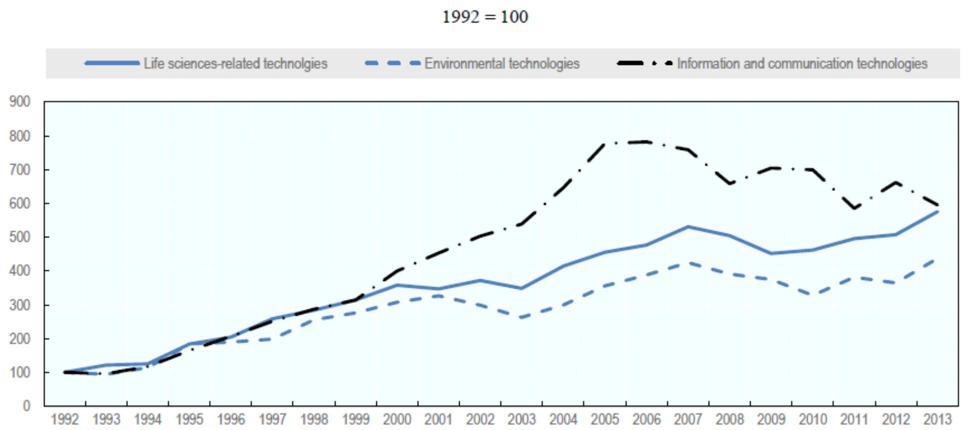
Table 7. Core needs of innovative businesses

Enabling conditions for business innovation	Mentioned by		
	Large globals	SMEs	Tech Spin-offs Start-ups
Skills and talent			
Availability of skilled labour/ talents with scientific/ technical qualifications	xx	xx	xx
Low cost skilled labour	x	x	x
Availability of skilled labour (University graduates / Mobile experts) with interdisciplinary problem-solving skills	xx	xx	xx
Graduates / Mobile experts with (interdisciplinary) ability to identify future innovation potential, adapt to disruptive innovations	xx		
Flexible visa /working permit regulations for net in-migration of skilled labour	xx	x	
Attractive living environment for international mobile talents	xx	x	x
Favourable labour market regulations	x	x	
Easy access to identify relevant researchers	x	xx	
Concentration of internationally competitive/ excellent research in the sector	xx		
Language competences (English)	x		
Research and knowledge creation			
Availability of relevant university research for problem solution		x	x
Innovation platforms bringing relevant experts together to identify / scan new and future technological and social trends	xx	x	x
Companies, public agencies or cities which offer themselves as application systems or reference cases for new products			xx
Financial conditions			
Public funding for business-university collaboration	x	xx	
Level of public R&D expenditures in university sector	xx		
Venture capital			xx
Favourable fiscal conditions	x	x	x
Infrastructure and context			
Competitions, support services for spin-offs, start-ups	x		xx
Contexts for joint system developments (platforms, joint labs, bringing multiples disciplines and actors together)	xx	x	x
Access to shared or subsidised costly research infrastructures / shared facilities	x	xx	xx
Co-location spaces for joint innovation development	x	xx	xx
Critical size of region, density of relevant partners, customers	xx	x	x
Market size	xx		

Source: European University Association study (2019)

In this regard, the regional context wherein HEIs and PRIs are inserted – including the European, national and regional policies in place, and the geographical proximity to other research institutions, industries, or innovation hubs – plays an essential role in explaining the development of university-business partnerships. In addition to the catalyst role of the regional context, HEIs and PRIs and SMEs are driven by a variety of factors or motivations to take part in collaborative research projects. HEIs and PRIs have an essential role as well as applied knowledge and they can contribute to extending the current knowledge of SMEs which is a key component of the growth in pre-competitive collaborative research projects (Bayona Sáez, 2002; Tether, 2002). HEIs and PRIs mostly engage in life science-related technologies (i.e. biotechnology), information and communication technologies (ICT), and environmental technologies, including C02 storage, electric vehicles, renewable energy, and water and waste treatment. Between 1992 and 2013, 48% of all EPO patent applications of HEIs and PRIs have filed in life science-related technologies, while 16% of HEI and PRI patents involved ICT, and 13% environmental-related technologies. This confirms existing evidence that research produced in these fields is more tangible and easier to codify, leading to more opportunities for HEIs and PRIs to patent and license their inventions. Regarding the contributions of HEI and PRI technologies to the overall numbers of EPO patents, HEIs and PRIs produced 4% of all patent applications in life sciences, 1% in ICT, and 1% in environmental technologies.

Figure 6. The trend in the number of EPO patent application in selected technologies



Source: OECD (2019), University-Industry Collaboration: New Evidence and Policy Options, OECD Publishing, Paris, https://doi.org/10.1787/e9c1e648-en calculations based on the EPO Worldwide Statistical Patent Database (PATSTAT) (2018)

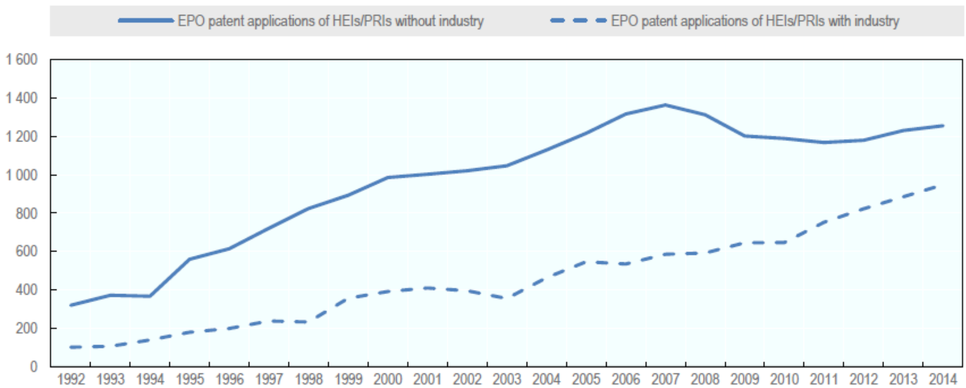
Moreover, universities are weaved with those from other countries, which encourages the entrance to international knowledge networks and the process of internationalization for SMEs (Bayona Sáez et al., 2002). Barajas and Huergo (2010) perceived HEIS to be among the most desired partners when directing collaborative RandD for SMEs. Besides, Johnson (2008) and Alexander et al. (2000) ensure that triple helix research, including industry and university as well as government partners, and from this time forward various sources of knowledge, is significant for knowledge integration as well as the success of RandD. Other than that, governments have advanced the estimate of university explore towards industry needs pointing at extended aggressiveness (Tie, 2002).

HEIs have a central role in the research and innovation “eco-system” and industry and business recognize the high estimation of this local proximity of expertise. They are the primary source for new knowledge, innovative thinking and skill development on such societal needs. The industry knows this and

HEIs thusly realize that the prime concern of industry and business focus on market application. Aligning interests – mutual interests and shared experience – is the challenge, as is keeping up the independence of science and new knowledge creation. Patent applications jointly filed by universities or PRIs and industry are a typical indicator of science-industry research collaborations. Figure 7 shows that science-industry co-applications grew faster than single patent applications by universities and PRIs. In 2014, the number of co-applications with industry stood at around 948, or 43% of all EPO patent applications of universities and PRIs, up from 24% in 1992.

Figure 7. Number of EPO applications of universities and PRIs with and without industry

1992-2014

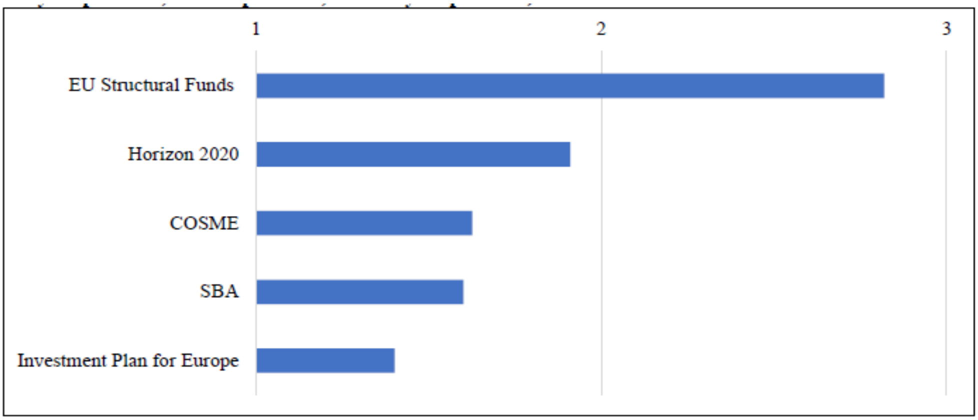


Source: OECD (2019), University-Industry Collaboration: New Evidence and Policy Options, OECD Publishing, Paris, https://doi.org/10.1787/e9c1e648-en calculations based on the EPO Worldwide Statistical Patent Database (PATSTAT) (2018)

HEIs and PRIs also highlighted the opportunity to develop high-quality research that could prompt an increase in the number of publications and the potential availability of essential research results that could be utilized in future collaborative projects with SMEs. In the same way, collaborative research was perceived as a profitable opportunity to maximize the impact of research at the societal level and to promote the competitive advantage of the HEIs and PRIs.

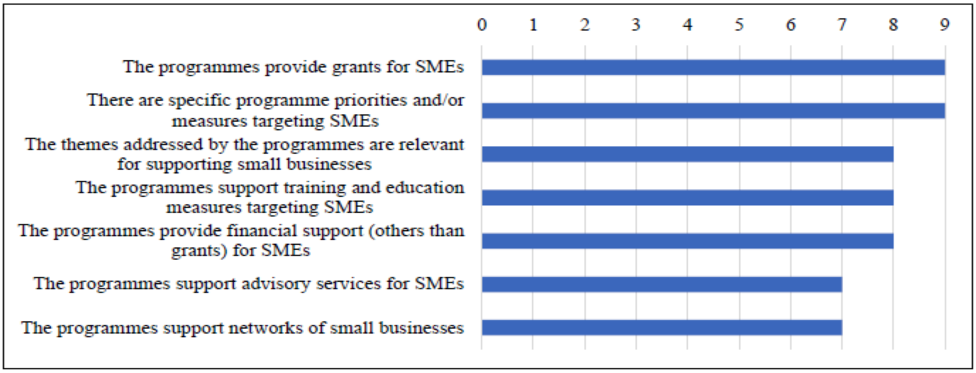
Motivations to plan the university-business collaboration also included broadening the university's research funding sources, identifying new research challenges, and the opportunity to translate research results into specific products or results that could directly affect customers' lives. HEIs and PRIs recognized several reasons to take part in collaborative research projects with SMEs. The availability of public funding programmes (see Figure 8 and 9) pointing directly at the exploitation of research results and the creation of cooperation among universities and SMEs.

Figure 8. The relevance of EU programmes supporting SMEs in the regions (1=Not very important; 2=Important; 3=Very important)



Source: EU Policy framework on SMEs: state of play and challenges based on Q.16, see Annex III and Annex IV, ECON (2019)

Figure 9. How EU Structural Funds support SMEs in the regions



Source: EU Policy framework on SMEs: state of play and challenges based on Q.9, see Annex III and Annex IV, ECON (2019)

Collaborative research was additionally perceived by HEIs and PRIs as an opportunity to enhance the business prospects of students and early-stage researchers in the non-academic sector and to improve inter-sectoral mobility. These coordinated efforts involved HEIs and PRIs and SMEs. On a broader level, some partnerships, especially research clusters, had been set up with the end goal of advancing the region's competitiveness, attractiveness and leading role in specific knowledge areas. Other collaborative research projects had been started to handle cultural and societal challenges and develop innovative solutions.

The impacts of HEIs and PRIs on innovation and entrepreneurship is important for designing policies aimed at strengthening knowledge transfer between research institutions and industry. Evidence from a new analysis of microdata on patenting and start-ups from across the OECD[22] area shows that contribute to innovation by patenting their technical inventions and by engaging in joint

[22] OECD (2019), University-Industry Collaboration: New Evidence and Policy Options, OECD Publishing, Paris, https://doi.org/10.1787/e9c1e648-en

patent activity with industry. PRIs and HEIs also stimulate start-ups established by researchers and students, which are a significant component of the innovative entrepreneurship ecosystem. The near future may provide fresh insights on additional knowledge transfer channels between science and industry, but not without comparable, cross-country information on science industry linkages, including industry-funded RandD, joint research projects, and new intermediaries for knowledge co-creation.

3.2.4 Role of Technology or Knowledge Transfer Office

Innovation has acquired strategic relevance in increasing and sustaining the economic growth of nations. In this context, governments from the developed and developing world see innovation as a strategy to increase their competitive advantage on the global stage. Therefore, nurturing innovation through policies and actions has become a priority in both the public and private sectors everywhere. Such policies and actions focus broadly on facilitating and regulating the transfer of knowledge and technology among the multiple actors in the innovation system – notably among universities, governmental agencies, and industry (Grimpe and Fier, 2010; Camison and Fores, 2010; Etzkowitz et al., 2008). At the beginning of the new millennium, many HEIs and PRIs focused on the expansion of technology transfer services as the most prominent part of knowledge transfer. Knowledge transfer has become a visible link between excellent science, industry, public and social actors to facilitate the efficient development and commercialisation of innovative products and services for the economic and societal benefit of Europe. The interaction between science and industry was expanded through various formal and informal channels (OECD, 2013a; Paunov, Planes-Satorra and Moriguchi, 2017):

Formal channels:

1. *Collaborative research* – research projects carried out jointly by public researchers and private firms. It can be fully or partly funded by

industry and can range from small-scale projects to strategic partnerships with multiple stakeholders (i.e. public-private partnerships).

2. *Contract research* – research that private firm commissions universities or PRIs to perform. It generally involves the creation of new knowledge in line with the specifications or goals of the client and is frequently more applied than collaborative research.

3. *Academic consultancy* – research and advisory services provided by public researchers to industry clients.

4. *Intellectual property (IP) transactions* – licensing and selling of IP generated by universities and PRIs to industry.

5. *Research mobility* – both university researchers working in the industry and the converse, including temporary assignments.

6. *Academic spin-offs* – entrepreneurial route to commercialising knowledge developed by public research.

7. *Labour mobility* – university graduates that join the industry.

Informal channels:

1. *Publication of public research* in scientific journals and other specialised media.

2. *Conferencing and networking* – the interaction between public researchers and industry actors can take place in formal conferences or dissemination events, but also in more informal settings (e.g. meetings of former classmates who are employed in public research and industry sectors).

3. *Networking facilitated by geographic proximity* – that is, informal interactions between public research staff and industry researchers. These might be made easy by, for example, locating science parks near university campuses, or firms' laboratories within university campuses.

4. *Facility sharing* between industry and public research (e.g. laboratories, equipment).

5. *Courses and continuing education* provided by universities to enterprises, and lectures at universities held by industry employees.

In general, technology transfer offices (TTOs) were expanded to sizeable operations that often needed their legal organisation to make a profit. In some countries, organisational formats which combined a new legal status with ownership by the HEIs, such as private legal entities were introduced. A growing emphasis on research commercialisation and IP protection spread from SMEs to research policies, funding schemes and reward systems, and then to researchers. Counting patents and licences as part of academic performance in grant selection criteria (e.g. Czech Republic, UK), performance-based financial allocations (e.g. Portugal, Poland) or promotion criteria, all form part of this trend. In a few cases, TTOs are also responsible for disseminating information on open calls and potential funding sources for projects and in supporting the development or management structure of collaborative research projects. In planting up SMEs-HEIs partnerships, institutions highlight the role of the research transfer office or other offices at the university, namely in:

- Identifying the needs of the company seeking a partnership with the university

- Matching those needs with the university's know-how

- Bringing together the university and company

- Organizing knowledge-transfer events
- Providing broad legal and administrative assistance to the partnerships

Table 8. Exchange and knowledge transfer: needs, responses and framework conditions

New needs and concerns related to universities' role in innovation	Institutional responses of universities	Necessary framework conditions
• Facilitate joint innovation between universities and companies, public organisations	• Create incentives to reward academic staff to engage in cooperation for external societal impact • Create joint labs with external partners • Establish and use advisory boards level to develop common agendas • Develop framework contracts for partners • Expand research contract support and business facilitation service	Regulatory: • Facilitate private-public partnerships by helping to minimise regulatory hurdles and transaction costs Financial: • Provide competitive support schemes for common research and research structures • Provide sufficient core funding to allow universities to be equal partners in joint structures
• Create and protect value from IP • Create new businesses with high innovation and growth potential	• Develop technology transfer/IP service • Develop start-up support service and spaces for students and researchers • Connect with external actors, such as start-up services, science parks, and investors	Regulatory and Financial: • Provide financial support for business creation and growth • Establish or support establishment of Venture Capital
• Promote social innovation, including civic participation	• Reward engagement for social innovation symbolically and in career advancement	• Create financial incentives to reward research and teaching engagement for social innovation

Source: European University Association study (2019)

The fundamental aim of (TTOs) consists primarily of support, manage and protect the Intellectual Property Rights of a university or research organization. Its activity can be defined as commercial since its objective is to find a “buyer” for the technologies through different mechanisms gathered by research-based results through licensing, patenting or consultancy of spin-offs. The TTOs concentrates much of their resources on identifying technologies that can be transferred and promote before their licence, in most cases, processes of protection of technology, through patent applications. Universities considered that the main strengths of the technology or knowledge transfer office related to the experience acquired over time in negotiating contracts and the high degree of specialization and expertise of management staff. These include the need to ameliorate the negotiation process of interdisciplinary contracts, lack of time of human resources to adequately support the negotiation stage of the projects, difficulties in promoting the added value of technological innovations, especially in its early stages, and lack of experience in negotiating with large companies. However, the level of interactions and the application of different channels depends on scientific fields and industry sectors (Schartinger et al., 2002). For example, evidence shows that patenting and licensing is very important for researchers in materials science and chemical engineering, but less so for those in computer sciences (Bekkers and Bodas Freitas, 2008). Contract and collaborative research, labour mobility, and the flow of students from the university to the industry are very important in engineering disciplines (Meyer-Kramer and Schmoch, 1998; Schartinger et al., 2002; Balconi and Laboranti, 2006); personal contacts, labour mobility and training courses for firms, meanwhile, have comparatively greater relevance in the social sciences (Bekkers and Bodas Freitas, 2008; Schartinger et al., 2002). Breakthrough academic discoveries in biotechnology are in many cases transferred to industry through university spinoffs (Zucker, Darby and Armstrong, 2002).

In other words, TTOs represent a sort of transmission channel between the research and market environments. On the contrary, in some cases, also contribute to give research institutions trends and indications arising from the same market, playing the role of advisers to support the top management of research institutions, as regards relationships with SMEs.

3.3 European Innovation policy in the age of Smart Specialisation Strategies (RIS3)

A new era in the history of European regional policy began in 2014 with the launch of the *Research and Innovation Strategies for Smart Specialisation (RIS3)* programme, the most ambitious regional innovation programme ever introduced in the EU.

The EU has set out its vision for Europe's social market economy in the Europe 2020 strategy[23], which aims at confronting structural weaknesses through progress in three mutually reinforcing priorities:

1. smart growth, based on knowledge and innovation

2. sustainable growth, promoting a more resource-efficient, greener and competitive economy

3. inclusive growth, fostering a high employment economy delivering economic, social and territorial cohesion.

Investing more in research, innovation and entrepreneurship is at the heart of Europe 2020 and a crucial part of Europe's response to the economic crisis. So is having a strategic and integrated approach to innovation that maximises European, national and regional research and innovation potential. As part of the Europe 2020 strategy, the Commission adopted the “Innovation Union”[24] flagship initiative. It sets out a comprehensive innovation strategy to enhance Europe's capacity to deliver smart, sustainable and inclusive growth and highlights the concept of smart specialisation as a way to achieve these goals. The “Digital Agenda for Europe”[25] flagship initiative is also part of Europe 2020 and aims to deliver sustainable economic growth and social benefits from Information and Communication Technologies (ICT). The Digital Agenda for

[23] http://ec.europa.eu/europe2020/index_en.htm
[24] http://ec.europa.eu/research/innovation-union/index_en.cfm
[25] http://ec.europa.eu/information_society/digital-agenda/

Europe initiative is therefore relevant to all regions and cities, as it focuses on a key element for the design of smart specialisation strategies.

The concept of smart specialisation has also been promoted by the Communication "Regional Policy contributing to smart growth in Europe 2020"[26]. In this document, the Commission encourages the design of national/regional research and innovation strategies for smart specialisation as a means to deliver a more targeted Structural Fund support and a strategic and integrated approach to harness the potential for smart growth and the knowledge economy in all regions.

Smart specialisation has also been strongly advocated by the Synergies Expert Group established by the Commission's Directorate-General for Research and Innovation. It argues that the concept is an important instrument for ensuring synergies between Horizon 2020[27] and the Structural Funds in the interest of capacity building and providing a stairway to excellence. Through its adoption and adaptation towards regional development, the smart specialisation concept has become a powerful instrument for place-based innovation-driven growth. Furthermore, evidence arising from regions and ongoing informal policy discussions signal that the smart specialisation approach may be evolving towards a methodology that goes beyond its application to the EU regional policy. Smart specialisation is gaining interest in both scientific and policy-making communities linked for instance to urban and local development and is also bridging the gap towards more thematic policy approaches such as industrial and energy policies.

Conceived within the reformed Cohesion policy of the European Commission, the S3 approach is characterised by the identification of strategic areas for intervention based both on the analysis of the strengths and potential of the economy and on an Entrepreneurial Discovery Process (EDP) with wide

[26] http://ec.europa.eu/regional_policy/sources/docoffic/official/communic/comm_en.htm
[27] http://ec.europa.eu/research/horizon2020/index_en.cfm?pg=h2020-documents

stakeholder involvement. It embraces a broad view of innovation including but certainly not limited to technology-driven approaches, supported by effective monitoring mechanisms.

In the context of Europe 2020, smart specialisation emerges therefore as a key element for place-based innovation policies. National/regional research and innovation strategies for smart specialisation (RIS3) are integrated, place-based economic transformation agendas that do five important things

1. They focus policy support and investments on key national/regional priorities, challenges and needs for knowledge-based development, including ICT-related measures

2. They build on each country's/region's strengths, competitive advantages and potential for excellence

3. They support technological as well as practice-based innovation and aim to stimulate private sector investment

4. They get stakeholders fully involved and encourage innovation and experimentation

5. They are evidence-based and include sound monitoring and evaluation systems.

The RIS3 approach is relevant to all three priorities of Europe 2020 i.e. smart, sustainable and inclusive growth. First of all, smart specialisation matters are important for the future of Europe because the development of an economy based on knowledge and innovation remains a fundamental challenge for the EU as a whole. Secondly, smart specialisation is relevant to achieve sustainable growth, as an important innovation effort and considerable investment are required to shift towards a resource-efficient and low carbon economy, offering opportunities in domestic and global markets. Finally, smart specialisation contributes to inclusive growth between and within regions by strengthening territorial cohesion and by managing structural change, creating economic opportunity and investing in skills development, better jobs and social innovation.

The RIS3 approach is also consistent with the aims and tools of the EU cohesion policy, promoting growth and jobs across EU countries and regions[28]. It suggests a strategy and a global role for every national and regional economy, including both leader and less advanced territories. It embraces a broader concept of innovation, not only investment in research or the manufacturing sector, but also building competitiveness through design and creative industries, social and service innovation, new business models and practice-based innovation. All regions have a role to play in the knowledge economy, provided that they can identify comparative advantages and potential and ambition for excellence in specific sectors or market niches.

The concept of smart specialisation is also consistent with and supports the main reform goals of the proposals for the EU Cohesion Policy 2014-2020, published in October 2011[29]:

- delivering the Europe 2020 objectives of smart, sustainable and inclusive growth,
- reinforcing policy performance and focus on results,
- maximising the impact of EU funding through thematic concentration.

From 2014 to 2020 Cohesion Policy has guided the investment of over EUR 450 billion (including national co-financing) to help achieve the EU-wide goals of growth and jobs and reduce economic and social disparities. It is the biggest investment instrument at the EU level for pursuing the objectives of the Europe 2020 strategy. Indeed, smart specialisation has a strategic and

[28] Article 174 of the Treaty on the Functioning of the European Union (TFEU) – Treaty of Lisbon.
[29] Brussels, 6.10.2011 COM(2011) 615 final 2011/0276 (COD). See: http://ec.europa.eu/regional_policy/what/future/proposals_2014_2020_en.cfm.

central function within the new Cohesion Policy being a key vehicle for ensuring Cohesion Policy's contribution to the Europe 2020 jobs and growth agenda. Within the new Cohesion Policy, smart specialisation has been proposed as an 'ex-ante conditionality. This means that every Member States and region have to have such a well-developed strategy in place before they can receive EU financial support through the Structural Funds for their planned innovation measures. This conditionality applies specifically to two of the 11 thematic objectives of the ERDF[30]:

- strengthening research, technological development and innovation (RanDI target),
- enhancing access to and use of quality of ICT (ICT target).

Likewise, the same conditionality applies to theme one ("Fostering knowledge transfer and innovation in agriculture, forestry and rural areas") of the European Agricultural Fund for Rural Development (EAFRD)[31].

In six years, smart specialisation has become a key instrument for place-based development. It now represents the most comprehensive policy experience on implementing innovation-driven progress in Europe. It is a cornerstone in the European Union's endeavour to continue driving countries and regions from recent setbacks onwards to success and to guarantee opportunities for each and all of its territories. Thanks to this effort, for the first time, public authorities and stakeholders across an area of more than five hundred million inhabitants have crafted their innovation policy according to a common set of principles and methodologies.

In the Open Innovation era, where social innovation and ecological innovation entail behavioural change at the individual and societal levels if the challenges of health, poverty and climate change are to be addressed, the regional

[30] Annex IV of the general SF draft regulation, COM (2011) 615.
[31] http://ec.europa.eu/agriculture/cap-post-2013/legal-proposals/com627/627_en.pdf

governance system should be opened to new stakeholder groups coming from the civil society that can foster a culture of the constructive challenge to regional status quo. In particular, to guarantee a livelier and truly place-based entrepreneurial process of discovery that generates intensive experimentation and discoveries, it is imperative that new demand-side perspectives, embodied in innovation-user or interest groups of consumers, are represented along with intermediaries who offer a knowledge-based but market-facing perspective. This means that the traditional, joint-action management model of the triple helix, based on the interaction among the academic world, public authorities, and the business community, should be extended to include a fourth group of actors representing a range of innovation users, obtaining what is called a quadruple helix[32]. This is the necessary organisational counterpart of open and user-centred innovation policy because it allows for a greater focus on understanding latent consumer needs and more direct involvement of users in various stages of the innovation process. RIS3 processes can develop environments that both support and utilise user-centred innovation activities also to secure better conditions to commercialise RandD efforts. The quadruple helix allows for a variety of innovations other than the ones strongly based on technology or science, in the spirit of the wide concept of innovation at the basis of RIS3, but it requires significant flexibility, the adaptation of processes, acquisition of new skills, and potential redistribution of power among organisations.

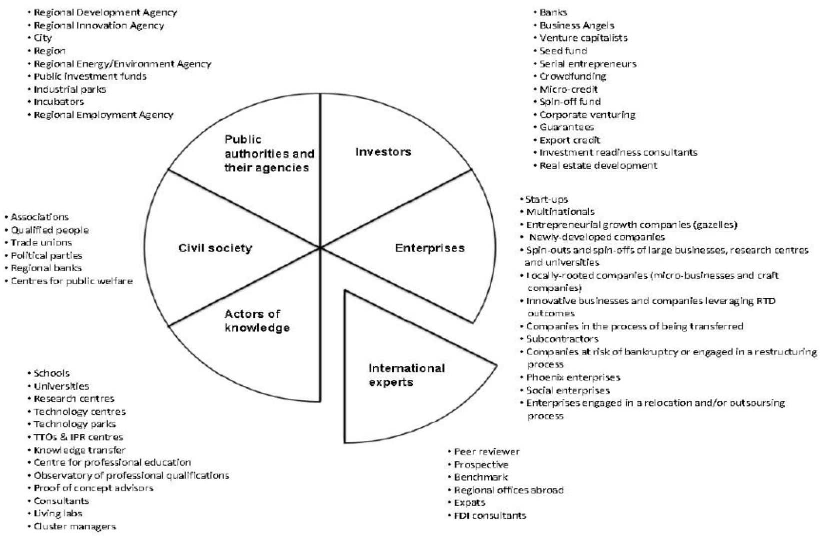
3.3.1 Key actors and sectors as part of Smart Specialization Strategies

In terms of process, RIS3 design involves analyses, experimentation, debates and decision-making, with wide participation of actors and sectors from within and outside the region. This needs to be communicated, understood and

[32] Arnkil R., et al. (2010). Exploring Quadruple Helix. Outlining user-oriented innovation models. University of Tampere, Work Research Center, Working Paper No. 85 (Final Report on Quadruple Helix Research for the CLIQ project, INTERREG IVC Programme).

acknowledged: it is a time-consuming process that should be seen as an investment rather than a burden. The most important key actors are organisations that need to be involved in the RIS3 process. They are 1) enterprises, 2) actors of knowledge and universities, 3) public authorities and their agencies, 4) civil society, investors, and international experts who can offer to benchmark and peer review services. Figure 10 exemplifies several organisations belonging to each of the previous categories, as identified by EURADA.

Figure 10. The regional knowledge ecology



Source: EURADA

The main key *actors* involved in the Smart Specialisation process are the following

1) *Enterprises* are at the centre of the creation of jobs and growth at the regional level. Furthermore, SMEs are key players in introducing new products/services into the market place and offering innovative solutions to the grand challenges. For the period 2007-2013, the Community Strategic Guidelines on Cohesion emphasise the key role of SMEs,

notably when it comes to increasing and improving their investment in RandD, facilitating innovation and promoting entrepreneurship. Cohesion Policy provides the largest financial Community support to SMEs through financial engineering instruments such as JEREMIE[33]. For the period 2014-2020, the Commission has proposed an even stronger focus on enhancing the competitiveness of SMEs in the context of Cohesion Policy. Moreover, the Cohesion Policy support often provides the initial platform for an increased number of SMEs to access the FP7 or the CIP, and will indeed continue to do so for the forthcoming successors of these programmes. Entrepreneurship is necessary to make sure that innovative ideas are turned into sustained growth and quality jobs. Therefore, it is important to provide, at the regional level, the right mix of financial and non-financial support to assist entrepreneurs to create new firms and existing enterprises to innovate and develop. The support should aim to increase the innovation capacity of SMEs, enabling them to develop, access and absorb new knowledge and thereby grow and compete on increasingly global markets. Regional policymakers also have to understand the different forms of innovation such as bio/nontechnology services, cross-sector technology integration, system and business model innovation, which are today as important as the technology breakthrough innovation for SMEs. It is relevant for the regional authorities to adapt their offer of support services to the demand of the different types of enterprises: manufacturing, service-oriented, high-tech or social. SMEs, and especially micro-enterprises, are heavily dependent on their regional environment where proximity plays a key role in innovation, in particular regarding the spread and absorption of tacit knowledge. SMEs need policy support in tapping into the necessary outside resources, principally access to knowledge in the form of advice through innovation support services and tailored counselling, technology or qualified human capital, to face up to the new forms of competition

[33] http://www.eif.org/what_we_do/jeremie/index.htm

that are developing in the global economy. SMEs are thus at the core of Cohesion Policy.

2) *Actors of knowledge* like Research infrastructures (RIs) are a driving force behind innovation. The term 'research infrastructures' refers to facilities, resources, systems and related services that are used by research communities to conduct top-level research in their respective fields. This definition covers major scientific equipment or sets of instruments; knowledge based-resources such as collections, archives or structured scientific information; ICT-based e-Infrastructures (networks, computing resources, software and data repositories) for research and education; and any other entity of a unique nature essential to achieving or enabling excellence in research. Research infrastructures may be 'single-site’ or 'distributed' (a network of resources). There are at least 300 such Research Infrastructures, which have strong international visibility, attracting world-class researchers. They represent an aggregate European investment of more than EUR 100 billion. Some 50,000 researchers a year use them to produce 3,000 to 6,000 high-impact research papers annually, as well as a chain of patents, spin-off companies and industrial contracts. Their know-how helps the European industry develop new pharmaceuticals and high-performance materials, monitor the earth’s oceans and air, and track the changing social attitudes and behaviour of our fellow citizens. They help provide the answers we will need to solve our grand societal challenges: energy supply, climate change and healthcare for all. They propel collaboration across borders and disciplines, promote mobility of people and ideas, and enhance quality in education. The resulting innovation ecosystem spurs new ideas, solutions and innovations of benefit to the European economy and society, as well as science. Consequently, the development of regional Research Infrastructures (in particular Regional Partner Facilities and Cross Border Facilities) should create a particularly important way of capacity-building, should help to concentrate regional human capital (e.g. training and attracting international researchers and technicians) and thus

stimulate turning science and innovation into a key instrument of regional development, in terms of socio-economic return. Research Infrastructures are often integrated with a wider eco-system encompassing science parks, incubators, sectoral excellence centres, living labs, prototyping centres, intellectual property right (IPR) centres, technology transfer offices, etc. which often facilitate the commercialisation of research results in market applications. Science parks provide the advanced infrastructure on which research-intensive enterprises rely, besides the location factor, often close to a university. They provide the necessary infrastructure for research, such as advanced ICTs, and are also expected to create proper conditions for informal exchanges between firms, creating a specific social milieu. They can also provide complementary services and support to local firms. Spin-offs and SMEs can find wider support services that allow them to better focus on their core business and research for the development of innovations in science parks. They are usually associated with strong networking effects and high levels of social capital. They also provide visibility and hence the attraction to wider local strategies aimed at the creation of conditions for high-tech industries to prosper. Sectoral excellence centres can be split into two categories: sectoral centres targeting specific industries (providing a range of specialised services, directly to firms) and cross-sector centres concerned with generic issues (such as product development and work in partnership).

In the framework of the Education, Research and Innovation triangle, the so-called knowledge triangle, *Universities*[34] have a crucial role to play in creating knowledge and translating it into innovative products and services, in cooperation with research centres and businesses. Successful mobilisation of the resources of universities can have a strong positive effect on the achievement of comprehensive regional strategies. Universities dealing with economics, public policy and administration, as

[34] The term 'university' includes all higher education institutions, in line with the Commission's Communication on the modernisation agenda for universities [COM (2006) 208].

well as those dealing with specific policy areas (such as industry, health, agriculture, environment and culture) can provide public authorities and private sectors with strategic advice, as well as experts to work directly on regional development priorities. Universities are a critical 'asset' of the region, mainly in the less developed regions where the private sector may be weak or relatively small, with low levels of research and development activity. There is a range of mechanisms by which universities can contribute to regional innovation systems. Universities can, for instance, stimulate the entrepreneurial spirit of their staff and students, provide advice and services to SMEs, and participate in schemes promoting the training and placement of high-level graduates in innovative businesses. They can also host incubators for spin-offs in science and technology parks and provide valuable input to innovative clusters and networks. These mechanisms can be delivered as stand-alone projects or within wider strategies. The latter is ideal and will ensure maximum impact but is difficult to achieve as there are many barriers to overcome and there are few good practice examples to draw on. Furthermore, Universities and Businesses should directly cooperate in curricula design and curricula delivery to ensure that graduates have the right skills and transversal competencies. By having businesses cooperating with the educational side of Universities, talent attraction and retention would be enhanced in the region. Universities can also play an important role in the field of vocational training.

3) *Public authorities and their agencies* are relevant actors for the effective implementation of the Cohesion Policy and the appropriate use of the European Structural Investment Funds. Most of the members of the European Association of Development Agencies (EURADA) have been leading the preparation of the Smart Specialisation Strategies in their territories and are driving their effective implementation. Regional Development Agencies are effective interfaces between public authorities, private industry and social stakeholders. The work carried out by public authorities and their agencies imply the use of the principles of

Smart Specialisation. Daily, development agencies establish place-based activities of strategic potential, set priorities to leverage private investment, design efficient support services to have an appropriate policy mix of the regional programmes, implement mechanisms for enterprises to maximise the knowledge-based development potential of a region and, finally, development agencies have to involve multi-stakeholder governance mechanisms to engage local actors. EURADA's overall assessment of the Smart Specialisation Strategies is extremely positive. There has been a consensus among the professionals of development agencies and regional practitioners about the suitability of the S3 tool to engage a multiplicity of stakeholders in a common transformation agenda. The process is inclusive, bottom-up, bring new actors to a shared decision process that is relevant for the economic growth of the countries and regions. Despite the complex governance that implies, the regional stakeholders have invested their best efforts to accomplish the ex-ante conditionality for the current programming period and have continued working with this relevant tool.

4) *Civil society* organisations contribute to the engagement of a critical mass of citizens in innovation action. ONGs, for example, are potential multipliers of participatory and inclusive approach, support communication activities with society and provide ownership in concrete energy priorities such as sustainable buildings (Boromisa, Door).

Key *sectors* involved in the Smart Specialisation process are the following:

1) *Information and communication technologies (ICT)* are a powerful driver for economic growth, innovation and increased productivity. Data from the 2010 Digital Competitiveness report[35] reveals that while representing 5% of GDP, ICT drives 20% of overall productivity growth and that the ICT industry has a 25% share in total business RandD. The Europe 2020

[35] See Digital Competitiveness Report 2010: http://ec.europa.eu/information_society/digitalagenda/documents/edcr.pdf

strategy has recognised the enormous potential of ICT and made the Digital Agenda for Europe[36] (DAE) one of its seven flagships. It aims to deliver smart, sustainable and inclusive economic growth through the realisation of the digital single market and the exploitation of the potential for innovation of fast and ultra-fast internet and interoperable services and applications.

DAE has set ambitious targets for high-speed internet infrastructure across the Union (by 2020: 100% coverage of EU households at 30 Mbps minimum + 50% take-up [subscriptions] at 100 Mbps minimum) and wide deployment and more effective use of digital technologies, applications and services. Successful delivery of this Agenda will enable Europe to deliver a better quality of life through, for example, better health care (eHealth Action Plan, Active and Healthy Ageing Partnership), social inclusion and education (eInclusion, eSkills, eLearning), a more effective public administration (eGovernment Action plan, eProcurement, eJustice) and dialogue between citizens and decision-makers (eParticipation), safer and more efficient transport solutions (Intelligent Transport Systems, eCall), a cleaner environment and more efficient energy networks (smart grids, smart metering), inter-modal and sustainable cities (smart cities), new media opportunities and easier access to cultural contents (eBooks, online platforms for music and movies, digitisation and access to Europe's cultural heritage[37]). The deployment of a culture of open data and secured online access, the harnessing of a true digital single market (eCommerce), together with affordable high-speed internet infrastructure, are essential components of these ambitious goals. Whether your region is struggling to provide medical and social care in times of austerity or trying to create the conditions to attract new investment, the smart specialisation strategy

[36] http://ec.europa.eu/information_society/digital-agenda/publications/index_en.htm

[37] www.europeana.eu

builds on or constitutes the first step towards local/regional 'digital agenda'. It provides a better understanding and the best leverages for the potential of digital technologies and services to meet today's challenges and prepare for tomorrow's opportunities. The long-term competitiveness and innovation potential of regional and rural areas and the ability to achieve the fundamental objectives of both regional and rural policies depend on the good planning of these investments. This is as much a socio-economic as a cultural and political challenge that management authorities of EU funds cannot afford to miss.

2) The Commission defined micro/nanoelectronics, photonics, nanotechnology, industrial biotechnology, advanced materials and advanced manufacturing systems as the six *Key Enabling Technologies*[38] of Europe. The Commission highlighted the need to develop a strategic approach for KETs, especially since the EU has good RandD capacities in some KETs but is not as successful in commercialising results. Although several member states and other regions have started to identify enabling technologies that are relevant to their future competitiveness, differences exist among member states on what should be regarded as KETs, and there is no shared understanding of the importance of KETs. KETs are knowledge-intensive and associated with high RandD intensity, rapid innovation cycles, high capital expenditure and highly-skilled employment. They enable process, goods and service innovation throughout the economy and are of systemic relevance. They are

[38] On 30 September 2009, the European Commission adopted a Communication on “Preparing for our future: developing a common strategy for key enabling technologies in the EU” (COM(2009)512 final, 30.09.2009). Key enabling technologies (KETs) are defined by the following features: i) they are knowledge-intensive (high RandD and capital expenditure); ii) they are associated with highly-skilled employment; iii) they are multi-disciplinary, cutting across many technology areas; iv) they create multiplier effects and v) they enable innovation and are of systemic relevance to economies. KETs are important for several reasons: a) They are the driving force behind the development of goods and services; b)They are at the forefront of competitiveness, innovation and the EU knowledge-based conomy; c) They modernise the industrial base and further strengthen the research base; d) They create related eco-systems of SMEs.

multidisciplinary, cutting across many technology areas with a trend towards convergence and integration. KETs can assist technology leaders in other fields to capitalise on their research efforts[39]. Key Enabling Technologies (KETs) have been singled out by the European Commission in the proposal for the new Cohesion Policy as one of the investment priorities of the European Regional Development Fund (ERDF) as a relevant investment for the smart growth of regions[40]. KETs are seen as the route to new and better products and processes, capable of generating economic growth and employment and strengthening the competitiveness of the EU economy. They bear enormous market potential. In the coming four years, the growth rates of each of these technologies range between 6%-15%. The overall global market volume will most likely increase from USD 840 billion to USD 1300 billion. Even more important are their spill-over effects on industry users from various industrial value chains, including suppliers and downstream sectors. KETs can spur innovation, increase productivity, give rise to new applications and help tackle societal challenges. The particularity of KET-related innovation policy is that it engages actors along different industrial value chains across the EU, including technology developers (universities, research and technology organisations), start-ups, SMEs and manufacturers. Consequently, a KET focused innovation policy allows most industrial sectors and any region to become involved and benefit from the EU's overall KET approach, whatever its specialisation and focus areas. The Commission is in the process of aligning and coordinating EU policies in favour of a coherent strategy on KETs, which will open up great opportunities for regions. Regions should indeed analyse those opportunities, either as an emerging sector or as a means to modernise traditional sectors.

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[39] (COM(2009) 512)

[40] See Article 5 (1) (c) ERDF: 'supporting technological and applied research, pilot lines, early product validation actions, advanced manufacturing capabilities and first production in Key Enabling Technologies and diffusion of general purpose technologies'.

3) In many cities and regions, including rural areas across Europe, investments in cultural and creative industries (CCIs) already have a significant impact on smart, sustainable and inclusive growth. Indeed, these industries have multiple roles to play in unlocking the creative and innovative potential of a region, as they:

   - are vital for the emergence of new economic activities and the creation of new and sustainable job opportunities[41];
   - have the potential to increase the quality of life in urban and rural areas and to make Europe and its regions more attractive places in which to invest and work;
   - contribute to the social integration of marginalised groups of the population and have wide-ranging social impacts, in particular in terms of social regeneration or social cohesion;
   - are catalysts for structural change and diversification in many industrial zones and rural areas with the potential to rejuvenate economies, stimulate innovation and contribute to growth;
   - constitute a powerful magnet for tourism, generate a creative buzz, attract talent and contribute to changing the public image of regions and cities;
   - have potential in generating social demand, engaging the public and addressing social concerns in rapidly growing markets, such as

[41] According to recent estimates, CCIs are one of Europe's most dynamic sectors and account for up to 4.5% of the total EU GDP and some 3.8% of its workforce, 'Building a Digital Economy: The importance of saving jobs in the EU's creative industries,' TERA Consultants, March 2010. See also the emphasis on the creative industries in the European Competitiveness Report 2010, Commission staff working document, COM (2010)614.

those relating to energy, recycling and biotechnology, ageing and health.

Moreover, culture and creativity also promote growth and qualified jobs, as CCIs contribute to and have a strong and positive influence on ICT, research, education and can increase the attractiveness of regions in terms of human resources and investments. These positive impacts are highlighted in different EU policy documents and studies[42].

4) *Internationalisation* is a crucial component of an S³ for at least three reasons:

- The world is flat and all elements of an enterprise value chain can be located anywhere in the world through FDI or outsourcing;

- The eco-system of Member States and Regions can be challenged by the eco-system of emerging countries. Today, even high added-value elements of the enterprise value chain (i.e. RandDandi, support services, access to finance, design) can be produced outside OECD countries. Regions have thus to benchmark themselves with any other regions to assess where the real or believed competitive advantages are challenged to permanently increase their values;

- Internationalisation is becoming a more and more sophisticated context. It is much more than export and FDI. It is indeed also strategic alliances, joint research, co-development, outsourcing,

[42] In particular in the 2010 Commission Communication '*Regional policy contributing to smart growth*': http://ec.europa.eu/regional_policy/sources/docoffic/official/communic/smart_growth/comm2010_553_en.pdf; the 2010 Commission Green Paper *'Unlocking the potential of cultural and creative industries':* http://ec.europa.eu/culture/documents/greenpaper_creative_industries_en.pdf; the 2011 analysis of the contributions to the public consultation launched by the Green Paper: http://ec.europa.eu/culture/documents/analysis_green_paper.pdf; as well as in the 2010 Study on the *Contribution of Culture to Local and Regional Development – Evidence from the Structural Funds*: http://ec.europa.eu/culture/key-documents/contribution-of-culture-to-local-and-regional-development_en.htm

relocation, mergers and acquisitions, licensing IPR, soft landing, technology showcase.

3.3.2 Smart Specialisation Strategies as a key instrument for innovation, industrial policies and regional economic development

Smart specialisation strategies are regional policies framework for innovation-driven growth. Regions are increasingly recognised as a relevant level of innovation policies given the weight of agglomeration economies (e.g. the benefits that firms obtain when locating near each other; the more related the firms that are clustered together, the lower the cost of production, the greater the learning and network effects). That said, many of the underlying elements of the smart specialisation approach are not new and have been part of the broader discussion on innovation, industrial policies and regional economic development for some time.

What distinguishes smart specialisation strategies from traditional industrial and innovation policies is mainly the process defined as "entrepreneurial discovery" - an interactive process in which market forces and the private sector are discovering and producing information about new activities and the government assesses the outcomes and empowers those actors most capable of realising the potential (Foray, 2012; Hausmann and Rodrick 2003). Hence smart specialisation strategies are much more bottom-up than traditional industrial policies. Besides, the focus of the choices is on the "enabling knowledge-based assets", both public (e.g. education, public research) and private, not on particular industries. This more upstream approach gives more of a margin for the market to determine and lead on downstream choices. Still, the operationalisation of entrepreneurial discovery processes from a policy perspective is a major challenge and requires the collection and analysis of diverse information that often is held by entrepreneurs themselves or embedded in firms and public institutions. Incentives and instruments for disclosing – passively or actively – this information (e.g. through stakeholder consultations, public-private partnerships, IPRs) will be key.

Like traditional industrial policy, smart specialisation strategies aim to address market/systems and coordination failures. But traditional industrial policies required significant levels of information to justify subsidy support and they tended to be implemented in vertically integrated sectors with stable technological paradigms. In contrast, smart specialisation strategies recognise the lack of perfect information, the level of advancement of a given activity, and the relative risks for policy. It thus focuses on helping entrepreneurs identify their knowledge-based strengths at the regional level and in a more exploratory approach in which public decision-makers listen to market signals using a range of assessment tools (e.g. SWOT analysis, surveys) and mechanisms such as public-private partnerships, technology foresight and road mapping to name a few. Recently, the *Organisation For Economic Co-Operation And Development (OECD)* surveyed regions[43] to investigate the governance of their innovation policy. The survey results show that the prioritisation of public investments in RandD and innovation is more intense at the regional than at the national level. This is especially the case in the EU regions and has to do with globalisation and the ensuing pressures for greater integration of research and innovation policies. The OECD categorisation of regions based on innovation-related indicators shows that different regions have different levels of performance. Some OECD regions perform better than their national average (e.g. Catalonia region and Spain). This means that the innovation challenge will vary according not just to the regions but also the economic structure and the specialisation of key agents; firms, public research institutions and universities (OECD, 2011).

Smart Specialisation Strategies are a central aspect to shape future policies and initiatives in the field of economic growth and to gather overall support of

[43] OECD-TIP enquiry in governance for smart specialisation (10 respondents from regional governments and 10 from national governments).

regional economic practitioners and experts because it has proven its impact to design economic reform agendas, to restructure regional innovation systems as an instrument for interregional governance. This has implications for the EU industrial, research and innovation and cohesion policies. Indeed the community of these practitioners and experts in regional development represents a unique opportunity to strengthen interregional cooperation. Initiatives like the thematic platforms in agro-food, energy and industrial modernisation are good initiatives that have been reinforced to provide an appropriate framework for investments in innovation across borders. In this sense, modern core technologies, referred to as "key enabling technologies" (KET) can give an important contribution to smart specialisation strategies. These key technologies such as nanotechnology, micro and nanoelectronics, advanced materials, photonics, industrial biotechnology and advanced manufacturing systems as well as "general-purpose technologies" such as ICT and biotechnology can address particular problems of quality and productivity[44]. The key question for regions is how to focus their knowledge investments to take advantage of these technologies. While some regions are better in carrying out basic research or technological development of these technologies, others should focus on the use and application of these technologies. Catching up regions may want to focus on policy instruments that increase the absorptive capacity for these technologies such as providing consultancy services to SME to facilitate the adoption of specific technologies; knowledge transfer institutions and educational programmes. Given the range of applications of these technologies, technology platforms involving public and private actors but also standards settings organisation can leverage productivity in existing sectors or help reveal or identify sectors in which to concentrate resources.

In general, the smart specialisation approach suggests regions, especially those regions which are not leaders in any of the major science and technology

[44] See also EC-IPTS S3 (2012) Guide on national/regional Research and Innovation Strategies for Smart Specialisation (RIS3) http://s3platform.jrc.ec.europa.eu/s3pguide at page 87 and annex II at page 65.

domains, to investing in RandD and innovation on a few key priorities[45]. The logic is 1) regions cannot do everything in science, technology and innovation and; 2) they need to promote what should make their knowledge base unique and superior to others. The key challenge for regions is how to identify those activities or domains where new RandD and innovation projects will create future domestic capability and interregional comparative advantage (Foray D. et al. 2011). Here, recent empirical evidence suggests that "related variety" - which refers to economic diversification offered by combining localised *know-how* and assets into innovations that are related to existing areas of strength - leads to the best economic returns (Frenken et al. 2007).

From this perspective, smart specialisation strategies offer an opportunity for the economic transformation of regions based on strategies that link actions to objectives to:

- Ensure differentiation and unique position in the market of the activities carried out in the region, based on the resources and capacities available (e.g. what is the value-added of the new products, what markets).

- Ensure differentiation and unique position of the activities and conditions offered by the region (e.g. to attract firms and/or foreign investments).

- Link economic goals with societal and environmental challenges

- Allow experimentation, creativity and rapid adjustment of the strategies to the changing conditions.

- Ensure the commitment and involvement of all stakeholders – regional, national or supranational – in the designing of the strategy and consecution of its objectives.

[45] COM(2010) 553 final of the European Commission.

3.4 EU innovation policy to support SMEs growth: European Commission perspective

The literature of the second half of the twentieth century depicted the innovation policy as a combination of science, technology and industrial-political strategies (Rothwell, Zegveld, 1982). Forty years later, innovation policy is considered an important part of economic policy, and its principal goals are:

- strengthening linkages in the national innovation framework
- creating positive conditions for the realization of new solutions (innovation)
- fostering structural changes in the industry (e.g. changes in technology, quality improvements)
- reinforcing SMEs to receive the benefits of globalization and international cooperation

Modern innovation policy includes some selected elements of the strategy toward science and technology as well as industrial strategies internationalize promote development, through a reasonable utilization of new products, services, and processes by enterprises, public and private organizations as well as individual people. The 'classic' innovation policy coincides with a linear model of innovation and it is known as the first-generation innovation policy (European Commission, 2002). Public support was focused fundamentally on the improvement of science and technological progress and was aimed at universities and other academic institutions occupied in RandD.

The 'modern' innovation policy watched out for the non-linearity of innovation, feedback loops, interdependencies and collaboration in the innovation process. Public support was addressed around the connection between science and business, as well as the application of scientific achievements in practice. This adjustment in the policy objectives was reflected in the passage from an immediate comprehension of innovation to intuitive models, including the innovation frameworks approach. As a result, the policy focus moved to the development of innovation frameworks and clusters. Strategy interventions were planned for improving the capacity of innovation networks. In this way, this strategy promoted the improvement of intermediary organizations, connecting science and business, and managing the transfer of knowledge. Consequently, the development of innovation frameworks, adaptable enough to regulate effectively to an advancing environment, was among the principal policy issues. This point contains three interrelated issues:

- empowering educational institutions and businesses
- improving an integrated vision for the future; organizing and implementing relating instruments to promote innovation
- developing new approaches that could empower continuous advancements and ameliorations to the new requirements of the economy (Lundvall, Borrás, 1997)

Besides, the role of regional and local administrations in shaping the innovation strategy and the ensuing innovation policy increased at that time. Innovation policy was co-created by central and regional administration and encompassed a variety of entities involved in the innovation process: research institutions, enterprises, and intermediary organizations in knowledge transfer, including the networks created by all these institutions. Furthermore, a support system expanded to indirectly influence research institutions through public investments in research infrastructure. The new tools implemented at that time also included programs directed at enterprises that implemented new solutions and new technologies. The further development of the knowledge-based economy and the emergence of new forms of innovation (social innovation, inclusive innovation) in the twenty-first century created new challenges. In order to respond to them the third generation of innovation policy was introduced (European Commission, 2002). What were the most important features that characterize this generation of innovation policy? First, its focus was on supporting innovations, regardless of the place where they arise (i.e. research organizations, business sector, public administration or the whole society). Second, innovation was supported in many different areas, which belong to the range of interest of other policies (e.g. competition policy, educational policy). Third, there was a further decentralization in the design and implementation of innovation policies, with regional and local administration playing an increasing role in these processes. An even stronger emphasis was put on entrepreneurship, the commercialization of knowledge and supporting the interactions within the innovation system. Therefore, the third generation of innovation policy was identified with numerous legislative areas, and also, more consideration was paid to the process of policy development and management of its implementation, monitoring, and evaluation of its effectiveness (European Commission, 2002).

The contemporary innovation policy that rose in the second decade of the twenty-first century has been shaped by the rapid development of information and communication technologies, changing the nature of innovations as well as introducing their new forms (social innovation, institutional innovation, eco-innovation).

The EU approach to innovation policy evolving from linear to that focusing on networks and clusters as well as mainstreaming innovation into sectoral policies was finally framed as an Innovation Union strategy. The key documents that set the scene for innovation policy in the EU were published in 1995 and 2000. The first was a Green Paper on Innovation. It identified the main challenges of innovation in Europe and it pointed out that "One of Europe's major weaknesses lies in its inferiority in terms of transforming the results of technological research and skills into innovations and competitive advantages." (European Commission, 1995). The second, the Lisbon Strategy signed in 2000 was another attempt undertaken at the EU level to strengthen the innovation performance of EU Member States. It had the target to make the EU "[...] the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion" (European Parliament, 2000). The strategy represented a ten-year reform program, which was designed as a response to global challenges. It focused on strengthening the EU's research capacity and entrepreneurship, promoted the development of the information society as well as the modernization of employment policy and social protection systems. In 2010 the Lisbon Strategy for growth and jobs was replaced by the Europe 2020 strategy. It defined five specific objectives connected to (1) RandD and innovation, (2) education, (3) employment, (4) poverty and social inclusion, and (5) climate change along with energy policy (European Commission, 2010b). Innovation constituted the core of the Europe 2020 strategy as it was regarded to be the main component of smart, sustainable and inclusive growth. Direct goals related to research and innovation were included in the Innovation Union initiative (European Commission, 2010c). It addressed Europe's innovation system, and it was aimed at fostering the capacity to produce knowledge and turn it into innovation.

3.5 Contribution of SMEs to the growth of the EU-28

Innovation and growth in SMEs across Member States and regions is a high priority in the EU's overall policy agenda. The ability to develop is perceived as one of the primary drivers of growth and a crucial ingredient in SMEs' capacity to resist and react to severe macroeconomic imbalances and market uncertainty (European Commission (2014b), Rosenbusch et al. (2011), Hall, B.H. (2011)). Flexibility, dynamism, high degrees of specialisation and local integration are fundamental assets of SMEs, which make them, in principle, well equipped to adapt to the new terms of international competition and to respond to changing market conditions, evolving consumer preferences, shortening of the product cycle and other economic challenges (Moore and Manring, 2009). Innovation is support for SMEs in their development, especially concerning their innovation performance since it's instrumental in increasing regional competitiveness and employment (European Commission, 2014a). Besides being a vital source of job creation and production, SMEs are also a fundamental driver of innovation and competitiveness.

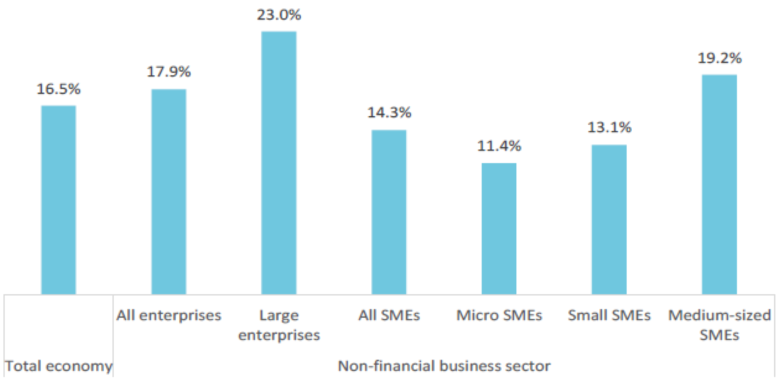
The European Regional Development Fund (ERDF) offers help for the improvement and structural adjustment of regional economies, including lagging-behind regions, and the modification of declining industrial regions. The large objective of EU industrial policy is to support structural change in European industry towards more high-tech activities, by embracing a forward-looking methodology and encouraging regions to expand their competitiveness and built up their ability to innovate, to satisfy the objectives set out in the Lisbon strategy and subsequently (European Commission, 2004). On one hand, in ‘Convergence’ regions the ERDF is more focused on promoting the modernization and diversification of economic structures and the creation and safeguarding of jobs; on the other hand, in ‘Regional Competitiveness and Employment’ regions, the ERDF prioritizes the promotion of innovation and the knowledge economy. According to Article 9(3) of the Council Regulation (EC No. 1083/2006), over the period 2007-2013, the Commission and the Member States were required to guarantee that 60% of expenditure for the Convergence objective and 75% of expenditure for the Regional Competitiveness and Employment objective for all Member States be reserved for investment. This was in keeping with the re-launched Lisbon agenda focusing on competitiveness, research and development, energy efficiency and human capital. In 2008 these targets were increased to 65% for the Convergence objective and 82% for the Regional Competitiveness and Employment objective, with variations across the Member States and regions. For the EU Member States, there was, however, no legal obligation to earmark expenditure. The literature investigating the relationship between firm innovation strategies and the crisis (Antonioli et al. (2011); Archibugi and Filippetti (2011)) demonstrates that the average firm reduced expenditure on RandD and innovation as a result of the economic crisis, but several firms, regardless of their sector, reacted oppositely by increasing their investment in activities like in-house RandD, purchase of RandD services, technology licensing, design and marketing, and training aimed at developing new goods and services. These are usually start-ups and firms in which continuous innovation is the fundamental competitive advantage. Regions in France, the Netherlands, Denmark, Germany, Northern Italy, Austria, the Czech Republic, Slovakia, and Poland recorded positive variations in terms of both RandD expenditure and value-added. Nevertheless, the dissimilarity among these and other EU countries and within the same countries can be very high. For instance, in Romania RandD grew by 91% in the North-West area, while it decreased by 64% and 97% in West and East Romania, respectively. The heterogeneity of firms' innovation capacity and the extent to which innovation can drive firm competitiveness and resilience to the crisis are strictly connected to the innovation potential of the territory within which the firm is embedded. A variety of innovation potential exists at both EU and country levels. This variety is due to different production structures, sectors of specialization, types of innovation actors, capacities for knowledge creation, transfer and exploitation, and other place-based structural conditions and explains the differences in innovation potential and the strategies pursued by regional and national governments. The 'innovation' position of regions/countries is activated by various drivers. Results from the connection analysis contained in the Regional Innovation Scoreboard Report (2014) underline that the Regional Innovation Index is higher in regions that have a larger portion of the population, that take part in continuous training and learning activities, that have a larger portion of households with broadband access, and that have the advantage of increased public funds for innovation. Other factors such as institutional and infrastructural conditions, the business climate for entrepreneurship, and the location of research infrastructures within the regional boundaries are likely to be important in explaining the innovation performance of a region.

Generally, the increasing role of knowledge and innovation as drivers of competitiveness has offered SMEs new chances to create and thrive, but most of them still face structural difficulties in following an innovation and growth way. Different territorial highlights have significant implications for SMEs' innovation capacities and advancement limits, and these cannot be neglected. They should be acknowledged by policymakers when designing support measures for SMEs.

3.5.1 Comparative analysis of the performance of EU-28 SMEs from 2008 to 2017

Over the period 2008 to 2017, SMEs made a large contribution to the economic recovery of the EU-28 economy following the economic and financial crisis of 2008/09[46]. Gross value added generated by the EU-28 non-financial business sector increased marginally more than EU-28 economy-wide gross value-added, and within the non-financial business sector, EU-28 large enterprises posted a much stronger value-added performance than EU-28 SMEs (Figure 11).

Figure 11. The increase from 2008 to 2017 in EU-28 gross value added (in current prices) economywide and in the non-financial business sector

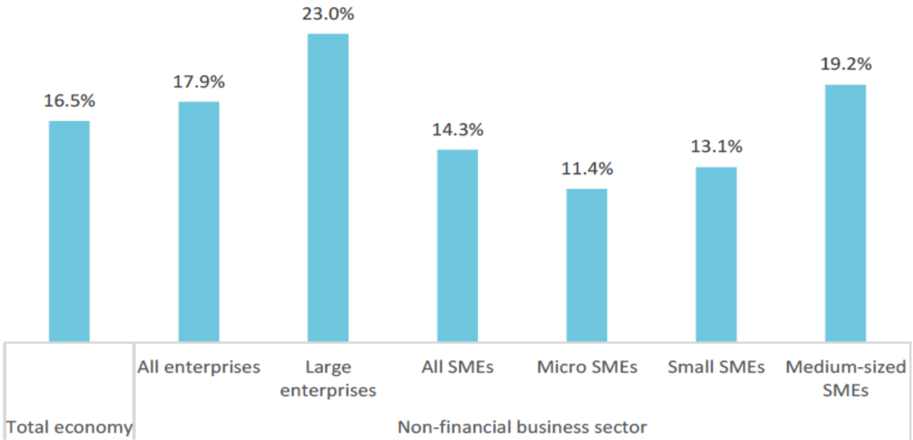


Source: Eurostat, National Statistical Offices, DIW Econ.

[46] As only information on value added in current prices is available in the Eurostat SBS database, the analysis in section 2.4 focuses on the growth in SME value added and GDP in current prices.

The weaker value-added performance of EU-28 SMEs reflects almost entirely the weaker performance of micro and small EU-28 SMEs. In contrast, non-financial business sector employment growth was notably stronger than in the economy, with large enterprises and, to a lesser extent, micro SMEs significantly outperforming the overall economy (Figure 12).

Figure 12. Increase from 2008 to 2017 in EU-28 employment economy-wide and the non-financial business sector



Source: Eurostat, National Statistical Offices, DIW Econ.

At the EU-28 level, the recovery of SME value added from the recession started in 2010 (with a minor setback in 2012) (Figure 13). In contrast, the recovery of EU-28 SME employment was markedly delayed, only starting in 2014.

Figure 13. Evolution of SME value-added and employment and number of SMEs in the EU-28 non-financial business sector (2008=100)

Source: Eurostat, National Statistical Offices, DIW Econ

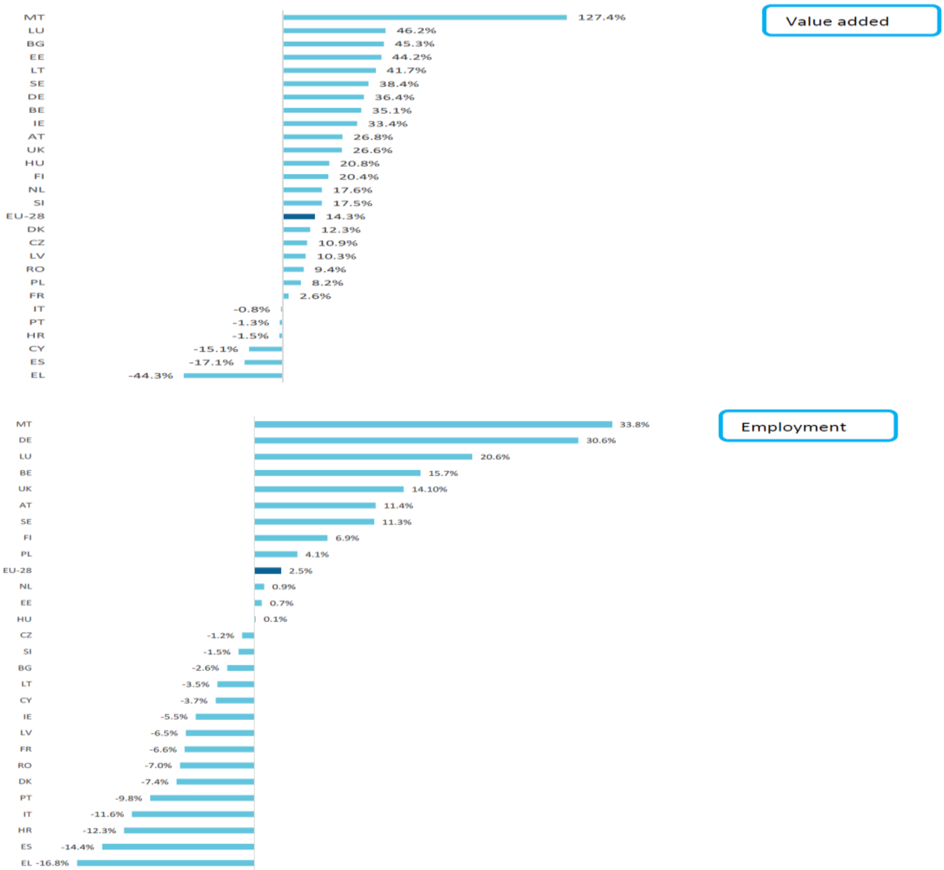
The recovery of SME value added at the EU-wide level masks highly divergent developments:

- in six Member States, the level of SME value added in 2017 remained below its 2008 level (CY, EL, ES, HR, IT and PT)
- in five Member States (BG, EE, LT, LU, and MT) the 2017 level of SME value added exceeded its 2008 level by 40% or more (Figure 6).

The differences are even more striking in the case of SME employment in the non-financial business sector:

- the SME employment level in 2017 was below its 2008 level in 15 Member States (BG, CY, CZ, DK, FR, EL, ES, HR, IE, IT, LT, LV, PT, RO, and SI)
- it exceeded its 2008 level by 20% or more in only 3 Member States (DE, LU, and MT) (Figure 14).

Figure 14. Cumulative change (in %) from 2008 to 2017 in SME value-added and employment in the non-financial business sector of EU-28 Member States



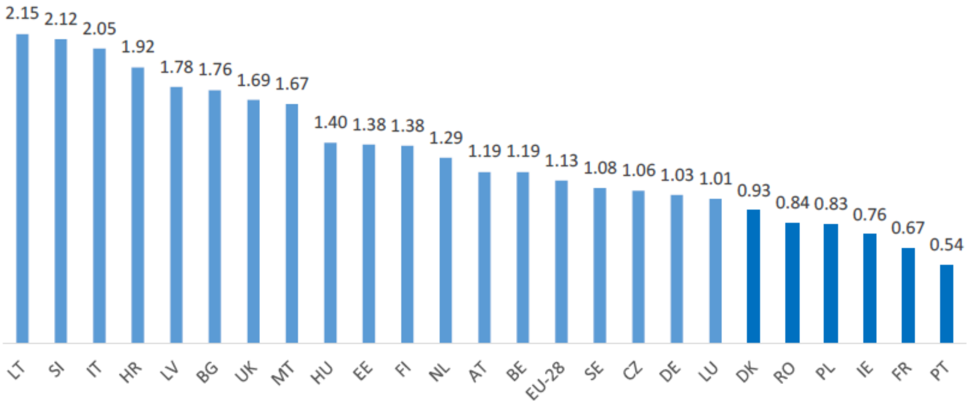
Note: Slovakia not shown because of a structural break in the data series

Source: Eurostat, National Statistical Offices, DIW Econ

Over the period 2009-2017, SMEs made a contribution to the economy-wide recovery and subsequent expansion which exceeds what would have been expected based on their relative importance in the economy in 2009 in the EU-28 and in the majority of Member States in which both SME value added (employment) and economy-wide employment increased from 2009 to 2017.

SMEs contributed 13% more than expected to the recovery in value-added based on their share of gross value-added in 2009 (Figure 15).

Figure 15. Contribution of SMEs in the NFBS to the recovery and subsequent expansion in economy-wide gross value added from 2009 to 2017 – the value of the contribution



Notes: The figure shows only data for the Member States in which SME value-added and economy-wide value added increased from 2009 to 2017

Source: Eurostat, National Statistical Offices, DIW Eco

Moreover, among the 24 Member States which demonstrated an increase in both the value-added created by SMEs in the *Non-financial business sector* (NFBS) and economy-wide gross value- added, SMEs contributed:

- less than expected in only 6 Member States (DK, FR, IE, PL, PT, and RO) because of their contribution to value-added in 2009
- only marginally more than expected in 2 Member States (DE and LU)
- somewhat more in 2 Member States (CZ and SE)
- between 9% and 40% more in 6 Member States (AT, BE, EE, FI, HU, and NL)

- between 50% and 100% more in 5 Member States (BG, HR, LV, MT, and UK)

- more than 100% more in 3 Member States (IT, LT, SI).

A comparative picture rises out of an investigation of the contribution of SMEs in the NFBS to the recovery of economy-wide employment. Although fewer Member States demonstrate an increase in SMEs' employment in the NFBS and the overall economy from 2009 to 2017.

At the level of the EU-28 economy, SMEs in the NFBS contributed 14% more to the economy-wide employment recovery than would have been expected since their share of economy-wide employment in 2009.

At the Member State level, SMEs contributed:

- less than expected based on their employment share in 4 Member States (CZ, HU, MT, and LU)

- slightly more than 30% in 2 Member States (DK and IE)

- between 45% and 60% more in 4 Member States (AT, EE, NL, and SE)

- between 140% and 170% more in 3 Member States (BE, DE, and PL)

- more than 200% more in 2 Member States (FI and LT).

Among the 6 Member States which demonstrated a decrease in both SME employment in the NFBS and the economy over the period 2009 - 2017:

- Member States (BG, CY, and EL) demonstrate a smaller SME contribution to the general decline than would have been expected based on their share of total employment in 2009

- 3 Member States (ES, HR, and PT) show a much greater contribution to the overall decline than expected.

The evolvement of the value-added generated by SMEs in the NFBS over the period 2008 to 2017 depended very much on the evolution of the demand they faced.

As already noted before in this chapter, exports of goods and services were by a wide margin the principal increment engine of the EU-28 economy over the period 2008 – 2017. In contrast, the increment in consumer expenditure remained repressed.

Consequently, it would be expected that SMEs providing directly or indirectly (through cooperation in global value chains) to outside business sectors would demonstrate a better performance than SMEs serving mostly consumers in home markets.

A basic relationship investigation between changes in the different total aggregate demand components (household consumption, government expenditure, gross capital and exports of goods and services) demonstrates that:

In the EU-28 economy, changes in household consumption are profoundly connected[47]with changes in the value-added produced by SMEs in ‘professional, scientific and technical activities’ and ‘transportation and storage’ and, to a somewhat lesser extent,[48] with changes created by SMEs in ‘accommodation and food service activities’, ‘administrative and support service activities’, ‘construction’, ‘information and communication’, ‘manufacturing’ and ‘real estate activities’.

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[47] The correlation coefficient between annual changes (in %) in the aggregate demand component and annual changes (in %) in SME value added in a particular sector is 0.90 or higher.

[48] The correlation coefficient between annual changes (in %) in the aggregate demand component and annual changes (in %) in SME value added in a particular sector range from 0.80 to 0.89.

- Changes in government current expenditures do not demonstrate a solid connection with annual changes in SME value-added in any of the sub-sectors of the NFBS.

- Changes in gross capital formation by family units, government and businesses are profoundly connected with changes in SME value-added in ‘construction’, ‘professional, scientific and technical activities’ and ‘transportation and storage’ and, to a somewhat lesser degree, with changes in SME value-added in ‘accommodation and food service activities’, ‘administrative and support service activities’, ‘information and communication’, ‘manufacturing’ and ‘real estate activities’.

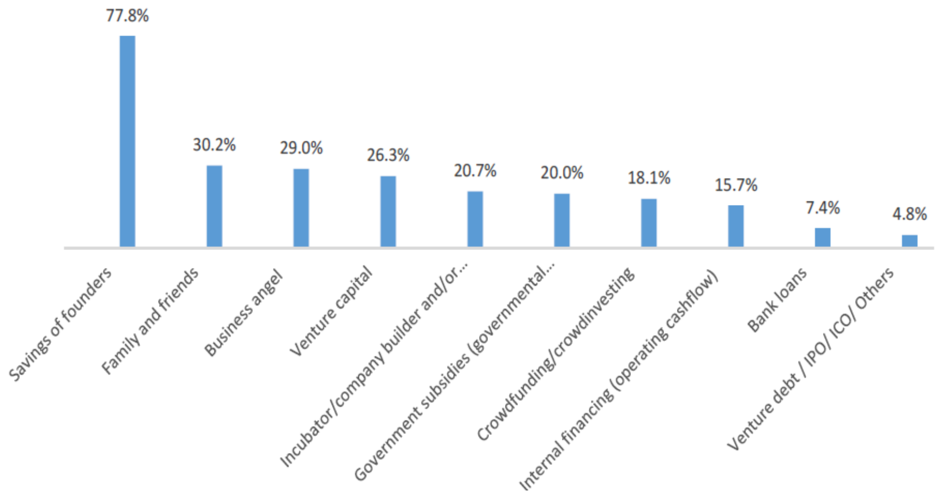
- Finally, changes in exports of goods and services are highly connected with changes in SME value-added in ‘manufacturing’, ‘transportation and storage’ and ‘professional, scientific and technical activities’, and to a lesser degree with changes in SME value-added in ‘administrative and support service activities’, ‘mining and quarrying’ and ‘water supply, sewerage, waste management and remediation activities’.

3.5.2 Start-ups

This section displays some key characteristics of start-ups in the European Union. Only two perceptions of start-ups appear to be regular crosswise over Europe, namely, their significance for financial development and their capacity to convey innovative ideas, products, and services. Unfortunately, no European central register of start-up businesses exists, and national business registries generally do not provide information on the degree of innovativeness of businesses, their growth objectives or their sources of financing during their creation. This makes it hard to discover information on start-ups.

All start-ups are SMEs, however not all SMEs are start-ups, because of contrasts in set-up and vision. As noted in the introduction, EU Recommendation 2003/361characterizes an SME dependent on business and either turnover or total balance sheet and for start-ups, these criteria might be hard to apply, since a company may have numerous employees but may not yet have a significant turnover. Moreover, the initial capital required to develop the business is commonly much higher (sometimes in the order of millions) for a start-up than for SMEs in general. Support is common for start-ups, whereas SMEs in general often rely on traditional bank loans or only the savings of the founders (Figure 16).

Figure 16. Sources of financing



Source: "EU-Startup Monitor"

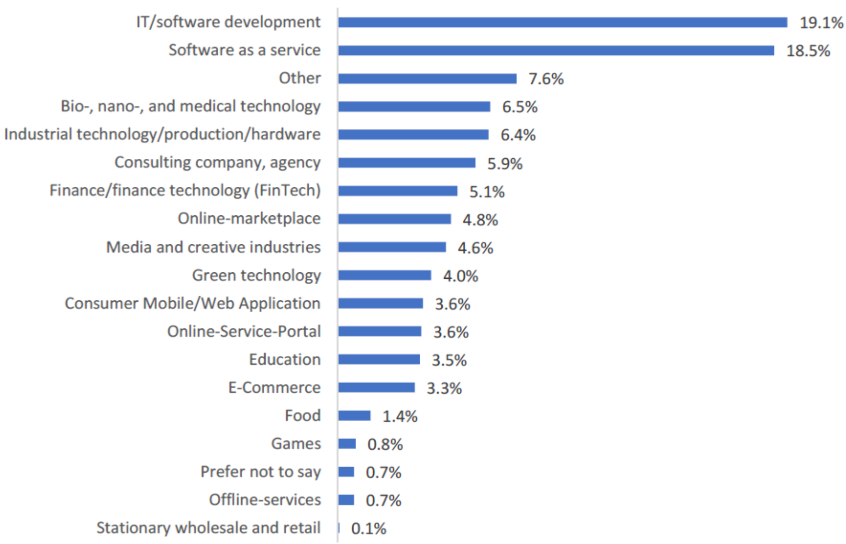
The definition of a *start-up* is taken from "EU Startup Monitor". There is not an official definition but is commonly based on specific criteria:

- age (start-up have to be younger than ten years)
- innovation (of product or business model)
- aim to scale up (intention to develop the number of employees and/or markets in which they operate).

The sectors in which the start-ups are active and dynamic are different (Figure 17). Most companies provide a product or service online (only 0.7% offer offline solutions). While sectors such as IT/Software Development (19.1%) or Software as a Service (18.5%) are still well-represented, new companies have also been created in trending sectors such as Green Technologies (4.0%) and the Fin-Tech sector (5.1%). Geographically, the greatest European start-up hubs have an increase in Berlin, Copenhagen, Lisbon, London, and Paris. Generally, start-ups develop in five stages: Seed Stage, Start-up Stage, Growth Stage, Later Stage, and Steady Stage.

Most start-ups that took part in the data collection are either in the start-up stage (46.1% have completed a marketable product or service and show first revenues/users) or in the growth stage (33.7% show significant positive developments in sales turnover and/or the number of users). Thus, the survey response sample includes companies that have successfully launched (entered the market) and are in the process of scaling up their business.

Figure 17. Sectors in which the start-ups are active



Source: "EU-Startup Monitor"

Many start-ups are so-called “born globals”, which means that they operate across borders and in some cases open an office in more than one country when starting operations.

Developing is a crucial part of the DNA of start-ups and along these lines, it is nothing unexpected that 88.0% of participating start-ups are planning to internationalize in the coming twelve months.

Most European start-ups first expand within the European Union and usually start with neighbouring countries before moving to more extensive international markets. It is, therefore, no surprise that 85.0% of participants revealed plans to internationalize inside the EU within the next 12 months. Outside of the EU, 43.4% of participants identified North American and California’s famous Silicon Valley as the most desired locations for development. More recently, there has been a perceptible interest in internationalization from Europe to Asia. One fourth (25.8%) of participating start-ups are looking to internationalize into the Asian region.

Developing across borders can be difficult and founders are confronted with numerous difficulties. Differences in legislation and regulations (59.1%), particularly concerning differences in tax frameworks (38.2%) are the greatest obstacles, followed by cultural differences (32.4%) and language barriers (26.8%). Internationalization is difficult but necessary to overcome the start-ups’ biggest business challenges. Profitability (86.2%) and cash flow (72.3%) are considered by most start-ups as their greatest difficulties and are typically addressed by the expansion of the start-ups’ activities. Moving to another market means access to a bigger number of potential customers, a larger pool of people from which to recruit and often new capital markets to approach for further funding.

Another way to overcome challenges and access new opportunities is through collaboration with other enterprises. Start-up collaborations with SMEs are almost three times as common as collaborations with large corporations:

78.64% of start-ups that engaged in cooperations are actively collaborating with SMEs, with 60.2% of these collaborations being cross-border. The main goal is to access new markets (76.5%) and a lesser goal is to boost reputation (24.2%).

3.6 Conclusions

The contribution of SMEs to innovation has expanded in ongoing decades because of changes in the way innovation takes place in the economy (OECD, 2017d). Enterprise innovation is never again constrained to corporate RandD labs and is regularly the result of collaborative and synergistic efforts wherein organizations interact and exchange knowledge and information with different partners as part of broader innovation frameworks. Furthermore, especially in science-driven sectors (e.g. biotech and nanotech), small businesses are often the source of radical innovations, thanks to their flexibility and to their ability to work outside of dominant knowledge paradigms (OECD, 2017d). SMEs are also a key component of the chain that transforms knowledge into new products, processes, and services. Faced with increasing competition on the internal and global markets, European SMEs need to increase their knowledge and research intensity, improve the way they exploit the results of research, expand their business activities to larger markets, and internationalize their knowledge networks. The priority is to help increase the competitiveness of SMEs by funding research and development activities in cooperation with public and private performers of research (universities, technology institutes, industry, SMEs). There are no restrictions in terms of research topics (bottom-up approach), provided the research meets the needs of the SMEs involved and has a clear potential for exploitation. The principle is as follows: qualified research institutions (e.g. universities, research centres) work with SMEs and associations of SMEs to develop solutions for the SMEs' problems.

CHAPTER 4 A CONCEPTUAL MODEL OF INNOVATION NETWORK. THE ROLE OF TECHNOLOGY TRANSFER, INNOVATION STRATEGY AND NETWORK IN SMEs

4.1 Introduction

Small and medium-sized enterprises (SMEs) have been drawing the attention of numerous researchers by playing active positions in international markets during the current years. SMEs have rapidly increased their positions in global markets and used international diversification as an essential strategic choice for growth. The contribution of SMEs to innovation has expanded in ongoing decades because of changes in the way innovation intervenes in the economy (OECD, 2017d). SMEs innovation is never again constrained to corporate RandD labs but is the result of collaborative and synergistic efforts wherein organizations interact and exchange knowledge and information with different partners as part of broader innovation frameworks.

The SMEs' innovative potential and introduction of new strategies of production have been considered the key elements for development (Schumpeter, 1934) but it has not been clarified immediately where those new techniques come from (Antonelli and De Liso, 1997). Transfer of technology has been used to solve this issue while innovation strategy has been indicated as the driver for the economic growth (Dutta, Lanvin and Wunsch-Vincent, 2014; OECD, 2007; Van de Ven, 1986). Indeed, technology transfer and innovation strategy are recognized as essential elements for SMEs' objectives achievement ensuring growth, sustainability and competitiveness. They are completely broad concepts and involve many distinct stakeholders varying from governments and scientists to business executives, advertising and marketing experts and consumers. Technology transfer and innovation strategy have been accredited within different fields of research (Mom, Oshri, and Volberda, 2012; Dasgupta and Taneja, 2011; Morrissey and Almonacid, 2005; Kneller, 2001; Grotz and Braun, 1993) as well as within the regulation and policy planning documents (Association of University Technology Managers - AUTM, n.d; European Commission, 2010a; European Commission, 2010b). The diversity of the associated parties results in exceptional perspectives of technology transfer and innovation strategy, thus resulting in distinct know-how of both concepts. Their major strategic objective is to foster scientific excellence, innovation, collaboration and a multidisciplinary method to investigate in numerous fields and technologies, and to make certain long-term recognition in the European environment. In particular science-driven sectors (e.g. biotech), small businesses are frequently the supply of radical innovations, thanks to their flexibility and their potential to work out of dominant knowledge paradigms (OECD, 2017d).

Even though SMEs are a key element of the chain that transforms knowledge management into new products, processes, and services, faced with increasing competition on the internal and global markets they need to increase their knowledge and research intensity, improve the way they exploit the results of research, expand their business activities to larger markets, and internationalize their knowledge networks. The priority is to help increase the competitiveness of SMEs by funding research and development activities in cooperation with public and private performers of research (High Education Institutions (HEIs), Public Research Institutions (PRIs), governments, technology institutes and industry) (Intarakumnerd and Goto, 2018). There are no restrictions in terms of research topics (bottom-up approach), provided the research meets the needs of the SMEs involved and has a clear potential for exploitation. The principle is as follows: qualified research institutions (e.g. HEIs, PRIs) work with SMEs and associations of SMEs to develop solutions for the SMEs’ problems.

The growing number of technology transfer and innovation strategy studies and the development of different kinds of theories and models, typologies and taxonomies proposed, forming different relationships between these concepts.

Taking into account the relevance of technology transfer and innovation strategy, the purpose of this chapter consists of developing a model of innovation network for SMEs based on the analysis of secondary data from a series of recent studies and focus group discussions in the domain of technology transfer and innovation strategy.

In this context, the networking and internationalization capacity of SMEs is a complex process that is based on the company innovation strategy and a series of techniques of technology transfer management. Accordingly, the following research question was developed: *How technology transfer and innovation strategy can facilitate the networking and internationalization capacity of SMEs?*

The remainder of this chapter is organized as follows. *Section 2* presents the conceptual framework of the IN model; *Section 3* explains the characteristics of the IN model and examines what role the model can play in the implementation of SMEs networking and internationalization. Finally, *Section 4* analyses case studies of clusters from Italy and Spain and explain the relationship with the IN model to these clusters. *Section 5* summarizes the findings in light of relevant literature and concludes the potential of the Innovation Network model for SMEs.

4.2 Conceptual framework of the IN model

Now that the important concepts and theories and a literature review of the current literature on technology transfer, innovation strategy, networking/networks and internationalization and, how they affect the internationalization of SMEs have been developed in previous Chapters, it is time to provide a framework that represents ways of thinking about a study. We believe that by constructing our conceptual framework which corresponds to the systematic conceptual model – IN Model, we can visualize different indicators and how they are inter-related. Bordage (2009) defines a conceptual framework as a framework that stems from theories with well-organized principles and propositions that have been confirmed by studies and observations in the field. We believe our thesis also follows a similar pattern where our conceptual framework resulted from the theories of technology transfer, innovation strategy, networking and internationalization, where both the network forms and the internationalization stage models were confirmed by researchers.

The increasing importance of technology transfer as sources of innovation and economic development in science-based industries reduces the slacks between scientific discoveries and industrial applications, and the limits among science and technology which are getting to be obscured (Gambardella, 1995; Powell and Owen-Smith, 1998; Gray, 1999).

The changing relations between university-industry also indicates a huge move in the relationship far from the older liner model of one-way knowledge transfer which firms are seen as the repository of the knowledge, to an intuitive model of two-way knowledge exchange between the two systems (Cooke and Morgan, 1998) because the two sides contribute to progressing procedures of ability creation, knowledge acquisition and knowledge transfer (Newlands D., 2002). One of the key confirmations of the evolving university-industry relation is the emerging role of the university as a knowledge institution in creating wealth and economy (Gunasekara, 2005; Asheim and Coenen, 2005; Etzkowitz, 2004; Gunasekara, 2004; Newlands D., 2002; Sutz J., 2001; Goddard J., 1994; Goddard J., 1999). The role of the university and industry in regional/local advancement in the field of innovation has likewise been given increasing attention in terms of providing human capital and shaping the social and cultural dimensions of economic development. Effective development in the field of innovation in those knowledge intense sectors progressively require a more noteworthy assortment of information crosswise over various scientific disciplines and functional areas, and the connectedness inside and among them (Liebeskind et. al., 1996; Shan et. al., 1994; Owen-Smith and Powell, 2004).

The role of the university and industry in creating effective technology-based clusters is clear in various high technology regions through the foundation of spin-off firms (Lawton Smith, 2003). The transformational connection/collaboration between university and industry is likewise shown in the reliant relations built up among academia and firms based on common interests. For example, the inspiration driving the university commercial activities (Thursby et. al, 2000) is the expanded readiness of professors to patent their inventions without a move in the sort of research itself or a considerably more crucial change in the type of research to be more commercially oriented. Empirical research demonstrates that not exclusively do university researchers work in participation with industry, but frequently university research produces knowledge or processes that are a spin-off from their institutions or have the privilege sold to private segment companies who at that point develop the technologies.

From the industry point of view, it is contended that the innovation strategies inside the industry have likewise changed with the increasing interest in new knowledge. As out Cooper et. al (1995) and Newlands (2002) state, firms are quick to buy the output of academic research for two reasons: first universities contain publicly financed academic researchers, so private expenses are retained at the public expense; second, the university can support the risk of intensely original research which would otherwise impose costs on business if they had to anticipate the burden of failure. Evidence also demonstrates that the profitability of firms having partnerships with universities is higher than those that do not have partnerships. Firms involved in research universities have significant advantages in expanded productivity, benefit, and innovation (Coopers and Lybrand, 1995).

The changing relationships between university-government-industry have additionally prompted a change of the organizational arrangements inside government designed to support innovation, collaboration and consortia in and across industrial sectors and the construction of hybrid organizations to facilitate connections, information exchange and collaborative innovations

(Etzkowitz and Kemelgor, 1998; Robertson, 1999; Gray, 1999). The dynamic role of government in creating technology transfer additionally encourages policymakers to comprehend and gain from the elements and bits of knowledge of the expansive scene of innovation, subsequently to grow new policies that address the issues raised during the process of technology transfer (Nauwelaers, 2000; Mytelka and Smith, 2002; Benz and Furst, 2002).

Despite the changes of university-government-industry relations and various numerous examinations of the studies on the external orientation of university has been described by a number analysis (Gulbrandsen and Smeby, 2002; Langberg, 2002; Benneworth, 2001) identifying with the commercialization activities, close examining existing literature demonstrates little evidence on what are the differences between university, government, and industry in developing knowledge-based innovation. Jensen (2002) revealed that even researchers need to get through the traditional limits and step into the new economy, the new roles are challenged during the interactions with TH partners.

Many kinds of research on technology transfer models argue that there are still obvious gaps between theories and practice, especially in the area of less-favoured regions (Morgan, and Nauwelers, 2003) where there have been issues of translating policy intentions of knowledge-based innovation policy into operational practice through fostering collaborative networks between innovation actors (Curds, 2004; Benz and Furst, 2002; Jensen and Trgrdh, 2004). Although the adoption of policy does not guarantee success (Stevens et. al, 1980) and it is too early to make a judgment on the impact of these innovation policies in terms of generating innovation capacities, the successful implementation of the innovation programme needs to consider several perspectives. As Morgan and Nauwelers (2003) point out, the absence of limit concerning participation between centre components of the innovation system is the key issue inside less-developed regions. Such structural weakness argued it tends to be improved through agreement-reaching and cooperation-enrolling instruments to promote the development of innovative linkages and more dynamic networks.

The implementation of innovation needs to consider the dynamic roles and interests of innovation actors engaged in the `overlapping spheres' and `network interfaces' as a result of the transformational relations between university-government-industry (Etzkowitz and Webster, 2000). Managing such complex networks requires collective endeavour and new ways of engagement with a variety of internal and external actors in the innovation process, spreading over the private and public areas (Lam, 2004). The pre-condition for implementing knowledge-based innovation has been emphasized in TH idea. In this manner, the implementation of the innovation policy needs to consider the historical and political process of the institutional relations inside the areas and identify barriers to creating aggregate activities and interactive networks.

Interactive networking between institutions requires ‘unfreezing’ of the traditional approaches towards its advancement ways and methods of activities to generate paradigm changes for knowledge creation in the areas (Benz and Furst, 2002). Innovation practice through aggregate actors is progressively founded on social skills and expertise in the structure up connections and overseeing expectations of diversified innovation actors. Furthermore, during the process of knowledge-based innovation, a large part of the transfer of knowledge from academia to industry is considered implicit and uncodified and requires the bench-level engagement among academia and firms which are characterized as two communities with different standards and methods of communications (Zucker et. al, 2002). Gibbons et. al (1994) point out that knowledge is constantly implemented through a continuous negotiation and it is not produced unless and until the interests of the different innovation actors are incorporated. Managing expectations and knowledge flows within and across institutional spheres remain a big challenge for the success of implementing innovation policy (Barrett and Fudge, 1981). If scholars are to achieve an understanding of the differentiation between ‘policy promises’ and ‘policy products’, the focus of research should be shifted from designing knowledge-based innovation models or innovation policies towards the analysis of the process of innovation policy implementation, the role of actors involved in creating innovation practice and the processes in which innovation capacities and internationalization of firms are produced (Schofield J., 2001).

To determine the key issue in the internationalization process of SMEs, explanatory research, including literary analysis was undertaken. Taking a qualitative research approach, we have analysed the main theories outlined in Chapter 2 so far in terms of how technology transfer and innovation strategy influence SME’s networking capacity and their engagement in foreign markets. However, some important considerations have not been adequately addressed in these theories.

To cope with all the interactions previously mentioned and the difficulties they exhibit, in this dissertation we have developed an SME’s innovation and internationalization model, named Innovation Network (IN model), using a methodological approach based on three different models: on one hand, the Triple Helix (Etzkowitz and Leydesdorff, 1995 and 2000) and the Uppsala models (Johanson and Vahlne, 1977) were used to measure the degree of relations between three actors (government-industry-university) and three variables (technology transfer-innovation strategy-networks); on the other hand, the Connectivity model (Virkkala, Mäenpää and Mariussen, 2017) was used to emphasize the increment of entrepreneurial innovation level in the regional interconnected ecosystems. We reevaluate those approaches in order to propose the IN model.

4.2.1 The TT Triple Helix model

The idea of Triple Helix (TH) has been summoned as a significant expression of the developing examples of innovation through investigating the relations of university-government-industry (Etzkowitz H. and Leydesdorff L., 2001, Leydesdorff L., 2001; Sutz J., 2001; Shinn, 2002; Inzelt, 2004; Sadd, 2005;

Marques, 2006; Baber, 2001). In this section, the Triple Helix relations of university-government-industry as a significant applied system will be explained and the key contentions will be fundamentally examined in creating technology transfer models. The core components of the TH model are encompassing new patterns of advancement in connection to economic development and the focal point of the examination depends on the connections between the university-government industry.

The Triple Helix model, which was founded by Etzkowitz and Leydesdorff, repays the breaking points of the traditional linear methodology of innovation where theoretical and practical issues are investigated inside a different institutional field (namely, university and industry) underlining the impact of the transformational changes across institutional boundaries between university, government, and industry, which are viewed as the key player of technology transfer. The focal point is that university, government, and industry that were differentiated from each other as a condition for the constitution of advancement are currently converging with each other to create a kind institutional arrangement (Baber, 2001) for improving knowledge-based innovation. It is argued that in knowledge-based innovation, changes happen inside and between the institutional spheres of the university, government, and industry (Etzkowitz and Leydesdorff, 1997).

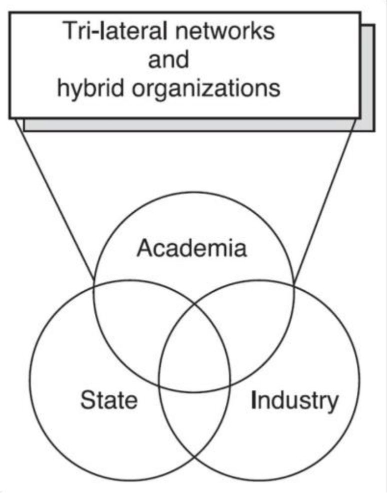
Universities are playing the role of business and become more entrepreneurial focused and act as experts (Etzkowitz, 2004). Industries are engaged in more research in new technology development through the foundation of research focuses. The government is pushing collaborations among university and industry through planning and implementing innovation projects (Etzkowitz and Leydesdorff, 2001). Subsequently, networks are created among the three institutional spheres in common projects for creating economic growth and knowledge-based innovation. New activities that emerge from these networks become a source of innovation. Etzkowitz (2003) proposes to focus on an extensive concern with making a framework for innovation through the development of a hybrid regime that included academic, industrial and governmental partners.

Four phases have been recognized in the development of a Triple Helix innovation model (Etzkowitz, 2003). These phases include:

- The internal change in every one of the helices
- Influence of one helix upon another
- Creation of a new overlay of trilateral networks
- Organizations from the communication among the three helices

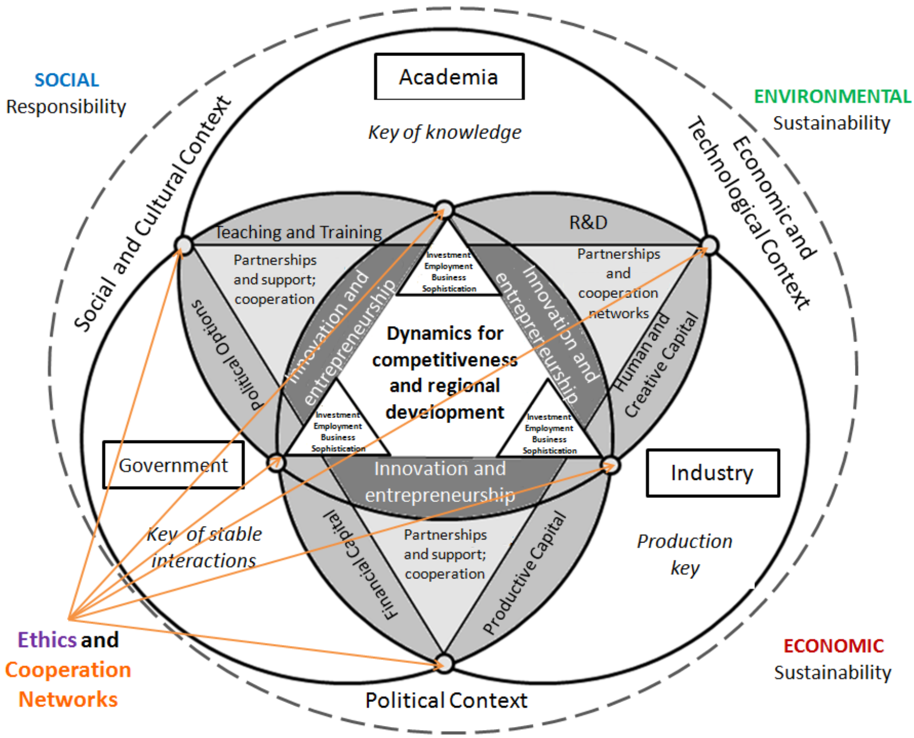
All four phases demonstrate the procedure of every sphere in adjusting its new role while performing existing roles, additionally making a new arrangement of connections while keeping up existing networks. The changing connections between university, government, and industry are shown in Figure 18 and 19.

Figure. 18 Triple Helix Model of University-Government-Industry relations



Source: Etzkowitz (2003)

Figure.19 Triple Helix Triangulation Model



Source: Farinha, L. and J. J. Ferreira (2013)[49]

The Triple Helix connection of university-government-industry as a valuable logical model has caught the new elements of technology transfer in terms of both content and procedure. There are various positive stories given by the Triple Helix approach of technology transfer.

As a matter of first importance, the TH expresses that new jobs of innovation actors which are risen out of the transformational changes between and inside the institutional spheres during the procedure of connections. University,

[49] Farinha, L. and J. J. Ferreira (2013): *Triangulation of the Triple Helix: A Conceptual Framework. https://www.researchgate.net/publication/234203424_TRIANGULATION_OF_THE_TRIPLE_HELIX_A_CONCEPTUAL_FRAMEWORK*

government, and industries are playing each other's role and limits between institutional spheres become obscured during the time spent in the procedure of connection. Furthermore, the TH idea implies a solid interest among the three institutional spheres for knowledge generation and economic development. Along these lines, the basic interest for collective learning link individual actors together and create interactive innovation networks. Thirdly, a collaboration between the university, government, and industry are seen as fundamental for the accomplishment of knowledge-based innovation.

Innovation is produced and advanced from the continuous connections and networking between the three spheres. Gebhardt et. al (2004) point out the connection between university, industry, and the government is the key to improving the conditions for innovation in a knowledge-based society. Networks among the institutional spheres progressively give the source of innovation rather than any single driver. New knowledge is delivered as well as circulated inside the three institutional spheres. Finally, based on the observations and empirical proof gathered from the fruitful areas, the idea of TH signifies that economic development is a result of effective connections and cooperation networks between the university-government industry.

Although the strategic value of TH idea has been broadly recognized as a model of technology transfer which highlights the core elements and subjects at the core of the economic development, the reasonable framework presented by TH should be inspected, specifically to what extent the theoretical arguments of TH model can be connected outside the high-performance region from which it is being inferred should be investigated. Investigating the implications of the TH concept requires a further understanding of the transformational relations of the university-government industry.

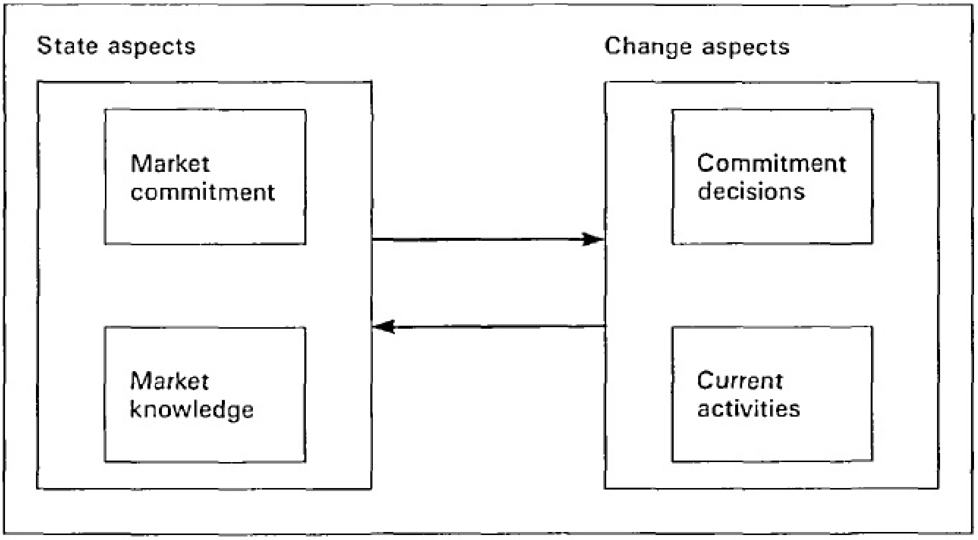
The principal conclusion underlined by TH is the reorganization of the transformational changes and knowledge flow inside institutional elements of the university, government and industry, and the effect of mutual connections in reconstructing their new jobs during the procedure of innovation. In this manner, it is important to comprehend the changing connections and roles played by each institutional actor in the technology transfer. The evolving university-industry connections can be seen driven by the following improvements: Increasing demand for new knowledge, skills in response to the new economy (Nonaka and Takeuchi, 1995; Lundvall, 1997) and grasping competitive advantages (Porter M. E., 1990).

4.2.2 Uppsala Internationalization model

The Uppsala model, *The Internationalisation of the Firm*, has its theoretical base within the behavioural theory of the firm (Cyert and March, 1963; Aharoni, 1966) and Penrose´s (1959) theory of the expansion of the firm. This model is seen as a process during which the enterprise gradually increases its international involvement. This process evolves in an interplay between the event of data about foreign markets and operations on one hand and an increasing commitment of resources to foreign markets on the opposite.

Johanson and Vahlne (1977) develop this theoretical model to explain the internationalization process of the firm. This model is concentrated “on the development of the individual firm and particularly on its gradual acquisition, integration, and use of knowledge about foreign markets and operations and on its successively increasing commitment to foreign markets.” (Johanson and Vahlne, 1977, p.23). According to the model (Figure 20), a distinction is formed between the state and change aspects of internationalisation. The state aspects of internationalisation are market commitment and market knowledge; the change aspects are business activities and commitment decisions. Market knowledge and market commitment are assumed to affect decisions regarding the commitment of resources to foreign markets and therefore the way activities are performed. Market knowledge and market commitment are, in turn, suffering from current activities and commitment decision. Thus, the method is seen as causal cycles (Andersen, 1993).

Figure.20 The Internationalization Process of the Firm.



Source: Johanson and Vahlne (1977)

“The basic assumptions of the model are that lack of such knowledge that is an important obstacle to the development of international operations and that the necessary knowledge can be acquired mainly through operations abroad” (Johanson and Vahlne, 1977, p.23). The gradual acquisition of knowledge amplifies foreign commitments (Karadeniz and Göçer, 2007). The increasing experience and knowledge about foreign markets lower the perceived risk and transaction costs, thus increasing the commitment to foreign markets (Karadeniz, 2007). Market knowledge and market commitment are assumed to affect both commitment decisions and therefore the way current activities are performed. Within the model, it is assumed that the firm strives to extend its long-term profit, which is assumed to be like growth. The firm is additionally striving to stay risk-taking at a low level. These strivings are assumed to characterize decision-making on all levels of the firm. Given these premises and therefore the state of the economic and business factors which constitute the frame which a choice is taken, the model assumes that the state of internationalization affects perceived opportunities and risks which successively influence commitment decisions and current activities (Johanson and Vahlne, 1977).

This theoretical model describes two patterns at the operational level: the primary pattern is that the firm´s engagement within the specific country market develops consistent with a longtime chain, i.e. at the beginning no regular export activities are performed within the market, the exports take place via independent representatives, later through a sales subsidiary, and eventually, manufacturing may follow. In terms of the method model, this sequence of stages indicates an increasing commitment of resources to the market. It also indicates current business activities which differ within the market experience gained. The primary stage gives practically no market experience. The second stage sees the firm as having an information channel to the market and receiving fairly regular but superficial information about market conditions. The next business activities being performed within the market cause a more differentiated and wide market experience, which even may include factor markets (Johanson and Wiedersheim-Paul, 1975).

The second pattern explained is that firms enter new markets with successively greater psychic distance. Physic distance is defined in terms of things like differences in language, culture, political systems, etc., which disturb the flow of data between the firm and therefore the market (Vahlne and Wiedersheim-Paul, 1993). Thus firms start internationalisation by getting to those markets they will most easily understand. There they're going to see opportunities, and there the perceived market uncertainty is low.

Later, Johanson and Vahlne (1990) attempted to increase the explanatory power of the model by emerging its theoretical basis to embrace new concepts and approaches. First, they connected the internationalization model to direct investment theory, by perceiving the eclectic paradigm (Ghanatabadi, 2005). Consequently, the aim of the model has been altered and defined as: “Explaining the pattern and mode of building marketing-oriented operations (including manufacturing for the local market)" (Johanson and Vahlne, 1990). Second, other restrictions are argued by relating the method model to the concept of the economic network (Ghanatabadi, 2005).

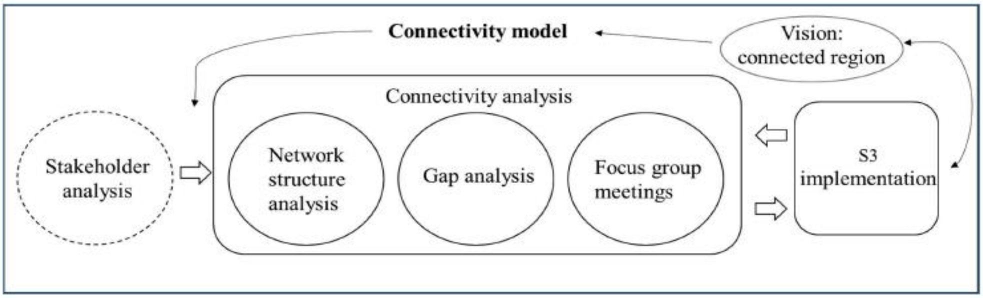
In response to the developing role of the network of business relationships among different business actors, Johanson and Vahlne (1990) argue that business relationships and industrial networks are subtle phenomena that aren't easily observable by outside observers. These relationships can only be understood through experience from interaction inside; therefore, regarding the internationalization process model, it is often assumed that "market (i.e., network) knowledge is predicated on experience from current business activities, or current business interaction" (Ghanatabadi, 2005).

4.2.3 Connectivity model

The Connectivity model was developed in 2012-2014 by regional studies faculty member Seija Virkkala, Åge Mariussen and Antti Mäenpää, in cooperation with the Regional Council of Ostrobothnia (Finland). Originally this model was developed to support the smart specialisation strategy (S3) in the Ostrobothnia region within the ongoing *Learning Among Regions in Sensible Specialisation - LARS* project (2019) but then has been extended to eight completely different regions in Finland, Sweden, Norway, Germany, Lithuania and Latvia. The connectivity model is a policy model which includes an overall vision of a connected region: the cooperation enhances strategic thinking within the region or nation and cooperation between totally different helices is particularly useful attributable to the numerous institutional views and logic.

The basic idea of the Triple Helix model has provided the rule for measure connections between the three main regional helices. The model conjointly includes three abstraction levels (regional, national and international) on notice some insights into however intra- and extra-regional cooperation appearance and from these inclusions the model concentrates on measuring nine connections, or relations between the regional actors. The focus of each relation is to measure “the number and importance of connections (network structure analysis) and the depth of these connections (gap analysis)” (Mäenpää, 2020). “The analysis is only a small part of the model, as there is a greater emphasis on the practical discovery of gaps in innovation activities and discussions which may provide more concrete ideas on how to improve connections” (Mäenpää, 2020).

Figure.21 Connectivity model and its components.



Source: Mäenpää, 2020.

The first step to implement the connectivity model is a *stakeholder analysis* which includes the recognition and categorisation of possible stakeholders who are later interviewed to get data for the particular connectivity analysis (Mäenpää, 2020). Within the context of the connectivity model, Virkkala and Mariussen (2018) have developed a stakeholder analysis based on an article by Mitchell, Agle and Wood (1977). They have analysed the power, legitimacy and urgency of potential stakeholders.

1. *Power* is referred to stakeholders which influence the development of the region. These stakeholders can be “companies or institutions which control money, knowledge, rules, decisions, or other crucial resources” (Virkkala and Mariussen, 2018).

2. *Legitimacy* is “a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions” (Suchman, 1995). The legitimised stakeholders such as organizations or NGOs, large firms take care of the interests of the region (Virkkala and Mariussen 2018).

3. *Urgency* represents the claims of the stakeholders towards regional development (Virkkala and Mariussen 2018; Mitchell, Agle and Wood, 1997).

The second step is *network structure analysis* to measure connectivity within the region taking into account the number and importance of partners viewing the regional collaboration and its strength. “This includes regional, national and international levels, so S3 mediators may quickly discover whether their region needs more connections or deeper connections to other geographical levels or helices” (Mäenpää, 2020).

The third step is a *gap analysis* that measures the gap between two values: expectations and experiences. Expectation means that what the cooperation is on an ideal level, i.e. what the respondent would like the cooperation to be; whereas experiences are the measurement of what the cooperation has been in real-life. The distinction between these two figures presents a gap. The larger the gap is, the bigger the problem is, as clearly the respondent isn't too happy concerning cooperation, where he/she expects for quite what the case currently is. These gaps will then be taken into discussion and solutions is looked upon alongside numerous regional actors. Collaboration is additionally measured at the regional, national and international level, so that one is in a position to visualize the broader picture.

Finally, the *focus group meetings* provide a forum for discussion regarding the discovered gaps. In these meetings, the respondents of the previous analyses and other regional experts discuss the discoveries from network structure and gap analyses and provide concrete ideas and suggestions on what the largest gaps might mean and the way they might bridge these gaps. This phase transforms abstract figures concerning the network structure and therefore the analysis results into concrete development ideas and suggestions, which is important for establishing a functional connectivity model (Virkkala, Mäenpää and Mariussen, 2017; Virkkala, 2014).

4.3 Characteristics of the Innovation Network model

4.3.1 Introducing the IN model

The Innovation Network Model summarizes the contributions of the Triple Helix, Uppsala and Connectivity models to make them work together. The IN model proposes a model for innovation and internationalization of SMEs.

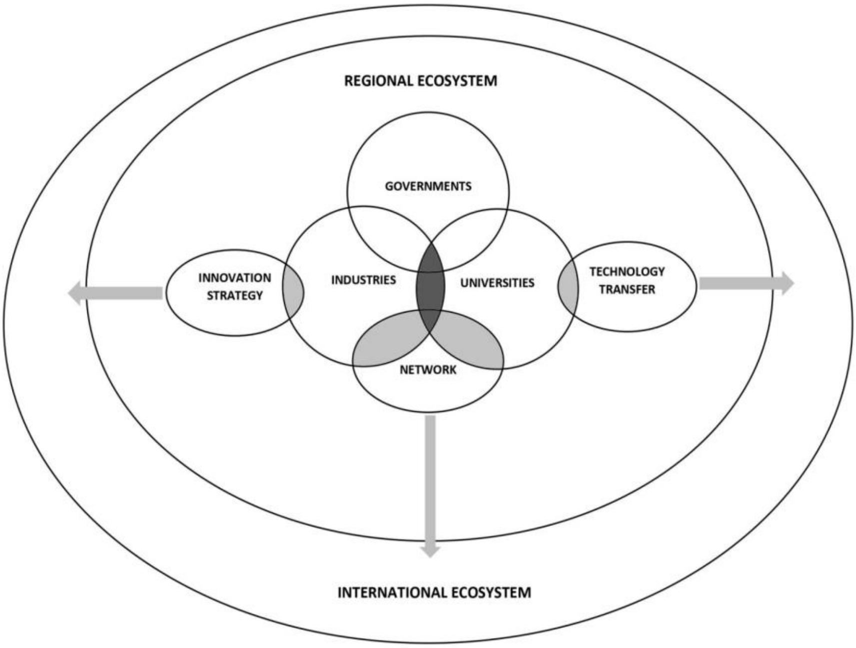
The systematic approach of the IN model consists of content analysis which can be implemented according to the modern cluster policy provided by the concept of Smart Specialisation. The IN model represents a pilot to extend knowledge of the innovative process and to make more interventions in the direction of developing joint roadmaps and aligning investment agendas on relevant topics for innovation policies. It will also serve to encourage entrepreneurs and other organisations such as Higher Education Institutions (HEIs) and Public Research Institutions (PRIs) to become involved in identifying the regions' specialisations.

Based on the literature review and focus group discussions, and following the Triple Helix (Etzkowitz and Leydesdorff, 1995 and 2000), Uppsala (Johanson and Vahlne, 1977) and Connectivity (Virkkala, Mäenpää and Mariussen, 2017) models, we have developed the IN model as a systematic conceptual model. The *Triple Helix model* of innovation has provided the guideline for measuring the grade of interactions between the three following elements and their associated 'initial role' (Leydesdorff and Lawton Smith, 2012): universities engaging in basic research, industries producing commercial goods and governments that are regulating markets (Leydesdorff, 2012). As interactions increase within this framework, each component evolves to adopt some characteristics of the other institution, which then gives rise to hybrid institutions. Bilateral interactions exist between university, industry and government. The *Uppsala Internationalization model* is utilized to discover that SMEs typically start their expansion in a psychically and culturally close by the market (regional ecosystem). There, they improve knowledge of the market and have more control of assets. Thereafter gradually when SMEs become more experienced and gained better assets, they expand to the more market which is culturally and geographically distant. Furthermore, regularly SMEs entered a new market through export before the establishment of foreign sales subsidiary or foreign production. Finally, the *Connectivity model* is used to find out the importance of connections in terms of proximity to regional ecosystems where SMEs play a crucial role because interacting through an overlay of networks which are a precondition for the creation of more opportunities for innovative interaction.

Our approach to analysing SMEs internationalization is to use the network as the starting point since it provides an appropriate framework for understanding SMEs as embedded actors in business networks. What follows is an elaboration of the IN Model, first explaining how continuous connectivity between actors and actors and variables reinforces the networking capacity of SMEs and second describing how this connectivity has an impact on their involvement in the international ecosystem. This model falls into the innovation network approach of the firm's internationalization, in line with which an enterprise may internationalize when it develops a set of exchange relationships (Kowalski, 2014).

Figure 22 describes the theoretical model and shows that the concrete collaboration between Governments, Universities and Businesses (actors) facilitate membership in networks or clusters via different channels of external knowledge (variables) stimulating SMEs' engagement into international systems.

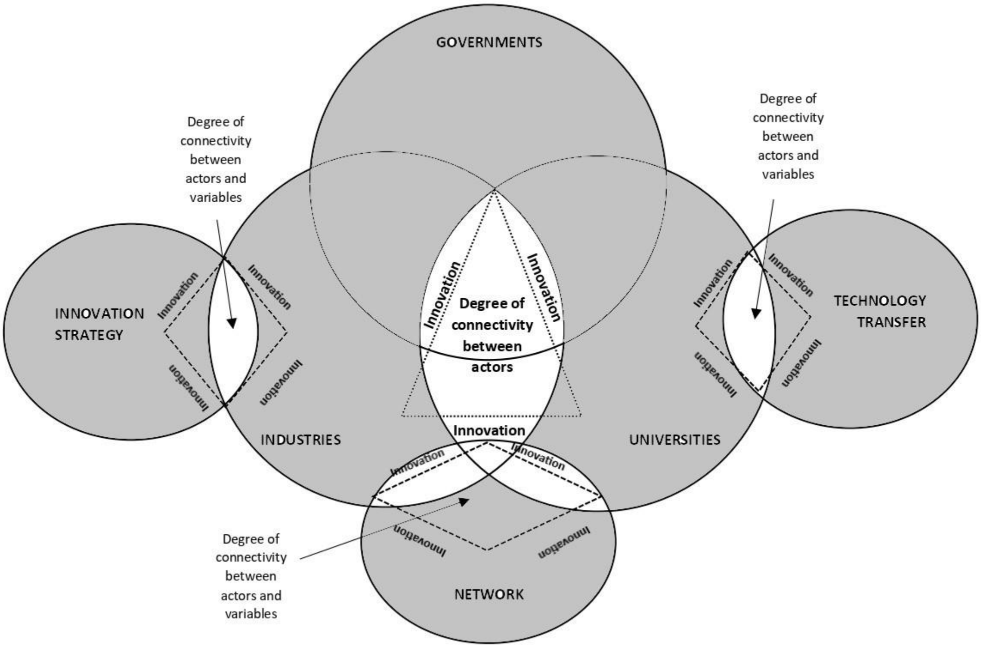
Figure.22 Innovation Network Model



Source: own compilation.

Figure 23 shows that in the IN model higher is the degree of connectivity between actors and actors and variables higher is also the level of innovation in the regional interconnected ecosystems network. The effect of the high degree of connectivity and level of innovation contribute to stimulating the networking capacity of SMEs to enter international ecosystems.

Figure.23 Components of the IN model



Source: own compilation.

The different phases of the IN model can be described by utilizing the four principles behind the ideas that SMEs have long been aware of as suggested by the Cluster policy of the European Union. These phases include the original principles from the Smart Guide to Cluster Policy (2016), as well as additions from the IN model.

1. *Location principle:* the guide underlines that location is the best possible sources for SMEs. The interactions that SMEs can achieve with local actors is much richer. The principle of IN model is the high degree of connectivity between actors and actors and variables push the innovation in regional ecosystems, such as clusters.

2. *Linkages principle:* an environment that supports active collaboration between SMEs is a principle of the guide. The IN model supports the mobilisation of actors to address common problems through variables and allow mutually beneficial collaboration to emerge.
3. *Related industries principle:* improving success is a learning and collaborative process that need coordination and organization. The key actors are members of regional ecosystems and clusters which build a collaborative organization and reflect the increasingly cross-industry nature of value chain and innovation systems. These key actors should be included in the coordinated organizations through focus group meetings. In regional ecosystems and clusters, temporary organizational connectivity and shared vision are implemented.
4. *Critical mass principle:* according to the abovementioned guide, the level of specialisation of SMEs in a certain set of industries is connected to the levels of productivity and innovation. The principle of the IN model is derived from that vision of specialisation which is partly due to competitive pressure on SMEs which is challenging but it makes them more likely to succeed in international and global competition. Formulating a vision of internationalization of SMEs requires more ideas and collaboration to develop unique products and services that stand out in the market.

4.3.2 The IN model added value

Much of recent research focusing on innovation and innovation capacity organizations has shifted from focusing on single organizations to looking at organizations from a network perspective (Corsaro, Ramos, Henneberg and Naudé, 2012). This shift from looking at single organizations and their innovation strategies to studying different types of collaborative clusters across a wide range of organizations stems from the idea that external knowledge is very valuable in the innovation process (Chesbrough, 2003). This means that organizations should move on the far side of their comfort zone and obtain input from alternative external sources (Corsaro et al, 2012). The cooperative setting is so one thing that has gained enlarged interest in research, wherever benefits and potential barriers and challenges are through empirical observation investigated. Collaboration, for example, scale back the number of time and resources spent within the single firm innovation method and unfold risks from one organization to several (Ritter and Gemünden, 2004). In this regard, the choice to combine three particular models to develop the IN model (Triple Helix, Uppsala and Connectivity models) is about the combination of the different fields itself that is the essence for generating innovations based on knowledge-technology transfer from different fields (Levén, Holmström and Mathiassen, 2014).

The IN model is based on the connectivity among network actors and their necessity to interact between them through external knowledge within the regional interconnected ecosystems. Connectivity among three separate institutional spheres government-industry-university (actors) promotes unique competencies, skills and knowledge which can diffuse spontaneously through personal contacts, formal and informal rules, organizational connectivity to the membership of the same organizational entity and cognitive connectivity to the distance between the knowledge base of actors (Virkkala, Mäenpää and Mariussen, 2017).

Connectivity among actors and, actors and variables in the regional entrepreneurial ecosystems is perceived in the IN model as a key driver to create conditions for the network dynamism of SMEs**.** What differentiates the IN model from the Triple Helix, Uppsala and Connectivity models is that it is based on the connectivity among network actors and their necessity to interact between them through external knowledge within the regional interconnected systems.

Indeed in the IN model, unlike the other three models, the external knowledge which is represented by technology transfer, innovation strategy and networks are key variables because:

- *Technology transfer* promotes a range of activities that involve researchers, entrepreneurs and technology transfer specialists. These activities include (1) identifying innovative technologies from numerous sources; (2) selecting and prioritizing technologies; and (3) determining, developing, and applying effective technology transfer methods.

- *Innovation strategy* refers to the creation process: how does SMEs create. Innovation must be a fluid process inside any organization. An innovation strategy encompasses a repetitive or iterative process to create.

- *Networks* foster inter-enterprise linkages as well as collaborative relations with institutions and local governments. Networks formed by SMEs only are termed horizontal, to distinguish them from those where one or more large-scale enterprises are involved which are of the vertical type. Whether horizontal or vertical, networks can be developed within or independently of clusters. Indeed, the main interest lies in the capacity of developing relational environments favourable to SMEs. These environments are the primary source of opportunity, not only in terms of customers but also in terms of suppliers and partnerships. They allow SMEs to combine their strengths and jointly take advantage of market opportunities.

However, we should supervise the use of the model since connectivity between actors in the IN model doesn't always increase their innovative performance and should even harm it: if two actors have an identical knowledge domain, the space between them is brief and their collaboration won't increase innovation performance since new ideas and a few recombinations are central to innovation; instead, the collaboration might produce to lock-ins. An intermediate level of differences in external knowledge bases is required for innovative cooperation.

Moreover, the strength of social connectivity between two actors can vary (Granovetter, 1973). Strong connectivity between the two actors is going to be redundant since other actors also will be tied to them. Weak connectivity is important since they will connect different social groups and function bridges.

An optimal balance of socially connection and socially distant relations is required. Generally, the potential of the relation depends on optimal levels of connectivity, and a balance between local and non-local links. An innovative regional ecosystem should be locally embedded, but at an equivalent time oriented towards a wider market to realize access to the international ecosystem. In the first step of the regional innovation ecosystems development, it develops a 'knowledge space', where knowledge institutions begin to concentrate certain RandD activities associated with the regional ecosystem, with some networks emerging around them. Within the second phase, the regional ecosystem develops a 'consensus space' where the actors begin to work together to get new strategies. Within the third phase, the regional ecosystem develops an 'innovation space', during which new organizational mechanisms are developed or introduced to understand strategies developed within the previous step.

4.3.2.1 Areas of the IN model development and enforcement

There are many areas where the IN model can be developed and enforced related to the potential benefits for actors which can help reduce costs for exploring and testing new innovative process and products, in ways that were previously unexplored due to not having access to technology transfer knowledge, innovation strategy and networks from different fields. This means that the interactions between actors help them to go beyond the actors' field of operation and achieve better innovations in terms of a wider range of knowledge, generated by the entrance in the special networks before at regional level and later at the international one.

Therefore, understanding the underlying role of individual actors in the IN model is important to better not needed to capture the different types of roles actors can have. As the main actor, the IN model focus lies on a selected SMEs ability and dedication to uphold and maintain a kind of connectivity with other actors (Governments and HEIs or PRIs). SMEs are the most focused and therefore the main driver of the IN model the maximum amount of time, resources and efforts are put into maintaining the steadiness of an ecosystem at different level (Eaton et. al, 2011). Hence, the general usefulness, also as the survival of the IN model depends on one single actor to fuel the participation of other actors (Bengtsson and Ågerfalk, 2011).

Furthermore, all participants within the IN model believe to succeed in the goals within the ecosystems which make SMEs the dominant factor. If most actor cannot convince other participating actors of the usefulness to be part active of the IN model, instability will presumably occur and therefore the prosperity of their connectivity is at stake (Bengtsson and Ågerfalk, 2011). Thus, main actors do have a chance to steer the direction and therefore the flow of resources and knowledge through technology transfer and networking capacity, ultimately resulting in the most actors' ability to choose the kinds of innovation strategy created (Perks and Jeffrey, 2006).

A potential barrier for the main firms is related to having too strong connectivity to the participating actors within the regional ecosystem. As Capaldo (2007) argues, having strong connectivity often indicate a strong yet small ecosystem and as a result, diversity often does not exist. An implication of lack of diversity makes the regional ecosystems tied and locked in on certain knowledge and technology and hence not aware of different angles from others outside the IN model. Thus, the power of collaboration with other organizations (government and universities) is therefore not fully exploited, since strong connectivity often make the ecosystem homogeneous and the actors cannot fully be explorative (Capaldo, 2007).

Even though strong connectivity yields more benefits for the focal firms, a dual network consisting of having both strong connectivity to few organizations and weak connectivity to many will allow the focal firm to fully exploit the regional ecosystems. Thus, main firms need to handle diversity to be fully innovative and managing strong and weak connectivity is, therefore, something that needs to be present when developing an innovation network strategy.

Another stream of research in the IN model is regarding the role that the variables (technology transfer-innovation strategy-networks) have. Variables are another concept explaining how the IN model can be viewed as profitable for the actors and especially for SMEs. These variables are positioned at the periphery of the IN model, compared to the actors who usually can be located at the centre. This means that the IN model is not dependent on variables in terms of sustainability and the survival of the ecosystem. This also means that variables generally do not generate strong long-term relationships and SMEs hence do not invest lots of resources and time in one network, instead focus lies on the extension. Thus, a benefit for SMEs is that engagement in many networks can be established and therefore extending the potential resources gained from these networks to fuel the innovativeness of the ecosystem (Selander et. al, 2013).

In this regard technology transfer may be a crucial instrument for the external acquisition of technological knowledge, resulting in a stimulating increase within the number of technology transfer agreements between different actors. This pushes the emergence of complex innovation strategies that develop in response to changes within the regional ecosystems. The actors became able to achieve sustainable competitive advantage as they allow members to understand access to critical resources beyond the boundaries of their assets.

Thus, actors performance are often related not only to their internal knowledge and their intangible assets but also to the results of networking that increase the opportunities of technology transfer across borders, with networks emerging as tools that enable members to foster their innovation strategies and spread knowledge beyond expectations.

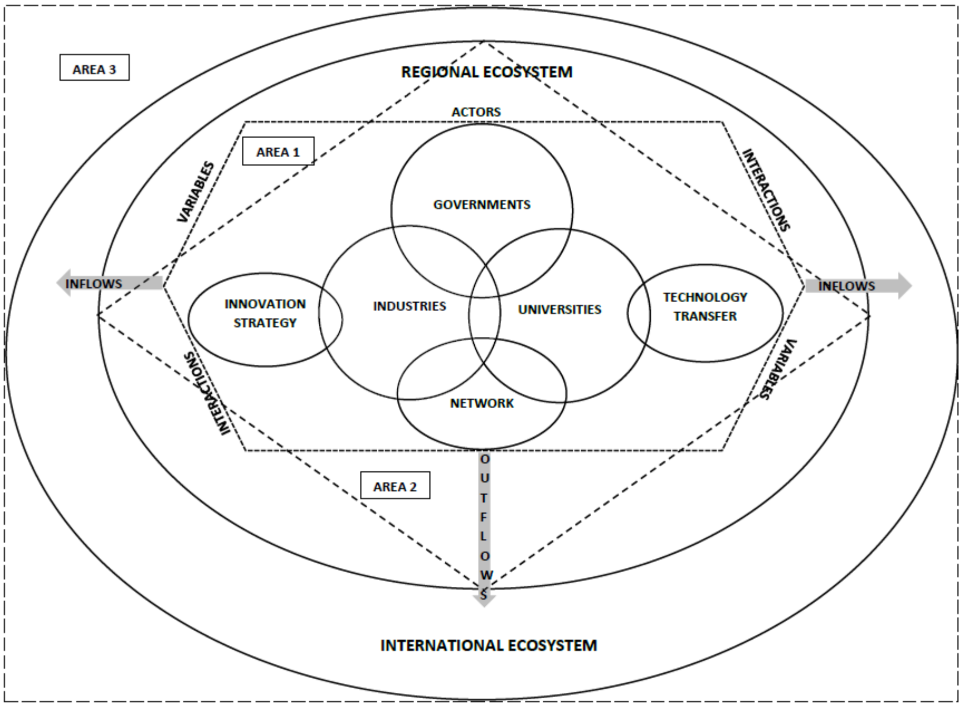
The fact that technology transfer enables emerging of networks permits to think about as attractive a regional ecosystem during which the innovation is generated in various sectors, also as being characterized by a recurring exchange of interactions among members that maintain residual control of their resources periodically, and jointly, make decisions regarding their use. Within these regional ecosystems, innovation isn't seen because of the product of one member, but the result of the interplay between several partners participating during a self-organizing process during which order emerges thanks to the interactions between actors.

4.3.3 The IN model relation to networking capacity and SMEs internationalization

Networking capacity and internationalization analysis of SMEs are the main elements of the IN model**.** The IN model shows how the networking capacity can influence the access of SMEs to the international systems which then have an impact on connectivity between actors and variables and vice versa. One of the main results of these emerging networks in the IN model is that an increasing number of SMEs start to develop the networking capacity and to connect to other actors across Europe for cross-border business cooperation, technology and knowledge transfer and innovation partnerships. SMEs acquires, develops and uses technology knowledge from one country to another entering the international ecosystems and starting to develop the capacity to internationalize internal processes.

As illustrates in Figure 24, the IN model shows that the six major drivers are interacting with one another in Area 1 where lies the international ecosystem and is divided into three *areas*. Firstly, the interactions are shown between the three actors and three variables also called indicators. As a result of *interactions*, the SMEs are assisted in networking creation within regional ecosystems (Area 2). The connectivity between six drivers provide benefits such as market knowledge, market access, trust etc. As a result of these benefits, the network capacity assists SMEs in Area 3 of internationalization.

Figure.24 Networking capacity and SMEs internationalization



Source: own compilation.

Within the IN model, the continuous connectivity between *actors* and *actors* and *variables* are useful for SMEs by better aligning their entrepreneurial innovation propositions with their stakeholder relationships to value co-creation. When both are at a high level, the relation can be seen as strong, indicating a good solution in terms of access to international markets.

Effective co-creation is perceived as even more efficient in the local ecosystems if the SMEs are open to both *inflows* and *outflows* of knowledge. When both actors and variables connectivity is low, the relationship is weak. When actors' connectivity is high and variables low, there is a development challenge that should raise concerns for international process planners. A high level of connectivity is central in the relationship with all drivers: it is what creates link and synergy in the regional entrepreneurial systems.

Connectivity is essential at all stages of the entrepreneurial process, such as generating an innovative idea, communicating it to other parties, materializing it in a successful profitable business and organizing a team. These actors and variables are interlinked to generate local SMEs development within regional ecosystems. A strong relationship might result in closer proximity between the drivers, which again might mean more interaction and a deeper relationship. Moreover, evidence from focus group discussions shows that networking capacity and joint action are more intensely when SMEs operate in a regime of connectivity and share business interests such as markets for products, infrastructure needs or challenging external competition. Within such groups or clusters, SMEs' joint initiatives are stronger, because of the critical mass of interested actors, more cost-effective due to shared fixed costs and easier to coordinate, with connectivity fostering mutual knowledge and trust.

In the IN model, SMEs networking capacity establishes themselves as important and dynamic players within the international systems responding to global competition challenges by capitalizing on local opportunities and collective competitive advantage. Internationalization occurs when SMEs are able to reach a foreign market. Exporting, the presence of foreign subsidiaries, share ownership, franchising, licensing including internationalization. Internationalization is the main dimension of the development of a firm (Peng and Delios, 2006) that encourages SMEs to operate across national borders and compete with other foreign enterprises (Barkema et al., 2002).

4.4 The IN model in practice: Clust-ER Health (Italy) and Aragón Health Cluster (Spain)

Cluster organisations are legal entities that support the fortifying of collaboration, networking and learning in innovation clusters. They act as innovation suppliers by providing specialised and customised business support services and facilitating strategic partnership across clusters to stimulate innovation activities, particularly in SMEs.

"Clusters should be considered as regional ecosystems of related industries and competencies featuring a broad array of inter-industry interdependencies" (Delgado, Porter and Stern, 2013). They are defined as groups of firms, related economic entertainers, and institutions (e.g.HEIs or PRIs) that are located near each other and have reached a sufficient scale to develop specialised expertise, services, resources, suppliers and skills (European Commission, 2016). Cluster initiatives are viewed as a new ecosystem that has opened the path for innovative bottom-up industrial approach strategies and has set up a favourable business environment for SMEs. This thus implies more than merely supporting networking activities and setting up cluster organisations that manage networking and provide support services to SMEs.

This thesis attempts to explore the empirical applications of the IN Model to point out common features that characterize Clust-ER Health and Aragón Health Cluster in health and life sciences sectors. Both clusters are a good example of how the IN model can be applied since SMEs are the true backbone of their regional economies, but due to the lack of dimension, they cannot face the global challenges alone. In both cases appear that cooperation is a must for SMEs to succeed.

Clusters are devoted to facilitate such cooperation and help to develop and agglomerate specific knowledge and skills and attract investments and talent to the territory. Cluster organisations provide business intelligence, initiate workgroups, help SMEs identify common challenges in the fields of

Innovation, Technology, R&D and Internationalisation and help SMEs to define common goals and implement projects at the European level in cooperation with HEIs and PRIs[50]. Due to the multiplier effect of cluster

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[50]Examples:

1. **PARTNER-ERN-PAEDCAN Partner: Paediatric Rare Tumours Network** (www.raretumors-children.eu) is a 48 months 3rd Health Programme funded project running from January 2018 to December 2021. The project is a collaboration between 6 HEIs and PRIs from Italy, Austria, Germany, France and Poland and 23 collaborating stakeholders from 19 EU and 2 extra-EU countries.PARTNER focuses on the creation of a Paediatric Rare Tumour European Registry dedicated to children and adolescents with VRT (Very Rare Tumours) linking the existing national registries and providing a registry for those countries not already having a registry for VRT in place. This project is under the umbrela on an European Union Initiative called *European Reference Network on Paediatric Oncology - ERN Paedcan* (www.paedcan.ern-net.eu) that make national health systems cooperate in the interest of patients reducing inequalities in childhood cancer survival by providing high-quality, accessible and cost-effective cross-border healthcare to children and adolescents with cancer, regardless to where they live. DataRiver Srl is the external IT provider and it is responsible for the implemation of this European Registry. DataRiver Srl is an Italian innovative SME accredited as an Industrial Research Lab of the High Technology Network of the Emilia-Romagna Region (Italy). Founded in 2009 as a Spin-Off of the University of Modena and Reggio Emilia, the company develops innovative software solutions in the fields of Big Data Integration & Analytics, IoT, Industry 4.0, Artificial Intelligence and Machine Learning, Semantic Search. DataRiver's mission is enabling companies and research centers to easily understand their data, through a clear and unified view of internal and external information sources. Big Data analysis allows companies and research centers to learn from experience and optimize decision-making, production and prediction processes. DataRiver is Associate Member of the European Big Data Value Association,and is also a technology provider of the Industry 4.0 Competence Center BI-REX (Big Data Innovation & Research EXcellence). Furthermore, DataRiver is one of the founding partners of Clust-ER–Health of the Emilia-Romagna Region.
2. **GENOMED4ALL-Genomics and Personalized Medicine for all though Artificial Intelligence in Haematological Diseases** (www.genomed4all.eu) gather 23 organizations from 8 EU countries. It will build a large-scale distributed repository of -omics health data across Europe, including: Electronic Health Record, PET, MRI and CT, Next Generation Sequencing, Microarray, Genome-Wide Association, Copy Number Variations, DNA and RNA sequencing. This scheme will enable the aggregation of a high number of repositories that are currently dispersed and non-homogenised while respecting the patient's rights. GENOMED4ALL will make use of the existing infrastructures and initiatives, including powerful High Performance Computing facilities, hospital registries, data processing tools, and pre-existing repositories, starting from 10 clinical partners repositories to be enlarged especially by the resources provided by *ERN-EuroBloodNet-ERN in Rare Hematological Diseases (RHD)* (www.eurobloodnet.eu) where GENOMED4ALL clinical partners have a leading position, which contain 66 relevant clinical sites providing repositories and knowledge, for the successful exploitation of genomics, clinical and other related "-omics" data to facilitate personalised medicine in common, rare and ultrarare haematological diseases to demonstrate the versatility and utility of the

activity, there is a need to overcome the traditional sectorial vision to build up new cross-cluster value chains to enter new emerging high growth domains according to regional smart specialisation strategies (RIS3) is strategic.

4.4.1 Clust-ER Health (Italy)

Emilia-Romagna is one of the northern regions in Italy with about 4.4 million inhabitants. It has a vibrant industrial sector, exemplified by the regional health system in and around the regional capital Bologna. Over 53% of the value of industrial production was exported in 2019, and Emilia-Romagna has been considered the richest European regions with the third-highest GDP per capita thanks to its innovative and very well-balanced economic system. The regional economy is more geared to export markets than other Italian regions: the main exports are from mechanical engineering (53%), the extraction of non-metallic minerals (13%) and the clothing industry (10%).

The innovation system of this region is characterized by the efficiency of the health system thanks to the quality of the universities and, a strong and mature industrial sector which boasts the most important biomedical district in Europe. For this reason, the regional authority considers the health and wellness of Emilia-Romagna one of the key sectors for the development of innovation policies.

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solutions, and 20 external of this network. CINECA is one of the partner of this consortium among HEIs and SMEs. With an excellent IT infrastructure and highly qualified personnel, CINECA allows the research world to successfully tackle frontier scientific challenges. In the context of CLUST-ER Health, CINECA operates in the creation of services in the particular context of Scientific and Biomedical Research. CINECA, for example, contributes with experiences, skills, SaaS information systems and technological infrastructures relating to: a) Big Data in Healthcare to support health governance, epidemiological research and clinical continuity of care, based on the integration of health and socio-health services data; b) Clinical Research to support all projects for the management and execution of research in the health sector (e.g. Clinical Trial, pharmaco-epidemiological registers, teleconsultation systems for diagnosis, etc.); c) E-Health to support dematerialization projects (FSE, CUP, Digitai Hospital) and virtualization of complex hospital systems with a view to "patient centered" and the correct production of dematerialized data.

In Emilia-Romagna, a policy model was developed according to this vision around 7 Clust-ERs which work to support the competitiveness of the main production sectors of this region. In the Clust-ERs, the research laboratories and innovation centres of the High Technology Network are integrated with the business system and those of higher education to multiply opportunities and develop high-impact strategic planning regionally. Clust-ERs are key players in the regional innovation ecosystem and they are coordinated by ASTER which is the regional consortium for innovation and technology transfer. In collaboration with local SMEs, the Technopoles, the Laboratories of the High Technology Network, the Innovation Centers and the Training System, contribute to the development of the regional ecosystem.

Clust-ER Health is one of the seven clusters. This cluster was established in 2017 and it brings together 80 members (23 SMEs; 13 LE; 25 among research organisations, universities and technology centres; 16 ecosystem actors) all dislocated in the regional ecosystem. The main actors (Government-University-Businesses) of the IN Model have well represented in this cluster as well as the main variables (technology transfer, innovation and networking strategies). After having to analyse these main drivers, the degree of connectivity between actors and actors and variables looks pretty good as well as the level of innovation in the regional ecosystem because the members have developed network links and extended their cooperation outside the regional ecosystem giving to SMEs the possibility to grow at the international level.

Clust-ER Health covers 4 different Value Chains in the health and life sciences sectors and ensures continuous industrial innovation, through shared projects between companies, research laboratories, healthcare systems to improve their competitiveness. The regional authority has identified in this cluster a key player in the regional innovation ecosystem capable of multiplying the opportunities for territorial development through the collaborative and participatory approach of its members. According to the international strategy, Clust-ER Health promotes cooperation and collaboration among its members in the most important scientific and economic events of international importance in the pharmaceutical, biomedical, biotechnology, life sciences and wellness sectors.

Clust-ER Health has the objective of enhancing the competitiveness of SMEs through building capacity and capability in the main drivers of business growth – innovation, internationalisation, leadership/ entrepreneurship and access to finance. In the Emilia Romagna region of Italy, these priorities reflect infrastructure gaps because of a dispersed business base. The region has many small businesses that cannot grow to scale, collaborate and improve their competitiveness. These are barriers to growth.

This cluster tries to achieve a better understanding of how to develop networking and internationalization capacity, focusing the investment on those sector and subsector opportunities that enable its businesses to integrate into internationally competitive supply chains. The investment priorities are: a) "Promoting business investment in R&I developing synergies between enterprises, HEIs and PRIs and, governments; b) Promoting investment in product and service development, technology transfer, clusters and innovation strategy through RIS3 among others and c) Supporting SMEs to grow in regional, national and international markets and to engage in innovation processes.

4.4.2 Aragón Health Cluster (Spain)

Aragón Health Cluster is the health cluster in the region of Aragon (Spain). The cluster was established in 2007 with the main objective to contribute to the improvement of competitiveness of the health sector in the regional ecosystem of Aragona to face the internationalization of its members.

37 members in the field of health (21 SMEs; 7 LE; 6 among research organisations, universities and technology centres; 3 ecosystem actors) compose Aragón Health Cluster. Most of them are companies (and particularly, SMEs), and some of them develop activities that are related to the biotech sector. This cluster promotes the collaboration between SMEs and

RandD and knowledge centres, with the support of local public administrations. The activity of Aragón Health Cluster is divided into four fields:

- *Innovation.* Aragón Health Cluster supports the development of RandD+i projects between its members, and it tries to help SMEs to identify and get funds to solve their financial needs, which is a critical issue for the development of this kind of projects.
- *Networking.* Aragón Health Cluster helps its members to contact each other and develop potential business opportunities.
- *Training and Education.* Aragón Health Cluster organises courses to solve the particular needs of its members, and helps to contact companies with education providers (Universities, business schools, etc.).
- *Internationalization.* In the same way, Aragón Health Cluster identifies the needs of business development in foreign markets (non-EU) and tries to organize direct or reverse international campaigns to help its companies to contact clients or investors around the world.

Aragón Health Cluster eliminates the barriers to entry to the markets, thus providing its members with the promotion of knowledge, networking and the business by carrying out different actions based on different strategic axes.

Also, the Aragón Health Cluster can be applied to the IN Model. Indeed this cluster supports R&D collaborative activities as part of the innovation strategy plan. The cluster is a tool to be implemented, in continuity with the previous policy cycle, to facilitate, among the companies that generate and share knowledge, industrial research, pre-competitive development and experimental new technologies, products and services. It stimulus for SMEs innovative activity, encouraging interaction with HEIs and PRIs, the common use of facilities and exchange of knowledge and experience, as well as contribute to technology transfer. The report "Lessons Learned", elaborated by the Regional Evaluation Team highlighted the importance of building high-quality networks and partnerships, so that will be improved the rationalisation and diversification of activities and projects in this Cluster should be also improved, supporting the activities of the managers to stimulate the preparation of research projects and the demand for services for innovation of the members to the clusters for internationalization purposes.

4.4.3 Discussion on roles and success factors of Clus-ER Health and Aragón Health Custer

Even though all two Clusters focus mainly on supporting SMEs, there are differences in mode of interaction with other actors in the regional ecosystems. The Italian Clust-ER Health promotes the integration with the healthcare system involving SMEs within the regional innovation ecosystem and supporting the internationalization of production systems. Aragón Health Cluster has as a priority the definition of technology roadmaps and the promotion of a high impact strategic planning, capable of supporting the competitiveness of the Aragonese regional ecosystem.

Interestingly, the intermediary role, especially for its industrial members, at the international level of all two clusters is increasingly significant. Both have been trying to be nodes facilitating network building to help SMEs in various forms especially RandD consortium and geographical clusters linking SMEs with experts and universities at a regional level. Particularly, Clust-ER Health is an integral part of the regional innovation ecosystem of Emilia-Romagna (Italy) alongside universities and industry research labs. Aragón Health Cluster deals with internationalization improving the innovation of its enterprises and the general conditions of the sector in the Aragón regional ecosystem.

Success factors of clusters is a big concern among policymakers. Clust-ER Health and Aragón Health Cluster monitor its success in terms of the technology transfer, innovation strategy and networking activities. However, inputs from the industry on management and governance of clusters are necessary to shape the overall strategic direction of them as well as of those of Universities with its research programs to be more relevant to industrial needs.

What is also important is the relationship with regional authorities, as these clusters focus on helping SMEs.

Both Clusters develop the strategic and programmatic lines for providing practical support to both business and technology support to companies, investors and scientific institutes i. e. integration of business-enhancing tasks with business service (inventory management), business development, start-up support. They organize sector-related working groups and workshops and initiate technology transfer and collaborative projects at different levels of complexity (regional, national and international level). Also, they support the actors in the development of projects (consortium building, themes sharpening, milestone/budget planning). In this way, both clusters present a relationship with the IN model since they serve as a mechanism for participating actors to work together in partnership to harmonize efforts and use available resources efficiently within the framework of agreed objectives, priorities and strategies. Moreover, they provide a framework for effective partnerships among health actors and ensures that health responses are appropriately aligned with national structures. Additionally, enables cluster partners, especially SMEs, to be more effective by working together, in a coalition, than they could individually, and to maximize the benefit for the target population of the cluster partners' inputs and efforts at the national and international level creating the condition to enhance the networking and internationalization capacity of SMEs.

Finally, both clusters are part of the process of the Intelligent Specialization Strategy (S3), the so-called third-generation regional innovation strategy which has been used by the European Union as one of the foundations of its cohesion and innovation policy "to ensure the continuous transformation of productive structures through research and innovation, a transformation that concerns the entire regional economy" (Virkkala, Mäenpää and Mariussen, 2017) and aims to the internationalization of SMEs through different paths.

4.5 Conclusions

The main conclusions we can extract from the analysis we have implemented in this Chapter are the following:

a) SMEs are very important players in contemporary economies. They are dynamic, flexible and adapt quite easily to changing economic conditions.

b) The contribution of SMEs to innovation has expanded. SMEs innovation is the result of collaborative and synergistic efforts wherein organizations interact and exchange knowledge and information with different partners as part of broader innovation frameworks.

c) Technology transfer and innovation strategy are recognized as essential elements for SMEs' objectives achievement ensuring growth, sustainability and competitiveness. They are completely broad concepts and involve many distinct stakeholders varying from governments and scientists to business executives, advertising and marketing experts and consumers.

d) Even though SMEs are a key element of the chain that transforms knowledge management into new products, processes, and services, faced with increasing competition on the internal and global markets they need to increase their knowledge and research intensity, improve the way they exploit the results of research, expand their business activities to larger markets and internationalize their knowledge networks.

e) The competitiveness of SMEs must be increased by funding research and development activities in cooperation with public and private performers of research (High Education Institutions (HEIs), Public Research Institutions (PRIs), governments, technology institutes and industry.

f) There has been a growing number of technology transfer and innovation strategy studies, with the development of many kinds of theories and models, typologies and taxonomies, forming different relationships between these concepts.

g) Following those studies and theories, in this Chapter, we have developed a model, the Innovation Network Model, for innovation and internationalization of SMEs. The IN model summarizes the contributions of the Triple Helix, Uppsala and Connectivity models to make them work together.

h) Our approach to analysing SMEs internationalization is to use the network as the starting point since it provides an appropriate framework for understanding SMEs as embedded actors in business networks. The IN model wants to emphasize that businesses should search for their competitive advantage by the implementation of the internationalization, Europeanization and even globalization strategy. Entries on foreign markets can improve their position on the market. It is because a firm is getting access to international competence and resources technologies, know-how and business relations.

i) The different phases of the IN model can be described by utilizing the four principles behind the Cluster policy of the European Union. Those principles are location, linkages, related industries and critical mass.

j) What differentiates the IN model from the Triple Helix, Uppsala and Connectivity models is that it is based on the connectivity among network actors and their necessity to interact between them through external knowledge within the regional interconnected systems. In the IN model, unlike the other three models, the external knowledge which is represented by technology transfer, innovation strategy and networks are key variables.

k) Moreover, in the IN model, a degree of relations between *actors* (government-industry-university) is required to connect to *variables* (technology transfer-innovation strategy-networks) and to emphasize the increment of entrepreneurial innovation level in the regional interconnected systems. The IN model sees the prioritization process from the functional point of view, as it focuses on the degree of relations and connections in the innovation system such as those of the regional ecosystems

l) In the IN model actors, performance is often related not only to their internal knowledge and their intangible assets but also to the results of networking that increase the opportunities of technology transfer across borders, with networks emerging as tools that enable members to foster their innovation strategies and spread knowledge beyond expectations.

m) The fact that technology transfer enables emerging of networks permits to think about as attractive a regional ecosystem during which the innovation is generated in various sectors, also as being characterized by a recurring exchange of interactions among members that maintain residual control of their resources periodically, and jointly, make decisions regarding their use. Within these regional ecosystems, innovation isn't seen because of the product of one member, but the result of the interplay between several partners participating during a self-organizing process during which order emerges thanks to the interactions between actors.

n) Finally, we should emphasize that the possibilities created for European businesses by the process of political and economic integration in the frame of the European Union, including the Europeanization of business activities, must be fully used. SMEs in comparison to large enterprises are less likely to globalize their activity, but an ongoing process of integration and globalization makes it different. According to the European Commission in 2020 just 44% of

EU-27 SMEs were involved in any international activity. Even though, many SMEs still function in local and domestic markets, the content of the IN model leads to the conclusion that a growing number of them is becoming international and few of them even global.

CHAPTER 5 CONCLUSION

With the main aim to enhance the understanding of internationalization processes of SMEs in the European emerging market context, the major conclusions of this thesis will be summarized in this final chapter to answer the overarching research question: *How the combination of technology transfer and innovation strategy has become a key element for ensuring the development and growth of SMEs enhancing their ability to be part of networks and facilitating their access to international markets?*

Based on the combined role of technology transfer and innovation strategy (T2IS), this thesis aims to investigate how the SMEs' strategic capacity of networking and their internationalization entrepreneurial process are connected to these variables.

Each chapter thus contributes to strengthening the understanding of the SMEs' behaviour and characteristics into regional ecosystems with the aims to develop a model of Innovation Network – IN for SMEs as an instrument of internationalization based on the analysis of secondary data from a series of recent studies and focus group discussions. Indeed, qualitative data processing into quantitative data and data acquisition by focus group discussions, questionnaire and analysis were mixed.

Overall, the key findings suggest a linkage between the firms' innovation strategy and a series of techniques of technology transfer management. Also, knowledge management is significantly associated with the increasing competition on the internal and global markets and increasing of exploiting innovation and research intensity of SMEs. And lastly but not least important, the firms' characteristics and orientation towards innovation also impose some effects on the SMEs' internationalization process.

5.1 Main contributions

Theoretical and practical contributions of this study will now be elaborated on. This study contributes to the ongoing research on improving knowledge and technology transfer and internationalization models, especially in the internationalization of research and innovation of SMEs in the sense of ability to innovate in an international inter and extra EU. In particular, chapter two and three of this thesis contribute to the theoretical background. On one hand, chapter two presents a review of the literature related to Technology Transfer's topic and its connected models and theories to determine a formal definition, to understand their overall landscape and to identify the gaps in the literature. More specifically, we have taken into account three fundamental categories of purpose: exploratory, descriptive and explanatory (Masum and Fernandez, 2008).

- Exploratory: the exploratory research purpose started from the assumptions that very few studies have been completed (Yin, 2003) and developed to understand the phenomenon of interest. For this reason, we have built a preliminary painting to give a comprehensive overview of the matter (Sekaran, 1992). The exploratory studies helped us to formulate hypotheses and suggested feasibility since they "are thus important for obtaining a good grasp of the phenomena of interest and for advancing knowledge through good theory building" (Sekaran, 1992). In this chapter, we have been focused on 'what' questions.

- Descriptive: the descriptive research purpose has been used to explain the relevant aspects of the phenomenon of interest (Sekaran, 1992) of a certain group in organizations. In this chapter, we have also been focused on 'how' and 'who' questions.

- Explanatory: the explanatory research purpose is based on previous theories and knowledge to point out the patterns related to the phenomenon of interest and to answer the research questions (Yin, 2003).

It involved formulating hypotheses and testing them empirically to identify potential relationships between the elements related to the phenomenon of interest. In this chapter, we have been used theory and focused on ‘why’ questions.

On the other hand, chapter three analyse the European Union (EU) innovation policy to support European SMEs concluding they need to increase their knowledge and research intensity, improve the way they exploit the results of research, expand their business activities to larger markets, and internationalize their knowledge networks, faced with increasing competition on the internal and global markets.

Chapter Four is the core of the dissertation. It develops an SME’s innovation and internationalization model, named Innovation Network (IN model), using a methodological approach based on three different models: on one hand, the Triple Helix (Etzkowitz and Leydesdorff, 1995 and 2000) and the Uppsala models (Johanson and Vahlne, 1977) were used to measure the degree of relations between three actors (government-industry-university) and three variables (technology transfer-innovation strategy-networks); on the other hand, the Connectivity model (Virkkala, Mäenpää and Mariussen, 2017) was used to emphasize the increment of entrepreneurial innovation level in the regional interconnected ecosystems. The IN model emphasizes that businesses should search for their competitive advantage by the implementation of the internationalization, Europeanization and even globalization strategy. Entries on foreign markets can improve the position of SMEs on the market. It is because a firm is getting access to international competence and resources technologies, know-how and business relations.

5.1.1 Theoretical and practical contributions

The *theoretical contributions* of this thesis come from addressing how technology transfer, innovation strategy, networking and internationalization process are understood in SMEs international performance. While numerous definitions, theories and models mainly arising from technology transfer, innovation strategy, network and internationalization of SMEs have been developed, in the majority of them some important considerations have not been adequately addressed and therefore encompass criteria suitable for evaluating the technology transfer and innovation strategy as key elements for generating the networking capacity and the access to international markets of SMEs. On the other hand, a gap in the related literature indicated a lack of comprehensive criteria that could be used to assess the role of intangible variables in reinforcing the networking and internationalization capacity of SMEs.

- In order to study SMEs entering emerging markets, the methodological approach applied is based on a conceptual framework of technology transfer theories, internationalization process theories and network theories on internationalization valid and suitable for research on networking capacity and internationalization of SMEs. Still, when it comes to SME internationalization, there appears to be a lack of knowledge since has so far attracted scarce research.

- In addressing this first sub-problem of the thesis, three theoretical concepts were identified as essential features in the internationalization process of SMEs. These are:

    - The concrete collaboration between Governments, Universities and Businesses which

    - facilitate membership in networks or clusters

    - via different channels of external knowledge stimulating SMEs' engagement into international ecosystems.

  These are theoretical extensions made from applying a network approach to the key concepts derived from the conceptual framework chosen for studying SMEs entry into international markets.

1. *The results presented in this study provide evidence of the value that intangible variables have for SMEs.* Intangible variables such as technology transfer and networking capacity and innovation strategy which include the creation and adoption of innovations are considered indispensable for SMEs in building sustainable competitive advantage. This thesis highlights the importance of such intangible variables and also provides evidence of their positive association with SMEs performance in term of the development of networking capacity and access to international markets.

2. *The importance of connectivity between actors and variables as a key theme is illustrated by this study in the IN Model.* The creation and maintenance of networks are expensive and time-consuming. Similarly, the introduction of various forms of innovation through a well-structured strategy and the implementation of business in a specific industrial sector are risky strategies for SMEs. Resource-constrained SMEs with limited administrative resources should therefore restrict their approach by concentrating their innovation activities and thus not over-extend their innovation breadth. On the contrary, SMEs focus on network partnerships in the regional ecosystems that promote innovation breadth which translates into higher performance not only at the national level but also international level.

3. *A major conclusion is that the logic of internationalization of SMEs differs.* This is due to dissimilar regional ecosystems mainly based on the degree of maturity of the markets, degree of internationalization, and the type of firms involved in the processes studied.

4. Firstly, the different degrees of maturity in the regional ecosystems are seen to affect the dissimilarities concerning governments, institutions, relationship with HEIs and PRIs and network structures. Also, there are some general characteristics of the regional ecosystems that provide

sufficient differences, such as the historical development, geographical location and size of the markets (number of inhabitants as well as land area).

5. Secondly, the degree of internationalization of the SMEs was seen to differ in terms of stage of internationalization from the later stages for the Spanish cluster to the early stages of the Italian. The export shares, in general, are high, they do reflect differences in the degree of international experience between the two types of a cluster. Similarly, even if both Italian and Spanish clusters utilize indirect triadic relations, they involve differences in getting international experience. Those clusters accessing host markets through a triad, including a global intermediary, gained more awareness than those indirectly engaged in international business through an intermediary in the home market. The latter also face the challenge of being caught in the pit of indirect exports.

6. Third, in both cases, the type of organizations (e.g. firms and HEIs or PRIs) involved in these processes is small to medium-sized, usually medium-sized.

7. Further, the other contribution of this thesis entails improving the understanding of the internationalization patterns of SMEs entering and taking off thanks to regional ecosystems or clusters. Both SMEs members of the Italian and Spanish clusters seem to have followed an incremental internationalization having accumulated former knowledge from close-by and similar mature markets.

8. Finally, the major contributions of this thesis highlight the driver of the internationalization processes of SMEs which is the high degree of maturity of the market, resulting in characteristics that facilitate or even force SMEs to go global. In term of geographical spread, the Italian and Spanish SMEs members of clusters in their regional ecosystems

entered both similar international markets from start. This approach is in line with the Uppsala assumption of entering close-by similar markets firstly.

The most important *practical contributions* arising from this study are addressed to advise practitioners, especially SME owners and cluster managers. This thesis clarifies through the IN model how the combination of technology transfer and innovation strategy are key elements for improving SMEs performance facilitating their access to international markets.

1. SMEs owners and clusters manager are encouraged to build heterogeneous and strong network relationships to implement different types of innovations. Establishing and maintaining networks can be costly, as time, effort and money are required. Nevertheless, to ensure that such investment networks improve firm performance requires selecting new and scrutinising existing ties to maximise their potential to access international markets.

2. While SME owners are encouraged to introduce various types of performance-enhancing innovation strategy, they are also cautioned not to over-enlarge their ability by innovating too widely through business functions and activities. The belief that each invention is advantageous is false and thus flawed. SMEs owners and cluster managers are advised to limit the number of innovation types they implement within any given year and to strengthen their network with HEIs and PRIs or with other SMEs. The positive performance benefits of moderate levels of access to international ecosystems are observed in the short term (one year), with no evidence of lengthy legs. The performance benefits of moderate levels of access to international ecosystems are also persistent, although decreasing with time, whereas the negative effects of overextended innovation strategy become more pronounced over time.

3. Lastly, moderate levels of networking capacity should be implemented in concert with designing transfer technology around the value theme of novelty, and to a lesser extent, innovation strategy. These value themes describe the overall emphasis or holistic gestalt of the IN model. Networking capacity and innovation strategy as value creation drivers are how SMEs performance benefits derived from the internationalization of SMEs.

5.2 Evaluation of the IN Model

We acknowledge that each EU Member State's regional innovation systems are different in terms of characteristics of actors, their interaction and underlying institutions. It would be difficult and inadvisable to have a wholesale prescription on how to run clusters successfully. Nonetheless, in practice, clusters have tried to learn from each other.

There is also a European Cluster Collaboration platform that organizes annual meetings and training workshops to share experiences among member clusters. From our case studies of two leading clusters from Italy and Spain with a specific mission of supporting the internationalization of SMEs, the authors have drawn the following concluding remarks, theoretical contribution, and policy implications for other clusters in developed countries considering the greatest effect of applying the IN model to those two clusters.

The Hypothesis listed in Chapter 2 permitted us to define a path to our research and restricted the dissertation to specific parameters. The hypothesis testing has provided primary results after executing the IN model. They are the following:

- *Hypothesis 1:* There is a positive relationship between technology transfer, research, industrialization process, and the network.

  Result 1: The analysis regarding clusters' location and objectives which measures the degree of connectivity between actors and variables in the regional innovation ecosystems, provides the relevant information needed for the internationalization process of its members and especially of SMEs. The success stories of Clust-ER Health and Aragón Health Cluster illustrate that to be successful, the roles of clusters should fit the nature and level of development of regional innovation systems where they are operating. *Hypothesis 1 is supported by this study.*

- *Hypothesis 2*: There is a positive relationship between technology transfer and inter-organizational networks. SMEs become part of networks, in which resources, knowledge, and information circulate rapidly and at low cost, and which strongly rely on collaborations and partnerships.

  Result 2: Focus group discussions helped us to understand the bottlenecks in the regional innovation ecosystems. The relationship between clusters and SMEs and non-firm actors, especially, universities became more intense, open, horizontal and longer-term. It is critical for clusters to adopt a more open attitude and to develop capabilities to effectively work with other actors not only in the regional ecosystem. At the same time, it is increasingly important to work with actors beyond national borders and taking into account the potentiality of technology transfer, innovation strategy and networking activities. In this way, clusters can pursue internationalization strategies for their members, especially SMEs, to collaborate with actors in both advanced and catching-up countries in the production of new knowledge and exploiting their existing ones. *Hypothesis 2 is supported by this study.*

- *Hypothesis 3:* There is a positive relationship between technology transfer, inter-firm collaboration and networking in innovation for SMEs. The internal innovation projects lead to greater firm performance than innovation projects with external partners.

  Result 3: The roles of clusters as 'intermediary' are more important to mitigate network failures, or "systemic failures" among SMEs and between SMEs and non-firm actors through mechanisms like RandD consortium and manufacturing extension programs incorporating local

SMEs, experts and universities in different geographical areas. Roles of clusters in educating and training human resources are of critical importance. Collaboration between SMEs, university, and regional authorities in research, European or international projects and training of young entrepreneurs, being carried simultaneously by Clust-ER Health and Aragón Health Cluster, is a good example for other clusters. *Hypothesis 3 is supported by this study.*

- *Hypothesis 4:* There is a positive relationship between the technology transfer and the SMEs' internationalization process because it is an integral part of the overall business strategy of the company and a consequence and extension of general firm strategy.

  Result 4: Beyond general interaction with the industry, the geographical operation of clusters matters significantly and it is linked to the issue of clusters being knowledge hubs of the regional innovation ecosystem. As each geographical area in a region can have different industry specialization, the localization strategy of clusters is necessary. Importantly, the technology transfer and innovation strategy of SMEs with universities and regional authorities as in the cases of Clust-ER Health and Aragón Health Cluster, are a critical factor for networking among the three parties, since it enables face to face-to-face daily interaction. *Hypothesis 4 is supported by this study.*

- *Hypothesis 5:* There is a positive interaction between Governments and SMEs dimension. And they know the importance of the contribution that can be expected from competent cluster organisations supported by a cluster policy.

  Result 5: Governments are important to make sure that clusters are relevant to the industry and at the same time, maintain research standards. They should provide only a broad direction and evaluate clusters based on short-term indicators like funding from the industry and long-term indicators such as contribution on creating new industrial sectors at a regional level. *Hypothesis 5 is supported by this study.*

These outcomes can be seen as useful phases in increasing IN model, which can increase the degree of connectivity between actors and variables. An IN model with structured dialogue between governments, SMEs and Universities is an approach for entrepreneurial discovery because it helps to improve regional innovation ecosystems by presenting the bottlenecks affecting them and by focusing support on the biggest issues.

5.3 Limitations of the IN Model

Limitations of the findings relevant for further improvements of the IN model will now be elaborated on. The *limitations* refer to the type of firm and markets studied, as well as the methodology utilized. This dissertation also considers a range of limitations of the IN Model as an instrument of internationalization for SMEs, many of which provide new directions for study.

First, the sample of the case studies of two leading Italian and Spanish clusters with a specific mission of supporting the internationalization of SMEs is diverse in terms of size, location, sector, objectives and country of origin, which may contribute to a bias in judging their innovation and international strategies.

Second, although most European Member States tend to have comparable national creative programs, the implications of the objectives setting should be taken into account.

Third, other limitations can be related to the generalisability of the variables as they may not apply to all industrial sectors, but it can be argued that the relationship between actors and variables is being analysed in-depth, which helps to get a more focused and accurate set of criteria.

Finally, the study only looks at SMEs, and therefore the full potential of the criteria might not have been exploited. Finally, suggestions for further research will be given in the next section based on alternative approaches of research and suggestions concerning elaborations of extant findings or the present methodology of the thesis.

5.4 Further lines of development of the IN model

Possibilities for *further lines of development* of the IN model in our analysis will now be elaborated on. From the thesis, several findings would be interesting to research further to extend the study we have developed.

The thesis tried to solve the limitations of dynamic relationships by using the proximity approach in TH relations in the regional ecosystems where there are many varying actors and also variables. Some of them might be closer than others on different dimensions of proximity. It would be interesting to investigate the internationalization process of SMEs in different industrial sectors and EU Member States separately.

As previously discussed, the IN Model is a soft and gradual approach of Triple Helix, Uppsala and Connectivity models coordinated in multilevel governance. It makes it possible to direct specialization and priority seeking in a narrow and specific way, which helps the policy process. It can be possibly combined with other approaches.

However, the IN Model has some bottlenecks that can be addressed, especially by creating more specific methods to evaluate the importance of actors and variables involved in the internationalization process of SMEs. For this purpose, we have summarized a list of recommendations through which the IN model can be further improved:

The IN Model was planned for SMEs integrated into regional ecosystems with problems of connectivity with other SMEs and non-firm actors, especially universities. It would be a good idea to categorize SMEs and then study their internationalization process to see if the IN Model can describe and explain the behaviour of those particular groups of SMEs. According to the IN model, new areas and activities can be discovered where perceived gaps might be bridged.

These new activities might be smaller entities than the new business areas (domains) that Foray (2015) emphasizes as a result of entrepreneurial discovery.

Moreover, in the IN model, a degree of relations between actors (government-industry-university) is required to connect to variables (technology transfer-innovation strategy-networks) and to emphasize the increment of entrepreneurial innovation level in the regional interconnected systems. Unlike the Triple Helix, Uppsala and Connectivity models, the IN model sees the prioritization process from the functional point of view, as it focuses on the degree of relations and connections in the innovation system such as those of the regional ecosystems. It shows that by improving the degree of relations between actors in the regional ecosystems and by building connections with specific variables, SMEs improves their networking and internationalization capacity by accessing new regional ecosystems or extra-regional links such as international ecosystems.

Actors performance are often related not only to their internal knowledge and their intangible assets but also to the results of networking that increase the opportunities of technology transfer across borders, with networks emerging as tools that enable members to foster their innovation strategies and spread knowledge beyond expectations.

The fact that technology transfer enables emerging of networks permits to think about as attractive a regional ecosystem during which the innovation is generated in various sectors, also as being characterized by a recurring exchange of interactions among members that maintain residual control of their resources periodically, and jointly, make decisions regarding their use. Within these regional ecosystems, innovation isn't seen because of the product of one member, but the result of the interplay between several partners participating during a self-organizing process during which order emerges thanks to the interactions between actors.

The changing relations between university-industry also indicates a huge move in the relationship far from the older liner model of one-way knowledge transfer which firms are seen as the repository of the knowledge, to an intuitive model of two-way knowledge exchange between the two systems (Cooke and Morgan, 1998) because the two sides contribute to progressing procedures of ability creation, knowledge acquisition and knowledge transfer (Newlands D., 2002). One of the key confirmations of the evolving university-industry relation is the emerging role of the university as a knowledge institution in creating wealth and economy (Gunasekara, 2005; Asheim and Coenen, 2005; Etzkowitz, 2004; Gunasekara, 2004; Newlands D., 2002; Sutz J., 2001; Goddard J., 1994; Goddard J., 1999). The role of the university and industry in regional/local advancement in the field of innovation has likewise been given increasing attention in terms of providing human capital and shaping the social and cultural dimensions of economic development. Effective development in the field of innovation in those knowledge intense sectors progressively require a more noteworthy assortment of information crosswise over various scientific disciplines and functional areas, and the connectedness inside and among them (Liebeskind et. al., 1996; Shan et. al., 1994; Owen-Smith and Powell, 2004).

The role of the university and industry in creating effective technology-based clusters is clear in various high technology regions through the foundation of spin-off firms (Lawton Smith, 2003). The transformational connection/collaboration between university and industry is likewise shown in the reliant relations built up among academia and firms based on common interests. For example, the inspiration driving the university commercial activities (Thursby et. al, 2000) is the expanded readiness of professors to patent their inventions without a move in the sort of research itself or a considerably more crucial change in the type of research to be more commercially oriented. Empirical research demonstrates that not exclusively do university researchers work in participation with industry, but frequently university research produces knowledge or processes that are a spin-off from their institutions or have the privilege sold to private segment companies who at that point develop the technologies.

From the industry point of view, it is contended that the innovation strategies inside the industry have likewise changed with the increasing interest in new knowledge. As Cooper et. al (1995) and Newlands (2002) state, firms are quick to buy the output of academic research for two reasons: first universities contain publicly financed academic researchers, so private expenses are retained at the public expense; second, the university can support the risk of intensely original research which would otherwise impose costs on business if they had to anticipate the burden of failure. Evidence also demonstrates that the profitability of firms having partnerships with universities is higher than those that do not have partnerships. Firms involved in research universities have significant advantages in expanded productivity, benefit, and innovation (Coopers and Lybrand, 1995).

The changing relationships between university-government-industry have additionally prompted a change of the organizational arrangements inside government designed to support innovation, collaboration and consortia in and across industrial sectors and the construction of hybrid organizations to facilitate connections, information exchange and collaborative innovations (Etzkowitz H. and Kemelgor C, 1998; Robertson, 1999; Gray, 1999). The dynamic role of government in creating technology transfer additionally encourages policymakers to comprehend and gain from the elements and bits of knowledge of the expansive scene of innovation, subsequently to grow new policies that address the issues raised during the process of technology transfer (Nauwelaers, 2000; Mytelka and Smith, 2002; Benz and Furst, 2002).

Despite the changes of university-government-industry relations and various numerous examinations of the studies on the external orientation of university has been described by a number analysis (Gulbrandsen and Smeby, 2002; Langberg, 2002; Benneworth, 2001) identifying with the commercialization activities, close examining existing literature demonstrates little evidence on what are the differences between university, government, and industry in developing knowledge-based innovation. Jensen (2002) revealed that even researchers need to get through the traditional limits and step into the new economy, the new roles are challenged during the interactions with TH partners.

Many kinds of research on technology transfer models argue that there are still obvious gaps between theories and practice, especially in the area of less-favoured regions (Morgan, and Nauwelers, 2003) where there have been issues of translating policy intentions of knowledge-based innovation policy into operational practice through fostering collaborative networks between innovation actors (Curds, 2004; Benz and Furst, 2002; Jensen and Trgrdh, 2004). Although the adoption of policy does not guarantee success (Stevens et. al, 1980) and it is too early to make a judgment on the impact of these innovation policies in terms of generating innovation capacities, the successful implementation of the innovation programme needs to consider several perspectives. As Morgan and Nauwelers (2003) point out, the absence of limit concerning participation between centre components of the innovation system is the key issue inside less-developed regions. Such structural weakness argued it tends to be improved through agreement-reaching and cooperation-enrolling instruments to promote the development of innovative linkages and more dynamic networks.

The implementation of innovation needs to consider the dynamic roles and interests of innovation actors engaged in the `overlapping spheres' and `network interfaces' as a result of the transformational relations between university-government-industry (Etzkowitz and Webster, 2000). Managing such complex networks requires collective endeavour and new ways of engagement with a variety of internal and external actors in the innovation process, spreading over the private and public areas (Lam A., 2004). The pre-condition for implementing knowledge-based innovation has been emphasized in TH idea. In this manner, the implementation of the innovation policy needs to consider the historical and political process of the institutional relations inside the areas and identify barriers to creating aggregate activities and interactive networks.

Interactive networking between institutions requires ‘unfreezing’ of the traditional approaches towards its advancement ways and methods of activities to generate paradigm changes for knowledge creation in the areas (Benz and Furst, 2002). Innovation practice through aggregate actors is progressively founded on social skills and expertise in the structure up connections and overseeing expectations of diversified innovation actors. Furthermore, during the process of knowledge-based innovation, a large part of the transfer of knowledge from academia to industry is considered implicit and uncodified and requires the bench-level engagement among academia and firms which are characterized as two communities with different standards and methods of communications (Zucker et. al, 2002). Gibbons et. al (1994) point out that knowledge is constantly implemented through a continuous negotiation and it is not produced unless and until the interests of the different innovation actors are incorporated. Managing expectations and knowledge flows within and across institutional spheres remain a big challenge for the success of implementing innovation policy (Barrett and Fudge, 1981). If scholars are to achieve an understanding of the differentiation between ‘policy promises’ and ‘policy products’, the focus of research should be shifted from designing knowledge-based innovation models or innovation policies towards the analysis of the process of innovation policy implementation, the role of actors involved in creating innovation practice and the processes in which innovation capacities and internationalization of firms are produced (Schofield J., 2001).

Therefore, we recommend further lines of investigation in the IN model conducting quantitative research. In principle, some companies, throughout Europe, should be analysed to generalize our results.

Moreover, our research has focussed on SMEs, however, we think that it can be a theoretical contribution to compare the internationalization process of SMEs to MNEs with the use of IN Model. The results could lead to SMEs growing more rapidly and at a faster pace, both company-wise and internationally. The application of focus group discussions could potentially lead to new technologies cross-fertilization, even unintentionally, when the actors ‘collide’. However, more research is needed on how to combine functional and thematic aspects of the model, such as specific technology or activity that enables the internationalization process of SMEs.

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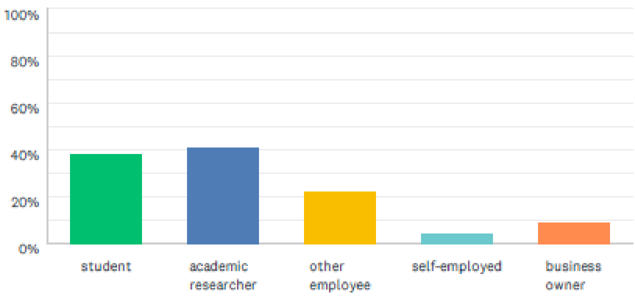
Appendices

Appendix A

Q1 I am a

Answered: 68 Skipped: 0



ANSWER CHOICES	RESPONSES	
student	38.24%	26
academic researcher	41.18%	28
other employee	22.06%	15
self-employed	4.41%	3
business owner	8.82%	6
Total Respondents: 68		

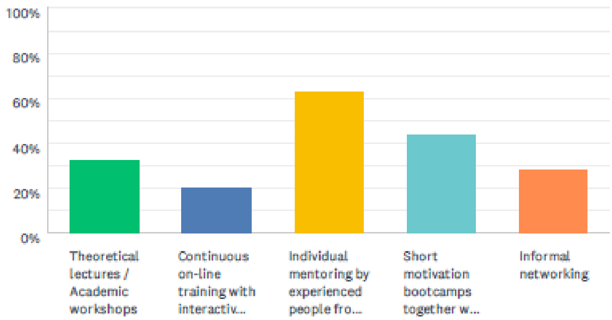
Q2 Please indicate your knowledge and experience level so far about academia-industry relations:

Answered: 68 Skipped: 0

ANSWER CHOICES	RESPONSES	
Never heard about it	11.76%	8
I have read some news articles	30.88%	21
I have attended a specialised training	17.65%	12
Yes, my team is engaged in some projects with business partners	25.00%	17
Yes, I have an extended personal experience as a coordinator/contact point for some academia – industry cooperation	20.59%	14
Total Respondents: 68		

Q3 Which of the following do find most useful for you to extend your knowledge and skills for practical cooperation with industry?

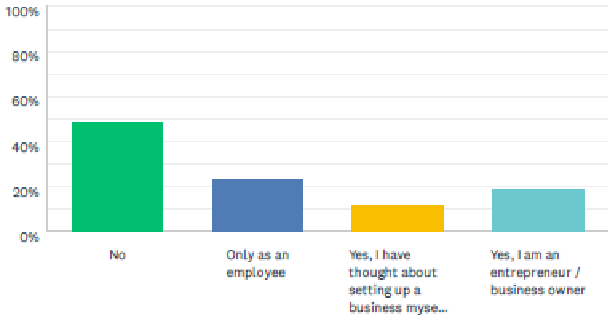
Answered: 68 Skipped: 0



ANSWER CHOICES	RESPONSES	
Theoretical lectures / Academic workshops	32.35%	22
Continuous on-line training with interactive live webinars	20.59%	14
Individual mentoring by experienced people from businesses	63.24%	43
Short motivation bootcamps together with people from businesses	44.12%	30
Informal networking	27.94%	19
Total Respondents: 68		

Q4 Do you have any previous direct personal experience with entrepreneurship / private business?

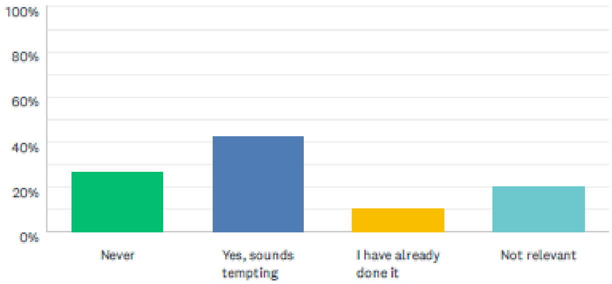
Answered: 68   Skipped: 0



ANSWER CHOICES	RESPONSES	
No	48.53%	33
Only as an employee	23.53%	16
Yes, I have thought about setting up a business myself but never did it	11.76%	8
Yes, I am an entrepreneur / business owner	19.12%	13
Total Respondents: 68		

Q5 Would you consider starting a spin-off company related to your research filed?

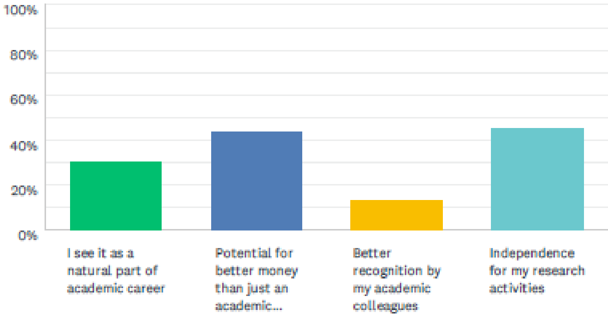
Answered: 68   Skipped: 0



ANSWER CHOICES	RESPONSES	
Never	26.47%	18
Yes, sounds tempting	42.65%	29
I have already done it	10.29%	7
Not relevant	20.59%	14
TOTAL		68

Q6 What would see as the main incentives to support you in potential development of a spin-off company / academic entrepreneurship?

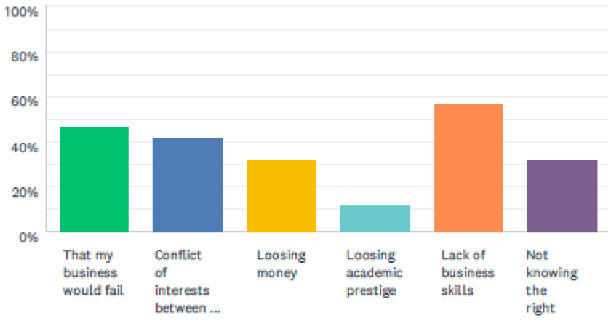
Answered: 66 Skipped: 2



ANSWER CHOICES	RESPONSES	
I see it as a natural part of academic career	30.30%	20
Potential for better money than just an academic researcher	43.94%	29
Better recognition by my academic colleagues	13.64%	9
Independence for my research activities	45.45%	30
Total Respondents: 66		

Q8 What would you personally be most afraid of in potential development of a spin-off company / academic entrepreneurship?

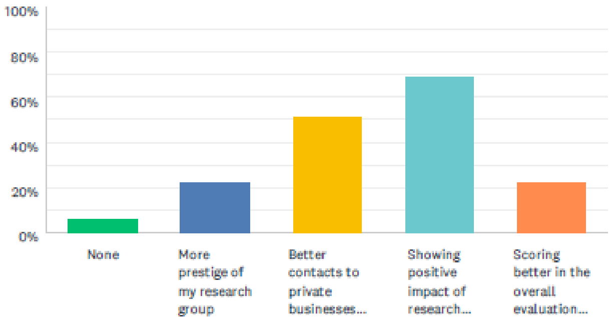
Answered: 67 Skipped: 1



ANSWER CHOICES	RESPONSES	
That my business would fail	46.27%	31
Conflict of interests between my academic career and the business activity	41.79%	28
Loosing money	31.34%	21
Loosing academic prestige	11.94%	8
Lack of business skills	56.72%	38
Not knowing the right people	31.34%	21
Total Respondents: 67		

Q9 Even if you do not have any practical experience so far in development of a spin-off company / academic entrepreneurship what would you see as the main potential benefit for your affiliated academic institution?

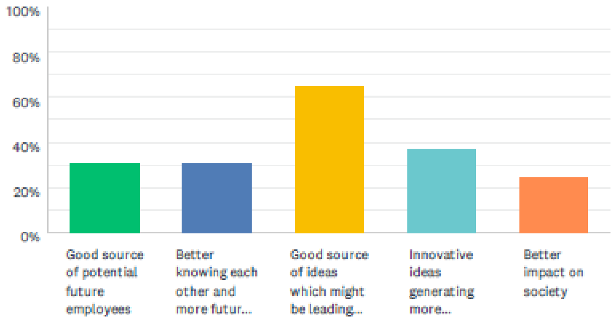
Answered: 68 Skipped: 0



ANSWER CHOICES	RESPONSES	
None	5.88%	4
More prestige of my research group	22.06%	15
Better contacts to private businesses and potentially more connections and collaboration	51.47%	35
Showing positive impact of research results on society	69.12%	47
Scoring better in the overall evaluation of my institution and therefore secured funding	22.06%	15
Total Respondents: 68		

Q10 If you come from business environment – what would you see as the main potential outcome from relationship to an academic institution via specific academia-industry project or a joint venture spin-off company?

Answered: 62 Skipped: 6



ANSWER CHOICES	RESPONSES	
Good source of potential future employees	30.65%	19
Better knowing each other and more future shared projects	30.65%	19
Good source of ideas which might be leading to new innovations and products	64.52%	40
Innovative ideas generating more financial outcomes	37.10%	23
Better impact on society	24.19%	15
Total Respondents: 62		