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Abstract

A key issue in economic geography is to examine the impact of proximity on innovation and technological development. Despite the past "geographical bias" in the explication of innovativeness, nowadays there is the consensus that proximity constitutes of both spatial and non-spatial elements, which are characterized by a substitutive relationship and cannot be assessed in isolation. Owing to the fact that geographical proximity does not represent the necessary and sufficient condition for innovation to take place, it is important to investigate the notion from a deeper perspective by shedding some light on its various dimensions. Here, we examine the role of proximity aspects in innovation, and the extent to which policy and strategy initiatives of the engaged players may contribute to the overcoming of distance-related barriers (in whatever form) for the facilitation of technological development.

Key words: proximity, proximity aspects, innovation, technological development, barriers

Περίληψη

Ένα βασικό θέμα στην Οικονομική Γεωγραφία είναι η εξέταση της επίδρασης της εγγύτητας στην καινοτομία και την τεχνολογική ανάπτυξη. Παρά την «γεωγραφική προκατάληψη» του παρελθόντος στην εξήγηση της καινοτομίας, σήμερα υπάρχει η συναίνεση ότι η εγγύτητα περικλείει χωρικά και μη χωρικά στοιχεία, τα οποία χαρακτηρίζονται από βαθιά σχέση υποκατάστασης και επομένως δεν μπορούν να αξιολογηθούν μεμονωμένα. Λόγω του γεγονότος ότι η γεωγραφική εγγύτητα δεν αποτελεί την ικανή και αναγκαία συνθήκη για την ανάπτυξη της καινοτομίας, κρίνεται σημαντική η διερεύνηση της έννοιας από μια βαθύτερη προοπτική μέσω της αναγνώρισης όλων των πτυχών της. Στην παρούσα εργασία θα εξετάσουμε τον ρόλο που διαδραματίζουν όλες οι πτυχές της εγγύτητας στην καινοτομία, καθώς και τον βαθμό στον οποίο πολιτικές και στρατηγικές πρωτοβουλίες των εμπλεκόμενων φορέων συμβάλλουν στην υπέρβαση των προβλημάτων που σχετίζονται με την απόσταση (σε οποιαδήποτε μορφή) για τη διευκόλυνση της τεχνολογικής ανάπτυξης.

Λέξεις κλειδιά: εγγύτητα, μορφές εγγύτητας, καινοτομία, τεχνολογική ανάπτυξη, φραγμοί

Table of Contents

List of Tables and Figures

CHAPTER 1: **Introduction**

1. INTRODUCTION

The debate on proximity and innovation reflects a complicated issue and has thrived with the nowadays consensus that in a world full of challenges, innovation will crucially contribute to the comparative advantage of firms and regions (Boschma R. , 2005, pp. 61-74). The skepticism about proximity and distance stemmed from the fact that heterogeneous players, which are not evenly contributed in space, should come together through the identification of a mechanism capable of both facilitating their effective communication and ensuring their coordination through trust-based relationships and shared values (Mattes, 2012, pp. 1085-99).

These assumptions brought to the surface the issue of proximity between the engaged players, and highlighted its role in the facilitation of innovativeness and technological development. They also raised questions as the following. Is geographical proximity a prerequisite for learning and innovation to take place? In what way are the different types of proximity associated with each other? Are they substitutes or complements? Which combination of the various proximity aspects is likely to co-exist and facilitate innovation? (Boschma, 2005) (Mattes, 2012).

In Chapter 2 we investigate the issue of proximity and distance in learning, technological development and innovation by providing the basic proximity dimensions according to the literature, and highlighting their significance and interplay. Owing to the fact that the argument "*the more proximity there is between actors, the more they interact, the more they learn and innovate*" (Boschma R. , 2005, p. 62) reflects a misunderstanding, we also present policies for proximity aspects in order to reduce the negative impacts of too much closeness in whatever form. Finally, toward a better understanding of this complex notion and its dimensions, we investigate it from a deeper perspective, that is, by linking it to different knowledge types.

After that we provide a practical illustration of the proximity issue in Chapter 3, through the examination of four case studies that managed to overcome distance in both absolute and relative terms and become global players with future growth potential. Towards this direction the section focuses on the identification of the policy and business initiatives adopted by each case for the overcoming of their initial limitations related to distance, and the strengthening of their innovation capacity.

Chapter 4 provides the comparative analysis of the four cases studies presented in the previous section, targeting on the identification of the common policy and business elements adopted for the reduction of the engaged actors' geographical, cognitive, institutional, organizational and social distance from global markets. Therefore it presents the basic initiatives introduced by each country's government and engaged firms for the overcoming of distance barriers and the facilitation of innovative performance and technological development. This approach finally defines the prerequisites under which proximity may reinforce innovation.

CHAPTER 2: **Proximity and Distance in Learning and Innovation**

2: PROXIMITY AND DISTANCE IN LEARNING AND INNOVATION

2.1 INTRODUCTION

In Chapter 2 we investigate the issue of proximity and distance in learning, technological development and innovation. Towards this direction, this section provides the identification of the basic proximity dimensions (2.2), the debate on the proximity issue (2.3), and the significance (2.4) interplay between the proximity dimensions (2.5). It also presents policies for proximity aspects (2.6) in order to reduce the negative impacts of too much closeness between innovation players. For a better understanding of this complex notion, we also attempt to investigate it from a deeper perspective, that is, by linking it to different knowledge types (2.7).

After studying the relative literature (Edquist & Johnson, 1997, Blanc & Sierra, 1999, Kirat & Lung, 1999, Torre & Gilly, 2000, Zeller, 2004, Boschma, 2005, Moodysson & Jonsson, 2007, Mattes, 2012), this section recognizes the basic proximity aspects, that is, the geographical, cognitive, organizational, social, institutional, relational, temporal, organized, cultural, technological and virtual. However we will focus on the five proximity types provided by Boschma (2005) and Mattes (2012). This selection will be performed for two main reasons. Firstly, according to my view, despite the fact that these authors' perspectives differ in some points, as to the significance of each proximity form on innovation, they basically agree with this fivefold typology. Secondly, these five forms represent an umbrella for all proximity types existing in the literature and, thus, they are capable of capturing the relevant barriers that hinder innovative performance.

2.2 THE DIMENSIONS OF PROXIMITY

2.2.1 GEOGRAPHICAL PROXIMITY

Torret and Gilly (2000) define geographical proximity as "*both the economical, geographical separation of the individual or collective agents…and their position in an economic problem resolution process"* (Torre & Gilly, 2000, p. 180). According to Kirrat and Lung (1999) the concept of geographical proximity reflects the most "intuitive" meaning, indicating "*the positioning of agents within a predetermined spatial framework"* (Kirat & Lung, 1999, p. 29). More specifically they state that:

> This type of proximity must therefore remain distinct from a physical proximity which would represent the outcome of 'natural' constraints in that it is a social

> construction, built as much by the installation and development of transportation and communication infrastructure as by architectural aspects and technical imperatives (Kirat & Lung, 1999, p. 29).

Torre and Rallet (2005) state that the notion expresses *"the kilometric distance that separates two units (e.g. individuals, organizations, towns) in geographical space"* weighted by the cost and time of transport as well as by individual perceptions of distance (Torre & Rallet, 2005, pp 49). Geographical proximity is also restrictively defined by Mattes as the *"co–location of the involved actors"* and by Boschma as *"the spatial or physical distance between economic actors, both in its absolute and relative meaning"* (Boschma R. , 2005, p. 69) (Mattes, 2012, p. 1090). Finally, Moodysson and Jonsson introduce the functional proximity –similar to the category defined as geographical proximity by Boschma- as *"the absolut and relative distance…affected by numerous factors such as mobility and associated with accessibility"* (Moodysson & Jonsson, 2007, p. 118).

2.2.2 COGNITIVE PROXIMITY

Torret and Gilly (2000) point out that cognitive proximity represents:

> Communication between actors, recurrent interactions, which are essential to the establishment of codes and common languages, a process of interpretation and of translation of partial tacit knowledge, and the transformation of this knowledge into operational questions" (Torre & Gilly, 2000, p. 177).

The notion of cognitive proximity concerns the actors' or organizations' knowledge base, absorptive capacity and potential for learning which derive from "*cumulative*" in time through usage "*and localized outcomes of search processes*" (Boschma R. , 2005, pp. 63-64). In order words Boschma states that cognitive proximity is related to "*the capacity of actors or firms to absorb new knowledge…in order to communicate, understand and absorb it successfully*" (Boschma R. , 2005, p. 63). According to Mattes, the capability of actors to *"understand each other, that is, use a common interpretative scheme"* in order to interpret and exploit new knowledge in an efficient way, on the basis of shared experience and common understanding, represents the heart of cognitive proximity (Mattes, 2012, pp. 1088-9).

2.2.3 ORGANIZATIONAL PROXIMITY

Torret and Gilly (2000) point out that this proximity form deals with two different types of logic, that is, adherence and similarity. More specifically:

> According to the adherence logic, the actors close in organizational terms belong to the same space of relations (firms, networks), that is, they are in interactions of various nature…according to the similarity logic, the actors close in organizational terms are quite alike, that is, they have the same reference space and share the same knowledges…and the economical separation and the relations in terms of organization of the production…, that is, they are in interactions (Torre & Gilly, 2000, pp. 177-180).

Blanc and Sierra (1999) state that:

> In order to build up an internal organization, it is required to promote compatibility within a group…by encouraging or imposing connecting principles, i.e. a corporate culture, which will guide not merely choices but the concepts to be used in framing problems (Blanc & Sierra, 1999, p. 196).

Zeller, in turn, in agreement with Blank and Sierra, defines the notion as "*the shared organizational principles, rules, and codes, including a corporate identity and a corporate philosophy*" (Zeller, 2004, p. 88).

According to Boschma organizational proximity reflects:

> The capacity to coordinate the exchange of complementary pieces of knowledge owned by a variety of actors within and between organizations…and includes similarity in which actors are connected by sharing the same reference space and knowledge (Boschma R. , 2005, pp. 64-65).

As a result, the notion is associated to the actors' closeness in organizational terms and refers to *"the set of interdependencies within and between organizations connected by a relationship of either economic or financial dependence/interdependence"* (Kirat & Lung, 1999, p. 30) (Boschma R. , 2005, p. 65). Mattes stresses out that this proximity aspect can be defined as *"the extent to which relations are shared in an organization arrangement…and the participants follow similar organizational logics or even belong to the same company group*" (Mattes, 2012, p. 1089).

2.2.4 SOCIAL PROXIMITY

According to Boschma innovative performance and interactive learning between the engaged innovation players can take place when trust based relationships are involved. As a consequence, he defines social proximity:

> In terms of socially embedded relations between agents in the micro-level. Relations between actors are socially embedded when they involve trust based on friendship, kinship and experience (Boschma R. , 2005, pp. 66-67).

Mattes points out that the notion *"relies on trust…as the result of shared personality characteristics, personal interaction and a sense of familiarity between individual actors"* (Mattes, 2012, p. 1089).

2.2.5 INSTITUTIONAL PROXIMITY

This proximity aspect is defined by Torret and Gilly as the *"adhesion of agents to common space of representation, of patterns, and of rules of thought and action"* (Torre & Gilly, 2000, p. 182). Blanc and Sierra define institutional proximity as the combination of organizational –formal institutions- and relational proximity –informal institutions (Blanc & Sierra, 1999, p. 197).

Zeller (2004) in turn introduces institutional proximity as follows:

> The institutional framework in countries and regions, such as legislative conditions, labor relations, business practices and accounting rules, dominant workplace practices, and the training system, which are all outcomes and elements of the evolution of political power relations that contribute to a cultural affinity (Zeller, 2004, p. 88).

Edquist and Johnson (1997) define institutional proximity as "*the set of common habits, routines, established practices, rules, or laws that regulate the relations and interactions between individuals and groups*" (Edquist & Johnson, 1997, p. 46). Boschma associates institutional proximity with the institutional framework at the macro level, implying that the actors in a socioeconomic system share the same "*institutional rules of the game, a common language, shared habits and a law system*" as well as the same "*cultural habits and values*" which define the scope of their actions (Boschma R. , 2005, pp. 67-68). Mattes in turn, argues that the notion represents *"a complex combination of macro-level factors, that is hard institutional factors like laws and rules…and soft ones, that is, norms, values and routines"* (Mattes, 2012, p. 1089).

2.2.6 RELATIONAL PROXIMITY

According to Blanc and Sierra (1999) the notion accounts for:

> The existence of non-economic relationships among individuals in the form of a common working ethos, a common language and culture, good mutual knowledge, mutual trust, mutually respected norms of behavior…involving the general institutional framework –including norms and codes- that permits individuals and organizations to decode information and ever-changing messages representative of innovation contexts (Blanc & Sierra, 1999, p. 197).

Torret and Gilly mention relational proximity as the dimension that reflects "*the relations between the individuals, that is the social networks,…involving sharply the productive aspects*" (Torre & Gilly, 2000, pp. 181-182). Moodysson and Jonsson introduce the concept of relational proximity as an umbrella encompassing all four of Boschma's non-tangible dimensions (cognitive, organizational, social and institutional) and rather similar to Torre and Gilly's organizational proximity presented above (Moodysson & Jonsson, 2007, p. 117). Towards this direction they state that "*the main rationale for grouping these into one category is that they are all ultimately affected by the same set of basic mediators*" (Moodysson & Jonsson, 2007, p. 117). Finally, Zeller defines relational proximity as "*the informal structures, that is, personal relationships that reinforce or counteract the effects of the formal organization*" (Zeller, 2004, p. 88).

2.2.7 TEMPORAL PROXIMITY

Blanc and Sierra (1999) distinguish this proximity form as:

> The convergence embodied in a shared vision of the future, a convergence of behavior patterns and anticipations which leads the actors to seek a certain complementarity between the individual projects and promotes a mobilization around a collective project (Blanc & Sierra, 1999, pp. 197-8).

2.2.8 ORGANIZED PROXIMITY

Torre and Rallet (2005) present organized proximity as not geographic but relational characterized by:

> The existence of interactions between members, inscribed in the genes (routines) of the organization", "the logic of belonging because interactions are facilitated by (explicit or implicit) rules and routines of behavior" and "the logic of similarity because individuals share the same system of representations (Torre & Rallet, 2005, pp. 49-50).

2.2.9 CULTURAL PROXIMITY

Zeller (2004) defines cultural proximity as interrelated with institutional proximity, expressed by:

> A common cultural background, that is, a common working ethos, a common language and culture, mutual knowledge, mutual trust and mutually respected norms of behavior, which facilitate the understanding of information and the establishment of norms of behavior between innovative actors and researchers (Zeller, 2004, p. 88).

2.2.10 TECHNOLOGICAL PROXIMITY

According to Zeller (2004), this proximity aspect is based on:

> Shared technological experiences, bases, platforms, common standards and interfaces that facilitate shared perceptions, as well as the anticipation of technological developments (Zeller, 2004, p. 88).

2.2.11 VIRTUAL PROXIMITY

The notion refers to this proximity form that "*can be produced by using communication and information technologies to allow real communication to be established*" when spatial, organizational, cultural and relational proximity among members is absent (Zeller, 2004, pp. 88-9).

2.2.12 BEHAVIORAL PROXIMITY

According to Lang (2005) behavioral proximity encompasses what Boschma describes as organizational, social and institutional proximity due to the strong interconnection of these three proximity aspects, and is defined as:

> A set of rules and routines — explicit or implicit — which allow individuals to be coordinated without having to define beforehand how they must do it…and comprises the non-market content of relationships (Lang, 2005, pp. 6-7).

In other words, Lang uses the term behavioral proximity as an umbrella that reflects the "*non-market content of relationships*", motivated by Boschma's statement that organizational, social and institutional types of proximity "may be strongly interconnected, because the ways intra- and inter-organizational relations are governed are deeply embedded in institutional settings" (Lang, 2005) (Boschma, 2005, pp. 61-74).

Table 2.1: Proximity categories presented in this subsection

French School of Proximity Dynamics	Blanc & Sierra (1999)	Torre & Gilly (2000)	Zeller (2004)	Torre &Rallet (2005)	Boschma (2005)	Mattes (2012)
Geographical	Geographical	Geographical	Spatial	Geographical	Geographical	Geographical
Organizational	Organizational	Organizational	Institutional	Organized	Cognitive	Cognitive
	Relational		Cultural		Organizational	Organizational
	Institutional		Organizational		Social	Social
	Temporal		Relational		Institutional	Institutional
			Technological			
			Virtual			

Source: Blanc & Sierra, 1999, Torre & Gilly, 2000, Zeller, 2004, Boschma R. , 2005, Moodysson & Jonsson, 2007, Mattes, 2012, own elaboration

2.3 THE DEBATE ON THE ISSUE OF PROXIMITY

Particularly in the past there has always been a geographical bias in the explanation of innovative activities and proximity was interpreted only in terms of space (Mattes, 2012, pp. 1086-8). Therefore, the emphasis was put on two central issues. The first concerned the spatial scaling of innovation systems and networks, whereas the second focused on the nature and the intensity of the relationships between the players involved in innovative activities (universities and research labs, firms, funding organizations and public/governmental institutions) (Hamdough, 2008, pp. 2-9).

The skepticism about the role of proximity in technological development stemmed from the realization that heterogeneous players, which are not evenly contributed in space, require some certain prerequisites in order to effectively approach, perceive and interpret knowledge (Pavitt, 2005, pp. 87-96) (Mattes, 2012, pp. 1086-7). It was soon highlighted that in order for technological development and innovation to take place, there is the need for the establishment of a certain degree of closeness between the engaged actors both for their effective communication and the overcoming of technological, organizational, institutional and social barriers (Keeble, et al., 1998) (Boschma R. , 2005, pp. 61-2, 71-2) (Mattes, 2012, pp. 1085-90)**.** It also became clear that the role of spatial proximity for the players' effective interactions and collaboration cannot be assessed in isolation as it is rooted in both physical and relative terms including geography, laws, norms, culture, knowledge etc (Howells, 2002, pp. 873-6) (Boschma R. , 2005, pp. 71-2) (Mattes, 2012, pp. 1087-90).

Under a closer examination of the proximity notion, its meaning becomes loose and hazy (Lang, 2005) because learning is a complicated socio-economic process and "*space turns into a relational issue that ceases to be a purely geographical concept*" (Mattes, 2012, p. 1088). The conversion of space from a geographical into a relational issue paved the way for the study of proximity and innovation under a complex perspective and introduced the perception that geographical closeness could not be the only solution to the coordination problem of the innovation actors. Without stating the "death of geography" (Morgan, 2004, pp. 4-5), a complex perspective on proximity is indispensable "*in order to abolish the geographical bias in the explication of innovativeness and instead fully grasp both the spatial and non-spatial dynamics inherent in innovation*" (Mattes, 2012, p. 1086). In other words, the inherent

complexity by which knowledge transfer and innovation are characterized involves a constant deal between various forms of proximity (Mattes, 2012, pp. 1085-7).

These assumptions led to the need for a more analytical exploration of the extent to which different kinds of innovation demand specific knowledge sources and closeness and forced the scientific community to open the black box of proximity and reconsider the relationship between space and innovation (Boschma R. , 2005). Economic geographers embraced the concept of proximity in order to shed some light on the question whether geographical proximity represents the prerequisite for learning and innovation (Gertler, 2003, pp. 83-9) (Boschma, 2005). They initially contributed to the literature by putting emphasis on the many advantages of being co-located. In doing so, they have also pointed out that besides geographical proximity, other dimensions are equally crucial in understanding the processes of innovation and interactive learning (Boschma R. , 2005, pp. 62-3). As a result a variety of other factors entered the innovation game leading to the nowadays consensus that proximity is not merely geographically oriented.

The first critical contribution to the literature on proximity and innovation was made by the French School of Proximity Dynamics in the 1990s, highlighting that it means more than just geography (Torre & Gilly, 2000, pp. 170-180). The School proposed that the notion consists of geographical and organizational elements (Torre & Gilly, 2000, pp. 170-180) (Boschma, 2005, pp. 63) (Moodysson & Jonsson, 2007, pp. 117-118) with each proximity form performing a special role in innovation (Boschma R. , 2005). Geographical proximity reflected the spatial distance between actors in both absolute and relative meaning. According to the School, geographical proximity reinforces learning due to small distances, low costs and less effort and contributes to both the facilitation of knowledge transfer and the adoption of same or similar behavioral rules (Torre & Gilly, 2000, pp. 178-9) (Boschma R. , 2005, p. 63). Organizational proximity was related to the players' closeness in organizational and cognitive terms[1], synonymous with a network of co-ordination and hierarchy, capable of reducing transaction costs and encouraging collaborations (Torre & Gilly, 2000, pp. 178-9) (Boschma R. , 2005, pp. 64-6).

[1]The fact that innovation actors share the same relational and cognitive space highlighted the "*cognitive dimension of organizational forms*" (Boschma R. , 2005, p. 63).

Boschma, (2005) catalytically participated in the debate about proximity and innovation by adopting a critical stand and attempting to "discover" the extent to which proximity leads to good innovative performance. His work relied on the French School's aspects but differs in some respects, as –for analytical reasons- he distinguishes five instead of two proximity dimensions, that is, cognitive, organizational, social, institutional and geographical (Boschma R. , 2005, pp. 63-74). With a few words his aspects can be epitomized in the argument that "*geographical proximity per se is neither a necessary nor a sufficient condition for innovation*" and a balance between proximity and distance must be established, in favor of the actors' performance (Boschma R. , 2005, p. 62). According to Boschma (2005):

> What unites the different dimensions of proximity is that they reduce uncertainty and solve the problem of coordination, and, thus, facilitate interactive learning and innovation. In the literature, more often than not it is argued that the more proximity there is between actors, the more they interact, the more they learn and innovate…Proximity in its different dimensions may also have negative impacts on innovation (Boschma R. , 2005, p. 62).

Mattes (2012), who participated in the issue from a deeper perspective, emphasized that although proximity has often been considered as a spatial and "highly localized phenomenon", its organizational, social, institutional and cognitive characteristics contribute to a better understanding of the innovation process (Mattes, 2012, pp. 1085-90). In agreement with Boschma he provided the same fivefold proximity typology and classified them as strategic, normative, cognitive and supporting (Mattes, 2012, pp. 1085-90). He also embraced Boschma's argument that innovation can occur with no geographical closeness as the contribution of non spatial factors is equally important.

2.4 THE SIGNIFICANCE OF PROXIMITY DIMENSIONS

Geographical proximity

Geographical proximity reflects a complex and difficult issue. Regardless the scale of a system's embeddedness in inter-firm relations (local, regional, national), spatial proximity always mattered in the sense that distance was accompanied by various constraints (linguistic, cultural, institutional etc), while closeness facilitated face to face interactions, the easier transfer of tacit knowledge and timely responses to potential conflicts (Torre & Rallet, 2005, pp. 48-50). However, the role of geographical proximity has been expressly questioned, as collaborations have been

developed at a variety of scales and nowadays it is known that it does not represent a prerequisite for learning and innovation to take place (Malmberg & Maskell, 2002, pp. 442-3) (Jong & Freel, 2010, p. 4). Mattes confirms this argument by stating that geographical proximity reflects a reinforcing dimension rather than a sufficient condition for any knowledge generating activity (Mattes, 2012, pp. 1086-8).

For clarity reasons, Bochma attempted to isolate geographical closeness from the other proximity forms, in order to provide a clear picture of the advantages aroused from co-location. In this case no other proximity types, interactions or coordination mechanisms between the engaged players are involved, and knowledge externalities are regarded as strictly geographically bounded (Boschma R. , 2005, pp. 69-71). The findings indicate that in co-location situations successful actions are directly noticed and the potential benefit of the engaged players increases (due to spatial externalities), as long as the economy provides an "open membership" for each one of them (Antonelli, 2000, pp. 535-6, 540-2) (Malmberg & Maskell, 2002, p. 439) (Boschma R. , 2005, pp. 69-71). Spatial proximity is capable of strengthening informal relationships and face to face interactions, and stimulating the evolution of the institutional framework, contributing both to the emergence of trust-based relationships between parties and the facilitation of codified and tacit knowledge transfer (Howells, 2002, pp. 873-9) (Fritsch & Franke, 2004, pp. 245-55) (Boschma R. , 2005, pp. 69-71).

More specifically, according to Mattes *"the geographical arrangement of activities"* is accompanied by *"a smoother and less complicated interaction"* (Mattes, 2012, p. 1088). Towards this direction, geographical proximity plays an important role in knowledge transfer, and part of the scientific community points out that players sharing the same geographical space are more capable of rapidly reaping the benefits from the emerged knowledge externalities (Torre & Rallet, 2005, p. 51) (Moodysson & Jonsson, 2007, p. 117). As the intensity of these externalities weakens proportionally with distance growth, their spatial concentration facilitates the exchange of information and the transfer of tacit or codified knowledge (Malmberg & Maskell, 2002, pp. 433-9). It is generally believed that regardless the kind of the knowledge transferred, short distances contribute to the creation of a common interpretative language with no cost and no special effort (Boschma & Lambooy, 1999, p. 415) (Malmberg & Maskell, 2002, p. 439). At the same time empirical

studies tend to confirm that "*knowledge externalities are geographically bounded*" and firms located in closeness to knowledge sources perform a better innovative activity (Jaffe et al., 1993, pp. 579, 584-6, 591) (Audretsch & Feldman, 1996, pp. 630-9) (Boschma R. , 2005, p. 69)**.**

Breschi and Lissoni emphasized that in cases of location-specific networks -which are formed and organized by local collective performance- knowledge spillovers will be spatially localized and available to the members of the network (Breschi & Lissoni, 2001, pp. 977-9, 986-7). In this condition, geographical proximity between actors will be necessary. Nevertheless, the fact that social networks may exclude outsiders even if they are local players indicates that geographical closeness is not a prerequisite for learning and innovation (Boschma R. , 2005, pp. 69-71). Consequently, since networks reflect the vehicles for information transmissions and are not necessarily spatially confined, it is misleading to suppose that knowledge is territorially bounded and can be acquired only in cases that players are spatially close (Rallet & Torre, 1999, pp. 373-80) (Boschma R. , 2005, p. 69) (Mattes, 2012, p. 1088).

Cognitive proximity

Under the consideration that knowledge is not a public good -unlike neoclassical economists' beliefs- and cognitive restrictions are responsible for the incapability of innovation actors' optimal action and cooperation, an important dimension is the cognitive one which is indispensable for their mutual understanding and effective communication (Simon, 1955, pp. 99-101) (Boschma R. , 2005, pp. 63-4) (Torre & Rallet, 2005, pp. 49-51). The term of cognitive closeness refers only to individuals, while the respective perspective of the firm can be translated as technological/ industrial proximity (Lang, 2005, pp. 8-10). In other words, the difference between cognitive and technological/ industrial proximity is that the first refers to individuals while the latter to firms, but in any case they both represent the need for a common interpretative language that allows communication and cooperation (Lang, 2005, pp. 8-10).

The variety of knowledge sources for innovation indicates the need for heterogeneous actors and complementary capabilities to be brought together and combine their diversity (Nooteboom, 2006). In other words, the effective exchange of information pieces demands an absorptive capacity in order for the engaged players to be able to

efficiently identify, interpret and make use of the new knowledge (Cohen & Levinthal, 1990, pp. 129-33). As a consequence, there is the need for innovation players to develop a cognitive base "*close enough to the new knowledge in order to understand and process it successfully*" (Boschma & Lambooy, 1999, pp. 423-6) (Boschma R. , 2005, p. 63). Boschma (2005) highlights that:

> With the notion of cognitive proximity, it is meant that people sharing the same knowledge base and expertise (skills) may learn from each other. This is not only a matter of speed and efficiency of the acquisition of information, but also, and even more so, of extending the scope of cognition (Nooteboom, 2000, pp. 15-25) (Boschma R. , 2005, p. 63).

At this point, Mattes reasonably underlines that "*having to people sitting in the same room does not necessarily imply that learning will take place*" (Mattes, 2012, p. 1088). Consequently, the cognitive aspect of learning reflects the very core of the learning process, but except for the building of a common interpretative language, the transfer of knowledge simultaneously requires the intention to co-operate, split and absorb information (Mattes, 2012, pp. 1088-9).

The cognitive dimension is translated as a shared knowledge background which contributes to the successful interpretation of information regardless the diversity of the sources it originates from (Boschma R. , 2005, pp. 63-4) (Jong & Freel, 2010, pp. 4-5). It reflects a common language in cognitive terms which facilitates interactive learning, networking among the engaged actors as well as their capability to learn from each other assisted by common skills and expertise. As it becomes obvious, cognitive proximity among the innovation players assists the understanding and exploitation of new knowledge as it acts as a "*common interpretative scheme*" (Boschma R. , 2005, p. 63) (Mattes, 2012, pp. 1088-9) (Markusen, 1996, pp. 293-313).

Firms, for instance, search for new information which is close to their existing knowledge base (Boschma R. , 2005, pp. 63-4). New knowledge within firms generates unexpectedly and is characterized by uncertainty and opportunism and, thus, the latter adopt routines and search for knowledge which is close to their existing cognitive background for the reduction of these uncertainties (Nelson & Winter, 1982, pp. 50-72) (Boschma R. , 2005, pp. 63-4) (Torre & Rallet, 2005, p. 48). Nevertheless, the "*cumulative, localized and tacit nature of knowledge*" contributes to the differentiation of actors' knowledge base over time, as *"cognitive differences*

often tend to persist as long as the firm-specific competences are difficult to imitate by competitors" (Antonelli, 2000, p. 538) (Boschma R. , 2005, p. 63). Such an attitude may be beneficial for firms in terms of expertise, but may also be detrimental in terms of further improvements, as it may lead to cognitive lock - in and a lack of fresh ideas as it will be analyzed below (Boschma R. , 2005, pp. 63-4).

Organizational proximity

Mattes argues that once the cognitive aspect of proximity is set up, in terms of providing a basis for learning, then, the strategic, control–oriented dimension (organizational) and the normative dimension (institutional) enter the game (Mattes, 2012, p. 1089). Boschma in turn stresses out that although trust-based and hierarchical relationships between actors do not reflect a presupposition for learning, organizational proximity may be beneficial for its stimulation, in the sense that "*organizational arrangements (such as networks) are not only mechanisms that co-ordinate transactions*" but also act as "*vehicles that enable the transfer and exchange of complementary pieces of information*" (Boschma R. , 2004) (Boschma R. , 2005, pp. 64-6).

Although often considered as an issue that includes the cognitive dimension, one can argue that it represents a separate category of proximity's forms (Torre & Gilly, 2000, pp. 10-6) and Boschma points out, that in a world full of uncertainty as far as the exchange of information is concerned, organizational proximity is related to a mechanism that coordinates the transactions of knowledge between heterogeneous actors (Boschma R. , 2005, pp. 64-6). According to him organizational proximity is associated with the network type of economic co-ordination, characterized by trust-based relations among local organizations and is regarded as essential, because it tends to lower transaction costs (Malmberg & Maskell, 2002, p. 439) (Boschma & Lambooy, 2002, p. 291) (Boschma R. , 2004) (Boschma R. , 2005, pp. 64-6).

More specifically, organizational proximity implies the hierarchical ties within a same group or organization, which simultaneously influence their capacity or incapacity to acquire new knowledge, derived from different agents (Hansen, 1999, pp. 82-8, 101-7) (Boschma R. , 2005, p. 65). The involvement of various forms of governance in knowledge transfer, defines to some extent the "*degree of autonomy of exchange partners*" as well as "*the control over knowledge flows*" (Boschma R. , 2005, p. 65),

as the relations shared in an organizational arrangement are connected to and determinant of the actors' autonomy and logic (Mattes, 2012, p. 1089). In this respect a socioeconomic system may go from the one end, i.e. no ties between independent actors, to "*loosely coupled networks*", i.e. weak ties between independent actors, or even to the other end, i.e. embodied strong ties between actors (Grabher & Stark, 1997, p. 538) (Boschma R. , 2005, pp. 64-6).

According to Boschma "*organizational proximity is believed to be beneficial for learning and innovation*", as it is strongly related to the monitoring and control of the exchanged pieces of information (Boschma R. , 2005, p. 65). Therefore, it is control – oriented, as it guarantees ownership rights and rewards for investments in new technological fields, by preventing external actors of accessing specific knowledge (Zeller, 2002, pp. 283-7) (Becker & Knudsen, 2006) (Mattes, 2012, p. 1089). In other words, it represents a common reference space of relations and the extent to which they are shared, contributing to the reduction of knowledge generation's uncertainty and opportunism (Torre & Gilly, 2000, pp. 11-3) (Boschma R. , 2005, pp. 64-6). For all these reasons this proximity form facilitates learning by acting as a strong coordination mechanism, which on the one hand leads to the reduction of uncertainty that goes along with the creation of knowledge and on the other hand contributes to the development of hierarchical relationships between actors (Boschma R. , 2005, pp. 64-6). After all, a mechanism capable of solving coordination problems seems to be more than compelling, so that knowledge exchange among various parties to be both achieved and controlled (Zeller, 2002, pp. 283-7) (Mattes, 2012, p. 1089) (Becker & Knudsen, 2006). Towards this direction, the term "strategic" that Mattes adopted for its description, overemphasizes all the above mentioned positive characteristics of this proximity form.

Social proximity

The notion of social closeness originates from the embeddedness literature, implying that "*economic relations are to some extent always embedded in a social context*" (Boschma R. , 2005, pp. 66-7). Unlike neoclassical economists' beliefs, the literature argues that socially embedded relationships within a firm contribute to the facilitation of interactive learning and innovation suggesting that "*the more socially embedded the relationships of a firm are, the more interactive learning, and the better its (innovative) performance*" (Boschma R. , 2005, p. 66). Social proximity more than

any of the other proximity form relies on trust, reflects the social closeness of the engaged players, and facilitates their ability to learn, absorb external information, interact and innovate within a framework of real interactions and communication (Torre & Gilly, 2000, pp. 12-3) (Boschma R. , 2005, pp. 66-7) (Lang, 2005, p. 9). Social proximity besides contributing to the reduction of transaction costs and the encouragement of cooperation, it also facilitates the exchange of tacit knowledge and the stimulation of interactive learning in an effective way, as Maskell and Malmberg point out (Maskell & Malmberg, 1999, pp. 16-20) (Malmberg & Maskell, 2002, pp. 434, 444).

Given that the existing ties between actors catalytically affect their economic outcomes, this form of proximity can be highly beneficial as the ability for actors to learn and innovate may entail social closeness and trust based relations turn to be a valuable mechanism for the triggering of interactive learning and innovative activity (Boschma R. , 2005, pp. 66-7). Taking under consideration that devoted and long-lasting ties may comprise a necessary condition for interactive learning, Boschma embraces Lundvall's argument that "*social proximity encourages a social and open attitude of communication rationality rather than a pure, calculative and narrow market orientation towards minimizing costs*" (Lundvall, 1993, pp. 52-64) (Boschma R. , 2005, pp. 66-7). Furthermore, due to the creation of trust-based relationships, it offers actors the capability to reduce or even eliminate situations related to opportunistic behaviors, which usually go along with the production of new knowledge (Boschma R. , 2005, pp. 66-7) (Moodysson & Jonsson, 2007, pp. 118-9).

Mattes on the other hand, points out that social closeness between actors represents a reinforcing dimension for collaboration and innovation to take place, in the sense that it is not associated with the fundamental issues of control, laws or cognition (Jong & Freel, 2010, p. 4) (Mattes, 2012, p. 1089). More specifically, Mattes states that this does not imply that the social dimension is less important, but it rather reflects an intermediate factor for innovation or an "*innovation–relevant bonding mechanism*" if accompanied by cognitive, organizational and institutional proximity aspects (Mattes, 2012, p. 1089). He states that this type of proximity results from shared personal characteristics, present or past interactions and friendship or kinship in the micro level, which in turn bring about "*a sense of familiarity*" between actors (Mattes, 2012, p. 1089). In this manner it creates a level of "familiarity" among players, but it does

not focus on the coordination and control of the exchanged information, which according to him represent the very core of the learning and innovation process (Mattes, 2012, p. 1089).

Nevertheless, he comes to the conclusion that such informal relationships may act as "door – openers" and "gatekeepers", capable of providing access to new jobs and links between different actors respectively (Malmberg & Maskell, 2002, pp. 434, 444) (Grabher & Ibert, 2006, pp. 251-4, 264-5) (Breschi & Catalini, 2010, pp. 14-26) (Mattes, 2012, p. 1089). Towards this direction, he highlights that the notion's importance should not be ignored or underestimated, as it strongly contributes to the conversion of space from a physical into a relational and social issue (Mattes, 2012, pp. 1088-90). As a result, the encouragement of communication and cooperation leads to the emergence of well-connected actors, capable of learning from each other and performing a better innovative activity, a fact that implies how powerful social proximity can be (Mattes, 2012, pp. 1089-90).

Institutional proximity

According to Boschma institutional proximity often represents the micro-level social proximity on the macro-level, in the sense that the latter relies upon trust and committed relationships on the micro–level, while the former is related to the institutional framework on the macro–level (Boschma R. , 2005, pp. 67-8) (Jong & Freel, 2010, p. 4). Roughly, institutional proximity is related to coherence with regard to laws and values (Torre & Gilly, 2000, pp. 11-2, 21) (Moodysson & Jonsson, 2007, p. 118) (Mattes, 2012, p. 1089). The notion guarantees the protection of ownership and intellectual property rights and reflects the foundations for economic coordination and interactive learning. Hence, "*a culture of shared trust*" is considered as an important factor that supports the processes of learning and innovation, because cultural proximity and a "*common language*" facilitate the easier knowledge transmission (Antonelli, 2000, p. 539) (Boschma R. , 2005, pp. 67-8). In this perspective Boschma stresses that institutional closeness may reflect an enabling factor for learning and innovative activity, as "*institutions function as a sort of 'glue' for collective action because they reduce uncertainty and lower transaction costs*" (Boschma R. , 2005, pp. 67-8).

In any case, this form of proximity has been distinguished to account for the fact that networking and interactions between the engaged innovation players may be affected, formed or limited by the institutional environment. Mattes, who defines it as the normative aspect of proximity, emphasizes that institutional closeness represents the basis for cooperation and, due to the complex combination of the macro–level factors it consists of, it can either support or hamper learning (Lang, 2005, p. 9) (Mattes, 2012, p. 1089). Thus, it is commonly accepted by the scientific community nowadays that the effective knowledge transfer may be facilitated by institutions, i.e. laws, rules, norms etc. In other words formal and informal institutions, laws and rules on the one hand, and habits and norms on the other, are capable of shaping to a great extent the actors' or organizations' actions (Malmberg & Maskell, 2002, pp. 434-40) (Boschma R. , 2005, pp. 67-8). As it is stated by Gertler (2003) "*we cannot sort out the geography of tacit knowledge without inquiring more systematically into the fundamental nature of "culture" and the institutional underpinnings of economic activity*" (Gertler, 2003, pp. 90-1), or in other words, the significance of geographical co-location is inherent in the "context-specificity of knowledge" ,that is, institutional proximity (Mattes, 2012, p. 1089).

2.5 THE INTERPLAY BETWEEN PROXIMITY DIMENSIONS

According to the theory all five proximity forms are strongly interconnected, and cognitive, organizational, institutional and social aspects are capable of substituting geographical proximity (Torre & Rallet, 2005, pp. 373-80) (Boschma R. , 2005, pp. 62-72) (Mattes, 2012, pp. 1086-90). In other words, except for the geographical aspect of closeness, other forms may provide solutions for the overcoming of coordination and communication problems between the engaged innovation players (Torre & Rallet, 2005, pp. 373-80). Despite the past belief that geographical closeness may reflect the sufficient condition for innovation, it is now clear that it is strongly interrelated to all proximity aspects and, thus, it cannot be assessed in isolation (Boschma R. , 2005, p. 61). Nowadays there is the consensus that geographical closeness does not reflect a prerequisite for learning and innovation and other proximity aspects are equally important for the engaged players' effective communication, understanding and networking (Lang, 2005) (Boschma R. , 2005, pp. 63-72) (Mattes, 2012, pp. 1086-90, 1094-5).

According to Mattes (2012):

> Constellations of proximity dimensions are neither universal nor fully industry specific, but appear as a dynamic process of adaptation, substituting each other in innovation processes. In this manner organizing innovation involves a constant trade-off between various forms of proximity (Mattes, 2012, p. 1086).

Boschma also argues that various proximity combinations are capable of solving coordination problems in order to foster and facilitate innovation between the engaged players (Boschma R. , 2005, pp. 63-4). However, according to him, there is yet little understanding of what ways proximity dimensions are related to each other, which ones are more likely to co-exist or matter more (Boschma R. , 2005, pp. 63-4). Towards these questions he states that:

> All these aspects offer, by their own, or in combination, mechanisms to make connections between actors in order to combine complementary pieces of knowledge…There is as yet little understanding of how proximity (in whatever form) affects innovation over time (Boschma R. , 2005, p. 72).

Torre and Rallet (2005) state that knowledge exchange –particularly tacit knowledge- requires the establishment of organizational and cognitive proximity, in the form of coordination mechanisms and a shared knowledge base respectively (Rallet & Torre, 1999, pp. 373-80). Under this perspective the transfer of tacit knowledge, which is synonymous with face to face interactions- requires to "*bring people together through travel now and then*" and trough the establishment of other proximity forms, minimizing the issue of permanent co-location (Boschma R. , 2005, p. 69). As a result, the question is not related to whether long-distance coordination might replace geographical proximity, but to the understanding of the mechanism that allows the development of interactions between actors at different spatial scales (Torre & Rallet, 2005, pp. 51-7).

Back to the issue of the aspects' interplay, in theory, geographical proximity, in combination with cognitive proximity, reflects a sufficient condition for innovation and interactive learning to take place (Boschma R. , 2005, pp. 71-2). Freel (2003) underlines that geographical and cognitive proximity are characterized by an inverse relationship, in the sense that "*only when knowledge differs considerably from the internal knowledge base of firms can geographical proximity then play a role in bridging this gap*" (Freel, 2003, pp. 753-5) (Boschma R. , 2005, p. 70). According to Mattes geographical closeness, which is not control, framework or cognition oriented,

represents either an auxiliary proximity form or an "*innovation–relevant bonding mechanism*" (Mattes, 2012, p. 1089). Towards this direction he underlines that organizational, social, cognitive and institutional forms of proximity may complement or even substitute it and provide alternative solutions to the possible coordination problems that distance may bring about (Mattes, 2012, pp. 1086-90, 1094-5).

Boschma, in turn, underlines the direct benefits aroused from the innovation actors' spatial concentration, but he argues that geographical closeness may contribute to the facilitation of innovation in an indirect way, that is, by stimulating the other proximity aspects (Boschma R. , 2005, pp. 69-71). Towards this direction he states that social proximity between actors is more important than geographical for knowledge spillovers, because trust-based relationships generate more knowledge and "*provide the main channels for knowledge diffusion*" (Breschi & Lissoni, 2001, pp. 978-81) (Boschma R. , 2005, p. 69). This argument is reminiscent of the fact that knowledge (and particularly tacit knowledge) does not represent a common good, but it is only available to "*members of epistemic communities or communities of practice, wherever they are located*" (Breschi & Lissoni, 2001, pp. 988-91) (Gertler, 2003, pp. 86-8) (Boschma R. , 2005, p. 69).

Hausmann states that organizational and social proximity are more likely to facilitate learning and innovation, whereas, in this case, geographical closeness only contributes to the "*building and strengthening of social, organizational, institutional and cognitive proximity*" (Hausmann, 1996). This is reminiscent of Mattes' argument that geographical proximity may reflect a reinforcing mechanism for the easier establishment of other forms of proximity, in the sense that space "carries strong relational elements" (Mattes, 2012, p. 1090). Boschma points out that the social dimension is to some extent related to other forms of proximity, in the sense that trust-based relationships stimulate interactive learning and innovation (Boschma R. , 2005, pp. 66-7). However he emphasizes that organizational proximity, which goes along with "*hierarchical forms of governance*" and tight relationships between actors, may not necessarily require social closeness and trust based relationships (Boschma R. , 2005, p. 66). In parallel, although organizational and social proximity are related to different coordination mechanisms -hierarchy and trust respectively- he identifies a common feature between them, in the sense that they both rely on the development of strong relationships between the engaged partners (Boschma R. , 2005, p. 67).

Gertler (2003) stresses that social and organizational closeness may not be capable of contributing to interactive learning when actors are ruled by different institutional contexts (Gertler, 2003, pp. 84-96). Institutional proximity instead is capable of contributing to a better development of organizational arrangements in a socioeconomic system because of shared values, cultural habits, common laws and rules of the game (Gertler, 2003, pp. 84-96) (Mattes, 2012, pp. 1094-5). Moreover, institutional proximity seems to be closely related to geographical proximity in the sense that common informal or formal institutions are often spatially localized (Mattes, 2012, pp. 1085-90). Boschma argues that formal institutions, such as laws and rules, are equally important as informal ones, such as habits and values, and shape and influence the socioeconomic system (Boschma R. , 2005, pp. 67-8). Social proximity may fill the gap of institutional weaknesses, and therefore actors tend to rely more on informal trust-based relationships (Boschma R. , 2005, pp. 67-8), proving that social and institutional proximity forms are closely interrelated.

Moreover, Boschma and Mattes argue that the organizational and cognitive dimensions of proximity are complementary for the understanding, absorption, exploitation and control of new knowledge, even in cases of imitation (Boschma R. , 2005, pp. 61-74) (Mattes, 2012, pp. 1085-99). Towards this argument, Boschma points out that actors characterized by a certain degree of cognitive proximity may be grouped together "*either through organizational arrangements within an organization…or through trust-based networks between organizations*" (Boschma R. , 2005, p. 66). Moreover, according to Nooteboom (2000):

> Cognitive proximity and distance can be combined by having a group of people with cognitive proximity, typically within an organization, as well as communication with groups at a cognitive distance, typically between different organization units (Nooteboom, 2000, p. 158).

All the above mentioned arguments highlight once again the strong complementarity between proximity dimensions and underline the difficulty in finding their ideal combination for the facilitation of innovation and technological development.

2.6 POLICIES FOR PROXIMITY DIMENSIONS

Although often argued that the more proximity there is between players, the more they interact and innovate, the literature highlighted that too much proximity (in whatever form) may be detrimental to learning, innovation and technological

development. Therefore, it is important to adopt a critical stand towards proximity aspects and their contribution to these processes.

Geographical proximity

A too much inward-looking orientation of regions -particularly of the highly specialized ones- may be accompanied by spatial lock-in, and reduce the actors' ability to learn and innovate. This ability may be weakened to such an extent that actors may not take into consideration global changes or challenges, and thus perform an inability to meet new developments and requirements (Boschma R. , 2005, pp. 69-71). Boschma states that geographical closeness itself cannot harm interactive learning and innovation (Boschma R. , 2005, p. 70). These processes may be negatively affected only when too much geographical proximity is simultaneously accompanied by too much cognitive proximity between players, as a lack of openness to the outside environment may hamper the access to new ideas (Boschma R. , 2005, pp. 69-71). In these cases agglomeration economies will eventually corrode and turn into "blind – spots", whereas independent firms, unaffected by regional lock-in, will be able to successfully adapt to new developments (Pouder & St. John, 1996, pp. 1199-1200).

Since interactive learning and innovation occur at different spatial scales, a possible solution to the problem of spatial lock-in may be the adoption of an open attitude to the outside world through the establishment of local and non-local linkages (Jaffe et al., 1993, pp. 591-7) (Malmberg & Maskell, 2002, pp. 429-36) (Boschma R. , 2005, pp. 69-71). In other words, the scientific community underlines that knowledge generation and innovation require a mix of local and non-local relationships for the promotion of interactive learning and networking between the engaged players. However, geographical openness, which depends on the question which spatial scale is considered as local (inter-firm networks usually refer to higher spatial scales, while labor mobility tends to operate at the local level) (Malmberg & Maskell, 2002, pp. 442-4), should also be accompanied by the establishment of other proximity dimensions for the provision of alternative solutions to break with cognitive and organizational lock-in situations (Gertler, 2003, pp. 90-1) (Boschma R. , 2005, pp. 69-71).

Cognitive proximity

Innovation is receptive to a fruitful combination of cognitive distance and similarity, namely closeness and proximity, as the common understanding of new knowledge is both a matter of speed for the acquisition of new knowledge, and of broadening the scope of cognition (Boschma R. , 2005, pp. 63-4). Too little cognitive proximity indicates that actors cannot communicate with each other and are incapable of effectively interpreting and exploiting new knowledge (Mattes, 2012, pp. 1088-9). On the other hand, too much cognitive proximity may be detrimental for learning and innovation for three main reasons for the sake of interactive learning and innovative performance (Boschma R. , 2005, pp. 63-4).

The first one is related to the fact that knowledge generation requires diverse bodies and various sources of knowledge and, thus, some cognitive distance tends to increase the potential for learning and the triggering of creativity (Cohendet & Llerena, 1997, pp. 223-41). The second reason refers to the fact that too much cognitive proximity may lead to cognitive lock-in, in the sense that actors may not adapt to technological changes and new market demands, because of their adherence to past path dependencies and routines (Lambooy & Boschma, 1999, pp. 413-7). In other words, cognitive proximity may lead to cognitive lock-in with innovation actors and "*obscure the view on new technologies or new market possibilities*" (Boschma R. , 2005, p. 64). The third reason concerns unintentional knowledge spillovers, as too much cognitive proximity increases the risk of involuntary or accidental spillovers, especially when actors compete in same technological fields (Boschma R. , 2005, pp. 63-4). Boschma states that:

> Cognitive differences between agents are likely to persist, due to many barriers of diffusion. However, knowledge cannot always be totally appropriated and, therefore, knowledge may spill over across organizations and individuals (Boschma R. , 2005, p. 64).

Moreover, according to Cantwell and Santangelo (2002), common cognitive bases make competitors unwilling to share knowledge and, thus, they usually do not co-locate their research activities in order to protect new knowledge (Cantwell & Santangelo, 2002, pp. 163-89).

Consequently, we could argue that a not too great cognitive distance between innovation players facilitates their effective communication, while a not too small

distance avoids lock-in situations and facilitates innovation. As a result, there must be a constant strive to achieve the appropriate level of cognitive distance and proximity, whereas an absorptive capacity that is open to new perceptions is crucial for learning an innovation (Nooteboom, 2000, p. 153) (Grabher, 2004, pp. 1495-6, 1506-10) (Mattes, 2012, pp. 1088-9). However, innovation actors must ensure that their cognitive distance will not become too great to be bridged, as too much variation makes communication and interactions between them impossible (Boschma R. , 2005, p. 64). In this respect Noteboom (2000) states that:

> A tradeoff needs to be made between cognitive distance, for the sake of novelty, and cognitive proximity, for the sake of efficient absorption. Information is useless if it is not new, but it is also useless if it is so new that it cannot be understood (Nooteboom, 2000, p. 153).

Organizational proximity

Too much organizational proximity may entail negative impacts on learning and innovation in the sense that strong ties between the engaged players may lead to inward-looking and relations-specific systems. A too small organizational distance between the engaged players is synonymous with lock-in situations due to "*specific exchange ties"* which may limit access to diverse knowledge sources. Moreover strong ties between agents may contribute to the building of strong bureaucratic system, incapable of rewarding novel ideas and facilitating innovation. Another disadvantage of too much organizational proximity concerns the establishment of organizational flexibility, which may discourage the introduction of new initiatives and therefore hamper innovative performance. On the other hand, too little organizational proximity marks the lack of hierarchy, control and coordination in knowledge exchange. In this respect Frenken and Valente (2002) argue that:

> Organizational proximity, as reflected in a hierarchical governance structure, is unlikely to provide such flexibility. The tighter and more dependent are the relations in an organizational arrangement, the less initiatives are undertaken and rewarded, with negative effects on innovation (Frenken & Valente, 2002).

Powell and Grodal (2005) state that the achievement of an appropriate level of organizational proximity is a hard subject for internationally oriented companies (Powell & Grodal, 2005, pp. 56-85). Mattes in turn states that:

> It may be necessary to draw upon additional knowledge and incorporate external partners in order to be innovative. At the same time, protecting the

> company's knowledge base is one of the most important keys to competitiveness (Mattes, 2012, p. 1089).

As a consequence, it is argued that loosely coupled systems -"*weak ties between autonomous entities e.g. a joint venture or a flexible firm or network*" (Boschma R. , 2005, p. 65)- are accompanied by a degree of organizational distance and therefore they can satisfy the abovementioned requirements, by guarantying both organizational flexibility and control (Lawson & Lorenz, 1999, pp. 305-317) (Boschma R. , 2005, pp. 64-6). Towards this perspective, Grabher and Stark (1997) point out that:

> In loosely coupled networks where the identity and separateness of elements is preserved, the network can potentially retain a great number of mutations and novel solutions than would be the case with a tightly coupled system (Grabher & Stark, 1997, p. 538).

Social proximity

Despite the positive effects of social closeness between the engaged actors, too much proximity may harm their capability to learn and innovate, in the sense that strong social ties with high levels of friendship, kinship and emotional bonds, may lead to the underestimation of opportunism (Uzzi, 1997, pp. 36-65). Towards this direction Boschma points out that in a world full of "calculating actors" and changing markets, all actors should be aware of the common opportunistic behaviors, as too much commitment and loyalty "*may lock members of social networks into established ways of doing things at the expense of their own innovative and learning capacity*" (Boschma R. , 2005, p. 66). On the other hand, too much social distance may be harmful for learning and innovation due to the lack of trust, commitment and shared relationships (Boschma R. , 2005, pp. 66-7).

Towards these perspectives, Uzzi argues that the social aspect of economic relationships positively influences the performance of a firm up to a certain threshold, after which these effects turn negative when the relationships become too closely tied (Uzzi, 1997, pp. 35-65). Therefore he suggests that a possible solution to this problem might be the combination of both embedded and market relationships in the sense of some social proximity and distance respectively (Uzzi, 1997, pp. 35-65).

Institutional proximity

Institutional closeness between innovation players may turn into a constraining factor for learning and innovation, if keeping in mind that an "*institutional environment*

consists of an interdependent set of institutions" (Boschma R. , 2005, p. 68). Hall and Soskice (2001) refer to "institutional complementarities", implying that the effectiveness of one institution may increase the returns from complementary institutions (Hall & Soskice, 2001, pp. 17-21, 625-4)**.** This interdependent relationship may also lead to inertia, in the sense that change disturbs the structural position of elements and induces instability and, as a consequence, either no change or minor changes take place (Boschma R. , 2005, pp. 67-8). Moreover, powerful institutional players may dominate inward-oriented networks and react to changes "*especially when their vested interests are threatened, or when they have obligations towards other actors in the network*" (Boschma R. , 2005, p. 68). As a result, an institutional system may involve into a lock-in situation if it does not provide opportunities for newcomers or lead to institutional inertia, discouraging innovation.

As it becomes clear, too much institutional proximity is unfavorable for innovation due to lock-in and inertia, whereas too much distance marks the lack of formal institutions, shared values and social cohesion. Boschma underlines that the description of the way that an institutional system may overcome these weaknesses is not an easy subject (Boschma R. , 2005, pp. 67-8). However, he suggests that a possible solution might be the combination of:

> Institutional stability (reducing uncertainty and opportunism), openness (providing opportunities for newcomers) and flexibility (experimenting with new institutions). In order to achieve this, the institutional system should fulfill several requirements that guarantee checks and balances. (Boschma R. , 2005, p. 68).

Table 2.2: Five forms of proximity and their features

PROXIMITY FORM	DEFINITION	KEY DIMENSION	COST OF TOO LITTLE PROXIMITY	COST OF TOO MUCH PROXIMITY	POSSIBLE SOLUTIONS
Geographical	▪ "The positioning of agents within a predetermined spatial framework" (Kirat & Lung, 1999, p. 29) ▪ "Both the economical, geographical separation of the individual or collective agents…and their position in an economic problem resolution process" (Torre & Gilly, 2000, p. 180) ▪ "The kilometric distance that separates two units (e.g. individuals, organizations, towns) in geographical space" (Torre & Rallet, 2005, pp 49). ▪ "The spatial or physical distance between economic actors, both in its absolute and relative meaning" (Boschma, 2005, p. 69) ▪ "The co–location of the involved actors" (Mattes, 2012, p. 1090)	▪ Space-oriented ▪ Spatial allocation of innovative actors	▪ No spatial externalities ▪ Lack of face to face interactions ▪ Difficulties in the transfer of tacit knowledge	▪ Lack of geographical openness ▪ Spatial lock - in, weak learning abilities, poor innovative capacities and no access to variety	Mix of local 'buzz' and extra-local linkages
Cognitive	▪ "Communication between actors, recurrent interactions, codes and common languages, a process of interpretation and translation of partial tacit knowledge, and the transformation of this knowledge into operational questions" (Torre & Gilly, 2000, p. 177) ▪ "The capacity of actors or firms to absorb new knowledge…in order to	▪ Knowledge-based ▪ Reduction of knowledge gaps	Misunderstanding	▪ Lack of sources of novelty ▪ Path dependencies and cognitive lock – in ▪ Unintentional spillovers	Common knowledge base with diverse but complementary capabilities

	communicate, understand and absorb it successfully" (Boschma, 2005, p. 63) ▪ "The localized outcomes of search processes" (Jong & Freel, 2010) ▪ "The capability of actors to understand each other, that is, use a common interpretative scheme" (Mattes, 2012, pp. 1088-9)				
Organizational	▪ "The compatibility within a group, connecting principles, i.e. a corporate culture (Blanc & Sierra, 1999, p. 196) ▪ "The set of interdependencies within and between organizations connected by a relationship of either economic or financial dependence/interdependence" (Kirat & Lung, 1999, p. 30) ▪ "The same space of relations (firms, networks)" (Torre & Gilly, 2000, pp. 177-180) ▪ "The shared organizational principles, rules, and codes, including a corporate identity and a corporate philosophy" (Zeller, 2004, p. 88) ▪ "The capacity to coordinate the exchange of complementary pieces of knowledge owned by a variety of actors within and between organizations" (Boschma R. , 2005, pp. 64-65)	▪ Control and hierarchy based ▪ Coordination mechanism	▪ Opportunism and uncertainty in knowledge generation ▪ Coordination problems	▪ Bureaucracy ▪ Organizational inflexibility	Loosely coupled system

Social	▪ "Embedded relations between actors that involve trust based on friendship, kinship and experience" (Boschma R. , 2005, pp. 66-67) ▪ "The result of shared personality characteristics, personal interaction and a sense of familiarity between individual actors" (Mattes, 2012, p. 1089)	▪ Trust-based ▪ Social relations, friendship, kinship and experience	▪ Lack of trust and commitment ▪ No social cohesion and shared values	▪ No economic rationale ▪ Underestimation of opportunistic behavior ▪ Lock - in due to loyalty and strong ties	Mixture of embedded and market relations
Institutional	▪ "The set of common habits, routines, established practices, rules, or laws that regulate the relations and interactions between individuals and groups" (Edquist & Johnson, 1997, p. 46) ▪ "The adhesion of agents to common space of representation, of patterns, and of rules of thought and action" (Torre & Gilly, 2000, p. 182) ▪ "The legislative conditions, labor relations, business practices and accounting rules, dominant workplace practices, and the training system, which are all outcomes and elements of the evolution of political power relations that contribute to a cultural affinity (Zeller, 2004, p. 88) ▪ "The institutional rules of the game, a common language, shared habits and a law system… cultural habits and values" (Boschma, 2005, pp. 67-68)	▪ Framework-based ▪ Common institutions and rules of the game	▪ Opportunism ▪ Lack of common formal and informal values	▪ Lock-in and inertia ▪ Rigidity in institutional transformations ▪ Institutional complementarities	Combination of institutional stability and flexibility, checks and balances

	▪ "A complex combination of macro-level factors, that is hard institutional factors like laws and rules…and soft ones, that is, norms, values and routines" (Mattes, 2012, p. 1089)				

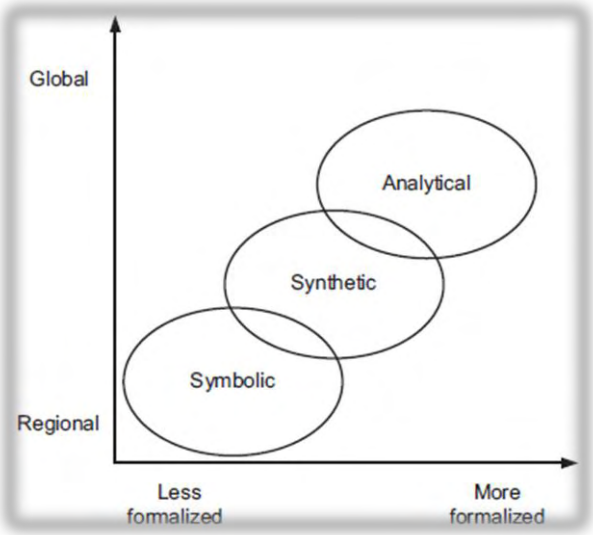
Source: Torre & Gilly, 2000, Zeller, 2004, Boschma R. , 2005, Moodysson & Jonsson, 2007, Mattes, 2012, own elaboration

2.7 PROXIMITY AND TYPES OF KNOWLEDGE

Mattes attempted to open the black box of proximity and deal with the issue from a deeper perspective. Motivated by the distinction between tacit and explicit knowledge, he states that the required degree of proximity in knowledge transfer depends on the nature of the involved knowledge (Asheim et al., 2007, pp. 655-70) (Moodysson et al., 2008, pp. 1040-56) (Mattes, 2012, pp. 1090-4). Tacit knowledge, for instance, can be more easily transferred through face to face interactions and, thus, it requires geographical proximity, whereas explicit knowledge, which can be easily codified and transmitted in greater distances, mostly requires cognitive proximity (Breschi & Lissoni, 2001, pp. 988-91) (Gertler, 2003, pp. 86-8) (Torre & Rallet, 2005, pp. 48-50) (Boschma R. , 2005, p. 69) (Asheim et al., 2007, pp. 655-70).

Mattes argues that the understanding of proximity dimensions can be facilitated if linked to different types of knowledge and, thus, he distinguishes three categories of knowledge bases: synthetic, analytical and symbolic knowledge (Mattes, 2012, pp. 1090-5). In any case he states that regardless the nature of the knowledge transferred, the establishment of some cognitive and organizational proximity between actors is essential, whilst social and geographical aspects facilitate its transmission in the early explorative stages of the project and then become negligible (Mattes, 2012, pp. 1090-5).

Figure 2.1: Expected patterns of knowledge sourcing



Source: Martin & Moodysson, 2013, p. 175

2.7.1 SYNTHETIC KNOWLEDGE BASE

Synthetic knowledge base, also known as "*industrial knowledge base*", is characterized by "*mainly incremental innovation, whereby hands – on solutions emerge from current work and informal coordination with client and suppliers are crucial*" and learning occurs "*coincidently and without a purpose or a fixed aim in mind*" (Bathelt et al., 2004, pp. 31-56) (Asheim & Gertler, 2005, p. 294) (Mattes, 2012, p. 1091). The ultimate of goal is the application of what has been found through experimentation, testing and practical work (Moodysson et al., 2008, pp. 1040-56)**.** Innovation occurs from applied R&D, whereas learning evolves a continuous problem-solving process through the application or new combination of the existing knowledge (Moodysson et al., 2008, pp. 1040-56) (Mattes, 2012, pp. 1090-5). Synthetic knowledge takes place in the workplace as part of an interactive process and, thus, industries tend to concentrate in agglomerations and clusters, in order to reap the benefits of being in close proximity to both suppliers and consumers (Asheim et al., 2007, pp. 655-70). Typical examples of industries drawing on a synthetic knowledge base are the automobile industry, manufacturing, activities in plant engineering etc. (Asheim et al., 2007, pp. 655-70) (Mattes, 2012, pp. 1090-4).

Personal interactions and know-how represent the very core of this knowledge type, whereas face to face interactions act as reinforcing factors (Moodysson et al., 2008, pp. 1040-56). Industries based on synthetic knowledge base strongly rely on personal relationships due to the significance of customized solutions to "*develop and improve technical systems*" (Asheim et al., 2007, p. 663). Tacit knowledge, which is embedded in individuals and organizations and considered as spatially sticky, also plays its role in this knowledge base, and therefore, the coordination of interactions between clients and suppliers is crucial (Mattes, 2012, pp. 1090-4).

The above mentioned underline the strong need for effective communication and mutual understanding between the players involved in this knowledge type, that is, for social and cognitive proximity respectively (Mattes, 2012, pp. 1090-4). Moreover, institutional proximity plays an important role, in the sense that common values and norms define a common space of reference that breeds trust and facilitates knowledge exchange (Mattes, 2012, pp. 1090-4). Organizational proximity in turn, does not reflect a prerequisite for synthetic knowledge, as face to face and trust–based relationships do not necessarily require control and hierarchy (Mattes, 2012, pp. 1090-

4). Geographical proximity is important in the sense that spatial co-location is usually accompanied by a common formal and informal framework that encourages knowledge exchange and innovation (Martin & Moodysson, 2013, pp. 170-5) Consequently, synthetic knowledge basis mostly require cognitive and social proximity, whereas geographical and institutional proximity further facilitate knowledge exchange and interactions between actors (Mattes, 2012, pp. 1090-4).

2.7.2 ANALYTICAL KNOWLEDGE BASE

Analytical knowledge base engages scientific knowledge, mechanisms and principles, and is characterized by the intention to innovate through the creation of new knowledge (Asheim et al., 2007, p. 663) (Mattes, 2012, pp. 1090-4). "*Innovation is hereby regarded as something which can be planned, and intentional action is taken to move towards innovation step by step*" and thus know-why represents the heart of this knowledge type (Asheim et al., 2007, pp. 655-70) (Moodysson et al., 2008, pp. 1040-56) (Mattes, 2012, p. 1091). Representative examples involving analytical knowledge are the pharmaceutical industry, biotechnology, nanotechnology, as well as energy related projects (Asheim et al., 2007, pp. 655-70) (Mattes, 2012, pp. 1090-4)**.**

A major goal for industries drawing on an analytical knowledge base is to rapidly access and absorb new knowledge before both its publication and their rivals (Mattes, 2012, pp. 1090-4). This continuous need for access to codified knowledge, that is, principles, methods and laws is extremely necessary and thus, a common phenomenon is the emergence of links and networking between industries, universities and research organizations engaged in this knowledge type (Mattes, 2012, pp. 1090-4). Therefore, the engaged players tend to cluster around or locate in close proximity to universities and research organizations within their field (Asheim et al., 2007, pp. 655-70)**.**

In analytical knowledge base the establishment of cognitive proximity between the engaged players is essential, in order to effectively acquire, interpret, absorb and exploit new knowledge (Mattes, 2012, pp. 1090-4). Organizational closeness is also significant as it coordinates the exchange of complementary pieces of knowledge, offers access to the stored information and guarantees property rights (Mattes, 2012, pp. 1090-4). Social proximity is helpful at the initial stages of a project in the sense

that it facilitates the actors' easier communication, while geographical proximity is not necessary and sometimes intentionally avoided, particularly in cases that research activities concern competitive sectors (Mattes, 2012, pp. 1090-4). In sum, cognitive and organizational proximity are essential for the emergence of analytical knowledge, while geographical and social closeness between actors are helpful in the early stages of the project and then become negligible (Mattes, 2012, pp. 1090-4).

2.7.3 SYMBOLIC KNOWLEDGE BASE

Symbolic knowledge base reflects the unintentional outcome of the existing knowledge's recombination in novel ways, as it "*does not emerge by applying scientific principles but through know-who and socialization in this particular business*" (Mattes, 2012, p. 1092). This knowledge type is associated with the "*aesthetic characteristics of products (tokens, artifacts, symbols)*", with representative examples the automobile sector, cultural and creative industries, such as advertising, design or fashion (Asheim et al., 2007, p. 663) (Mattes, 2012, pp. 1090-4). These activities are design intensive in the sense that they involve the generation of new ideas, and thus "*the input tends to be aesthetic rather than cognitive in quality*" (Asheim et al., 2007, p. 664). Reasonably, this knowledge type is highly affected by taste and trends, and involves tacit knowledge, trust-based relations and face to face communication (Asheim et al., 2007, pp. 655-70) (Mattes, 2012, pp. 1090-4)**.**

Asheim et al. (2007) point out that:

> It is difficult to generate clear spatial implications for the industries drawing on a symbolic knowledge base compared with the industries relying on analytical and synthetic knowledge bases (Asheim et al., 2007, p. 666)**.**

Unlike the synthetic and analytical knowledge base, creative industries tend to be urban industries due to the need to ensure communication and face to face relationships with suppliers (Asheim et al., 2007, pp. 655-70). Towards this direction, large cities appear to an attractive location choice as they reflect a "*broad sense of the world*" and a variety of tastes that provide inspiration and attract creative workers (Asheim et al., 2007, p. 666)**.**

This knowledge type is characterized by a strong "tacit component" as it has its roots on a deep understanding of cultural habits, norms and characteristics (Asheim et al., 2007, p. 664). According to this perspective, some, even not permanent, geographical proximity is essential, because networking between partners can be easily achieved

through observation and interactions (Mattes, 2012, pp. 1090-4). Some level of cognitive proximity between players is important but it can remain comparatively low, if keeping in mind that symbolic knowledge does not involve scientific procedures and methods (Mattes, 2012, pp. 1090-4).

Institutional proximity also plays a role, as local laws may influence or even shape values, taste and preferences, particularly in cases that the product aims at global market and has to be fit into international legal frameworks (Asheim et al., 2007, pp. 655-70) (Mattes, 2012, pp. 1090-4)**.** The basic element of this knowledge type is social proximity in the sense that it breeds trust and facilitates the development of personal ties. Social closeness also contributes to the strengthening of institutional proximity, and substitutes the cognitive dimension (Mattes, 2012, pp. 1090-4). Finally, given that the informal interactions between players cannot be easily controlled and, thus, organizational proximity does not reflect a prerequisite for this knowledge base (Mattes, 2012, pp. 1090-4).

Table 2.3: Typology of knowledge bases

SYNTHETIC KNOWLEDGE	ANALYTICAL KNOWLEDGE	SYMBOLIC KNOWLEDGE
Innovation through the application or novel combination of existing knowledge	Innovation through the creation of new knowledge	Innovation through the recombination of existing knowledge in novel ways
Importance of applied, technological problem-related knowledge	Importance of scientific knowledge, mechanisms and principles through deductive processes	Importance of recombining or reusing existing outcomes
Interactive learning with clients and suppliers	Co-operations between firms and research organizations	Learning through interactions and observations and interactions within and of community
Dominance of tacit knowledge, practical skills and know-how	Dominance of codified knowledge and know-why	Dominance of tacit knowledge, practical skills, socialization and know-who
Requirement of cognitive and social proximity, whereas geographical and institutional proximity act as reinforcing factors	Requirement of cognitive and organizational proximity, whereas geographical and social closeness between actors are helpful in the early stages of the project and then become negligible	Social proximity as the basic requirement. Requirement of some -even not permanent- geographical proximity and some level of cognitive proximity between players but it can remain comparatively low. Limited role of Institutional and organizational proximity.

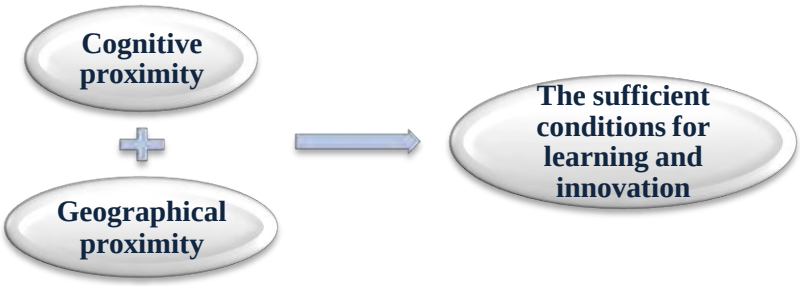
Source: Asheim et al., 2007, p. 661, Mattes, 2012, pp. 1090-4, own elaboration

2.8 CONCLUSIONS

In this section we attempted to shed some light on the complex issue of proximity and underline the way it may contribute to the facilitation of learning and innovation. Towards this direction, we identified the key proximity aspects presented in the literature and concentrated on the fivefold proximity typology presented by Boschma (2005) and Mattes (2012). The inherent complexity of knowledge and innovation, and the proximity aspects' complementarity, complicate the issue which still remains undefined.

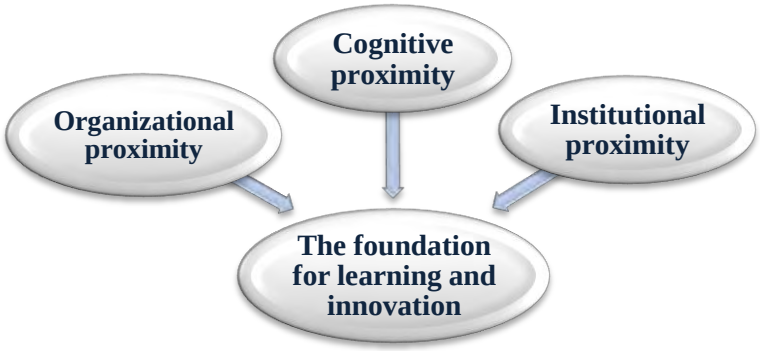
Although the introduction and categorization of the five proximity forms has shed some light on the issue of proximity and innovation, the debate has failed to clarify the ideal combination between the proximity dimensions for learning and innovation to take place. A certain argument emphasizes that proximity should not be associated with its geographical meaning or assessed in isolation, as it is strongly interconnected to the other four aspects which may frequently substitute it (Boschma R. , 2005, pp. 61-74) (Mattes, 2012, pp. 1085-99). Moreover, innovation should not be considered as a spatial concept, as it requires the involvement of all five dimensions of proximity and "their complementarities and substitution effects" (Mattes, 2012, p. 1094).

Boschma (2005) argues that learning and innovation require the activation of all proximity forms, which -by their own or in combination- may coordinate heterogeneous knowledge sources. According to his perceptions the establishment of cognitive proximity between the engaged players reflects a prerequisite for interactive learning and innovation, in the sense that it establishes a common language and facilitates both their effective communication and the successful exploitation of new knowledge (Boschma R. , 2005, pp. 61-74). The need for a constant and costless monitoring of the engaged partners, the control of knowledge exchange, and the development of face to face interactions and socially embedded relationships with respect to laws and culture, also underline the significance of geographical, organizational, social and institutional closeness respectively (Boschma R. , 2005, pp. 61-74). As a consequence, Boschma underlines that, according to the theory, the combination of geographical and cognitive proximity reflect the sufficient conditions for interactive learning and innovation (Boschma R. , 2005, pp. 61-74).



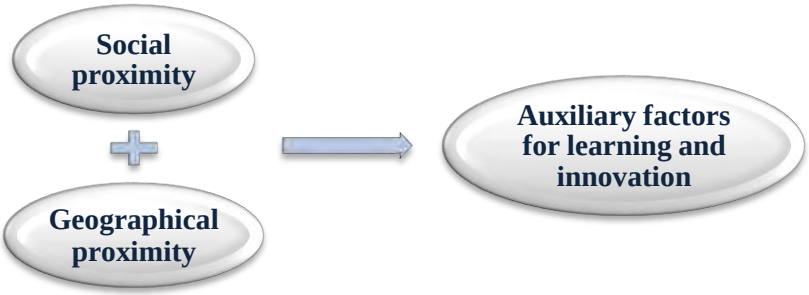
Source: Boschma, 2005, own elaboration

Mattes (2012), in turn, argues that cognitive, organizational and institutional aspects of proximity represent the enabling factors for learning and innovation in the sense of a common understanding, control and rules of the game (Mattes, 2012, pp. 1085-99).



Source: Mattes, 2012, own elaboration

Moreover, he points out that geographical and social proximity types reflect auxiliary factors for learning and innovation (Mattes, 2012, pp. 1085-99). This does not mean that they are less significant, but implies that they constitute an innovation-relevant mechanism, if accompanied by cognitive, organizational and institutional closeness.



Source: Mattes, 2012, own elaboration

The two researchers emphasized the strong interdependent relationship between all proximity aspects in the sense that proximities emerge, develop and disappear, which explains why they are capable of reinforcing or substituting each other. They also underline that too much closeness between the engaged innovation players may be

detrimental to learning and innovation, and therefore some distance is required. Towards this direction, Boschma provides policies for dimensions and a fruitful conceptualization of the circumstances under which proximity brings about positive or negative effects, and of how these circumstances might change due to that changing importance of the different dimensions of proximity over time.

Mattes attempted to deal with proximity from a deeper perspective, by linking it to different knowledge types, that is, synthetic, analytical and symbolic. According to him, the nature of the underlying knowledge base requires a different combination of proximity aspects for learning and innovation to take place (Mattes, 2012, pp. 1085-99). However, he points out that all knowledge types require a constant trade – off between the various forms of closeness in order to balance the actors' heterogeneity and distance. More specifically, some cognitive proximity between players is essential for the exchange of any knowledge type, whereas institutional and organizational aspects also play their role by providing a framework of values, norms, formal and informal relationships. Geographical proximity is important for industries drawing on synthetic or symbolic knowledge, as these knowledge types tend to vary across places. This is less the case for industries engaged in analytical knowledge, as they rely on codified/scientific knowledge which is universal and less sensitive to geographical distance (Mattes, 2012, pp. 1085-99).

CHAPTER 3: **Case Studies**

3. CASE STUDIES

3.1 INTRODUCTION

After the examination of the various proximity aspects, the significance and their interconnections in the first Chapter, this section provides a more practical illustration of the proximity issue. Towards this direction, it presents four case studies and attempts to analyze the way they managed to overcome their geographical, cognitive, organizational, institutional and social barriers in order to reinforce their innovation performance and become global players with future growth potential. More specifically, Chapter 3 consists of four case studies, that is, NOKIA (3.2), SAMSUNG (3.3), the Skane region (3.4) and the Indian pharmaceutical firms (3.5), and focuses on the identification of the policy and business initiatives adopted by each case for the overcoming of their initial limitations related to distance –in both absolute and relative terms- and the strengthening of their innovation capacity.

3.2 THE CASE OF NOKIA

NOKIA has a long tradition in technological breakthroughs. The corporation started out in 1865 as a paper manufacturer, due to Finland's wealth of natural resources, and operated as such for almost 90 years. In 1967 merged with the factories Finnish Rubber Works and Finnish Cable Works and diversified into unrelated business such as rubber, cable, forestry, electronics and power generation (www.academia.edu). In 1991 the NOKIA Corporation made a strategic shift towards the high-tech industry and entirely focused its business on telecommunications systems and mobile phones manufacturing (see The Appendix for an overview) (www.nokia.com) (Oinas, 2005: 1232-3). The following table highlights NOKIA's key development steps in combination with the challenges it had to face, in the attempt to become the largest conglomerate in the Nordic region and one of the key innovation players in the world.

3.2.1 PUBLIC INITIATIVES FOR THE DEVELOPMENT OF THE TELECOM SECTOR

> *When an inventor in Silicon Valley opens his garage door to show off his latest idea, he has 50% of the world market in front of him. When an inventor in Finland opens his garage door, he faces three feet of snow.*
>
> J.O. Nieminen, 1984

The institutionalization of science and technology policy started in Finland in the early 1960s and highlighted the importance of research and development for the country's industrial reformation (Lemola, 2002, p.1483). As a result, new measures for the promotion of industrial R&D were taken, and towards this direction, the Finnish National Fund for Research and Development (SITRA) was founded in 1967 to promote industrial research (Lemola, 2002, p.1484). Already the late 1970s were accompanied by the introduction of new priorities in the fields of science and technology policy, while in the 1980's the government's vision geared towards the development of a knowledge-based economy through the creation of a collaborative business model with close research and industry linkages (Lesser, 2008, p. 9). The adopted Western European and Nordic patterns (Solvell & Porter, 2002, p.3) and several other political choices -such as the persistent priority to higher education (Lemola, 2002, p.1484), the encouragement of "*linkages and spillovers among various industries and partners*" and the promotion of industrial R&D - finally succeeded in establishing a certain framework for innovation, capable of promoting the development of new knowledge-oriented industries like NOKIA (Lesser, 2008, p. 11).

In general, public choices attempted to assist the rise of the NOKIA Corporation and accelerate its engagement in the telecommunications sector (Miettinen, 2013, p.76). Important factors for NOKIA's success were the government's participation in the establishment of both the NMT in the early 1980s and the pan-European GSM system (Miettinen, 2013, p.77). More specifically, the government played an active role in the early phases of the mobile communications' technology by exploiting its proximity to the other three Nordic regions. In 1981 the state-owned Post, Telegraph and Telephone (PTT) operator collaborated with the Swedish, Norwegian and Danish PTTs for the development of the Nordic Mobile Telephony standard (NMT) (Lesser, 2008, p. 14), a *"pan-Nordic automatic mobile communication network"* that targeted on the encouragement of competition between equipment manufacturers (Ali-Yrkko & Hermans, 2004, p. 111). The network's introduction *"marked the start of a fast expanding new industry"* (Solvell & Porter, 2002, p. 5) and benefitted the whole telecommunication industry –including NOKIA- in terms of manufacturing experience (Schienstock, 2004, p. 111). As mentioned it also was the prime mover for the creation of the Global System for Mobile Communication (GSM) in collaboration

with the Post and Telegraph Office, which was the first to finance GSM research by industry and technical universities in 1981 (Schienstock, 2004, p. 111) (Ali-Yrkko & Hermans, 2004, p. 111). In 1987 the GSM was adopted as the European standard for digital mobile technology (Lesser, 2008, p. 14) and the first GSM call was made with NOKIA equipment in 1991 (Ali-Yrkko & Hermans, 2004, p. 79) (Lesser, 2008, p. 14) (www.nokia.com).

NOKIA's developing activities –at that time- were surely supported by the above mentioned public choices, as increased competition and consumer's feedback led to NOKIA's preparedness to satisfy the needs of a rapidly expanding new business area. Simultaneously, Finland's early presence in the international mobile networks and the high national phone penetration, resulted in the creation of *"a good test field and a pilot region"* for NOKIA (Ali-Yrkko & Hermans, 2004, p. 112).

The 1970s and 1980s, which were characterized by the political concentration on the promotion of industrial R&D and technology intensive activities, increased the demand for skilled employees (Solvell and Porter, 2002, p.8) for the creation of a critical expertise mass in top Finnish innovative companies and research institutes (Ali-Yrkko & Hermans, 2004, p. 78). Towards this direction, the continuous public spending on education was responsible for the country's sophisticated education and university system (Solvell & Porter, 2002, p.3). This traditional well-functioned system with intense synergies between universities and research institutions resulted in the preparation of a highly skilled labor force, able to support NOKIA's cutting edge activities.

In the early 1990s, the NOKIA Corporation decided to entirely focus its core business on telecommunications, with the goal of establishing leadership in every major global market (http://company.nokia.com). In this period the Finnish government, which realized NOKIA's capabilities for future growth potential, further concentrated on the development of knowledge-related activities by promoting innovation and ICT activities (Solvell & Porter, 2002, p. 7) and investing additional funding in R&D (Pillay, 2010, pp. 33-4). As a consequence, "know-how" started to represent the country's critical resource (Pillay, 2010, pp. 34-5) and contributed to the fast rise of the ICT sector in comparison with other OECD economies (Lesser, 2008, p. 11). Particularly in the period between 1981 and 2005, R&D expenditure -mostly led by the private sector- more than doubled, reinforcing the emergence of the

telecommunications sector and contributing to NOKIA's and the Finnish economy's faster development (Lesser, 2008, p. 11). At this point it should be stated that NOKIA conducted almost 60% of its research in Finland, accounting for approximately 45% of all private R&D expenditure in the country (Solvell and Porter, 2002, p.17).

In response to NOKIA's strategy to gear towards ICT and telecommunication activities it is stated that: *"from a modest base in the 1960s and 1970s, the Finnish telecommunications cluster began to emerge in earnest in the 1990s"* (Solvell & Porter, 2002, p.15). Obviously, NOKIA's innovative efforts were assisted by the emergence of a promising ICT and mobile telecommunications cluster, supported by the government, that encouraged co-operation, learning, innovation and technology transfer between "*domestic and foreign companies, providers, academic and research institutions and standardization authorities*" (Lesser, 2008, p. 12). NOKIA operated in the cluster both as a producer and a user of the innovation resources and finally dominated it due to its size and effect (Lesser, 2008, p. 12). In 2005, this cluster consisted of almost 6,000 small, medium-sized and large companies, *"300 of which were Nokia's first-tier subcontractors"* and enabled the firm's competitive participation in global markets (Lesser, 2008, p. 12).

In 1983 the National Technology Agency (TEKES) was established under the Ministry of Trade and Industry, and became the principal organization for the implementation of technology policy (Ali-Yrkko & Hermans, 2004, p. 107) (Miettinen, 2013, p. 78). TEKES directed public funding to telecommunication projects in collaboration with universities, research institutes and telecom firms (Solvell & Porter, 2002, p.15) (Ali-Yrkko & Hermans, 2004, p. 107) (Miettinen, 2013, p. 78). Later, in 1987, the Science and Technology Policy Council[2] - another research related body- was founded, in order to direct research policy and develop strategies relative to technological activities (Solvell & Porter, 2002, p. 4). TEKES in particular, played a crucial role in NOKIA's support in the sense that it facilitated the digital media industry's emergence through the promotion of interactions between firms, venture capitalists, universities, and research institutes. In the 1990s, when the political decision marked the concentration on mobile technology, its funding entirely

[2]The Science and Technology Policy Council was headed by the Prime minister and included the Ministers of Finance, Trade and Industry, Education, four other Ministers, and representatives from the main research organizations and the private sector (Solvell & Porter, 2002, p. 4).

geared towards the information and communication companies (Ali-Yrkko & Hermans, 2004, pp. 107-9) (Lesser, 2008, p. 27) and was mostly channeled to NOKIA (Ali-Yrkko & Hermans, 2004, p. 108) (Miettinen, 2013, p. 78). As a consequence, NOKIA's R&D activities were assisted by the received financial support and its Research Center managed not only to sustain its activities but even develop a large diversified conglomerate through mergers and acquisitions (Ali-Yrkko & Hermans, 2004, pp. 107-8) (Miettinen, 2013, p. 78). Moreover, the participation of various partners in most of the TEKES financed NOKIA projects, such as research institutes and universities (Ali-Yrkko & Hermans, 2004, pp. 107-14), facilitated the establishment of social and organizational proximity between NOKIA and its partners and contributed to the expansion of the company's cognitive scope.

Finnish and global policies dynamically supported market openness and free trade, influencing the innovation process in the telecommunications industry and accelerating NOKIA's global rise. The elimination of trade and investment barriers facilitated operations between NOKIA and the European market. Lesser (2008) points out that trade between Finland and EU partners was facilitated:

> Due to the harmonization of essential product regulations and specifications and the introduction of the EU Suppliers' Declaration of Conformity for telecom and electrical equipment and parts among EU countries (Lesser, 2008, p. 5).

This governmental initiative supported NOKIA's initial openness to European markets, in the sense that it established institutional proximity between Finland and the EU which resulted in a substantial increase of trade volumes with other European member states. Additionally, it paved the way for NOKIA's global operations by contributing to the encouragement of technology transfers, the increase of competition towards international markets, and the stimulation of economies of scale (OECD, 2006a) (Lesser, 2008, p. 6).

Table 3.1: Practices adopted by the Finnish government in order to overcome distance in its various dimensions

ADOPTED PRACTICES	BARRIERS OVERCOME DUE TO THE ADOPTED PRACTICES				
Government	**Geographical**	**Social**	**Institutional**	**Organizational**	**Cognitive**
Adoption of Western European and Nordic patterns for the establishment of a certain framework for innovation in the 1980s	✓		✓		
High public spending on education due to the demand for skilled employees in the 1980s					✓
Establishment of the pan-Nordic automatic mobile communication network, NMT, in 1981for the encouragement of competition between equipment manufacturers	✓	✓			
Public Financial support for GSM research by universities and research institutes in 1981				✓	✓
Promotion of a collaborative research-industry model for innovation				✓	✓
Increase of the R&D spending due to the concentration on the development of ICT and electronics in the 1990s					✓
Emergence of the Finnish communications cluster in the 1990s for the facilitation of NOKIA's development		✓		✓	✓
Support of NOKIA's R&D activities by TEKES' funding in the 1990s					✓
Harmonization of essential product regulations and specifications between Finland and the EU partners			✓		

Technology transfer between domestic and foreign companies, providers, academic and research institutions and standardization authorities in the 1990s and 2000s	✓	✓	✓	✓	✓

Source: own elaboration

3.2.2 NOKIA's CHOICES FOR THE OVERCOMING OF DISTANCE BARRIERS

As Craig Barrett –Intel's former CEO and Chairman- says about NOKIA: *"one thousand companies can recognize a strategic opportunity but only one can grow to dominate the market"* (www.kauppapolitiikka.fi) and, thus, many people believe that when it comes to globalization, the Nokia Corporation is a category of its own (www.kauppapolitiikka.fi). *"As NOKIA became an international success story, Finns came to see the mobile phone as a national symbol",* implying that the firm's development was considered as a national issue of great significance (Solvell & Porter, 2002, p. 14). Despite the government's assistance, the firm itself followed strategic steps in order to overcome geographical, cognitive, institutional, organizational and social barriers with its collaborators, and guarantee its future growth potential.

Table 3.2: NOKIA's evolution and barriers that had to be overcome

	NOKIA's stages of development	**Barriers that had to be overcome**
1960	Cooperation with the Finnish Cable Works (FCW) for the production of radio-transmission equipment (company.nokia.com)	Cognitive Organizational
1967	Establishment of the NOKIA Corporation (the merger of Idestam's NOKIA, the Finnish Cable Works and the Finnish Rubber Works)	Cognitive Organizational
1970	Televa and NOKIA combined their R&D and marketing efforts in digital technology exchange	Cognitive Organizational
1979	Creation of a radio telephone company as a joint venture with leading Finnish TV set maker Salora in order to market and develop radio technology (www.theguardian.com)	Cognitive Organizational Social
1980	Acquisition of Luxor, the PC and office electronics business of Ericson and Standard Elektrik Lorenz for the operation in the electronics industry	Geographical Cognitive Organizational
1982	Introduction of the first car phone and the first digital telephone switch (www.theguardian.com) (company.nokia.com)	Geographical Cognitive Social
1984	Introduction of the Mobira Talkman portable car phone (www.theguardian.com)	Geographical Cognitive

		Social
1987	Introduction of the first handheld mobile phone (Mobira Cityman) (www.theguardian.com)	Geographical Cognitive Social
1991	Engagement in the Global System for Mobile Communications (GSM) (company.nokia.com)	Geographical Cognitive Institutional Organizational
1992	Launch of its first digital handheld GSM phone (www.theguardian.com)	Geographical Cognitive Social
1997	Supply of GSM networks in other European countries (www.theguardian.com) (company.nokia.com)	Geographical Cognitive Institutional Organizational
1999	Launch of a phone with rudimentary web-based functions, including email (www.theguardian.com)	Geographical Cognitive Social
2000	Deal with EMI, allowing users to choose their favorite tunes as ringtones (www.theguardian.com)	Geographical Cognitive Institutional Organizational Social
2001	Introduction of its first phone with a built-in camera (www.theguardian.com)	Geographical Cognitive Social
2002	Introduction of its first video capture phone and its first 3G phone (www.theguardian.com)	Geographical Cognitive Social
2006	Acquisition of a mapping software specialist (Gate5) (company.nokia.com)	Cognitive Organizational Social
2008	Acquisition of NAVTEQ (a US-based maker of digital mapping and navigational software) (company.nokia.com)	Geographical Cognitive

		Institutional Organizational Social
2011	Creation of a strategic partnership with Microsoft and launch of new smartphone (www.theguardian.com)	Geographical Cognitive Institutional Organizational Social

Source: (Solvell and Michael, 2011) (www.theguardian.com), (company.nokia.com), own elaboration

NOKIA and its collaborators had to deal with distance in both absolute and relative terms, as every development step was accompanied by a series of barriers that had to be overcome. Except for Finland's peripheral geographic location, the NOKIA Corporation, as a newcomer in telecom and mobile segments in the 1960s and 1970s, also had to deal with cognitive, organizational, institutional and social obstacles. The existence of cognitive distance between NOKIA and its partners was a major barrier. Therefore, the engaged companies had to create a common knowledge base with diverse but complementary capabilities in order to reduce misunderstanding and enable effective communication. Organizational barriers had to be overcome as well, in the sense that the engaged firms had to develop a common coordination mechanism for the control of knowledge exchange and a strong hierarchy base, capable of reducing opportunism and uncertainty in knowledge generation.

NOKIA and its partners also had to pay attention to the development of social proximity between them in order create trust-based cooperative relationships which reinforce the ability to perceive and absorb external information. The breed of trust, commitment, social cohesion and shared values between the engaged actors undoubtedly encouraged their cooperation and contribute to effective interactions. Finally, institutional barriers had to be overcome. The firms had to create a common framework base with regard to laws and values characterized by both institutional stability and flexibility which would enable them to rapidly react to institutional transformations.

As presented, the government assisted NOKIA's expansion and encouraged its joint venture with the Finnish Cable Works and the Finnish Rubber Works for the formation of the NOKIA Corporation (see the Appendix for an overview) (Ali-Yrkko

& Hermans, 2004, pp. 111-2) (www.fundinguniverse.com). The firm's collaborations in production and R&D with other companies were not too close at its first stages of development (Ali-Yrkko & Hermans, 2004, p. 113). However, during the early 1980s, motivated by the government's vision of a collaborative business model (Ali-Yrkko & Hermans, 2004, pp. 112-4), it decided to diversify and expand its interests beyond Finnish borders through acquisitions, joint ventures and collaborations (www.fundinguniverse.com). In this period NOKIA started systematically relying on external partners by adopting an *"open innovation model"* (Ali-Yrkko & Hermans, 2004, p. 113) (Lesser, 2008, p. 29), and made enormous efforts to reduce its cognitive distance from its partners and support its engagement in the high-tech sector.

More specifically, the collaboration with Televa for the combination of their R&D and marketing efforts in digital technology (Solvell & Porter, 2002, p. 5), the establishment of a division for the development of *"design and manufacturing capabilities in data processing, industrial automation, communications systems"* and information systems (http://www.fundinguniverse.com) -since style was a crucial factor in Scandinavian markets- in cooperation with Salora in 1967, as well as the creation of Mobira for the marketing and development of radio technology, only begin to highlight NOKIA's persistence on knowledge accumulation (see the Appendix for an overview). The establishment of joint ventures in Korea and the US for mobile telephones manufacturing in combination with the Tandy Corporation (a leather goods company in Texas, established in 1919, which started the personal computer evolution in 1977), also emphasize the corporation's strategy to improve its capabilities by learning from outsiders, and marks its willingness to create a strong collaborative model capable of "reducing" to some extent the physical distance from its partners (see the Appendix) (Solvell & Porter, 2002, p. 6) .

The firm initially attempted to exploit its geographical proximity to its neighboring countries. Therefore, a basic strategy was the consolidation of its business in Finland, Sweden, Denmark and Norway[3] and then in the rest of the world (www.fundinguniverse.com). Over the course of the 1980s, driven by the need for interactive learning and innovation, the firm acquired nearly 20 companies and mostly focused on three segments of the electronics industry: consumers, workstations, and

[3]Before 1980 NOKIA's products were sold in its domestic market and neighboring countries (Solvell & Porter, 2002, p. 5).

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mobile communications (http://www.fundinguniverse.com). Some of its most known acquisitions concerned companies that were mostly operating in the electronics industry, such as Luxor (a Sweden owned electronics and computer firm established in 1923), the PC and Office Electronics Business of Ericson (1988) and Standard Elektrik Lorenz (a German manufacturer of TV sets and other electronics) (Solvell & Porter, 2002, p. 6) (Aluya, 2014, pp. 6-8).

Although a market leader in Scandinavia, the European market was dominated by large Japanese and German companies (www.fundinguniverse.com**)**. NOKIA still lacked a degree of competitiveness and, thus, it decided to become an original equipment manufacturer for competitors. It manufactured items for Hitachi in France, Ericsson in Sweden, Northern Telecom in Canada, and Granada and IBM in Britain. In doing so the NOKIA Corporation was able to increase its production capacity, develop a degree of cognitive closeness to its competitors and improve its technological capabilities (www.fundinguniverse.com**)**.

In the period of the 1980s and the 1990s, severe competition in the telecommunications sector forced NOKIA to expand its R&D activities overseas (Ali-Yrkko & Hermans, 2004, pp. 112-3). Therefore, in the 1990s, the company internationalized its R&D function, by spreading its researchers to various R&D units and establishing numerous research centers abroad (Lesser, 2008, pp. 28-9). The majority of the company's R&D centers were located in close proximity to its offshore production sites, leading universities and research institutions, aiming at both the exploitation of knowledge from each engaged global source and the adaptation of products to the needs and preferences of consumers in the host regions and countries (Lesser, 2008, p. 28) (Solvell & Porter, 2002, p. 18). As reported:

> By 1998 more than half of the company's R&D was conducted outside of Finland (though the main Nokia Research Center remained in Finland). Some of these centers, located in regional clusters of scientific excellence (e.g., Silicon Valley), have helped Nokia tap knowledge from rivals and foreign markets (Lesser, 2008, p. 28).

By the 1990s, collaborations with other companies, research institutes and universities became the central part of Nokia's global R&D strategy (Table 3.3) (Lesser, 2008, p. 7) (Ali-Yrkko & Hermans, 2004, pp. 112-3) and contributed to the exchange of know-how from external partners to NOKIA and vice versa (Ali-Yrkko & Hermans, 2004, pp. 112-20). The creation of a global R&D network for the building of technological

competencies has been a central part of NOKIA's strategy, as although more than half of its total R&D activities were located in Finland, by the 1990s the firm had R&D units located in 14 countries (Solvell & Porter, 2002, p. 18). Some of its widely known R&D centers are in Berkeley, US, for radio technologies, in Bangalore, India, for imaging technologies and spatial audio, in Sunnyvale, US, for research into novel imaging technologies and computational photography, in Cambridge, UK, for the development of nanotechnologies, advanced sensors and quantum technologies for mobile communication, in Espoo, Finland, for research on radio technologies, media technologies, interaction technologies and sensor systems for mobile devices, and in Tampere, Finland, for research in media technologies, audio and visual technologies, media systems and novel radio technologies (research.nokia.com/locations).

Table 3.3: NOKIA's operations in R&D Units and Production Facilities (2000)

R&D Units		**Production Facilities**	
Australia - Qt cross-platform application framework	Italy	Finland	Brazil
China - mobile applications based on 3G and IP Multimedia Subsystem (IMS) for both Chinese and global markets -wireless and Internet for Asia	Japan -mobile phones terminals and business -online business -IP network security, mobile connectivity	Germany	Mexico
Denmark -development and testing of selected mobile phones	South Korea - software development -applications & platforms for 3G	United States	Malaysia
Finland - radio technologies, media technologies	Sweden - software development, communication research and hand-set technology	Hungary	South Korea
Germany -global R&D services to Nokia Siemens by leveraging its expertise in the telecommunications sector	United Kingdom	China	
Hungary - development of Nokia's Mobile Switching software and	United States -ATM (Asynchronous Transfer Mode) product development for the		

applications	strengthening of Nokia's ATM expertise	

Source: Solvell & Porter, 2002, p. 18, news.softpedia.com, www.etla.fi, www.smh.com.au, www.zdnet.com, www.hindustantimes.com, own elaboration

Reinforced by TEKES' funding and other political initiatives in the 1990s, the company invested more heavily in R&D, proved by the fact that whereas R&D spending represented some 5.5 percent of total sales in 1991, it more than doubled in 2005 with most of the spending concerning Mobile Phones and Networks business subsidiaries (Lesser, 2008, p. 7). Especially in 2003, Nokia's R&D spending reflected 33 percent of Finland's total gross domestic R&D expenditure and 47 percent of private sector's R&D expenditure (Lesser, 2008, p. 27). "*Between 2004 and 2007 Nokia's total research and development spend was €17.1 billion"* and this explains why NOKIA has significantly impacted Finland's overall R&D intensity (blogs.wsj.com).

NOKIA relocated some of its production activities abroad *"by establishing factories in various foreign countries and working with a selected number of external suppliers in Finland and abroad"* as far as electronic components, mechanical components and software are concerned (Lesser, 2008, p. 7). The production of mobile phones particularly took place in Brazil, China, Germany, Finland, Hungary, India, Mexico, South Korea and the UK, whereas component suppliers were located across a wide range of countries, including Austria, Brazil, China, Chinese Taipei, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, India, Ireland, Israel, Japan, Korea, Malaysia, Mexico, Morocco, the Netherlands, the Philippines, Portugal, Singapore, Slovakia, Spain, Sweden, Switzerland, Thailand, the UK and the USA (Lesser, 2008, p. 30) (www.nokia.com). "*By the end of 2006 Nokia was operating 15 manufacturing facilities in a total of 9 countries for the production of mobile devices and network infrastructure"* (www.nokia.com).

Although NOKIA used to face *"the Finnish home market as a large test-trial laboratory prior to internationalization"* (Lesser, 2008, p. 16), the above mentioned complementary competences enabled it to satisfy various requirements in an effective and rapid way, and overcome its initial limitations implied by its small home market and its non-central geographic location. The spatial diffusion of NOKIA's collaborators offered an international character through the blend of social characteristics, international design norms and different cultures. NOKIA's

worldwide presence marks its willingness to engage with the foremost minds and partners in the mobile field for the conduction of leading-edge research. Through this bridging of cultures, environments and skill-sets across diverse geographies, NOKIA became capable of developing products and services that meet the needs of its customers.

The NOKIA Corporation was actively engaged in open innovation though the creation of deep research co-operations with leading institutions with whom it collaborated relatively well (Ali-Yrkko & Hermans, 2004, pp. 116-9). Although there were 12 colleges and universities engaged in information technology and telecommunications research, NOKIA's main R&D center was established in the University of Oulu which had a long tradition in telecommunications and ICT from 1960 (Solvell & Porter, 2002, p. 17) (Ali-Yrkko & Hermans, 2004, pp. 117-9). The firm also developed strong collaborations with numerous universities both in Finland and abroad as displayed in Table 3.4 (Lesser, 2008, p. 29). This openness resulted in a two-way knowledge transfer between the company and the universities, and facilitated the exploitation of external technology and expertise.

Table 3.4: NOKIA's collaborations with Finnish and foreign universities

Collaborations	Activities
Finland	
Aalto University (2010)	Interdisciplinary activities that combines technology, economics and industrial design
Tampere University of Technology (1965)	Signal processing-based technologies, nanophotonics, biotechnology and intelligent mobile machines
University of Tampere (1925)	Research on humans and technology, research on society and administration
Abroad	
Massachusetts Institute of Technology (MIT) (1861)	Teaching and research with relevance to the practical world
Beijing University of Posts and Telecommunications (BUPT) (1955)	A research-oriented university with information technology and telecommunications as primary areas of research and study
Stanford University (1891)	Multidisciplinary research within its schools, departments and independent laboratories, centers and institutes

Tsinghua University, China	Basic research, applied research and scientific innovation in science, engineering, economics, management and art
University of California, Berkeley (1868)	History of innovation and scientific discovery such as the advent of open source software
Cambridge University (1209)	Large and vibrant high-tech entrepreneurship tradition, an Open Innovation hub, with start-ups and large corporate research labs

Source: Solvell & Porter, 2002, p. 5, research.nokia.com, own elaboration

The company participated in various international R&D projects with other academics, research institutes, firms and universities of technology, as part of a strategic attempt to further expand its cognitive scope and multiply its technological capacities (Lesser, 2008, p. 29). It also recruited a considerable number of R&D employees in Finland, which offered it the capability to access foreign knowledge and expertise (Ali-Yrkko & Hermans, 2004, pp. 110-1). Simultaneously, the involvement of various partners in most of the TEKES financed NOKIA projects (Ali-Yrkko & Hermans, 2004, pp. 107-9,114) contributed to the improvement of its technological capacity and paved the way for interactive learning and innovation. According to NOKIA's belief the mixing of participants across business groups leads to knowledge generation *"because traditions and experiences can be shared among employees"* (Lesser, 2008, p. 31) (Solvell & Porter, 2002, p. 17) (answers.mheducation.com).

In its attempt to further expand its cognitive scope, NOKIA attempted *"to influence the level and direction of higher education"* and *"increase the number of university starting places available in the fields of electronics, telecommunications and information technology"* (Ali-Yrkko & Hermans, 2004, pp. 110-1). It has also invested substantial funds in *"specialized in-house training programs, sometimes in collaboration with Finnish universities"* (Roos et al., 2005, p. 10) and established *"a wide variety of training and development opportunities, including learning centers"* (answers.mheducation.com). It could be stated that the firm has always been strongly committed to continuous learning, in the form of self-development, coaching and training, for the creation of personal and professional growth opportunities (answers.mheducation.com).

NOKIA paid great attention to the elimination of institutional barriers with its collaborators. Therefore, it created of a comprehensive institutional base which was

constantly updated on changes in the countries of operation. EU regulation has promoted the business between NOKIA and its customers within the single market of the European Union, but the firm never stopped being particularly attentive to regulatory changes affecting trade, such as customs changes, import and export procedures (Lesser, 2008, p. 30). This awareness offered the company the opportunity to rapidly react to global changes and meet the new needs.

Moreover, a great share of NOKIA's success is attributable to its capability to develop a strong organizational relationship with its partners, in the sense of control and hierarchy, which increased its capacity to coordinate the exchange of complementary knowledge (Boschma, 2005, pp. 61-74). The company managed to build a strong organizational base, by adopting an adequate protection framework which safeguarded patents, design, trademark and copyrights, guaranteed ownership rights and rewards for investments in new technological fields, and prevented external actors from accessing specific knowledge (Mattes, 2012, pp. 1085-99). Finally, the simplification of its organizational structure worldwide further encouraged effective communication and trust among its various partners (Lesser, 2008, p. 29). "*Nokia promoted the emergence of tightly knit teams and close co-operation between employees in view of creating products that meet customer needs*" (Lesser, 2008, p. 29). This strategy to respect culture and diversity enabled the company and its partners to develop deep personal relationships and trust (Ali-Yrkko & Hermans, 2004, p. 114).

Table 3.5: Practices adopted by NOKIA in order to overcome distance in its various dimensions

ADOPTED PRACTICES	**BARRIERS OVERCOME DUE TO THE ADOPTED PRACTICES**				
NOKIA	**Geographical**	**Social**	**Institutional**	**Organizational**	**Cognitive**
Collaborations in production and R&D with foreign companies and the adoption of an open innovation model	✓	✓	✓	✓	✓
Collaborations in production and R&D with foreign companies				✓	✓
Increase of R&D activities overseas in the 1990s, in close proximity to its offshore production sites, regional clusters of scientific excellence, leading universities and research institutions	✓	✓		✓	✓
Establishment of plants in various parts of the world in order to perceive changing consumer needs and demands in any market	✓	✓			✓
Collaboration with suppliers from a wide range of countries	✓			✓	✓
Strong co-operations with key universities both in Finland and abroad	✓	✓			✓
Participation in various international R&D projects with other academics, research institutes, firms and universities	✓	✓			✓
Involvement of various partners in most of NOKIA's projects		✓		✓	✓
Attempt to influence the level and direction of Finland's higher education					✓
Investments in specialized in-house training programs and continuous learning, sometimes in collaboration with Finnish universities					✓

Recruitment of foreign R&D employees in Finland	✓	✓			✓
Special attention to regulatory changes affecting trading, such as customs changes, import and export procedures			✓		
Adoption of a comprehensive organizational base (strong intellectual property rights protection) and simplification of the organizational structure (flattening of hierarchy)				✓	
Promotion of tightly knit teams and close co-operation between employees and various external partners		✓			

Source: own elaboration

3.3 THE CASE OF SAMSUNG ELECTRONICS

The Samsung Group, a South Korean multinational conglomerate company headquartered in Seoul and founded by Lee Byung-Chul in 1938, started out as a small trading company (selling noodles and dried seafood) but it managed to evolve into a brand that resonates with global leadership in various industries including IT, shipbuilding and engineering[4] (www.samsung.com). Samsung Electronics Co. (established in 1969) and its affiliated firms: Samsung Electron-Devices Co., Samsung Electro-Mechanics Co. and Samsung Corning Co. represent the core electronics producers of the group (Youngsoo, 1998, p. 517). Samsung Electronics, located in Suwon, South Korea, represents the major subsidiary of the Samsung Group (www.samsung.com). Therefore, this case study will mostly focus on its efforts to overcome its initial limitations, by providing the strategic steps it made in order to improve its technological capabilities, prepare for globalization and "*adapt with increasing speed to market pressures and competitors' innovations"* (Cho, 1996, p. 783).

3.3.1 PUBLIC INITIATIVES FOR THE DEVELOPMENT OF THE KOREAN KNOWLEDGE-BASED ECONOMY

South Korea has been transformed from an agrarian into an industrialized economy with a rapid economic growth since the 1960s (Kim, 1998, pp. 311-3) (Chung, 2010, p. 333). This success, which required the government to play an active and interventional role, was mostly achieved by the increase of capital and labor input (Pillay, 2010, pp. 71-89). The economic policies responsible for this growth have highlighted the concentration on the development of a dynamic, export-orientated manufacturing industry with a progressive move towards high technology (Pillay, 2010, p. 71). More specifically, during the 1960s and since the 1980s, like any other developing country and due to its weak local capabilities, South Korea focused on the acquisition, assimilation and imitation of mature foreign technologies from industrially advanced countries (Kim, 2004, p. 345) (Sohn & Kenney, 2007, p. 993). At the beginning of its developmental time, the country was characterized by a protected economic environment, as it discouraged FDI by "*restricting ownership and*

[4]SAMSUNG established Samsung Heavy Industries (1974), Samsung Shipbuilding (1977), and Samsung Petrochemical (1974) (Lee & Lee, 2007, p. 494).

repatriation of profits and imposing requirements on technology transfer and exports" (Chung S. , 2010, p. 335) (www.ida.org/).

In the late 1960s public agents made some strategic steps to reinforce the country's transition to an industrialized economy (Sohn & Kenney, 2007, p. 997) (Chung, 2010, p. 334). In this period there were two public institutes for scientific research and technological development: the National Defense R&D Institute (established in 1953) and the Korea Atomic Energy Research Institute (established in 1959) (Chung, 2010, p. 334). Education also was a driving force behind South Korea's development as, since the 1960s, the government's plans have been directly reflected in education policy (Pillay, 2010, p. 73). The Korean experience indicates that the investments in education for the creation of highly skilled personnel before the industrialization process can crucially support economic development in an effective and efficient way (Kim, 1998, p. 316) (Kim, 2004, p. 361).

In the early 1970s the Korean government facilitated exports by promoting a General Trading Company (GTC) system[5], which both assisted global players to enter the protected Korean environment and facilitated local firms' international orientation (Cho, 1996) (Cho, 1996, p. 787). It could be stated that the government's strategy towards restricting FDI but promoting technology transfer, encouraged Korean firms to insist on learning and invest heavily in technology for the building of their innovative capacities (Kim, 1998, p. 317) (Chung S. , 2010, p. 353). In parallel, capital accumulation and knowledge sourcing allowed a gradual shift to more sophisticated activities (Pillay, 2010, p. 72). Therefore, in the 1970s, the government attempted a strategic shift to more technology-intensive activities, initially related to the building up of machinery and chemical industries (Sohn & Kenney, 2007, p. 993) (Pillay, 2010, p. 72). Still, due to the lack of technological capabilities, the country had to rely almost totally on foreign sources of technology. As a result, the political strategy promoted the inward transfer of foreign technologies for the development of a *"domestic capacity to digest, assimilate, and improve upon the transferred technologies"* (Chung, 2010, p. 334). Towards this direction, the government established government R&D institutes, such as the Korea Institute of Machinery and Metals, the Electronics and Telecommunications Research Institute, the Korea

[5] Nevertheless, foreign funds and institutions have a limited role in R&D and innovation in Korea (Chung S. , 2010, p. 342).

Research Institute of Chemical Technology, the Korea Research Institute of Standards and Science, the Korea Institute for Energy Research and the Korea Ocean R&D Institute (Chung, 2010, p. 336).

In the 1970s the government made efforts to build a proper base for science, technology, and innovation through the introduction of the Science and Technology Promotion Act and the Science Education Act in 1967. The Korea Institute of Science and Technology (KIST) and the Ministry of Science and Technology (MOST) were established as the central government agencies for S&T policy (Lee, 2003, p. 30) (Kim, 2004, p. 354) (Sohn & Kenney, 2007, pp. 991-1004) (Chung S. , 2010, pp. 336-7). Moreover, in 1970 the government enacted the Korea Advanced Institute of Sciences Act, which created the basis for the foundation of the Korea Advanced Institute of Sciences (KAIS, currently KAIST). KIST was the first organization strictly dedicated to R&D and enabled industries to strengthen their capabilities in acquiring foreign technology (Kim, 2004, p. 354), whereas KAIS introduced the U.S. graduate education system to the country (Chung S. , 2010, pp. 336-7). Simultaneously, various government research and development institutes were also established to support industries as far as the absorption and assimilation of new technologies is concerned (Chung S. , 2010, pp. 336-7). These institutions combined with the government's initiative for the "repatriation" of Korean scientists and engineers from abroad (Kim, 2004, p. 358) (Chung S. , 2010, pp. 336-7) assisted private companies to acquire new technologies and improve their R&D capabilities.

Beginning in the 1980s, South Korea "*undertook efforts to ensure a market-conducive environment by deregulating various sectors and liberalizing trade*" (Pillay, 2010, p. 72). As a result, the concentration on R&D performance and innovation started getting transferred from the government to private firms (Sohn & Kenney, 2007, p. 993). Nevertheless, due to the complex technological requirements of Korean industries, such as the demand for skilled labor force (Pillay, 2010, p. 76) and the increasing concentration on the promotion of an information society, the government established the Ministry of Science and Technology in 1967, to focus on S&T issues, and promote infrastructures and public R&D activities (Kim, 2004, p. 318). Moreover, it created the Korea Technology Development Corporation in 1981, together with the Industrial Development Fund (1986), the Science and Technology Promotion Fund (1991) and the Information and Telecommunication Technology

Fund (1993) to reinforce the development and commercialization of technology (Chung S. , 2010, pp. 337-40).

The government launched the National Research and Development Program in 1982, to promote and facilitate private R&D activities (Pillay, 2010, p. 72) and enacted the Basic Research Promotion Law in 1989, in order for universities to both upgrade their research capabilities and support private industries (Kim, 2004, p. 359) (Chung, 2010, pp. 337-340). This experience indicates that both public and private initiatives must evolve in response to the changing technology environments (Kim, 1998, p. 322). Since firms needed to further improve their capabilities, the government emphasized on the development of "*collaborations between industry and the R&D community…and became mostly interested in networking among firms, universities and public research institutes*" (Lee, 2003, p. 30). Towards this direction, public agents designed and implemented policy programs capable of encouraging R&D cooperation, such as the Promotion Law of Research Cooperatives and the Promotion Law of Cooperative Research Activities, inaugurated in 1986 and 1994, respectively (Lee, 2003, p. 30). Since the late 1980s, South Korea had already created a cognitive base capable of supporting knowledge-intensive activities, and as a result, in this period, the government aimed at the engagement in high-tech industries (Yoo et al., 2005, p. 335).

In the 1990s, the Korean government had already set up the necessary information infrastructure and in the mid-1990s intense policy efforts were made to transform the Korean economy into a strong innovation player (Pillay, 2010, pp. 72-3). In this period there was a strong concentration on three principles in order to tackle new technological capabilities: *"foreign technology transfer through formal mechanisms, the recruitment of high-calibre human resources from abroad and local R&D efforts"* (Kim, 2004, p. 356). Towards this direction, the government introduced "*science and technology development as part of the national economic development plan*", and created state-led R&D institutes in the fields of innovation related activities, so to assist industries adapt to new technologies (Chung, 2010, p. 353). Moreover, Korean students were encouraged to travel abroad for postgraduate education and later import their knowledge and experience of foreign universities to their home country (see the APPENDIX for an overview) (Sohn & Kenney, 2007, p. 995).

Due to the lack of research in universities, the government initiated the establishment of government-sponsored laboratories which offered South Korea an advantage over other Asian and Western economies (www.ida.org/). The Korea Institute of Science and Technology (KIST), an example of the government-led research institutes, recruited Korean scientists that were trained overseas in order to facilitate the acquisition of foreign technology (Kim, 2004, p. 354). The KIST was an important contributor to the acquisition, assimilation and adaption of foreign knowledge in Korea (Kim, 2004, p. 354) and, thus, researchers have pointed out that:

> National laboratories, private industries and government-sponsored research institutes (GRIs) have played important roles in Korea's economic development and they emerged as strategic partners in the local R&D policy mix (Chung S. , 2002, p. 487) (ec.europa.eu/).

In 1968 the government officially marked the beginning of public support for the industry by introducing the Electronics Industry Promotion Law, while in 1983 it promoted the semiconductors policy (Youngsoo, 1998, p. 518). In this year SAMSUNG exploited the government's initiatives and entered the international DRAM market (Dynamic Random Access Memories) as it will be further analyzed below (Youngsoo, 1998, pp. 518-26) (Sohn & Kenney, 2007, p. 993) (Lee & Slater, 2007, p. 248). In 1984 Korea launched the first mobile telecommunication service (based on analogue technology), in the 1990s it succeeded in the second generation technology (Code Division Multiple Access- CDMA), and in 2002 it moved towards the third generation phase of broadband mobile telecommunication, marking Korean firms' leadership in the sector (Lee & Lim, 2001, p. 473) (Lee & Han, 2002, p. 161) (Lee et al., 2003, p. 84) (Yoo et al., 2005, p. 335).

The major players in the first generation technology were the Korean government and foreign companies, as the domestic firms were beginning to develop their technological competences (Lee & Han, 2002, pp. 170-2). The first attempted to establish the industry's key players by *"selecting the industry standard and restricting the monopoly power of foreign companies"* (Lee & Han, 2002, pp. 170-1). Nonetheless, the Korean telecommunication industry was highly dependent on foreign companies (such as AT&T and Motorola) and technologies (Lee & Han, 2002, p. 169). Displeased by the heavy dependence on foreign sources, the Ministry of Communication initiated a project in 1989, which is now characterized as one of the most successful projects ever managed by the government (Lee & Han, 2002, p. 172).

It aimed at the development of digital network systems in order to "*replace imported products and to satisfy growing market demand*", and led to the generation of the world's first digital mobile telecommunication service in 1996 (Lee & Han, 2002, p. 172). In general, in this generation there was no national innovation system, but the government managed to gain the leadership and reduce the Korean firms' uncertainty.

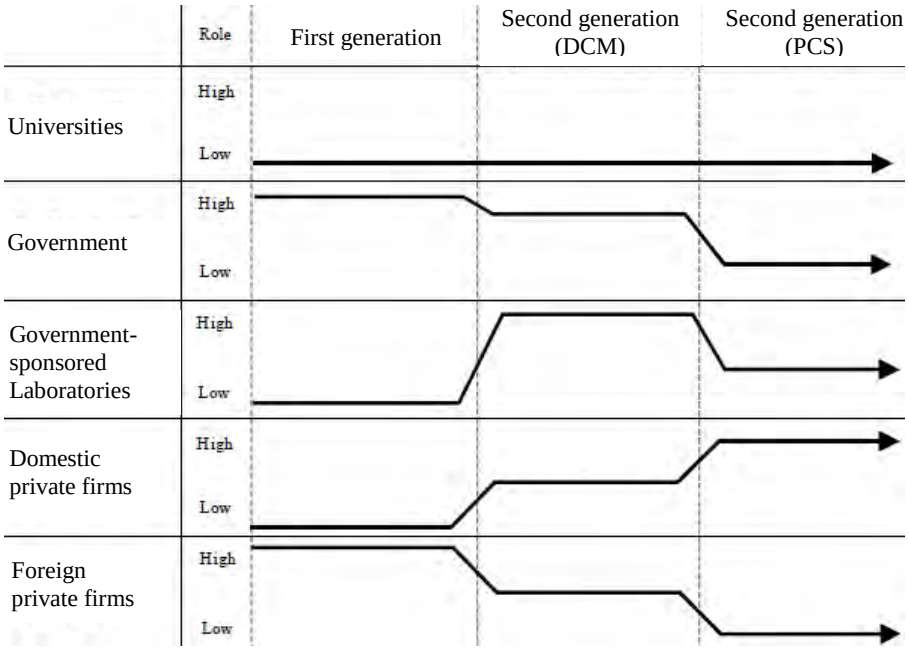
The creation of a *"fully-fledged national innovation system"* guaranteed the second generation technology's success (Lee & Han, 2002, p. 176). Except for the government's initiatives –which were reduced in comparison to the first generation phase- government-sponsored research laboratories also played a pivotal role at the early stage of basic learning (Choung et al., 2014, p. 161). Electronics and Telecommunications Research Institute (ETRI) – "*a consortium for joint research and development with support from the Ministry of Science and Technology and the Ministry of Commerce*"- appeared to be a key player in this stage (Choung, Hwang, & Song, 2014, p. 161). This government-led research institute (founded in 1985) managed to advance the sector's capabilities by providing a well educated human force, experience and resources that aimed towards the sophistication of information and communication technologies (Lee & Lim, 2001, p. 471) (Lee & Han, 2002, pp. 178-82). Moreover, it contributed to the reduction of technological uncertainties by *"providing accurate and up-to-date information on technology trend"* (Lee & Lim, 2001, p. 473).

Providing a comparison between the two generation stages, as illustrated in Figure 3.1, it could be stated that the government played a leading role in the development of the telecommunications technology which however diminished over time. Similarly, government-sponsored laboratories –like ETRI- had a dominant contribution to the first stage which then decreased, while foreign firms' assistance, high in the first stage, was later replaced by the domestic firms' engagement in the sector (Lee & Han, 2002, p. 182). Finally universities played a limited and rather insignificant role, either due to their incapability to support the specific type of R&D needed in the industry (Lee & Han, 2002, p. 182) or due to their persistence on providing human capital and not ideas (www.ida.org/).

There is a sense of dissatisfaction about the quality of university education in South Korea deriving from the lack of focus on independent thinking (www.ida.org/). The Korean experience indicates that universities contributed to the country's economic

development not through the transfer of research results, but through the "creation" of high-quality graduates (Sohn & Kenney, 2007, p. 992). There is the belief that "*Korean universities were and are still, to a substantial degree, embedded in a hierarchical and conservative system creating significant obstacles to inter-institutional knowledge transfer and entrepreneurship*" (Sohn & Kenney, 2007, p. 1002). Historically, there have been weak interactions between business and universities with a possible reason being the large private firms' strategy to create their own education facilities (Pillay, 2010, p. 87). Nowadays basic research in universities is complementary for the development-oriented R&D of firms, so as to contribute to the firms' innovative performance, but there is still the consensus that *"R&D outsourcing from universities to firms has been negligible in Korea despite the fact that it brings about university-generated cooperative R&D with firms"* (Lee K.-R. , 2014, p. 23).

Figure 3.1: The evolution of the national innovation system in the Korean mobile telecommunications industry



Source: Lee & Han, 2002, p. 181

Except for all the initiatives mentioned above, the government also attempted the organizational reformation of the traditional Korean system. Since the late 1990s the Korean government introduced "*ambitious goals in the form of publication and patenting targets for public research institutes*" (www.ida.org/). At this period someone could clearly observe "*a steady rise in patent applications*", which indicated

a degree of South Korea's integration with worldwide economic activities (www.ida.org/). The mix of intellectual property protection and governmental priorities on "*export orientation and competitiveness*" for science and technology activities, assisted Korea to evolve in a top exporter in the field of high-technology products in a rather short period of time (www.ida.org/).

Moreover, the country paid attention to the mixing of "*policy-driven investments with market-driven business strategies*" in order to move from imitation to innovation (Chung S. , 2010, pp. 353-4) (www.ida.org/). The adoption of an outward-looking strategy and the firm-oriented industrial reflect the enabling factors for South Korea's sustainable growth and have contributed to what is called the "Korean miracle" (Chang & Choi, 1988, p. 142) (Chung S. , 2010, pp. 333-4). The country's successful movement towards a knowledge-based economy is the result of "*a concerted effort*" between the government and private industries, in the sense that the first managed to provide the right framework conditions for the creation of an information society, while the latter, concentrated on the exploitation of these political initiatives and improved their capabilities (Youngsoo, 1998, p. 518) (Pillay, 2010, pp. 72-3).

Table 3.6: Practices adopted by the South Korean government in order to overcome distance in its various dimensions

ADOPTED PRACTICES	**BARRIERS OVERCOME DUE TO THE ADOPTED PRACTICES**				
Government	**Geographical**	**Social**	**Institutional**	**Organizational**	**Cognitive**
Establishment of public institutes for scientific research and technological development: the National Defense R&D Institute (1953) and the Korea Atomic Energy Research Institute (1959)					✓
Facilitation of exports by the Korean government in the early 1970s and the promotion of foreign technologies' inward transfer	✓		✓		✓
Establishment of numerous Korean R&D institutes in the 1970s					✓
Introduction of the Science and Technology Promotion Act and the Science Education Act in 1967 and the establishment of the Korea Institute of Science and Technology (KIST) and the Ministry of Science and Technology (MOST) for the creation of a strong cognitive base for science and technology					✓
Creation of the Ministry of Science and Technology in 1967, the Korea Technology Development Corporation in 1981, together with the Industrial Development Fund (1986), the Science and Technology Promotion Fund (1991) and the Information and Telecommunication Technology Fund in order to focus on S&T issues, and promote infrastructures and public R&D activities					✓
National Research and Development Program in 1982 for the facilitation of private R&D activities					✓
Implementation of the Promotion Law of Research Cooperatives (1986) and the Promotion Law of Cooperative Research Activities (1994) for the	✓			✓	✓

encouragement of cooperation between industries and the R&D community					
Encouragement of Korean students to travel abroad for postgraduate education and import their knowledge and experience to their home country	✓	✓	✓		✓
Establishment of the Korea Institute of Science and Technology (KIST), which recruited Korean scientists that were trained overseas in order to facilitate the acquisition of foreign technology	✓	✓	✓		✓
Promotion of R&D outsourcing from universities to firms especially in the 1990s				✓	✓
Promotion of the acquisition, assimilation and imitation of mature foreign technologies from industrially advanced countries	✓	✓	✓	✓	✓
Organizational reformation of the traditional Korean system					
Huge investments in the improvement of education					✓

Source: own elaboration

3.3.2 SAMSUNG's CHOICES FOR THE OVERCOMING OF DISTANCE BARRIERS

As mentioned in the foregoing, the Korean government facilitated the development of large Korean firms by adopting business practices and strategic policies for the creation of a knowledge-based economy (Youngsoo, 1998, p. 518). The promotion of the GTC system in the early 1970s and "*the formation of a semiconductor R&D consortium with the participation of Samsung, LG and Hyundai to develop successive generation memory chips"* in 1986 (Lee & Lim, 2001, p. 472) for example, made SAMSUNG the first formally defined trading company to establish overseas branches and collect foreign information (Cho, 1996, p. 787). However, the SAMSUNG Group and particularly SAMSUNG Electronics[6] have made great efforts in order to improve their capabilities and reduce their distance from global markets in physical and absolute terms. The aggressive and risk-taking investment behavior in search of new knowledge and the effective policy of managing technology development contributed to the company's remarkable transformation over the last three decades and facilitated its extraordinary achievements (Lee & Slater, 2007, p. 241).

Table 3.7: SAMSUNG Electronics' evolution and barriers that had to be overcome

	SAMSUNG's stages of development	**Barriers that had to be overcome**
1948	The Company focused on trade in agricultural commodities with partners in Southeast Asia and the	Geographical Institutional Organizational
1970	Black-and-white TV set production by Samsung-Sanyo	Geographical Cognitive Institutional Organizational Social
1974	Samsung Heavy Industries incorporated and Samsung Petrochemical established. Began washing machine and refrigerator production.	Cognitive Organizational

[6]Samsung Electronics consists of five business divisions: the Semiconductor Business, which is the core business in the company, the Digital Media Business (TVs, AV equipment, and computers), the Telecommunication Business (mobile phones and network equipment), the LCD Business (LCD panels for notebook computers, desktop monitors, and HDTV) and the Digital Appliances Business (refrigerators, air conditioners and washing machines) (Lee & Slater, 2007, p. 248).

1977	Export of color televisions	Geographical Institutional
1980	Production of air conditioners	Cognitive
1983	Production of personal computers (PCs)	Cognitive
1987	Samsung Advanced Institute of Technology opened for R&D purposes	Cognitive Organizational Social
1988	Samsung Semiconductor & Telecommunications Co merged with Samsung Electronics with home appliances, telecommunications and semiconductors as core business	Cognitive Organizational Social
1989	20 millionth color TV produced	Cognitive
1991	Development of mobile phone handset	Cognitive
1992	Development of mobile phone system, 250MB and 64M DRAM hard disc drive. Began manufacturing in China	Geographical Cognitive Institutional Organizational Social
1993	Samsung Electronics acquired U.S. firm HMS (Harris Microwave Semiconductor)	Geographical Cognitive Organizational Social
1994	Development of the first Korean-built electric car , the first 256M DRAM and the first four-power zoom camera	Cognitive
1995	Development of the world's first real-time MPEG-3 technology and first 33" double-screen TV	Cognitive
1998	Top share of world’s TFT-LCD market with mass production of world's first digital TV and development of completely flat-screen TV completed	Geographical Cognitive

1999	Development of the wireless Internet phone (Smartphone), a small, multi-function phone	Cognitive
2000	Samsung Electronics and Yahoo! form a strategic alliance	Geographical Cognitive Organizational Social
2002	Development of color mobile phones	Cognitive
2004	Development of the world's first 60-nano 8GB NAND Flash memory chip and the 3rd Generation Optical Blu-Ray Disc Recorder	Cognitive
2006	Samsung Electronics introduced of the world's first real double-sided LCD, the first 10M pixel camera phone, the worlds' first Blu-Ray Disc Player	Cognitive
2009	Samsung Electronics displayed the world's thinnest TV, the world's first 40 nanometer DRAM and the world's thinnest Blu-ray player	Cognitive
2011	Samsung Electronics signed the patent cross license agreement with IBM of the US	Geographical Institutional Organizational Social
2013	Samsung Electronics launched Galaxy S4 in the Korean market and global markets	Geographical Institutional

Source: www.samsung.com, own elaboration

Unlike the 1960s and 1970s, when the government was responsible for business regulations, the 1980s and 1990s were characterized by "*liberalization and privatization*" (Lee & Lee, 2007, p. 494), resulting in SAMSUNG's rapid evolution into one of the most competitive firms worldwide. In the 1980s the company engaged in the high-tech industry and evolved *"from a late starter to a technology leader"* through the gigantic investments in R&D and the constant efforts for the improvement of its technological capabilities (Gil et al., 2003, p. 338). As a Korean firm, its cultural environment was considerably different to that of Western firms (Lee & Lee, 2007, p. 492), resulting in the existence of social and cognitive distance from global markets. However, "*the challenge of competing on a global basis is causing firms to behave in*

different ways from what had been established" (Cho, 1996, p. 783) and, thus, the company succeeded in becoming more internationally oriented (Choi, 1995, p. 79) and overcome the distance barriers presented in Table 3.7.

SAMSUNG had to rely on foreign linkages from the very beginning of its electronics endeavors. The company developed a degree of *"know-how through learning-by-doing for more than a decade before it entered the electronics industry by its previous activities*", but during the 1960s and the 1970s, it concentrated on the import of foreign technologies and the development of close relationships mostly with Japanese electronics companies due to the lack of previous experience in the electronics sector (Choi, 1995, p. 77) (Youngsoo, 1998, pp. 518-9). SAMSUNG Electronics did not have the resources to engage in frontier technology, but it managed to expand its cognitive scope and improve its technological capabilities by making use of foreign know-how and creating new combinations of processes (Lee & Slater, 2007, p. 246). Through persistence and determination the company managed to gradually access foreign companies, assimilate foreign technologies from the simplest to more complicated and finally imitate them (Lee & Slater, 2007, pp. 250-1).

Toward the expansion of its cognitive capabilities, the company gathered *"management, production and marketing"* knowledge from foreign sources and collaborated with foreign technology suppliers, such as NEC (information technology services and products), Sanyo (radios and television sets), Corning Glass Works (materials for the electronics industry and glass substrates), ITT (telecommunication switches) and Honeywell (semiconductors) (Youngsoo, 1998, pp. 518-9). Moreover, a number of technical agreements *"to assemble electronics products for foreign original equipment manufacturer (OEM) buyers"*, such as JC Penney, Sears Roebuck, GTE, Toshiba, IBM, Hewlett- Packard, RCA, and Crown Corporation, offered it some experience on product design, engineering support and international markets (Youngsoo, 1998, pp. 518-20). The acquisition of foreign technology has been a core industry for Korean firms -especially SAMSUNG- and since the 1980s it was aggressively *"obtaining technologies from abroad –mostly from Japan and the USA- and using them to improve its capabilities"* (Sohn & Kenney, 2007, p. 993). This strategy, in combination with the adoption of Western business practices and the constant investments in R&D, enabled the company to move "*from safe technology*

investments and incremental innovation toward cutting-edge science-based innovation" (www.ida.org/).

During the early 1970s SAMSUNG Electronics began operations in semiconductors (Lee & Slater, 2007, pp. 248-9), while in the 1980s it further expanded and diversified (Youngsoo, 1998, p. 519). More specifically, in the early 1980s, with its own initiatives and with no government help, the company engaged in the production of DRAM (Dynamic Random Access Memories) (Lee & Lim, 2001, p. 471) (Lee & Slater, 2007, pp. 248-9). Investment in research and development in semiconductors and production facilities were enormous, and Korean skilled engineers working abroad, mostly in the USA and Japan, were invited to return and transfer the technologies they had obtained (Choi, 1995, p. 74). Towards the success of this venture, SAMSUNG was continuously seeking technologies and, thus, it collaborated with American and Japanese firms, Micron (an American multinational corporation based in Boise, Idaho, best known for producing many forms of semiconductor devices) and Sharp (a Japanese multinational corporation that designs and manufactures electronic products, headquartered in Osaka, Japan) respectively, in order to tap knowledge and reduce its cognitive gaps (Choi, 1995, p. 77) (Lee & Lim, 2001, p. 472) (Lee & Slater, 2007, pp. 248-9). Especially Micron provided SAMSUNG a cognitive platform that reduced time in learning the DRAM technology (Lee & Slater, 2007, pp. 248-9).

In the 1980s SAMSUNG attempted to further improve it cognitive capabilities. As a result, the business strategy was based on the expansion of Korea-based R&D centers for the assimilation and adaptation of foreign technology (Youngsoo, 1998, p. 519). Another choice was the foundation of foreign-based R&D centers, which could offer the firm *"new technologies, up-to-date information, and training for Korean R&D personnel"* (Youngsoo, 1998, pp. 518-20). In the early 1980s the US market was by far the most important for SAMSUNG and, thus, it founded several subsidiaries in the US (Table 3.8). In the 1990s the company attempted to further decrease its geographical distance from global markets, by creating collaborative ventures with European and other Asian firms (Youngsoo, 1998, p. 520).

Table 3.8: Samsung's Subsidiary Companies in the US

SAMSUNG Subsidiary	Description of the subsidiary
Samsung Electronics America	Wholly-owned subsidiary of Samsung Electronics Co. Ltd , which is engaged in global electronics markets
Consumer Business Division (CBD)	A full range of digital products for the home and personal use. It also houses Samsung's Home Appliance group
Enterprise Business Division (EBD)	A wide range of technology products and solutions for businesses of all sizes across various industries. It also houses Samsung's Health and Medical group
Samsung Telecommunications America (STA)	Founded by Samsung Electronics in 1996 in order to research, develop and market communication products
Samsung Semiconductor, INC. (SSI)	Samsung's leader in DRAM, NAND Flash, SSDs, mobile DRAM and graphics memory.
Samsung Austin Semiconductor (SAS)	It represents the company's only semiconductor manufacturing plant outside Korea, producing NAND Flash memory and Mobile SoC chips
Samsung Electronics America Logistics (SALS)	It was established in 2000 as the responsible organization for consumer electronics and home appliance distributions in North America

Source: www.samsung.com

SAMSUNG Electronics' main R&D facilities were located in Seoul, where the foremost and core semiconductor research is conducted, and information and research results from overseas are concentrated (Lee & Slater, 2007, p. 252). The firm's knowledge sourcing was facilitated by its overseas R&D laboratories, such as the R&D outpost in Silicon Valley (Lee & Lim, 2001, p. 472), which provided a campus to support the organization's rapid growth and the infrastructure to facilitate SAMSUNG's open innovation and university collaboration activities (www.businesswire.com). Throughout the years it has established numerous R&D centers as illustrated in Table 3.9. The company's R&D network spans six centers in Korea and more than 18 across the U.S., U.K., Russia, Israel, India, Japan, China, Bangladesh etc. It has also founded organizations in Universities across the globe in order to detect the latest technology trends (www.samsung.com). This strategy of

sharing competences with academic partners enabled Samsung to leverage ideas and tap into foreign expertise, in order to trigger creativity, enhance the speed and efficiency of innovation, and generate more value for people and society. Simultaneously, the development of networks with Korean and non-Korean organizations resulted in the establishment of institutional, social, cognitive and organizational closeness to foreign markets.

Table 3.9: SAMSUNG's global R&D centers

SAMSUNG R&D Centers	R&D Area
Samsung Information Systems America, Inc. (SISA)	Strategic parts and components, core technologies
Dallas Telecom Laboratory (DTL)	Technologies and products for next-generation telecommunications systems
Samsung Electronics Research Institute (SERI)	Mobile phones and digital TV software
Moscow Samsung Research Center (SRC)	Optics, software algorithms and other new technologies
Samsung Electronics India Software Operations (SISO)	System software for digital products, protocols for wired/wireless networks and handsets
Samsung Telecom Research Israel (STRI)	Hebrew software for mobile phones
Beijing Samsung Telecommunication (BST)	Mobile telecommunications standardization and commercialization for China
Samsung Semiconductor China R&D (SSCR)	Semiconductors and packages
Samsung Electronics (China) R&D Center (SCRC)	Software, digital TVs and MP3 players for China
Samsung Yokohama Research Institute	Core next-generation parts and components, digital technologies
Samsung Poland R&D Center (SPRC)	Systems of digital television, platform convergence, mobile systems, smart solutions, and enterprise solutions.
Samsung India Software Center (SISC)	S/W Platform and Application Design, Graphic design
Samsung R&D Institute Bangladesh Ltd. (SRBD)	Software for mobile devices marketed in Asia, Africa and Australia, advanced technologies and IT researches
Samsung Electronics Research Institute in Espoo, Finland	Development of the Tizen Linux-based operating system

Samsung R&D Institute India - Bangalore (SRI-B)	Mobile technology, digital printing, memory solutions and research in diverse and emerging areas of technology
Samsung Guangzhou Mobile R&D Center (SGMC)	Mobile software and hardware
Samsung R&D Center Israel	Telecommunications products, and semiconductors
Samsung R&D Center Canada	Security solutions and technical support
Samsung Strategy and Innovation Center (SSIC) California	Cloud infrastructure, mobile privacy, and mobile health

Source: www.samsung.com, archive.indianexpress.com, news.techtime.co.il, www.investinfinland.fi, www.samsungindiasoft.com, goaleurope.com, www.techvibes.com, own elaboration

The 1990s forced SAMSUNG to make strategic steps in order to overcome challenges implied by globalization (Youngsoo, 1998, p. 521). Therefore, the company attempted to increase its overseas operations by establishing joint ventures in Portugal (1982), the US (1984) and Mexico (1988) (Youngsoo, 1998, p. 521). The SAMSUNG Advanced Institute of Technology (SAIT) was responsible for the interconnection of its affiliates (Youngsoo, 1998, p. 519), their active interactions and strong collaborative relationships that eventually facilitated the effective transfer of explicit and tacit knowledge (Lee & Slater, 2007, pp. 251-2). Moreover, in 1995 SAMSUNG designated regional headquarters in America ("*five sales affiliates, two production affiliates and four branch offices*"), Europe ("*eight regional sales affiliates, five production affiliates and five branch offices*"), China ("*two sales affiliates, four production affiliates and four branch offices*"), Southern East ("*two sales affiliates, four production affiliates and eight branch offices*") and Japan ("*one sales affiliate and one branch office*") (Youngsoo, 1998, p. 521). In 1988 SAMSUNG Information Systems America (SISA) was also established, with its main research areas being *"advanced software, interactive services, user experience, and emerging technologies in convergence"*, in order to develop cutting-edge technology and also increase SAMSUNG products' competitiveness (www.businesswire.com) (www.samsung.com).

By establishing joint ventures and research centers, SAMSUNG Electronics attempted not only not to lag behind, but also leap to the forefront of technology. For example it established a subsidiary in Bombay, India, to employ local highly-skilled software

engineers and a design center in London, UK to learn design skills from London designers. It also founded design centers in its main market regions in order to promote the development of products that are suited to local needs, *"following a pattern already well established by its Japanese rivals"* (Youngsoo, 1998, p. 522). This pattern also enabled the company to carefully monitor the potential of consumer markets and rapidly adopt "*appropriate strategies to tap into them and catch up*" (Lee & Slater, 2007, p. 249).

The aggressive and outward oriented behaviors throughout the 1980s and 1990s enabled the company to note the potential of consumer markets, identify consumers' taste, which could be much different from that in Korea, establish a degree of social closeness to foreign markets, and finally outwit rivals (Lee & Slater, 2007, pp. 248-50). In 2005 for instance the SAMSUNG Group had 337 offices, facilities in 58 countries globally and employed approximately 229,000 people worldwide (Lee & Slater, 2007, p. 247). Moreover, it had 14 listed companies within the group with the three core business sectors being electronics, finance, and trade and services (Lee & Slater, 2007, p. 247). In general, the company proved that *"the key to successful international production is to recombine the knowledge acquired at home with the gradual accumulation of learning in the foreign market"* (Youngsoo, 1998, p. 524).

Table 3.10: Samsung's Technological Capabilities

	1970s	**1980s**	**1990s**
Key activities	Conglomerate diversification	Entry into DRAM market	Organizational reform, internationalization
Main sources of capabilities	Original Equipment Manufacturer (OEM) buyers and overseas training	OEM buyers, foreign licensing, reverse engineering	Acquisitions, strategic alliances, in-house R&D
Level of technological capabilities	Capabilities in mass production	Broader product range, but weak in ability to introduce a major change of product	Continued weakness in product development
International production and scope of interaction		US & EC for low-end markets	International production of low-end items in peripheral regions.

Source: Youngsoo, 1998, pp. 517-518

Particularly in the 1990s, SAMSUNG intensively recruited engineers and scientists from overseas, mostly from the United States by appealing to them "*with a strong sense of national mission*" (Choi, 1995, p. 77). It could be stated that the biggest part of SAMSUNG's success is the fact that it tackled its employees as its most important asset and focused on their constant training by enormously investing in research and development (Choi, 1995, p. 74). Undoubtedly SAMSUNG has always been strategic in asset-seeking and market-seeking (Lee & Slater, 2007, p. 249) and characterized by a great sense of openness towards learning from outsiders (www.ida.org/). Therefore, it never stopped seeking for qualified engineers all over the world, in order to improve its capabilities through an ongoing development process.

The company's receptiveness to learning from outsiders also derives from its choice to dispatch part of its specialists in foreign companies, in order to be trained to both assimilate new technologies and gain familiarity to new products and processes (Lee & Slater, 2007, p. 250). Additionally, in 1983 the Samsung Foundation for Overseas Technical Scholarship (SFOTS) program was established as part of the effort to extend economic cooperation to developing countries. As a result, engineers and managers mostly from Malaysia, Pakistan, India, Egypt and Hungary were offered technical training at company facilities in Korea (Cho, 1996, p. 787).

Finally, in order to reduce its organizational distance from rivals and global markets, the firm undertook a series of organizational innovations such as operating teams, flattening of hierarchies and networking which offered employees a degree of autonomy and flexibility (Choi, 1995, p. 79) (Cho, 1996, p. 787). It improved its innovation processes by "*integrating customers and suppliers into the innovation process as early stage as possible*" and towards this direction "*costumer decision groups and focus groups have been used for testing and feedback from Korean consumers*" (Baloh et al., 2008, p. 435). Additionally, the introduction of special education programs in Korea for non-Korean employees of overseas branches, contributed to the emergence of "*cross-cultural understanding and self-development*" (Cho, 1996, p. 787) that promoted the emergence of social closeness both to its partners, consumers and global markets. Moreover, by 1995 the English language was introduced in the company, implying its effort for globalization (Choi, 1995, p. 79) (Cho, 1996, pp. 787-8). Despite the fact that South Korea is largely monolingual,

SAMSUNG first promoted competence in English as a major criterion in job performance (www.ida.org/).

Table 3.11: Practices adopted by SAMSUNG in order to overcome distance in its various dimensions

ADOPTED PRACTICES	**BARRIERS OVERCOME DUE TO THE ADOPTED PRACTICES**				
SAMSUNG	**Geographical**	**Social**	**Institutional**	**Organizational**	**Cognitive**
Concentration on the import of foreign technologies and the development of close relationships mostly with Japanese electronics companies during the 1960s and 1970s, due to the lack of previous experience in the electronics sector	✓			✓	✓
Collaborations with foreign technology suppliers such as NEC, Sanyo, ITT etc	✓	✓	✓	✓	✓
Technical agreements for the assembly of electronics products for foreign original equipment manufacturer such as Toshiba, IBM, Hewlett- Packard etc	✓	✓	✓	✓	✓
Recruitment of Korean skilled engineers working abroad, mostly in the USA and Japan, in order to transfer the technologies they had obtained	✓				✓
Collaborations with American and Japanese firms, Micron and Sharp	✓	✓	✓	✓	✓
Expansion of Korea-based R&D centers for the assimilation and adaptation of foreign technology in the 1980s					✓
Creation of joint ventures with European and other Asian firms and establishment of many subsidiaries mostly in the 1990s	✓	✓	✓	✓	✓
Foundation of numerous foreign-based R&D centers	✓	✓	✓		✓

Establishment of design centers in the main market regions for the development of products that suit to local needs	✓	✓			✓
Establishment of the Samsung Foundation for Overseas Technical Scholarship (SFOTS) program in 1983 in order to extend economic cooperation to developing countries	✓				✓
Organizational innovations such as operating teams, flattening of hierarchies and networking		✓		✓	
Promotion of competence in English as a major criterion in job performance	✓	✓			

Source: own elaboration

3.4 THE CASE OF THE SKANE REGION

The Skane region is located in the southernmost part of Sweden and is one of the most populated and urbanized regions of the country (Roman & Moodysson, 2013, p. 175). National and regional authorities attempted to strengthen its role both nationally and internationally by implementing strategic policies towards an *"innovation-based regional development"* (Roman & Moodysson, 2013, pp. 175-6). As a result the region has undergone remarkable industrial transformation in recent history (in the 1970s and 1980s), as it has shifted from *"industry (ship building, pulp and paper, concrete and stone), food production and processing, shipping and trade, chemical, plastics and textile industries"* to more knowledge intensive activities (Nilsson & Moodysson, 2011, p. 13).

By the end of the 1970s *"the economy in Skane has seen a redistribution of employees from workplaces classed as industrial to those categorized as services and this is also indicative of the structural development at a national level"* and, particularly from the 1990s onwards, new technological industries such as such as telecommunications, pharmaceuticals and advanced business services contributed to Sweden's and Skane's economic transformation (Henning et al., 2010, p. 69). The first decade of the 21st century was accompanied by Skane's intense shift from traditional activities towards the development of a service economy, which also reflects a national transformation, as the region can be considered *"the miniature of Sweden"* (Henning et al., 2010, pp. 60, 65-70). As it will be analyzed, regional and national policies played a major role in decreasing the consequences of these structural adjustments especially through labor and social security systems (Henning et al., 2010, p. 61), and aimed to reinforce the regional innovation system's capacity by assisting it to overcome its cognitive, social, institutional and organizational distance from global markets (Roman & Moodysson, 2013, pp. 175-8).

3.4.1 THE SWEDISH GOVERNMENT's INITIATIVES FOR NATIONAL AND REGIONAL INNOVATION

Sweden's consecutive ways of development over more than a century (between the 1850s and the 1970s) could be characterized as impressive (OECD, 2012, p. 94). Technology policy was first introduced in 1940, when a group of organizations was proposed for supporting technological change. Nonetheless, the country started its

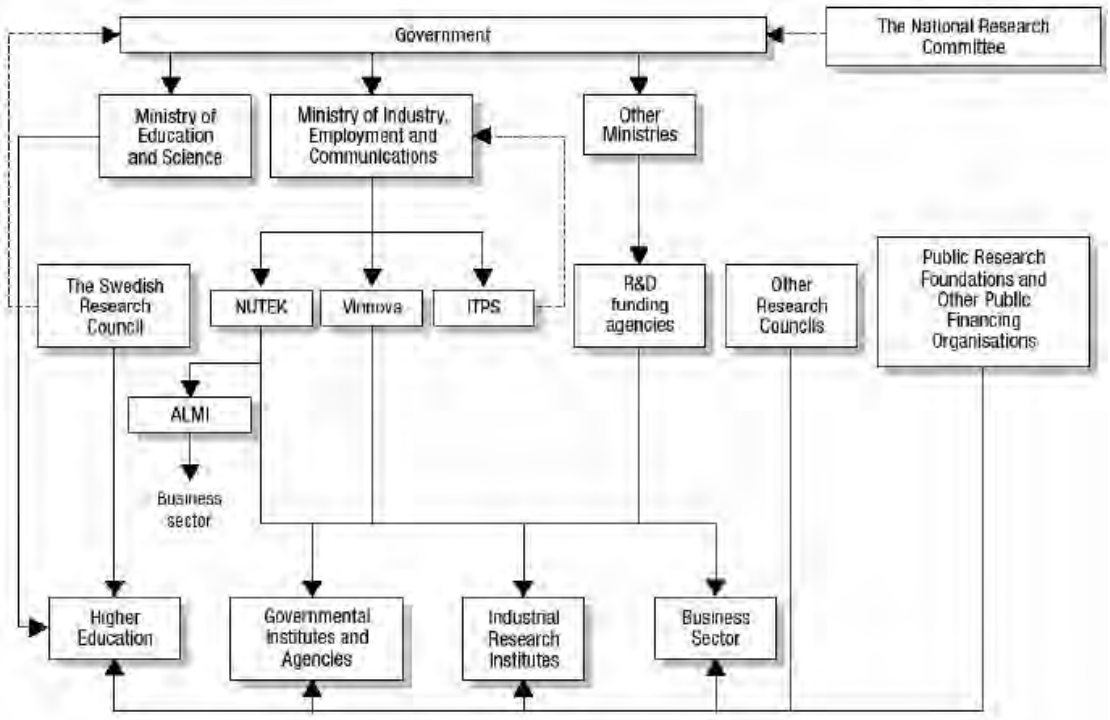
systematic development process in the 19th century as a relatively poor and resource-based economy (around 1900, it was a net importer of capital from Europe and a net exporter of labor to the United States), but thanks to the continuous government support and collaboration between the state, large industrial firms, academic institutions and labor unions, it finally succeeded in transforming itself into a global innovation actor (OECD, 2012, p. 94). Despite the fact that Sweden suffered a severe recession in the 1990s, its accession to the European Union as well as its population's willingness to adapt to structural changes implied by globalization, contributed to its ever since remarkable social, economic and technological progress (OECD, 2012, p. 11-2) (www.government.se/). Undoubtedly, Sweden showed a high degree of resilience, as it managed to weather the crisis better than other countries and recover rapidly.

The country's openness, mostly in terms of international trade, enabled it to overcome the initial limitations related to its small home market and peripheral location (OECD, 2012, p. 73-5). The open economy of Sweden with competition from outside, led to the pressure for change and the government was a central contributor to this venture. The ultimate goal was the construction of an adequate and well-functioned system, capable of fostering innovation and upgrading Sweden's innovative. Therefore, numerous technological achievements are attributable to the public commitment to the building of a powerful innovation climate on the national and regional level (www.government.se/). It is stated that "i*nnovation has long been a pillar of Sweden's development, even before it was explicitly highlighted as a key driver of economic growth and social development*" (OECD, 2012, p. 11).

More specifically, the Swedish government is in charge of the development of general innovation policies (Chaminade et al., 2010, pp. 23-8). Given this responsibility, the introduction of key political adjustments led to the creation of a strong and resilient innovation system based on three perspectives: the national, the sectoral and the regional innovation system (Chaminade et al., 2010, pp. 23-8). The national innovation system of Sweden is characterized by highly internationalized research, fast adoption of novel techniques, heavy investments in education and an *"industrial orientation towards resource intensive industries"* (Roos et al., 2005, p. 12). Nowadays Sweden's competitiveness is largely based on its strong R&D performance (OECD, 2012, p. 24), as the country invests more in R&D that any other country in relation to its GDP,

and is a global leader in scientific output (per head of population) in terms of scientific publications and registering patents (Roos et al., 2005, p. 12). Additionally, in the past decade, the implementation of the cluster approach as the vehicle for the development and promotion of regional innovation in Sweden in combination with the engagement of research organizations, firms and various players for the encouragement of *"soft skills and delivering hard outputs"*, resulted in the strengthening of innovative capacity and the increase of innovative performance (Wise & Johansson, 2012, p. 95).

Figure 3.2: The Swedish National Innovation System's structure



Source: Roos et al., 2005, p. 12

Strategic political initiatives, such as the establishment of numerous public organizations, led to the formation of a confident socioeconomic environment capable of supporting and reinforcing innovation (www.government.se/). More specifically, under the auspices of the Ministry of Industry, Employment and Communication, the Swedish Business Development Agency (NUTEK) -the central public authority aiming at cluster formation -is responsible for issues related to economic development includig funding for companies, information services as well as networking (Roos et al., 2005, pp. 13-4) (ec.europa.eu/). The Swedish Agency for Innovation Systems (VINNOVA), funded by the government, also plays an important role in Sweden's NIS and overall sustainable development, through the financial support of needs-

based R&D and the promotion of effective innovation networks (Roos et al., 2005, pp. 13-4) (Wise & Johansson, 2012, p. 95) (ec.europa.eu/). The Institute for Growth Studies (ITPS) in turn, is responsible for the evaluation of political actions and strongly focuses on strengthening *"the competence of future oriented growth policy"* (Roos et al., 2005, pp. 13-4).

The ALMI group is another state-led organization, which concentrates on the motivation and stimulation of SMEs for future development, mostly through the provision of loans (Roos et al., 2005, pp. 13-4). Finally, the Swedish Research Council is responsible for the support of fundamental research in all scientific fields, the Swedish Foundation for Strategic Research facilitates research in natural science, engineering and medicine, and the Foundation for Knowledge and Competence Development promotes information technology (Roos et al., 2005, pp. 13-4). Most of the agencies that undertake national policy tasks adopt programs and initiatives with an international scope and are successfully engaged in EU research policies and R&D- and innovation-related Framework Programs (OECD, 2012, p. 13-5, 24-9).

The government tackled human capital as its biggest endowment and paid great attention to the advancement of the education system and the creation of a skilled labor force, capable of supporting selected industries with competitive advantages. Towards this direction, it has invested heavily in education and attracted top international researchers for the creation and diffusion of new knowledge (OECD, 2012, p. 15-28). The government also initiated massive investments in R&D[7], the improvement of ICT infrastructures and participations in various international *"academic and industrial networks"* (OECD, 2012, p. 14) (www.government.se/). As a consequence, since the 1990s Sweden is steadily included in the list of countries with the most massive expenditures on R&D and the highest R&D intensity[8] (www.pwc.com/), whereas nowadays, its competitiveness is largely based on this strong R&D performance and the favorable conditions for innovation (OECD, 2012, p. 150-8). The political pursue for the attraction and retaining of a continuous inflow of foreign talents, resulted in both the creation and diffusion of knowledge which was

[7]Sweden is an internationally open economy with many foreign companies actively engaged in R&D (OECD, 2012, p. 122).
[8]Sweden together with Germany, Finland and Switzerland, they have the highest R&D performance (www.pwc.com/).

generated outside the country and the advancement of the Swedish absorptive capacity (OECD, 2012, p. 203-5). Being closely linked to and embedded in international knowledge networks offered Sweden the opportunity to improve its technological capacities and expand its cognitive and organizational scope.

Universities played a crucial in the country's transition to an information-society. Sweden is home to a number of internationally renowned universities, well-networked with various research groups. The most basic research in the country is noted in the universities, university colleges, several private universities and educational institutions that compose the higher education system (Chaminade et al., 2010, pp. 10-7). Therefore, it is stated that *"aside from large private-sector corporations"*, universities in Sweden are considered to be the main R&D and innovation actors (OECD, 2012, p. 165-70). The Lund University in particular has played a major role in Sweden's transformation. It is *"the largest university of the Nordic countries and one of the oldest… aiming to become one of Europe's leading entrepreneurial universities with an emphasis upon increased regional engagement"* (Benneworth et al., 2009, p. 1646). Among others, LU is responsible for the commercialization of research, the maintenance of academic standards and the promotion of social development (Benneworth et al., 2009, p. 1653).

In the 2000s, the political system introduced institutional and organizational changes in an attempt to advance the country's innovative potential (Chaminade et al., 2010, pp. 23-5.). Towards this direction, the new national structure stimulated interdisciplinary and multidisciplinary research (Chaminade et al., 2010, p. 36) and promoted the creation of *"strategic alliances between the business and the public sector"* (OECD, 2012, p. 244). Ever since Sweden is among the leading countries as far as patent applications are concerned (Benneworth et al., 2009, pp. 1650-3), while the establishment of strong intellectual property rights, the increase of foreign ownerships and the notable innovative activity of Swedish firms have turned Sweden into an important player on international markets (OECD, 2012, p. 98, 184-5, 247). Additionally, for a country of its size Sweden also performs a strong export-oriented culture[9], with highly internationalized and well linked firms in *"global value chains"*

[9]Sweden's intense export orientation combined with the activities of highly internationalized large enterprises represent the key factors for the country's economic development (OECD, 2012, p. 24).

(OECD, 2012, p. 33-6) (www.government.se/). As it is stated, half of the Swedish firms are engaged in international co-operations, through *"mostly firm-PRO cooperation and less firm-firm co-publications"* with the dominant partners being Germany, the United Kingdom and the USA (Hane & Jansson, 2010, p. 26).

Overall, the Swedish model proved that the creation of a strong cognitive base through the advancement of education and R&D, the development of socially embedded relationships and the facilitation of well-organized collaborative networks with foreign innovation players, are more important than geographical location (Coenen et al., 2005, pp. 14-16). All the above mentioned, combined with the high quality of the Swedish institutions managed to offer transparency, high levels of trust, "*public acceptance and recognition of the importance of science, technology and innovation for sustainable future growth*" (OECD, 2012, p. 14).

Table 3.12: Practices adopted by the Swedish government in order to overcome distance in its various dimensions

ADOPTED PRACTICES	**BARRIERS OVERCOME DUE TO THE ADOPTED PRACTICES**				
Government	**Geographical**	**Social**	**Institutional**	**Organizational**	**Cognitive**
Adoption of an open economy and an open innovation model	✓	✓	✓	✓	✓
Establishment of the Swedish Business Development Agency (NUTEK) for the promotion of networking between Swedish and foreign firms	✓	✓	✓	✓	✓
The foundation of the Swedish Agency for Innovation Systems (VINNOVA) for the encouragement of effective innovation networks	✓	✓		✓	✓
The establishment of the Swedish Research Council, the Swedish Foundation for Strategic Research and the Foundation for Knowledge and Competence Development for the support of fundamental research in all scientific fields					✓
Heavy investments in education and constant attraction of top international researchers for the creation and diffusion of new knowledge	✓	✓		✓	✓
Massive investments in R&D and participations in international academic and industrial networks	✓	✓			✓
Strong collaborations with key universities in Sweden and abroad		✓		✓	✓
The stimulation of interdisciplinary and multidisciplinary research and the creation of strategic alliances between the business and the public sector	✓			✓	✓

The promotion of international collaborations with foreign firms through well-organized innovation networks	✓	✓	✓	✓	✓

Source: own elaboration

3.4.2 REGION SKANE's CHOICES FOR THE OVERCOMING OF DISTANCE BARRIERS

Skane's regional development is based on theoretical concepts such as clusters (Porter, 2003), learning regions (Asheim, 1996) and regional innovation systems (Cooke et al., 2004, Asheim and Gertler, 2005) (Roman & Moodysson, 2013, pp. 175-6). However, the cluster approach has dominantly influenced the region's development (Henning et al., 2010, p. 19) (Hane & Jansson, 2010, p. 23). According to Henning et.al (2010), in the region someone could identify two sectors with clear cluster tendencies, the food and the life science sectors, and four additional areas with some cluster tendencies, that is, the wood, hospitality and tourism, ICT and the packaging sectors (Henning et al., 2010, pp. 43-4). As a result, this analysis will mostly concentrate on the way the life science and the food sector managed to overcome their weaknesses, bridge their distance from global markets and become successful innovation players.

The regional authority, Region Skane, is responsible for the coordination of the actors' activities in the RIS (Nilsson & Moodysson, 2011, p. 13). The Region Skane initiated an open innovation model, based on the mobilization of regional resources and the attraction of foreign national and multinational resources (Wise & Johansson, 2012, p. 99). It included a wide variety of innovation actors, aiming at the promotion of structures for innovation, the support of *"innovation work that takes place in the boundaries between different industries to utilize unexpected opportunities*", the development of international cooperation and contacts in order to reinforce innovation work in Skane, and the advancement of innovation capacity through the facilitation of R&D by public and private sectors (Wise & Johansson, 2012, pp. 97-8). This strategy towards the stimulation of creativity, openness and diversity, facilitated the continuous flow of internal and external information and the generation of different knowledge types (Wise & Johansson, 2012, p. 99).

The increasing emergence of knowledge-based industries in the mid-2000s, such as pharmaceutical, medical technology and ICT, first appeared in close proximity to major universities in the region, Lund and Malmo (Nilsson & Moodysson, 2011, p. 13). Policy makers realized that universities are important generators of knowledge and useful contributors to the facilitation of interactive learning processes (Coenen, 2007, pp. 816-8) and, thus, they focused on the improvement of cooperation and

"knowledge exchange between industry, university and government at the regional level" for the development of selected industries in which the region was thought to have a competitive advantage and future growth potential (Roman & Moodysson, 2013, p. 176).

The Lund University in collaboration with the Swedish Agricultural University and the Kristianstad University College, played an important role in the Skane RIS by providing a strong knowledge infrastructure and facilitating research and development in knowledge intensive fields *"both in terms of knowledge production and dissemination and training of highly skilled labor"* (Henning et al., 2010, p. 123) (Nilsson & Moodysson, 2011, p. 13). LU played the role of *"an extended R&D laboratory"* that managed to structurally transform the industrial environment (Benneworth et al., 2009, pp. 1646-7, 1652-3) (Coenen, 2007, p. 817) and contributed to the development of regional and sectoral innovation processes in Skane by:

> Creating a series of internal structures, associated companies, partnership bodies and external connections to engage with and support Scania's industrial base[10]…and participating in global projects with global critical mass, while ensuring that knowledge capitalization is encouraged in the region (Benneworth et al., 2009, p. 1656).

The life science sector

The life science core activities consist of industries related to "*pharmaceutical base products, pharmaceutical preparations, medical equipment and instruments, manufacture of dentures, medical and pharmaceutical R&D*" (Henning et al., 2010, p. 49). The life science industry in Skane –which includes both the service industry for medical R&D and the manufacturing sectors in life science- is composed of more than 20 research-based biotechnology companies that focus on new pharmaceuticals, and the same number of firms based on medical technology, employing 7.000 active individuals (Henning et al., 2010, pp. 49-51) (Roman & Moodysson, 2013, p. 176). Historically, large companies such as Astra and Pharmacia, which since the 1990s are parts of multinational pharmaceutical corporations, have dominated the pharmaceuticals industry in the region (Henning et al., 2010, p. 138).

[10]The university created a new organization within its institutional boundaries, Lund University Innovation, in order to encourage its staff to *"commercially exploit their knowledge"* (Benneworth et al., 2009, p. 1655).

Skane represents one of the three major locations for the pharmaceutical and biotechnological industry in Sweden. It has developed cooperative relationships with Denmark through the cross-border cluster Medicon Valley (since 2000) that covers *"life science companies in the south of Sweden and the neighboring part of Denmark"* (Coenen et al., 2005, p. 13) (Hane & Jansson, 2010, p. 23) (Roman & Moodysson, 2013, p. 176). As it becomes clear, geographical closeness encouraged the emergence of bi-national co-operation between Swedish and Danish life science companies. The University of Lund as well as university hospitals also played a major role in the development of the life science sector, in the sense that they contributed to the attraction of small research-oriented biotechnology companies that focus on new pharmaceuticals (Henning et al., 2010, p. 138).

The organization Medicon Valley Alliance (MVA) clearly represents the dominant actor for the strengthening of life science in Skane (Henning et al., 2010, p. 141). This organization was formulated by the initiative of Lund University and Copenhagen University, three of the region's largest pharmaceuticals companies and a number of public actors engaged in regional development in Sweden and Denmark -"*all within the framework of the Oresund Committee, which is a body for policy cooperation*"- (Henning et al., 2010, p. 141). The MVA's goal focused on the transformation of the Oresund region into one of the world's top five life science regions, in terms of both research and commercialization (Henning et al., 2010, p. 141). Towards this direction MVA concentrated on the support of integration between the region's main actors in life science, and the development of cross-border collaborations between universities and private firms (Henning et al., 2010, p. 141). Moreover, in recent years, attention has been given to the *"marketing of the region internationally"* through the facilitation of better access to venture capital and the encouragement of public and private investments in research and development (Henning et al., 2010, p. 141).

The development of the life science sector is a success story due to Region Skane and private actors' persistence to eliminate their cognitive and geographical distance from global markets. Toward this direction, regional and private actors initiated collaborations and nodes with excellent pharmaceutical mega centers such as Boston, San Francisco and San Diego in the US, Toronto and Montreal in Canada, and Munich, Stockholm and Oxford-Cambridge in Europe (Coenen et al., 2005, p. 11). The geographical allocation of collaborations was initially concentrated in two nodes

outside Skane: Stockholm and Frankfurt, but later on Skane's collaborations became more diffused, however still concentrated in Scandinavia and northern Europe (Coenen et al., 2005, p. 14). The cooperative relationship of Skane's firms with mega centers and other peripheral regions in the pharmaceutical sector, proved that regardless of geographical location, a *"high degree of shared cognitive understanding and affinity in terms of professional skills"* are more significant (Coenen et al., 2005, pp. 15-6).

Another choice for the expansion of the life science industries' cognitive base was the acquisition of knowledge through intermediaries[11], that is, scientific journals and surveys. Such a practice can be easily understood, as novelty in life science is based on codified knowledge, formal models and principles stemming from academia (Roman & Moodysson, 2013, pp. 178-9). Moreover, life science companies sought for skilled labor from universities and other firms in the same sector, as they were more likely to carry highly specialized knowledge and education (Roman & Moodysson, 2013, pp. 179-80). Skane's access to qualified labor resulted in the creation of a specialized node that attracted foreign firms, research institutes and researchers, and as a consequence, life science industries managed to expand their cognitive, social and organizational base (Coenen et al., 2005, pp. 14-6).

The food sector

The core industries in the food industry cluster are composed by agriculture, livestock breeding, agricultural services, fishing and food industries (Henning et al., 2010, p. 46). The Skane food industry cluster engages 25.000 active individuals and except for the core industries, it also includes *"the wholesale and commission trade in food, the manufacture of packaging for food and direct support activities such as the manufacture of tractors and fertilizers"* (Henning et al., 2010, p. 46). The food sector performs an important role in the regional economy which is historically related to the favorable natural conditions for agriculture and food production (Roman & Moodysson, 2013, pp. 176-7). However, increasing competition in the agricultural sector resulted in the food industry's sharp restructuring process and brought to the

[11]Intermediaries concern the acquisition of knowledge without direct interaction. Examples of intermediaries are *"scientific journals reporting results from basic research, surveys and questionnaires carried out and published by various business and support organizations, specialized magazines focusing on specific industries or technologies, and trade fairs and exhibitions targeting these industries"* (Roman & Moodysson, 2013, p. 178).

surface the need for changes. Towards this direction, food companies developed collaborations with foreign partners and R&D facilities located both inside and outside the region of Skane (Roman & Moodysson, 2013, pp. 180-3). Yet, the biggest share of the collaborations occurs nationally and regionally, or in other words, compared with the life science sectors, the food industry involves a smaller number of actors (Roman & Moodysson, 2013, pp. 180-3), which are mostly based in the region (Hane & Jansson, 2010, pp. 23, 39).

Despite the fact that Skane still possesses a strong national position in food, like any industrialized economy, the agricultural sector's importance has decreased over time in terms of the employees' number (Henning et al., 2010, p. 122). Moreover, the reduction of trade barriers implied by Sweden's membership in the EU, exposed companies to fierce competition and forced them to diversify (Henning et al., 2010, p. 122). As a response to these threats, the Oresund Food Network[12] (a knowledge-based Danish-Swedish network uniting research, business and authority within the food value-chain, part of Oresund Science Region, that concentrates on triple helix collaboration between academia, industry and authorities across Oresund), the Skane Food Innovation Network and the Ideon Agro Food represent the major foundations that aim both at the strengthening of the food industry and the reinforcement of its competitive performance (Henning et al., 2010, p. 124) (www.oresundfood.org) . The Ideon Agro Food, founded in 1986from the University of Lund and the Swedish University of Agriculture, represents companies in the food industry and science and acts as a broad platform *"between a good idea and the food market"* (www.ideonagrofood.se). It also gears towards the strengthening of academic and business links through the promotion of innovation projects and technological development in the industry (Henning et al., 2010, p. 125) (www.ideonagrofood.se).

The most prominent role has been played by the Skane Food Innovation Network (SFIN), a network organization established in 1994 on the initiative of the business community (www.livsmedelsakademin.se). SFIN started as a local policy initiative

[12]The Oresund Region is a cross-border region including "*the Swedish region of Skane and the Capital Region of Denmark and Region Zealand in the Danish Copenhagen region",* characterized by close co-operations between local and regional government as well as universities in the two countries in order to promote industrial synergies. The food industry is s central example, as it represents a strong sector both in Skane and Denmark (Nilsson & Sia-Ljungström, 2013, p. 167)**.**

within the Oresund region, that has developed into *"a hub gathering actors who want to develop Skane into a food central for Europe"* (Nilsson & Sia-Ljungström, 2013, p. 168). As a result, it managed to strengthen network links within the food sector between business, researchers, companies, organizations, public authorities, universities and colleges, and promote innovation by attracting skilled personnel, arranging seminars and developing projects, such as the VINNOVA project between the Region Skane, Lund University and food companies in the region (Henning et al., 2010, p. 125) (Nilsson & Sia-Ljungström, 2013, p. 168).

In the food sector innovation occurs from the recombination of the existing knowledge and, thus, specialized magazines, fairs and exhibitions expanded the firms' cognitive base (Roman & Moodysson, 2013, p. 179). The primary source for recruitment of skilled labor was the private sector, mostly firms in the same industry, as there was no need for specialized knowledge acquired from universities and research institutes

The ICT sector

The ICT sector is described as a sector with some cluster tendencies in Skane, including as core activities the manufacture of electronics and ICT equipment, computer consultancy activities, computer services, and telecommunications (Henning et al., 2010, p. 150). Ericsson's international presence resulted in Sweden's strong position in ICT, but the company has also contributed to Skane's development in the sense that Ericsson in Lund employs a noteworthy number of qualified employees (Henning et al., 2010, pp. 150-1). Ericsson's growth in Lund was reinforced both by the availability of labor force and the emergence of Lund Institute of Technology (LTH), founded in the 1960s, which still represents a major actor for research and skills in the ICT sector (Henning et al., 2010, pp. 150-1) (www.lunduniversity.lu.se/).

Oresund IT and the established Mobile Heights are the most important initiatives introduced by the regional innovation system (Henning et al., 2010, p. 152). The first one represents a network organization aiming at the promotion of cooperative relationships between the various ICT actors within the Oresund region and the overall expansion of the firms' cognitive base. The second refers to a project initiated by three major companies in the ICT sector in Skane (Ericsson, Sony Ericsson and

TeliaSonera – the dominant telephone company and mobile network operator in Sweden and Finland-), the Region Skane, the Lund Institute of Technology as well as the Malmo University College (Henning et al., 2010, p. 152). This project directly engaged the regional economy, authorities and academia in order to cope with specific problems of the innovation system and has been an issue on which the Region Skane had invested a lot of resources (Henning et al., 2010, p. 152).

Nonetheless, whereas in 2002 it was characterized by high knowledge content, extensive R&D and a promising growth potential, *"the lack of regional agglomeration and the limited amount of strategic exchanges"* led to the conclusion that the sector is not capable of constituting a regional cluster (Henning et al., 2010, p. 150).

The Packaging sector

> The boundaries of the packaging sector's core industries consist of the following industries: wooden containers, corrugated paper and paperboard and corrugated board containers, other paper and paperboard containers, plastic packing goods, light metal packaging, packaging activities (Henning et al., 2010, p. 56).

Traditionally, the packaging industry has been an important contributor to Skane's economic development, mostly due to the presence of large international actors in the region, such as Tetra Pak and Ekerlund & Rausing and the existence of links to the food industry (Henning et al., 2010, p. 56). Nevertheless, the number of employees in the packaging industry remains relatively constant over the years and labor productivity in Skane has declined, more than in the country as a whole (Henning et al., 2010, pp. 56-8).

The Hospitality and Tourism sector

The hospitality and tourism sector consists of industries such as hotels, camping, restaurants, bars, tourist assistance, theatres, concert halls, amusement parks, other entertainment activities, museum activities, botanical gardens, zoos, nature reserves, skiing facilities, golf courses, sports events and other recreational activities (Henning et al., 2010, p. 58). The sector undoubtedly reflects a large and important industry in Skane, but it is still doubtful whether this significance differs from other Swedish regions of the same size (Henning et al., 2010, pp. 58-60).

The Wood sector

The wood sector is composed of the industries related to forestry, forest management and wood products (Henning et al., 2010, p. 52). In 2002, the wood sector in Skane was characterized as an industry with some cluster tendencies, but both low productivity and specialization due to the limited natural resources are now marked as worrying signs for the sector's future growth (Henning et al., 2010, pp. 52-3).

Table 3.13: Practices adopted by Region Skane and private firms in order to overcome distance in its various dimensions

ADOPTED PRACTICES	**BARRIERS OVERCOME DUE TO THE ADOPTED PRACTICES**				
Region Skane	**Geographical**	**Social**	**Institutional**	**Organizational**	**Cognitive**
Adoption of an open innovation model, based on the mobilization of regional resources and the attraction of foreign national and multinational resources	✓	✓	✓	✓	✓
Domestic firms' encouragement for the development of international cooperation and contacts	✓	✓		✓	✓
Facilitation of R&D by the public and the private sector within and outside from the Skane region	✓				✓
Concentration on the improvement of cooperation and knowledge exchange between industry, university and government at the regional level	✓	✓		✓	✓
Provision of a strong knowledge infrastructure and facilitation of research and development by the Lund University, the Swedish Agricultural University and the Kristianstad University College				✓	✓
Creation of partnership bodies and external connections, and participation in global projects by the Lund University	✓	✓		✓	✓
The life science sector					
Development of collaborative relationships with Denmark through the cross-border cluster Medicon Valley Alliance	✓	✓	✓	✓	✓
Concentration on the development of cross-border collaborations	✓	✓	✓	✓	✓

between universities and private firms					
Attraction of domestic and foreign research-oriented biotechnology companies by Lund University and university hospitals	✓	✓		✓	✓
Facilitation of a better access to venture capital and encouragement of public and private investments in R&D for the international marketing of the region	✓	✓	✓	✓	✓
Collaborations and nodes with excellent pharmaceutical mega centers from abroad	✓	✓		✓	✓
Acquisition of knowledge through scientific journals and surveys	✓				✓
Searching for skilled labor from universities and other firms in the same sector	✓	✓			✓
The food sector					
Collaborations with foreign partners and R&D facilities located both inside and outside the region of Skane	✓	✓	✓	✓	✓
Establishment of the Skane Food Innovation Network (SFIN) for the promotion of networking between business, researchers, companies, organizations, public authorities, universities and colleges	✓	✓		✓	✓
Acquisition of knowledge through specialized magazines, fairs and exhibitions	✓				✓

Source: own elaboration

3.5 THE CASE OF INDIA

The Indian pharmaceutical industry, which refers to *"pharmaceutical firms that have integrated modern biotechnology in their research, production or marketing activities"* (Ramani, 2002, p. 381), has its roots to the formation of Bengal Chemical and Pharmaceutical Works in Calcutta by Professor P.C. Roy in 1903 and represents part of the country's success story (Smith, 2000, p. 13). Over the years the domestic pharmaceutical industry has emerged as one of the most technologically advanced knowledge-based industries in a developing country, and since 1991, India is widely known as the country of *"very low drug prices while producing high quality medicines"* (Haley & Haley, 2012, p. 608) (www.gersterconsulting.ch/). There is the consensus that the pharmaceutical industry reflects the product of the micro economic environment that state regulations and interventions managed to build over time for the shift from duplicative imitation to creative imitation, that is *"from importing bulk drugs to exporting formulations to highly regulated markets in the developed world"*(Kale & Little, 2007, p. 589).

Nowadays, the Indian pharmaceutical industry is sizeable[13] -it ranks globally *"4th in terms of volume and 13th in terms of value"* (Chittoor et al., 2008, pp. 255-6) (Haley & Haley, 2012, pp. 611-2)- and plays a dominant role in the pharmaceutical market potential, due to the rapidly expanding population and the alliances between biopharmaceutical firms (Chakraborty & Agoramoorthy, 2010, p. 2). Contract research and manufacturing, clinical research, research and development related to vaccines reflect the strengths of the pharmaceutical industry (business.mapsofindia.com) and its industrial performance is synonymous to the *"best developed technological capabilities in the third world"*, although it has been a poor performer regarding the introduction of innovative products both in domestic and foreign markets (Kale & Little, 2007, p. 590) (business.mapsofindia.com). The country is steadily increasing its efforts to become a global player in biotech activities and investments supported by manpower, knowledge, biodiversity and technology and the government is concentrating on biotech investment in countries such as USA, EU and Japan (Chakraborty & Agoramoorthy, 2010, pp. 1-2).

[13]The supply side is fragmented and consists of 3000 firms in the "organized" sector and 13,000 firms in the "unorganized" small-scale sector, of which 48 are listed in government lists as active in the biopharmaceutical sector (Ramani, 2002, p. 381).

3.5.1 PUBLIC INITIATIVES FOR THE DEVELOPMENT OF THE PHARMACEUTICAL INDUSTRY

For many years the Indian economic and industrial policy was characterized by *"an import substitution ideology"* but persistent state interventions –particularly after India's independence in 1947- which focused on pharmaceuticals as a priority area finally managed to highlight the role of indigenous technology capabilities (Felker et al., 1997, p. 6) (Smith, 2000, p. 13) (Kale & Little, 2007, pp. 589-95). The broad philosophy underscored that if something is imported, then discover the mechanism to develop it in the local scale (Kale & Little, 2007, p. 590). This indigenization strategy forced domestic firms to make increasing technical efforts for the formation of a wide production base and the strengthening of their technological capabilities (Kale & Little, 2007, p. 590). Nonetheless, the period soon after independence was characterized by little progress in the production of basic chemicals and the country was heavily dependent on imports (Felker et al., 1997, p. 9).

In India there was also a lack of complementary competences between industry and academia, partly due to the protected environment which restricted incentives for innovation and limited collaborative relationships (Kale & Little, 2007, p. 590). This situation reflected a major issue for policy makers, if keeping in mind that the pharmaceutical sector demands strong industry-academia linkages (Kale & Little, 2007, p. 590). In respond, the government attempted to both strengthen the sector's development and the firms' processes in an indirect way, by introducing R&D institutions and intellectual property rights (IPR) regulations (Kale & Little, 2007, p. 590). In other words, the government's industrial and technology policies, combined with regulatory changes, crucially contributed in developing the country's R&D capability, as it will be analyzed.

The Indian pharmaceutical industry has evolved through three important phases, with each one of them being characterized by diverse regimes and industrial responses (Chittoor et al., 2008, pp. 255-6) (Kale & Little, 2007, pp. 594-6). The first period, prior to 1970, was characterized by a small industrial base in terms of production capabilities and no Indian firm was a major player in the manufacture of basic ingredients (bulk drugs) and the subsequent formulation for final use by consumers (Ramani, 2002, p. 383) (Kale & Little, 2007, p. 591) (Chittoor et al., 2008, pp. 255-6). Given this lack of local capabilities, the production of low−cost pharmaceutical

products by domestically owned companies represented the primary policy goal (Felker et al., 1997, p. 15). The second period, from the 1970s to the beginning of 1990s, was accompanied by a remarkable growth of the industry's output (Ramani, 2002, p. 383) (Kale & Little, 2007, p. 591) (Chittoor et al., 2008, pp. 255-6), whereas the third expansion phase, from 1990 onwards, was marked by liberalization measures and strategic policy regulations highlighting the government's willingness to further promote the sector's development (Kale & Little, 2007, pp. 590-1) (Chittoor et al., 2008, pp. 255-6). The impact of these policy changes was the gradual shift of the pharmaceutical industry from imitation to innovation, or in other words, *"from the acquisition of a basic minimum knowledge-base towards the creation of new competences for innovation"* through the engagement of various learning processes and development stages (Kale & Little, 2007, pp. 590-1).

During the 1950s, the 1960s and until the 1970s, foreign firms had the dominant share of the Indian pharmaceutical production[14], and multinationals imported medicines from their home countries to sell them in India (Ramani, 2002, p. 383) (Kale & Little, 2007, p. 595) (Chittoor et al., 2008, p. 256). These firms were mostly based in UK, France and Germany, and the Indian population was largely dependent on their imports (Smith, 2000, p. 13) (Kale & Little, 2007, p. 595). In order to reinforce the sector's capabilities, policy makers considered scientific research as vital for technology progress and made enormous efforts to create scientific institutions and skilled workforce (Kale & Little, 2007, pp. 590-1). Towards this direction and mostly since the 1950s, the government developed a highly diversified network of R&D institutions under the auspices of the Council of Scientific and Industrial Research (CSIR), which consisted of nearly 43 national laboratories (Felker et al., 1997, pp. 16-7) (Kale & Little, 2007, p. 591). CSIR, established in 1942, is the leading industrial R&D organization in India and plays a remarkable role as far as patent applications are concerned (www.csir.res.in). This autonomous body has emerged as a global player due to the mix of multi-disciplinary expertise that covers a wide spectrum of sectors, such as Aerospace, Biotechnology, Chemicals, Drugs and Pharmaceuticals, Energy, Food and Food Processing, Information Dissemination, Leather and Metal, Mineral and Manufacturing etc (www.csir.res.in).

[14]In 1960 almost 90% of market share was dominated by multinational corporations and 10% by Indian firms (Kale & Little, 2007, p. 595).

In order to support the domestic drug industry the government established research institutes in the form of CSIP laboratories, such as the Central Drug Research Institute (CDRI) and invested in public sector firms (Kale & Little, 2007, p. 595). Gearing towards self-reliance –as the country was importing *"almost 90% of its bulk drugs requirements"*- it established two public sector units (PUSs), the Hindustan Antibiotics Ltd. (HAL) in 1954 and the Indian Drugs and Pharmaceuticals Ltd. (IDPL) in 1961 (Smith, 2000, p. 13) (Ramani, 2002, p. 383) (Chittoor et al., 2008, p. 256)**.** The first concentrated on the production of penicillin and sulfa drugs, whereas the second, established with Russian cooperation[15], except for developing drug technology and exploiting talent and knowledge for innovation, it also evaluated natural resources for contingent development and provided testing services to academia and industry (Felker et al., 1997, pp. 9-17) (www.csir.res.in). A decade later, the public sector units, research institutes and multinational firms managed to develop the required cognitive base for the industry, reinforcing the sector future potential growth (Kale & Little, 2007, p. 595).

In the 1970s, which marked a milestone in the evolution of the pharmaceutical industry, the government attempted to both reduce India's dependence on foreign firms and facilitate the domestic industry's growth by introducing three policy initiatives (Kale & Little, 2007, p. 595). The first one was the Drug Price Control Order (DPCO), which aimed at the control of drugs in order to guarantee access to essential drugs by the average consumer and ensure quality (Felker, 1997, pp. 15-6) (Smith, 2000, p. 17) (Kale & Little, 2007, p. 595) (home.iitk.ac.in/). The second initiative, which reflects the most conscious attempt by Indian policy makers to improve access to international intellectual property, was the introduction of the Indian Patent Act in 1970, which by replacing a product-patent regime that had constrained the Indian pharmaceutical industry's participation in its domestic home market, it provided legal access to process patents for pharmaceutical products (Felker et al., 1997, pp. 16-8) (Smith, 2000, p. 7) (Kale & Little, 2007, p. 595) (Chittoor et al., 2008, p. 256). In other words, this act recognized patents on processes but not patents on products, enabling local firms to legally produce compounds that were patented elsewhere through reverse engineering and providing the way for local firms to build

[15]Russians supplied machinery, personnel, and technical know-how to produce antibiotics (Smith, 2000, p. 13).

basic capabilities in pharmaceutical R&D (Smith, 2000, pp. 13-18) (Ramani, 2002, p. 383) (Haley & Haley, 2012, p. 608). The third initiative concerned the adoption of a drug policy in 1978 which promoted a complex use of industrial licensing for the creation of capabilities in domestic pharmaceutical firms, whereas the Foreign Exchange Related Act (FERA) managed to reduce the multinationals' foreign holdings in India to 40% (Kale & Little, 2007, p. 595).

India is characterized by well a developed research workforce (fluent in English due to its English-language education system), while several universities and technology institutes have started under and postgraduate biotech degree programs to prepare highly skilled workforce (Haley & Haley, 2012, p. 613). The national education system includes 29 agriculture universities, 204 state universities and more than 500 national laboratories and research institutions, with the most notable organizations being the Centre for Cellular and Molecular Biology, the Center for DNA Fingerprinting and Diagnostics, the National Institute of Immunology and the Indian Institute of Chemical Biology (Chakraborty & Agoramoorthy, 2010, p. 4). India's Central Universities (CU) and Indian Institutes of Technologies (IITs) play a key role in preparing the required manpower by introducing research programs comparable to most developed countries and providing quality education in science and technology (Chakraborty & Agoramoorthy, 2010, pp. 4-5). Nevertheless, despite the strong capabilities in process and technology research, Indian universities have a poor performance in new product innovations commercialization (Felker et al., 1997, p. 7).

Table 3.14: The most important health care-biotechnology research institutes in India

National Institute of Virology (NIV) www.icmr.nic.in/pinstitute/niv.htm	Centre for Cellular and Molecular Biology (CCMB) www.ccmb.res.in
National AIDS Research Institute (NARI) www.nari-icmr.res.in	Indian Institute of Chemical Biology (IICB) www.iicb.res.in
National Institute of Cholera and Enteric Diseases (NICED) www.niced.org	Institute of Genomics and Integrative Biology (IGIB) www.igib.res.in
Centre for DNA Fingerprinting and Diagnostics (CDFD) www.cdfd.org.in	Institute of Microbial Technology (IMT) www.imtech.res.in
National Institute of Immunology (NII)	All India Institute of Medical Science

www.nii.res.in	www.aiims.edu
National Centre for Cell Sciences (NCCS) www.nccs.res.in	Indian Institute of Science www.iisc.ernet.in
National Brain Research Centre (NBRC) www.nbrc.ac.in	

Source: Chakraborty & Agoramoorthy, 2010, p. 5

In the 1990s "*the Indian policy regime saw the rest of the world as something to engage, not keep out"* (Smith, 2000, pp. 7, 19). In this period, the creation of competent research reflected the very core of political focus and, thus, the government provided grants to universities and a selected number of research institutes (Indian Institute of Science, All India Institute of Medical Science, etc) in order to launch programs related to biotechnology (Ramani, 2002, p. 385). Furthermore, due to the limited number of financial bodies, the government founded the public company Biotechnology Consortium of India Ltd. (BCIL) in 1990 to promote the establishment of firms by providing both venture capital and complementary competencies (Ramani, 2002, p. 385). It also created various schemes in order to facilitate collaborations between industry and academia, and in 1995 under the Department of Science and Technology, it launched both the New Millennium Leadership Technology Initiative (NMLTI) with the main objective being the creation of synergies and complementary competencies of publicly funded R&D institutions, academia and private firms, and the Pharmaceutical Research and Development Support Fund (PRDSF) for the promotion of industrial R&D (Kale & Little, 2007, pp. 605-6).

Currently, all biotech products are subject to state and federal committees in the country, such as the Department of Biotechnology, the Department of Health, the Ministry of Agriculture and the Ministry of Environment in order to get the approval from the Drug Controller General of India (DCGI) prior to sale (Chakraborty & Agoramoorthy, 2010, p. 4). The Department of Biotechnology (Government of India) in particular, has launched numerous programs[16] for manpower development, including the scientists' continuous training for the expansion of pharmaceutical R&D activities and the bridging of internal cognitive gaps (Chakraborty & Agoramoorthy,

[16]These programs include "*short-term training courses, MSc., M. Tech., doctoral and post-doctoral programs, national and overseas associations, visiting scientists from abroad, courses for industrial personnel, technician training, etc*" (Chakraborty & Agoramoorthy, 2010, p. 5).

2010, p. 5). Additionally, another vehicle for global patent protection has been the World Trade Organization (WTO), whose agreements cover goods, services and intellectual property issues and include commitments for the lowering of customs tariffs and other trade barriers (www.wto.org). India became a member of WTO in 1995 as no country keen on being integrated in the world economy can do without WTO membership (Smith, 2000, p. 7) (www.gersterconsulting.ch/) (www.wto.org). It also participated in the Trade Related Aspects of Intellectual Property Rights (TRIPS) agreement, which represents the belief that product-patent regimes promote innovation, and reflects part of the international community's effort to move towards a global economy (Chittoor et al., 2008) (Haley & Haley, 2012, p. 608) (www.gersterconsulting.ch/) (home.iitk.ac.in/).

Table 3.15: Practices adopted by the Indian government in order to overcome distance in its various dimensions

ADOPTED PRACTICES	BARRIERS OVERCOME DUE TO THE ADOPTED PRACTICES				
Government	**Geographical**	**Social**	**Institutional**	**Organizational**	**Cognitive**
Development of a highly diversified network of R&D institutions since the 1950s for the reinforcement of the sector's capabilities				✓	✓
Establishment of numerous research institutes and public sector units for the encouragement of the domestic drug industry and the reduction of dependence on foreign MNCs		✓		✓	✓
Introduction of the Indian Patent Act in 1970 for legal access to process patents for pharmaceutical products	✓		✓	✓	✓
Adoption of a complex industrial licensing policy in 1978 for the creation of capabilities in local pharmaceutical firms	✓		✓		✓
Advancement of education and introduction of under and postgraduate biotech degree programs					✓
Adoption of market liberalization measures and the opening of the Indian pharmaceutical market to multinational firms in the 1990s	✓	✓	✓		
Provision of grants to universities and research institutes to launch programs related to biotechnology	✓				✓
Foundation of schemes and programs for the facilitation of collaborations between industry and academia		✓		✓	✓
Introduction of programs and continuous training for manpower development, for the expansion of pharmaceutical R&D activities and the		✓		✓	✓

bridging of cognitive gaps					
World Trade Organization membership in 1995 for the integration in the world economy and participation in the TRIPS agreement	✓		✓		

Source: own elaboration

3.5.2 THE INDIAN FIRMS' INITIATIVES FOR THE DEVELOPMENT OF THE PHARMACEUTICAL INDUSTRY

The Indian pharmaceutical industry is not characterized by a national champion, but many alert and aggressive companies managed to exploit political initiatives and become global players with a promising growth potential. The industry is highly segmented and consists of large local, foreign and joint−venture firms, medium−scale producers, and several small−scale units, but numerous large Indian pharmaceutical companies compete globally (Felker et al., 1997, p. 6) (Haley & Haley, 2012, p. 612). Biocon, Bharat Biotech, Shantha Biotechnics, Wokhardt, Panacea Biotec, Bharat Serums and Vaccines, Serum Institute of India, Indian Immunologicals, Cadila Healthcare, Cadila Pharmaceuticals, Intas Pharmaceuticals, and Novo Nordisk are the corporations that maintain a remarkable grip in the pharmaceutical market, but especially Biocon and Serum Institute of India appear to be the most impressive performers (Chakraborty & Agoramoorthy, 2010, p. 2). Moreover, leading institutions in the area of stem cell research appear to be the All India Institute of Medical Sciences (New Delhi), Centre for Cellular and Molecular Biology (Hyderabad), Reliance Life Science (Mumbai), Indian Institute of Science (Bangalore), National Center for Biological Sciences (Bangalore), and LV Prasad Eye Institute (Hyderabad) (Chakraborty & Agoramoorthy, 2010, p. 3). However, the Indian pharmaceutical firms do not compete with multinational giants such as Pfizer or Glaxo in terms of new chemical research, but their strategy gears towards the leverage of technological skills (Kale & Little, 2007, p. 604).

Historically, the protection policies and the indigenization strategy that the government adopted shortly after independence had an important impact on private firms, as it forced them to build useful technological capabilities, become more self-efficient and gradually move from imitation to incremental innovation (Kale & Little, 2007, p. 591). Before the 1970s local firms, which were benefitted from the weak patent law and the protected local environment, focused on the adaptation of foreign technology mostly through duplicative imitation and learning by doing (Kale & Little, 2007, p. 591). The Indian pharmaceutical companies had their cognitive base steadily *"embedded in organic and synthetic chemistry"* and did not attempt to involve in other scientific disciplines, but duplicative imitation enabled Indian firms to move further along the pharmaceutical value chain. (Ramani, 2002, p. 384) (Kale & Little,

2007, p. 593). Moreover, the introduction of the drug price control in the 1970s, led to the reduction of MNC pharmaceutical firms' operations in the country and provided space for domestic firms to dominate the large in volume but small in value local market (Kale & Little, 2007, p. 599). As a consequence, between the period of 1970 and 1990, private Indian firms managed to increase *"their share of the Indian drug market from less than 20 percent to 60 percent, primarily taking market share from the MNC subsidiaries"* (Smith, 2000, p. 7).

In general, the successful transformation of the pharmaceutical industry has been achieved due to the patent reform and the market liberalization (Felker et al., 1997, p. 7) (Chittoor et al., 2008, p. 257). The introduction of the patent law in the 1970s had the most important impact on the Indian pharmaceutical industry, as it both encouraged the development of the domestic health care industry and attempted to reduce the country's dependence on foreign drug producers. Indian firms responded to this organizational change by slowly building capabilities and developing alternative technology paths, through in−house R&D, national research laboratories and informal purchase of technology from abroad (Felker et al., 1997, p. 14) (Kale & Little, 2007, p. 591). The change on intellectual property enabled them to copy or use known processes with little modifications that were not under patent, and as a consequence, they gradually moved into the production of bulk drugs at low costs (Kale & Little, 2007, p. 595) (home.iitk.ac.in/).

The companies that recognized the opportunities afforded by this law, made investments in innovative R&D in order to create the required cognitive base for the production of selected pharmaceuticals identified as having *"good commercial prospects"* (Ramani, 2002, p. 384). In the Indian pharmaceutical industry –where R&D intensity is closely related to the research orientation regardless the firm's size- research was mostly undertaken by young, small or medium sized companies, whereas larger firms were mostly keen on the creation of market partnerships with foreign MNCs (Ramani, 2002, pp. 382-3). However, even though the R&D efforts of domestic firms are significantly lower than those of their counterparts in developed countries, though high for India, the Indian health care sector is evolving very fast (Felker et al., 1997, p. 21) (Chakraborty & Agoramoorthy, 2010, p. 5). The presence of affiliates and multinationals in India, in combination with the permissive patent on processes also contributed to the sector's development, by enabling both the diffusion

of knowledge and expertise to local firms (Felker et al., 1997, p. 8). As a result, the patent act paved the way for Indian companies to produce and market good quality and cheap substitutes for MNC products and create opportunities for future growth (Ramani, 2002, pp. 383-4). From 1970 Indian firms legally reverse-engineered their competitors' bulk drugs and pharmaceutical products, *"which they either sold wholesale or processed into simple formulations"* and systematically started the building of basic capabilities in pharmaceutical R&D (Smith, 2000, pp. 7-18) (Chittoor et al., 2008, p. 261).

The pharmaceutical industry's strategy focused on process researches and reverse engineering through trial and error or learning by doing, which were considered to be more cost effective practices than developing new pharmaceuticals from scratch (Haley & Haley, 2012, p. 612). However, the reverse engineering-based R&D had a negative impact as well, as it prevented the development of communication channels such as publications, which contribute to both the formation of networks with a larger scientific community and the expansion of the Indian firms' cognitive base (Kale & Little, 2007, pp. 598-9). The growth of Indian pharmaceutical firms on the pharmaceutical value chain is also closely related to various R&D learning processes such as creative adaptations and imitations[17], and collaborative R&D (Kale & Little, 2007, pp. 589-93). Creative adaptations are inspired by existing products but might be characterized by little modifications, whereas creative imitations concentrate on the generation of *"facsimile products but with new performance features"* (Kale & Little, 2007, p. 599). Collaborative R&D, in turn, enabled firms to develop advanced capabilities in pharmaceutical R&D (Kale & Little, 2007, p. 607).

Indian firms were characterized by fierce competition in their domestic market which entailed a double impact. On the one hand it resulted in the rapid acquisition and assimilation of foreign expertise and, thus, it is stated that:

> One of the indicators of Indian firms' superior imitative capabilities is the shortening of the time lag between the introduction of a drug in the global market by the inventor and the marketing of the same drug in the Indian market (Kale & Little, 2007, pp. 596-8).

[17] *"In the case of Indian pharmaceutical firms creative imitation in the form of generics R&D accelerated their movement towards the acquisition of advanced level capabilities further up the value chain in pharmaceutical R&D. Creative imitation in the form of generics R&D has increased Indian pharmaceutical firms' awareness of opportunities"* (Kale & Little, 2007, p. 603).

On the other hand, competition prevented the emergence of synergies between industry and academia as firms attempted to improve their capacities through in-house efforts (Felker et al., 1997, p. 21) (Kale & Little, 2007, p. 595). As a consequence, the Indian pharmaceutical industries are characterized by a lack of social proximity in the form of trust, socially embedded relationships and shared competences. Furthermore, the weak patent law influenced the Indian pharmaceutical sector's regulatory management, in the sense that information could not be protected or create value for domestic firms and, thus, there is primary *"publication and patenting activity by Indian pharmaceutical firms"* (Kale & Little, 2007, p. 599).

At the beginning of 1990 the government liberalized the economy and along with this change, it also opened the Indian pharmaceutical market to multinational companies and approved both processes for cooperation and payments for technology purchases (Vishwasrao & Bosshardt, 2001, p. 368). These liberalization measures aimed at the establishment of stronger linkages with the global economy for the reduction of India's geographical and institutional distance. Domestic firms, which witnessed a profound policy change, responded to this challenge by *"flooding the generics market in advanced countries with drugs developed through creative imitation"* (Kale & Little, 2007, p. 606) (Chittoor et al., 2008, p. 256). In general, the liberalization efforts of the 1990s brought about two important impacts on Indian firms. The first one is related to the technology adoption, as the latter were given the opportunity to tap into foreign knowledge, improve their technological capabilities and become more competitive in a global scale, whereas the second refers to technology collaboration, with local firms being more interested in the purchasing of foreign technology than in investments in R&D (Vishwasrao & Bosshardt, 2001, p. 385).

The post-1990 period was marked by the Indian firms' efforts to invest heavily in new drug discovery and new research processes in order to further improve their knowledge base for the shift *"from intermediate R&D capabilities to advanced R&D capabilities"* (Kale & Little, 2007, p. 603). In order to face their initial constrains such as the inefficiency of financial resources, the existence of cognitive gaps in new research fields and the lack of trained scientists in innovative R&D, Indian firms geared towards the investments in innovative R&D, the recruitment of Indian scientists experienced in drug discovery and the adoption of a strategy based on *"collaborative research with Indian and overseas research institutes"* (Kale & Little,

2007, pp. 604-5). Especially after 1995, Indian firms entirely focused on the acquisition of R&D scientists which originated either from domestic or foreign universities, firms and research organizations in order to tap into new interdisciplinary knowledge and encourage its diffusion (Kale & Little, 2007, pp. 604-5).

Moreover, whereas in the past the majority of Indian firms exported products to developed or developing countries with similar technological profiles and weak patent protection[18], after the pharmaceutical market's liberalization some Indian firms concentrated on exports in advanced economies (Smith, 2000, p. 28) (Kale & Little, 2007, p. 599). An important ambition of Indian firms was to enter the US generic market for the expansion of their international presence[19], and towards this direction, they established marketing facilities in the US, acquired US-based firms and created strategic alliances in the USA (Smith, 2000, p. 27) (Kale & Little, 2007, p. 601). Kate and Little (2007) also point out that:

> Indian pharmaceutical firms filed patents for indigenously developed novel and non fringing processes with the regulatory authorities in Europe and the USA. Filing patents in different regions, which required the same amount of data as regulators from the developed world, helped these firms to acquire the minimum regulatory expertise (Kale & Little, 2007, p. 602).

[18]Some dynamic companies, such as Lupin Laboratories, Dabur Research, and Knoll Pharmaceuticals sold the majority of their products within the domestic market whereas others, such as Sun Pharmaceuticals, sold large percentages of output to India and other developing economies characterized by low approval and patent standards (Smith, 2000, p. 24).

[19]About one half of collaboration agreements were conducted with US firms and the majority of the rest with other European firms (Vishwasrao & Bosshardt, 2001, p. 374).

Table 3.16: Practices adopted by the Indian firms in order to overcome distance in its various dimensions

ADOPTED PRACTICES	BARRIERS OVERCOME DUE TO THE ADOPTED PRACTICES				
Indian firms	**Geographical**	**Social**	**Institutional**	**Organizational**	**Cognitive**
Local firms focused on the adaptation of foreign technology through duplicative imitation and learning by doing in the period prior to the 1970s	✓				✓
Building of capabilities and alternative technology paths, through in−house R&D, national research laboratories and informal purchase of technology from abroad in the 1970s	✓	✓		✓	✓
Investments in innovative R&D for the production of pharmaceuticals with good commercial prospects	✓				✓
Production and marketing of good quality and cheap substitutes for MNC products through the concentration on process researches, reverse engineering, creative adaptations and imitations and in-house efforts	✓		✓	✓	✓
Exports of drugs in advanced countries after the pharmaceutical market's liberalization in the 1990s	✓		✓	✓	
Concentration on foreign technology adoption and collaboration in the 1990s onwards	✓	✓	✓	✓	✓
Recruitment of Indian scientists experienced in drug discovery and collaborative research with Indian and overseas research institutes	✓	✓		✓	✓
Recruitment of R&D scientists from foreign universities, firms and	✓	✓			✓

research organizations					
Establishment of marketing facilities in the US, acquisition of US-based firms and formation of strategic alliances in the USA	✓	✓	✓	✓	✓
Heavy investments in new drug discovery and new research processes in the post 1990 period				✓	✓

Source: own elaboration

3.6 CONCLUSIONS

In the present chapter we have both analyzed the barriers that each player had to face during the initial development stages, as well as the initiatives introduced by the government and private firms themselves, for the overcoming of their geographical, cognitive, organizational, institutional and social weaknesses from the outside world and the strengthening of their innovation performance. As presented, Finland, South Korea, Sweden and India were all characterized by a degree of absolute and relative distance from major global markets which hampered their innovation potential and the development of networking with global innovation players. Thus, policy agents and the firms themselves faced the need to introduce strategic initiatives for the overcoming of geographical, cognitive, organizational, institutional and social barriers.

The present chapter presented the strategic mechanisms introduced by each engaged actor towards:

- The development of face to face interactions through the overcoming of geographical distance
- The creation of common interpretative schemes for the exploitation of new knowledge through the establishment of cognitive proximity
- The building of control, hierarchy and coordination mechanisms for organizational flexibility through the development of a strong organizational base
- The development of committed relationships and shared values for social cohesion through the creation of social proximity
- The establishment of common institutions and rules of the game for institutional stability through the building of an integrated institutional base

The comparative analysis of the conclusions that derive from the examination of these four case studies will be the topic of the next chapter.

CHAPTER 4: **Comparative Analysis**

4. COMPARATIVE ANALYSIS

4.1 INTRODUCTION

Chapter 4 provides the comparative analysis of the four cases studies presented in the previous section, targeting on the identification of the common policy and business elements that were adopted for the reduction of the engaged actors' geographical, cognitive, institutional, organizational and social distance from global markets. As presented in Chapter 2, distance barriers in both absolute and relative terms may hinder the actors' innovative performance, in the sense that the lack of a certain degree of proximity lead firms and individuals to approach, perceive and interpret knowledge in different ways. Therefore, this section attempts to present the most strategic initiatives introduced both by each country's government and engaged firms for the overcoming of their initial limitations -as far as the five notions of proximity are concerned- and the strengthening of their innovation potential.

4.2 POLICY COMMONALITIES AND DIFFERENCES

The examination of the four case studies attempted to shed some light on the way innovation actors may exploit proximity and overcome distance in order to strengthen their innovative performance and become global players with future growth potential. The activities of the four case studies are based on analytical knowledge, which is characterized both by the intension to innovate through the creation of new knowledge and the development of collaborations between firms and research organizations. Given that this knowledge base involves scientific knowledge, mechanisms and global principles, it becomes clear that it does not necessarily require geographical, social and institutional closeness between the engaged actors. On the contrary, it mostly requires the building of cognitive and organizational proximity for the actors' effective communication and coordination (see Chapter 2 for an overview).

Chapter 3 revealed that the government in both developing and developed countries followed some common paths for the overcoming of distance barriers. In other words, we could state that government authorities concentrated on some common policy practices in order to establish a certain degree of proximity with global innovation actors. However, Chapter 2 emphasized on the strong interconnection between the five proximity aspects by underlining their complementarity as well as their capability of substituting each other (see Chapter 2 for an overview). As a result, we cannot

isolate the impact of the adopted initiatives on each one of the proximity forms. In other words, the introduction of a specific policy initiative could simultaneously contribute to the overcoming of various barriers related to distance due to their strong interdependence.

Nevertheless, we could summarize some common policy elements for the establishment of geographical, social, organizational, institutional and cognitive closeness with global innovation players as follows:

1. The improvement of education and the increase of R&D spending, for the overcoming of cognitive barriers
    - The Finnish government increased public spending on education due to the demand for skilled employees in the 1980s, and introduced public financial support for GSM research (1981) made by universities and research institutes (Solvell and Porter, 2002, p.8) (Schienstock, 2004, p. 111) (Ali-Yrkko & Hermans, 2004, p. 111). It also increased the R&D spending due to the concentration on the development of the ICT and the electronics sector in the 1990s. TEKES' funding also crucially supported local R&D activities mostly in the 1990s (Ali-Yrkko & Hermans, 2004, p. 108) (Miettinen, 2013, p. 78).
    - The South Korean government created state-led R&D institutes in the fields of innovation-related activities in order to assist domestic industries adapt to new technologies, and made huge investments for the improvement of education (Chung, 2010, p. 353). More specifically, it established two public institutes for scientific research and technological development: the National Defense R&D Institute (1953) and the Korea Atomic Energy Research Institute (1959) in the 1960s, and created numerous Korean R&D institutes in the 1970s, such as the Korea Institute of Machinery and Metals, the Electronics and Telecommunications Research Institute, the Korea Research Institute of Chemical Technology, the Korea Research Institute of Standards and Science, the Korea Institute for Energy Research and the Korea Ocean R&D Institute. It also introduced the Science and Technology Promotion Act and the Science Education Act in 1967, whereas in 1982 it initiated the National Research and Development Program for the facilitation of private R&D activities (Chung, 2010, p. 334).

- The Swedish government paid great attention to the advancement of education for the preparation of highly competitive workforce and also made massive investments in R&D. The country invests more in R&D that any other country in relation to its GDP and is a global leader in scientific output (per head of population) in terms of scientific publications and registering patents (Roos et al., 2005, p. 12).
- The Indian government developed a highly diversified network of R&D institutions since the 1950s for the reinforcement of the pharmaceutical sector's capabilities, which consisted of nearly 43 national laboratories. It also established research institutes in the form of CSIP laboratories, such as the Central Drug Research Institute (CDRI), and public sector units for both the encouragement of the domestic drug industry and the reduction of dependence on foreign MNCs (Kale & Little, 2007, p. 595). The Council of Scientific and Industrial Research (CSIR), established in 1942, is the leading industrial R&D organization in India with a remarkable role in patent applications. Gearing towards self-reliance, it founded two public sector units (PUSs), the Hindustan Antibiotics Ltd. (HAL) in 1954 and the Indian Drugs and Pharmaceuticals Ltd. (IDPL) in 1961, introduced under and postgraduate biotech degree programs and provided grants to universities and research institutes in order to launch programs related to biotechnology (Smith, 2000, p. 13) (Ramani, 2002, p. 383) (Chittoor, Ray, Aulakh, & Sarkar, 2008, p. 256). In addition, it initiated programs and continuous training for manpower development, for the expansion of pharmaceutical R&D activities and the bridging of cognitive gaps.

2. The introduction of initiatives and national policies targeting on the development of science and technology, for the reduction of institutional and cognitive distance from global markets
   - The Finnish government founded the Finnish National Fund for Research and Development (SITRA) in 1967, in order to promote industrial research (Lemola, 2002, p.1484). In 1981 it established the pan-Nordic automatic mobile communication network, NMT, for the encouragement of competition between equipment manufacturers. In 1983 the National Technology Agency (TEKES) was established under the Ministry of Trade and Industry, and became the principal organization for the implementation

of technology policy (Ali-Yrkko & Hermans, 2004, p. 107) (Miettinen, 2013, p. 78). In 1987, the Science and Technology Policy Council - another research related body- was founded, in order to direct research policy and develop strategies relative to technological activities (Solvell & Porter, 2002, p. 4). It also encouraged the emergence of the Finnish communications cluster in the 1990s for the facilitation of NOKIA's development.

- The South Korean government introduced the Science and Technology Promotion Act and the Science Education Act in 1967, and established the Korea Institute of Science and Technology (KIST) and the Ministry of Science and Technology (MOST) for the creation of a strong cognitive base for science and technology (Lee, 2003, p. 30) (Kim, 2004, p. 354) (Sohn & Kenney, 2007) (Chung, 2010, pp. 336-337).. It also created the Ministry of Science and Technology in 1967, the Korea Technology Development Corporation in 1981, together with the Industrial Development Fund (1986), the Science and Technology Promotion Fund (1991) and the Information and Telecommunication Technology Fund in order to focus on S&T issues, and promote infrastructures and public R&D activities (Kim, 2004, p. 318) (Chung, 2010, pp. 337-340).
- The Swedish government established the Swedish Business Development Agency (NUTEK) under the auspices of the Ministry of Industry, Employment and Communication, as the central public authority aiming at cluster formation, economic development and funding for companies (Roos et al., 2005, pp. 13-4) (ec.europa.eu/). It also founded the Swedish Agency for Innovation Systems (VINNOVA) for the encouragement of effective innovation networks, and established the Swedish Research Council, the Swedish Foundation for Strategic Research and the Foundation for Knowledge and Competence Development for the support of fundamental research in all scientific fields. The ALMI group, another state-led organization, concentrated on the motivation and stimulation of SMEs for future development mostly through the provision of loans. The Swedish Research Council is responsible for the support of fundamental research in all scientific fields, whereas the Swedish Foundation for Strategic Research facilitates research in natural science, engineering and medicine, and the

Foundation for Knowledge and Competence Development promotes information technology (Roos et al., 2005, pp. 13-4).

- The Indian government introduced the Drug Price Control Order (DPCO), which aimed at the control of drugs in order to guarantee access to essential drugs by the average consumer, and the Indian Patent Act in 1970 for legal access to process patents for pharmaceutical products. The third initiative concerned the adoption of a drug policy in 1978, which promoted a complex use of industrial licensing for the creation of capabilities in domestic pharmaceutical firms (Felker et al., 1997, pp. 15-6) (Smith, 2000, p. 17) (Kale & Little, 2007, p. 595) (home.iitk.ac.in/).

3. The development of strong collaborations with domestic and foreign universities, research institutes and academics, for the establishment of geographical, cognitive and social closeness
    - The Finnish government interest in the development of synergies between universities and research institutions resulted in the preparation of a highly skilled labor force, able to support cutting edge activities. It also encouraged co-operation and technology transfer between academic, research institutions and standardization authorities. Public initiatives crucially promoted the creation of networks and cooperative relationships between domestic and foreign universities for the building of national technological capabilities mostly through the participation in numerous international projects, whereas TEKES facilitated the digital media industry's emergence through the promotion of interactions between universities and research institutes (Ali-Yrkko & Hermans, 2004, p. 108) (Miettinen, 2013, p. 78).
    - The South Korean government enacted the Basic Research Promotion Law in 1989, in order for universities to both upgrade their research capabilities and support private industries (Kim, 2004, p. 359) (Chung, 2010, pp. 337-340). It also emphasized on networking among universities and public research institutes. Nevertheless, Korean universities were and are still, to a substantial degree, embedded in a hierarchical and conservative system creating significant obstacles to inter-institutional knowledge transfer and entrepreneurship (Sohn & Kenney, 2007, p. 1002).
    - The Swedish government initiated strong collaborations with key universities in Sweden and abroad. In Sweden aside from large private-

sector corporations, universities are considered to be the main R&D and innovation actors. The Lund University in particular has played a major role in the country's transformation, as it is responsible for the commercialization of research, the maintenance of academic standards and the promotion of social development (Benneworth et al., 2009, p. 1653).

- India's Central Universities (CU) and Indian Institutes of Technologies (IITs) have been constantly introducing research programs comparable to most developed countries and providing quality education in science and technology (Chakraborty & Agoramoorthy, 2010, pp. 4-5). In the 1990s the government provided grants both to universities and a selected number of research institutes (Indian Institute of Science, All India Institute of Medical Science, etc) in order to launch programs related to biotechnology and assist local firms. It also founded various schemes in order to facilitate collaborations between industry and academia and, towards this direction in 1995 -under the Department of Science and Technology- it launched the New Millennium Leadership Technology Initiative (NMLTI) and the Pharmaceutical Research and Development Support Fund (PRDSF) for the promotion of industrial R&D (Kale & Little, 2007, pp. 605-6).

4. The harmonization and integration with global institutions, for the building of a common institutional and social base and the overcoming of geographical distance
    - Trade between Finland and EU partners was facilitated due to the harmonization of essential product regulations and specifications, and the introduction of the EU Suppliers' Declaration of Conformity for telecom, electrical equipment and parts among EU countries (Lesser, 2008, p. 5). In general, the elimination of trade and investment barriers facilitated operations between Finland and the European market.
    - Beginning in the 1980s, South Korea undertook efforts to ensure a market-conducive environment by deregulating various sectors and liberalizing trade (Cho, 1996, p. 787).
    - In Sweden most of the agencies that undertake national policy tasks, adopt programs and initiatives with an international scope and are successfully engaged in EU research policies and R&D- and innovation-related Framework Programs.

- The Indian government adopted market liberalization measures and opened the Indian pharmaceutical market to multinational firms in the 1990s. In India all biotech products are subject to state and federal committees in the country, such as the Department of Biotechnology, the Department of Health, the Ministry of Agriculture and the Ministry of Environment in order to get the approval from the Drug Controller General of India (DCGI) prior to sale (Chakraborty & Agoramoorthy, 2010, p. 4). Another vehicle for global patent protection has been the World Trade Organization (WTO), as no country keen on being integrated in the world economy can do without WTO membership. India became a member of WTO in 1995 and participated in the Trade Related Aspects of Intellectual Property Rights (TRIPS) agreement, which reflects part of the international community's effort to move towards a global economy (www.wto.org).

5. The adoption of Western business practices, for the reduction of geographical distance and the development of institutional and cognitive proximity
    - The four case studies highlighted a strong political concentration on the introduction of new priorities in science and technology policy for the improvement of the national technological capacities. Towards this direction, political authorities crucially concentrated on the adoption of Western European practices from socioeconomically advanced societies.
6. The recruitment of foreign scientists, for the overcoming of geographical barriers and the strengthening of social, organizational and cognitive closeness
    - In all cases someone could observe the encouragement of students to travel abroad for postgraduate education in order to import their knowledge and experience to their home country. The national authorities also recruited scientists and academics for the encouragement of research activities, and concentrated on the attraction of a continuous inflow of foreign talents. Being closely linked to and embedded in international knowledge networks offered countries the opportunity to improve their technological capacities and expand their cognitive and organizational scope.
7. The promotion of collaborative relationships between industry and academia, for the expansion of their cognitive, social and organizational scope
    - The Finnish government promoted the creation of a collaborative research-industry model for innovation. Towards this direction, it managed to build a

well-functioned system with intense synergies between universities and research institutions for the preparation of a highly skilled labor force. TEKES also promoted the development of interactions between firms, universities, and research institutes.

- The South Korean government promoted R&D outsourcing from universities to firms especially in the 1990s. Since firms needed to further improve their capabilities, the government emphasized on the development of collaborations between industry and the R&D community and became interested in the development of networking mechanisms among firms, universities and public research institutes. For the encouragement of R&D cooperation, the Promotion Law of Research Cooperatives and the Promotion Law of Cooperative Research Activities were launched in 1986 and 1994 respectively (Lee, 2003, p. 30).
- In Sweden, in the 2000s, the political system introduced institutional and organizational structural changes in an attempt to advance the country's innovative potential. Towards this direction, the new national structure stimulated interdisciplinary and multidisciplinary research and focused on the development of strategic alliances between the business and the public sector. Policy makers realized that universities are important generators of knowledge and, thus, they focused on the improvement of cooperation and knowledge exchange between industry, university and government at the regional level.
- In India there was also a lack of complementary competences between industry and academia, partly due to the protected environment, which restricted incentives for innovation and limited collaborative relationships. Therefore, the government attempted to facilitate the required industry-academia linkages for the development of the pharmaceutical sector in an indirect way, that is, by introducing both R&D institutions and intellectual property rights (IPR) regulations (Kale & Little, 2007, p. 590).

8. The development of strong international collaborations with foreign firms, for the overcoming of geographical, social, organizational, institutional and cognitive barriers
    - The Finnish government encouraged the development of linkages and spillovers among various industries and partners for the promotion of

industrial R&D. It also facilitated technology transfer between domestic and foreign companies mostly in the 1990s and 2000s.

- Since the 1980s, due to its weak local capabilities, South Korea focused on the acquisition, assimilation and imitation of mature foreign technologies from industrially advanced countries. It had to rely almost totally on foreign sources of technology and, thus, the political strategy geared towards the promotion of foreign technologies' inward transfer. In the early 1970s the Korean government facilitated exports by promoting a general trading company (GTC) system, which assisted global players to enter the protected Korean environment and also encouraged local firms' international orientation (Lee & Lim, 2001, p. 472).
- The Swedish government emphasized on the development of international collaborations with foreign firms through well-organized innovation networks. As a result, half of the domestic firms are engaged in international co-operations, through mostly firm-PRO cooperation and less firm-firm co-publications, with the dominant partners being Germany, the United Kingdom and the USA. The Swedish Business Development Agency (NUTEK) focused on the promotion of networking between Swedish and foreign firms (Roos et al., 2005, pp. 13-4) (ec.europa.eu/).
- The Indian government facilitated collaborations with firms were mostly based in UK, France and Germany for the acquisition, assimilation and reverse engineering of foreign technological capabilities (Smith, 2000, p. 13) (Kale & Little, 2007, p. 595).

Moreover, the examination of the four case studies also revealed that developing countries, such as South Korea and India, concentrated on some policy initiatives which were different from the ones introduced by developed countries, such as Finland and Sweden. More specifically, developing-country governments adopted various strategies in order to promote technology transfer and integrate in institutional and social terms with global innovation players. These two cases proved that the adopted policies range from compulsory licensing laws, which enable early users to purchase patented technologies, protectionist policies, which encourage foreign direct investments with the hope of technology spillovers from foreign to domestic firms, to policy regimes related to flexible intellectual property protection, which promotes the

assimilation and imitation of foreign technology. Additionally, economic liberalization measures played a major role in South Korean and Indian development, in the sense that the exposure of firms to different business environments with fierce competition, changing regulations and increasingly demanding customers, forced them to rapidly acquire and assimilate foreign capabilities in order to survive.

A common strategy was the continuous interest in both establishing foreign collaborations with well known universities, research institutes and academics, and investing heavily in R&D. These practices both acted as strategic substitutes for the lack of internal technological capacities and contributed to the bridging of cognitive and social gaps between the examined countries and the outside world.

4.3 STRATEGY COMMONALITIES AND DIFFERENCES

We could summarize some common strategy elements introduced by the firms for the establishment of geographical, social, organizational, institutional and cognitive closeness with global innovation players as follows:

1. The development of co-operations with foreign firms (through acquisitions, joint ventures and collaborations) and the establishment of marketing and production facilities overseas, for the overcoming of all five proximity aspects
    - The NOKIA Corporation expanded its interests beyond Finnish borders through acquisitions, joint ventures and collaborations. It developed cooperative relationships in production and R&D with foreign companies, such as the Tandy Corporation, Texas, Luxor and the PC and Office Electronics Business of Ericson in Sweden, and Standard Elektrik Lorenz in Germany (Solvell & Porter, 2002, p. 6). The firm also established production facilities in Brazil, Germany, Mexico, the USA, Malaysia, Hungary, South Korea and China.
    - SAMSUNG Electronics had to rely on foreign linkages from the very beginning of its electronics endeavors and developed a degree of know-how through learning-by-doing. During the 1960s and the 1970s it concentrated on the import of foreign technologies and the gathering of management, production and marketing knowledge from foreign firms. It mostly collaborated with American and Japanese firms, Micron (an American multinational corporation) and Sharp (a Japanese multinational corporation

in Osaka, Japan), established joint ventures in Portugal (1982), the US (1984) and Mexico (1988) and designated regional headquarters in America, Europe, China, Southern East and Japan (Choi, 1995, p. 77) (Lee & Lim, 2001, p. 472) (Lee & Slater, 2007, pp. 248-9). It also founded a subsidiary in Bombay, India, to employ local highly-skilled software engineers and a design center in London, UK to learn design skills from London designers.

- The geographical allocation of collaborations was initially concentrated in two nodes outside Skane: Stockholm and Frankfurt, but later on Skane's collaborations became more diffused, however still concentrated to close-by Scandinavia and northern Europe (Coenen et al., 2005, p. 14). Pharmaceutical and biotechnological industries in Sweden have developed cooperative relationships with Denmark through the cross-border cluster Medicon Valley, which covers life science companies in the south of Sweden and the neighboring part of Denmark (Hane & Jansson, 2010, p. 23). They also initiated collaborations with excellent pharmaceutical mega centers such as Boston, San Francisco and San Diego in the US, Toronto and Montreal in Canada, and Munich, Stockholm and Oxford-Cambridge in Europe (Coenen et al., 2005, p. 11). Food companies in Skane developed collaborations with foreign partners, but compared with the life science sector, the food industry involves a smaller number of actors mostly based in the region.
- The Indian pharmaceutical industry is highly segmented and consists of large local, foreign and joint−venture firms, medium−scale producers, and several small−scale units. Local pharmaceutical firms do not compete with multinational giants such as Pfizer or Glaxo in terms of new chemical research, but their strategy gears towards the leverage of technological skills. In the 1990s onwards they highly concentrated on foreign technology adoption and collaboration mostly through the establishment of marketing facilities in the US, the acquisition of US-based firms and the formation of strategic alliances in the USA (Smith, 2000, p. 27).

2. The increase of R&D activities overseas, for the reduction of geographical, social, organizational and cognitive barriers
   - In the 1990s, the NOKIA Corporation internationalized its R&D function, by spreading its researchers to various R&D units and establishing

numerous research centers abroad. For instance, by the 1990s, the NOKIA Corporation had founded several R&D units in the USA, India, the UK, Italy, Japan, China, Australia, Denmark, South Korea, Germany, Sweden, Hungary etc (Solvell & Porter, 2002, p. 18).

- The gigantic investments in R&D, through the foundation of several foreign-based R&D centers, and the constant efforts for the improvement of its technological capabilities enabled SAMSUNG to transform itself from a late starter to a technology leader. The firm's knowledge sourcing was facilitated by its overseas R&D laboratories in the U.S., U.K., Russia, Israel, India, Japan, China, Bangladesh etc. Some of the company's famous R&D centers are: Samsung Information Systems America, Inc. (SISA), Dallas Telecom Laboratory (DTL), Moscow Samsung Research Center (SRC), Samsung Electronics India Software Operations (SISO), Samsung Telecom Research Israel (STRI), Beijing Samsung Telecommunication (BST), Samsung Electronics (China) R&D Center (SCRC), Samsung Yokohama Research Institute, Samsung Poland R&D Center (SPRC), Samsung India Software Center (SISC), Samsung R&D Institute Bangladesh Ltd. (SRBD) etc (www.samsung.com).
- Region Skane and private firms aimed at the promotion of structures for innovation, the support of innovation work between different industries, and the development of international co-operations for the advancement of their innovative capacity. LU played the role of an extended R&D laboratory and managed to induce various structural transformations in the industrial environment.
- Indian firms managed to slowly build capabilities through in−house R&D, national research laboratories and informal purchase of technology from abroad. The growth of Indian pharmaceutical firms on the pharmaceutical value chain is closely related to various R&D learning processes such as creative adaptations, imitations and collaborative R&D. In India R&D intensity is closely related to the research orientation regardless the firm's size. Therefore, research was mostly undertaken by young, small or medium sized companies, whereas larger firms were rather keen on the creation of market partnerships for foreign MNCs. However, even though the R&D efforts of domestic firms are significantly lower than those of counterparts

in developed countries, though high for India, the Indian health care sector is evolving very fast due to the investments in innovative R&D for the production of pharmaceuticals with good commercial prospects.

3. The creation of strong collaborations with local and foreign universities, for the overcoming of geographical, social and cognitive weaknesses
    - NOKIA's main R&D center was established in the University of Oulu which had a long tradition in telecommunications and ICT from 1960 (Solvell & Porter, 2002, p. 17) (Ali-Yrkko & Hermans, 2004, pp. 117-119). The firm also developed strong collaborations with key universities both in Finland and abroad, such as the Aalto University, the Tampere University of Technology and the University of Tampere, the Massachusetts Institute of Technology (MIT), the Beijing University of Posts and Telecommunications (BUPT), the Stanford University, the Tsinghua University, the University of California and the Cambridge University (Solvell & Porter, 2002, p. 5), (research.nokia.com).
    - SAMSUNG founded numerous organizations in Universities across the globe in order to detect the latest technology trends and improve its capabilities. This strategy of sharing competences with academic partners enabled Samsung to leveraging ideas and tap into foreign expertise.
    - The Lund University in collaboration with the Swedish Agricultural University and the Kristianstad University College played an important role in the RIS in Skane. They provided a strong knowledge infrastructure and facilitated research and development in knowledge intensive fields both in terms of knowledge production and training of the labor force. Medicon Valley Alliance (MVA), which was formulated by the initiative of Lund University and Copenhagen University, represents the dominant actor for the strengthening of life science in Skane (Henning et al., 2010, p. 141).
    - In India fierce competition in the local market prevented the emergence of strong synergies between industry and academia as firms attempted to improve their capacities through in-house efforts. As a consequence, the local pharmaceutical industries are characterized by a lack of social proximity in the form of trust, socially embedded relationships and shared competences.

4. The introduction of educational programs for the continuous learning and training of employees, for the expansion of cognitive scope
    - NOKIA attempted to influence the level and direction of higher education and increase the number of university starting places available in the fields of electronics, telecommunications and information technology (Ali-Yrkko & Hermans, 2004, pp. 110-1). It also invested substantial funds in specialized in-house training programs, sometimes in collaboration with Finnish universities, and created training and development opportunities including learning centers (Roos et al., 2005, p. 10).
    - In 1983 the Samsung Foundation for Overseas Technical Scholarship (SFOTS) program was established as part of the effort to extend economic cooperation to developing countries for the improvement of cognitive capabilities. As a result, engineers and managers mostly from Malaysia, Pakistan, India, Egypt and Hungary were offered technical training at company facilities in Korea. SAMSUNG also initiated special education programs in Korea for non-Korean employees of overseas branches for the development of cross-cultural understanding and self-development (Cho, 1996, p. 787).
    - The organization Medicon Valley Alliance (MVA) represents the dominant actor for the strengthening of life science in Skane by focusing on the transformation of the Oresund region into one of the world's top five life science regions, in terms of both research and commercialization. Thee Oresund Food Network, the Skane Food Innovation Network and the Ideon Agro Food represent the major foundations that aim both at the strengthening of the food industry and the reinforcement of its competitive performance (www.oresundfood.org). Especially the Skane Food Innovation Network has developed into a hub gathering actors who want to develop Skane into a food central for Europe by promoting network links within the food sector between business, researchers, companies, organizations, public authorities, universities and colleges, attracting skilled personnel, and arranging seminars and developing projects, such as the VINNOVA project between the Region Skane, Lund University and food companies.
    - Indian firms have collaborated with India's Central Universities (CU) and Indian Institutes of Technologies (IITs) for the introduction of several

research programs comparable to most developed countries and the provision of quality education in science and technology.

5. The recruitment of foreign scientists, for the overcoming of geographical distance and the establishment of social and cognitive proximity
    - NOKIA recruited a considerable number of R&D employees in Finland, which offered it the capability to access foreign knowledge and expertise (Ali-Yrkko & Hermans, 2004, pp. 110-1).
    - SAMSUNG has been strategic in asset-seeking and market-seeking with a great sense of openness towards learning from outsiders. Therefore, it invited Korean and non Korean skilled engineers working abroad, mostly in the USA and Japan, to return and transfer the technologies they had obtained.
    - The Region Skane initiated an open innovation model, based on the mobilization of regional resources as well as on the attraction of foreign national and multinational resources and scientists. Life science companies sought for skilled labor from universities and other firms in the same sector, whereas companies in the food sector attracted personnel mostly from firms in the same industry.
    - In order to face the lack of trained scientists in innovative R&D, Indian firms geared towards both the recruitment of Indian scientists experienced in drug discovery, and the adoption of a strategy based on collaborative research with Indian and overseas academics. They also invited R&D scientists from foreign universities, firms and research organizations.
6. Constant attention to regulatory changes, for the establishment of institutional closeness
    - The NOKIA Corporation created of a comprehensive institutional base which was constantly updated on changes in the countries of operation. EU regulation has promoted business between NOKIA and its customers within the single market of the European Union, but the firm never stopped being particularly attentive to regulatory changes affecting trade, such as customs changes, import and export procedures (Lesser, 2008, p. 30).
    - In the 1980s and 1990s, the Korean market liberalization and privatization, resulting in SAMSUNG's rapid evolution into one of the most competitive firms worldwide. The firm in turn made several institutional adjustments

including the adoption of Western business practices and the careful monitoring of regulatory changes.

- The reduction of trade barriers implied by Sweden's membership in the EU, exposed companies to fierce competition and forced them to focus on the marketing of the region internationally, through facilitating a better access to venture capital and encouraging public and private investments in research and development.
- The promotion of the patent law in the 1970s enabled local firms to legally copy or use known processes with little modifications that were not under patent. Whereas in the past the majority of Indian firms exported products to developed or developing countries with similar technological profiles and weak patent protection, after the pharmaceutical market's liberalization in the 1990s some Indian firms concentrated on exports in advanced economies.

7. Participations in international R&D projects with academics, research institutes, firms and universities, for the establishment of geographical, social and cognitive proximity
    - The NOKIA Corporation participated in numerous international R&D projects with other academics, research institutes, firms and universities of technology (Lesser, 2008, p. 29). The involvement of various partners in most of the TEKES financed NOKIA projects also contributed to the improvement of its technological capacity and paved the way for interactive learning and innovation.
    - SAMSUNG Electronics participated in numerous international projects with foreign universities, research institutes and academics for the improvement of its technological capacities.
    - Life science industries in Skane improved their cognitive base through numerous participations in scientific journals and surveys, whereas food companies performed participations in specialized magazines, fairs and exhibitions (Roman & Moodysson, 2013, pp. 178-9).
    - The reverse engineering-based R&D had a negative impact, as it prevented the development of communication channels such as publications and thus, the degree of participations in international projects in India is rather small.

8. The development of collaborations with foreign suppliers, for the overcoming of geographical distance and the strengthening of social, institutional, organizational and cognitive closeness
    - NOKIA manufactured items for Hitachi in France, Ericsson in Sweden, Northern Telecom in Canada, and Granada and IBM in Britain (www.fundinguniverse.com). Component suppliers were located across a wide range of countries, including Austria, Brazil, China, Chinese Taipei, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, India, Ireland, Israel, Japan, Korea, Malaysia, Mexico, Morocco, the Netherlands, the Philippines, Portugal, Singapore, Slovakia, Spain, Sweden, Switzerland, Thailand, the UK and the USA (Lesser, 2008, p. 30) (www.nokia.com).
    - SAMSUNG Electronics collaborated with foreign technology suppliers, such as NEC (information technology services and products), Sanyo (radios and television sets), Corning Glass Works (materials for the electronics industry and glass substrates), ITT (telecommunication switches) and Honeywell (semiconductors). It also made a number of technical agreements to assemble electronics products for foreign Original Equipment Manufacturers (OEM) such as JC Penney, Sears Roebuck, GTE, Toshiba, IBM, Hewlett- Packard, RCA, and the Crown Corporation (Youngsoo, 1998, pp. 518-9).
    - Life science and food companies in Skane focused on the creation of numerous partnership bodies and external connections with foreign suppliers for the improvement of their capabilities.
    - Indian firms focused on the adaptation of foreign technology through duplicative imitation and learning by doing in the period prior to the 1970s. They produced good quality and cheap substitutes for MNC products based on the concentration on process researches, reverse engineering, creative adaptations, imitations and in-house efforts.
9. The introduction of organizational innovations, such as the flattening of hierarchy and the protection of intellectual property, for the establishment of organizational closeness
    - NOKIA adopted an adequate protection framework which safeguarded patents, design, trademark and copyrights, guaranteed ownership rights and

rewards for investments in new technological fields. It also simplified its organizational structure worldwide through the promotion of tightly knit teams and close co-operation between employees.

- SAMSUNG Electronics undertook a series of organizational innovations such as the creation of operating teams, the flattening of hierarchies and the encouragement of networking, which offered employees a degree of autonomy and flexibility. Additionally, the company introduced the English language as a major criterion in job performance (Cho, 1996, p. 787).
- Industries in the Skane region were characterized by a strong organizational base in terms of intellectual property protection from their initial development stages, due to the well-functioned and advanced national socioeconomic system.
- Indian pharmaceutical firms filed patents for indigenously developed novel and non fringing processes with the regulatory authorities in Europe and the USA.

Faced with resource contains and internal limitations, the cases of South Korea and India proved that -at their initial development stages- they mostly relied on technology transfer through the purchase of foreign technology and the imitation of mature foreign technologies in order to build the required technological capabilities for the development of cutting-edge technology activities. This study revealed that firms in these countries began mainly as imitators, although South Korean industry experience shows that this does not continue indefinitely. Building on capabilities obtained through imitative R&D, Korean firms developed innovative products and emerged as main competitors to established firms in world markets. This examination points to a similar pattern of capability development in the Indian pharmaceutical industry, in which the non-formal modes of imitation and reverse engineering have crucially contributed to the development of basic capabilities in the Indian pharmaceutical sector.

Therefore, South Korean and Indian firms intensely concentrated on two business initiatives which are:

- The adoption of a strong export oriented culture after market liberalization, for the establishment of all five proximity dimensions

- The concentration on the import of foreign technology for its assimilation, imitation and reverse engineering, for the establishment of geographical, social, organizational, institutional and cognitive closeness

On the other hand, private firms in developed countries, like Finland and Sweden, were characterized by less intense efforts for the overcoming of their geographical, cognitive, organizational, institutional and cognitive barriers, as they mostly relied on the exploitation of public initiatives that targeted on the encouragement of innovation. This does not mean that their efforts were less important, but it implies that the Finnish and the Swedish socioeconomic systems were capable of providing domestic firms with the required technological base for their rapid development. As a result, technological change was generated through the combination of research activities of private firms and public institutions.

Consequently, Finnish and Swedish private firms mainly focused on two business strategies:

- The adoption of an open innovation model for their development, for the overcoming of all barriers related to distance in absolute and relative terms
- The development of strong collaborative linkages between industries, universities and the government for the establishment of all five proximity forms

4.4 THE INTERPLAY BETWEEN FIRMS' STRATEGY AND GOVERNMENT POLICY

In Chapter 3 we highlighted that government initiatives for both the overcoming of distance barriers and the encouragement of private firms' innovation potential is crucial. Nevertheless, it revealed that each case was characterized by a different degree of governmental involvement and intervention for the establishment of closeness in absolute and relative terms. In other words, in developing countries, the governments played a more interventional role, as far as the overcoming of distance related problems and the building of a strong socioeconomic system for the promotion of innovative activities are concerned. On the contrary, in the cases of developed countries, the government played an important but more discreet role, as given the well-functioned public system, firms were more able to take their own initiatives.

More specifically, an important question that arose was whether the political choice of Finland to focus on R&D and ICT affected NOKIA's strategy to exclusively aim at mobile telecommunications, or whether NOKIA's pioneering and ever increasing success at that field influenced governmental policies to direct their attention to technological education. After a closer examination of Finland and NOKIA's connection, the conclusion that derives is the existence of a bidirectional relationship between them, in the sense that the firm exploited the innovation system's resources, such as the skilled labor force, the sophisticated education system and the public R&D funding, whereas Finland has been simultaneously socially, economically and educationally benefited from NOKIA.

The examination of SAMSUNG Electronic revealed a different connection between the firm and the government. It highlighted that public authorities soon realized SAMSUNG's capabilities for future growth potential and, thus, the government in combination with policy actors made intense efforts for the building of a national structure capable of further promoting SAMSUNG's development. In other words, the firm's aggressive performance in the electronics sector, forced the government to adjust the national socioeconomic environment to the needs of SAMSUNG and shape the adequate framework conditions for the facilitation of both its competitive performance and willingness to become a global innovation actor.

As far as the case of Skane is concerned, it could be stated that public initiatives for the creation of a well-functioned socioeconomic structure and the overcoming of distance barriers, paved the way for its successful development. Finally, the case of India showed that the government took important initiatives for the initial support of domestic firms' engagement in the pharmaceutical sector, whereas, after liberalization, the Indian pharmaceutical sector was characterized by intense efforts made by the firms themselves in order to reduce their cognitive, institutional, social and organizational weaknesses from the outside world and finally become global players.

4.5 CONCLUSIONS

In general, all four case studies had to deal with geographical, cognitive, organizational, institutional and cognitive barriers in order to reduce their distance from global markets and advance their potential for innovation. Towards this

direction, the government and the firms themselves implemented strategic policies and introduced tactical business practices, as they recognized the importance of technological progress for long-run economic and social growth.

The NOKIA Corporation in Finland, SAMSUNG Electronics in South Korea, the Skane region in Sweden and the pharmaceutical firms in India in combination with the national policy authorities, had to make several adjustments in order to overcome geographical, cognitive, institutional, social and organizational barriers (see Chapter 1 for an overview). Therefore, they tackled education as the key to economic and social development and concentrated on its improvement for the preparation of a highly skilled labor force capable of reducing cognitive distance from key innovation players. Moreover, they focused on the creation of strong collaborations with domestic and foreign universities, research institutes and academics and the promotion of collaborative relationships between industry and academia.

CHAPTER 5: **Conclusions**

5. CONCLUSIONS

This study has definitely offered a clarified picture of the debate on proximity and innovation. Chapter 2 presented a literature review of the proximity issue and mainly focused on the five proximity aspects introduced by Boschma (2005) and Mattes (2012), that is, geographical, cognitive, organizational, social and institutional proximity. This selection was made for clarity reasons and in order to provide a comprehensive picture of the debate on proximity. Another reason has been that despite the French School's of Proximity Dynamics work reflects that first critical contribution to the proximity issue that paved the way for further research in the non-tangible dimension of proximity, Boschma deserves credit for being analytically sharper.

What differentiates Boschma and Mattes' arguments is the kind of proximity aspect as well as the extent to which each one is necessary for interactive learning and innovation to take place. The main common findings indicate that the inherent complexity of knowledge and innovation as well as the proximity aspects' complementarity further complicate the issue and reflect a fuzzy concept. A certain argument emphasizes that proximity should not be associated with its geographical meaning or assessed in isolation, in the sense that non-spatial elements are strongly interconnected to spatial and may frequently substitute each other (Boschma R. , 2005, pp. 61-74) (Mattes, 2012, pp. 1085-99). Consequently, innovation should not be considered as a spatial concept, as it requires the involvement of all five dimensions of proximity and "*their complementarities and substitution effects*" (Mattes, 2012, p. 1094). In addition, the scientific community proposes a constant trade-off between proximity forms, as too much heterogeneity or too much proximity on the other could be detrimental to interactive learning and innovation.

Boschma (2005) underscored that the combination of geographical and cognitive proximity reflect the sufficient conditions for interactive learning and innovation (Boschma R. , 2005, pp. 61-74), whereas organizational, institutional, social and geographical aspects are capable of offering solutions to the fundamental problem of coordination between the engaged players (Boschma R. , 2005, pp. 61-74). Mattes (2012) in turn, highlighted that cognitive, organizational and institutional aspects of proximity represent the enabling factors for learning and innovation to take place and geographical and social proximity types reflect auxiliary factors, mostly by

stimulating the establishment of the three afore mentioned proximity types (Mattes, 2012, pp. 1085-99). Moreover, she attempted to deal with proximity from a deeper perspective, by linking it to different knowledge types, that is, synthetic, analytical and symbolic, owing to the fact that the nature of the underlying knowledge base requires a different combination of proximity aspects for learning and innovation (Mattes, 2012, pp. 1085-99).

In Chapter 3 we provided a practical illustration of the way that public policies and business strategies can contribute to the overcoming of distance barriers in both absolute and relative terms for the promotion of effective communication, trust-based relationships, organizational and institutional flexibility. Towards this direction, we analyzed the barriers each player had to face during its development stages, and the initiatives introduced by the government and private firms themselves, for the overcoming of distance-related limitations and the encouragement of future growth potential. A certain argument derived by the examination of the four case studies implies that the NOKIA Corporation in Finland, SAMSUNG Electronics in South Korea, the Skane region in Sweden and the pharmaceutical firms in India in combination with the national policy authorities, had to make business and policy adjustments respectively, in order to overcome geographical, cognitive, institutional, social and organizational barriers and reinforce their innovation potential.

Finally, Chapter 4 presented the comparative analysis between the four case studies through the identification of the common policy and business practices for both the establishment of closeness to global innovation actors, and the reinforcement of their innovative performance. This examination indicated that the engaged players geared towards some common initiatives in order to tackle with distance, that is:

- The development of face to face interactions for the overcoming of geographical distance
- The creation of common interpretative schemes for the exploitation of new knowledge and the establishment of cognitive proximity
- The building of control, hierarchy and coordination mechanisms for organizational flexibility for the development of a strong organizational base
- The development of committed relationships and shared values for social cohesion and the creation of social proximity

- The establishment of common institutions and rules of the game for institutional stability and the building of an integrated institutional base

Further research

Despite the wide bibliography on the proximity issue, this study mainly focused on five proximity aspects for clarity reasons. As a result, it would be interesting to investigate the issue of proximity and innovation under the perspective of the rest proximity aspects, for the provision of additional mechanisms for the overcoming of barriers related to various forms of distance.

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Appendix

APPENDIX 3.

BACKGROUND FOR FINLAND AND NOKIA

Finland's historical background

Until the 1990s Finland was in the shadow of Russia and represented an agrarian and remote economy of Europe, driven by the wealth of its natural resources as forest-related industries (i.e., paper, wood and pulp products) reflected the dominant manufacturing and exporting activity (Lesser, 2009, p. 10). After six centuries of being Sweden's part, the country was finally independent in 1917 (Solvell & Porter, 2011, p. 1). By the end of World War II, Finland, which was still isolated and mostly characterized by heavy investments in social welfare and public infrastructure, attempted to catch up to the more advanced western economies (Solvell & Porter, 2011, p. 3).

The institutionalization of science and technology policy started in Finland in the early 1960s and highlighted the importance of research and development for the country's industrial reformation (Lemola, 2002, p. 1483). The period in the mid-1960s represents a modernization era of the Finnish socioeconomic system that was marked by five important changes. Firstly, the conceptual principles of science and technology policies were created. Secondly, the Science Policy Council was established in 1963 and became the central body for the formation and harmonization of science and technology related activities. Thirdly, a new structure for planning, coordination and financial support of university research emerged, initiating the creation of new research posts and projects. Fourthly, new measures for the promotion of industrial R&D were taken, and towards this direction the Finnish National Fund for Research and Development (SITRA) was founded in 1967 to reinforce industrial R&D. Fifthly, the advancement of higher education in general took place and led to the creation of a sophisticated university system, capable of preparing qualified personnel for the development of science and technology activities (Lemola, 2002, pp. 1483-4).

The development of science and technology policies and the rise of the Finnish telecommunication sector

More specifically, after Finland's independence, a national Public Telecommunications Operator (PTT) was founded, in order to exploit the network left

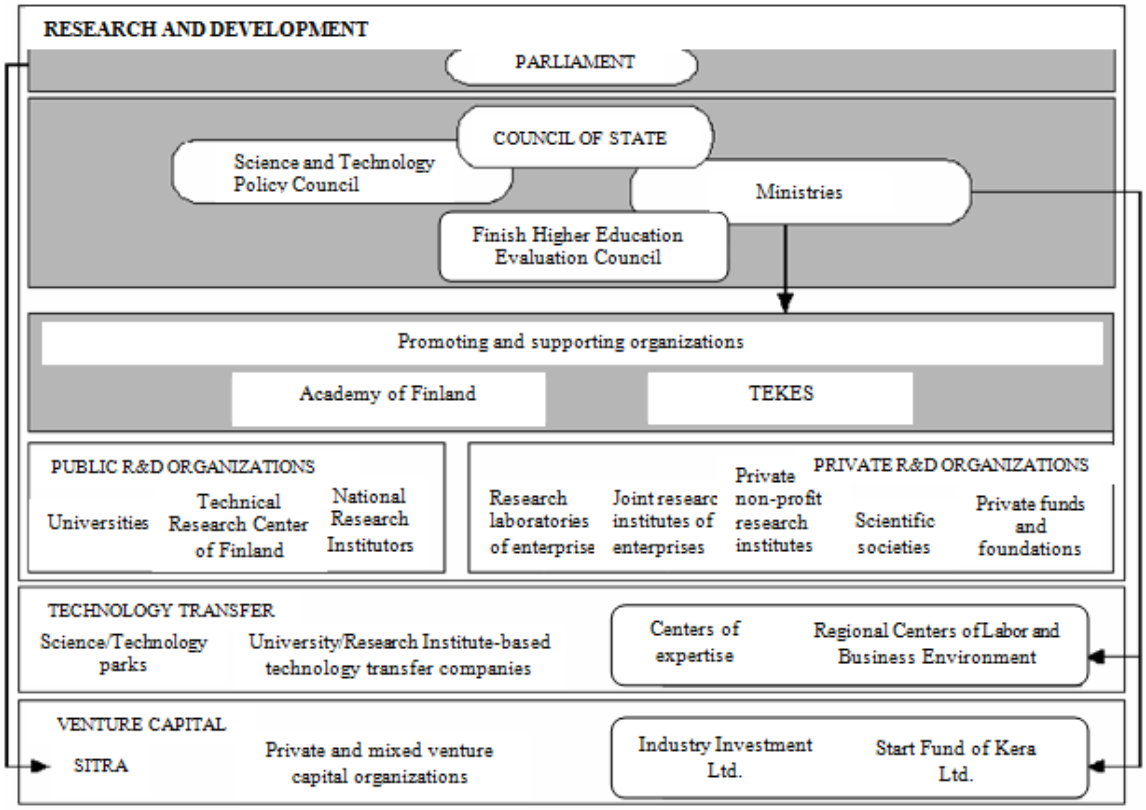
behind by Russia (Solvell & Porter, 2011, p. 4). The Finnish history in radiophone and mobile phone industries mostly comes from three companies: Salora, the State Electric Works and the Finnish Cable Works (Solvell & Porter, 2011, p. 5). More specifically, Salora was founded in 1928 as a regional manufacturer of TV and Radio sets and started its operations in radiophones in 1964. The State Electric Works was established in 1925 as the Ministry's of Defence radio laboratory, aiming at the reinforcement of national development and radio technology. Finally, the Finnish Cable Works was founded in 1917 as a producer of telecommunication cables (Solvell & Porter, 2011, p. 5).

Already the late 1970s were accompanied by the introduction of new priorities in science and technology policy and throughout the 1980s the government made a series of policy changes in reaction to a growing concern that the country's economy was losing ground internationally (Solvell & Porter, 2011, p. 4). In 1981, the PTTs in Denmark, Finland, Norway and Sweden collaborated and launched "*the world's first international cellular network and the first to allow international roaming, the Nordic Mobile Telephone (NMT) service*" (www.theguardian.com) (Lesser, 2009, p. 5). The NMT led the way for roaming technology and represented an open standard that could be implemented by any company (Solvell & Porter, 2011, p. 5). In 1987, a new Telecommunications Services law transferred regulatory authority from the PTT to an independent body under the Ministry of Transport and Communications and initiated the right of private companies to offer mobile communication network services (Solvell & Porter, 2011, p. 9). Simultaneously, in this period, the Global System for Mobile communications (GSM) was adopted "*as the European standard for digital mobile technology*" (Lesser, 2009, p. 5) and marked the beginning of a new business era (www.nokia.com).

The Finnish government aimed to coordinate its political initiatives with NOKIA's choices. Therefore, the government supported the idea of a collaborative business model with research and industry linkages (Lesser, 2009, p. 29). Towards this direction, the adopted political choices succeeded in the establishment of certain framework conditions for innovation, and gave a persistent priority to higher education, "*linkages and spillovers among various industries*" for the development of new knowledge-based industries (Lesser, 2009, p. 11). In the beginning of the 1990s, the government concentrated on the development of knowledge, by promoting

innovation, information and communication technologies, increasing the research and development spending (Pillay, Linking Higher Education and Economic Development: Implications for Africa from Three Successful Systems, 2010, pp. 33-34), introducing science and technology policies and investing additional funding in R&D (Solvell & Porter, 2011, p. 7). The government also involved in mergers and investments in the private sector, influencing the ownership structures of strong industries (Solvell & Porter, Finland and Nokia: Creating the World's Most Competitive Economy, 2011, p. 1) and was among the first countries to adopt the concept of a National Innovation System (NIS) as the basis for its technology and innovation policy (Roos, Gupta, & Fernstrom, 2005, p. 6).

Figure 1: Key flows between actors of Finland's National Innovation System



Source: Roos et al., 2005, p. 6

"From a modest base in the 1960s and 1970s, the Finnish telecommunications cluster began to emerge in earnest in the 1990s" (Solvell & Porter, 2002, p. 15). The cluster approach was introduced in the early 1990s and gave the central message that:

> All government actions had implications for national competitiveness. Therefore, economic and industrial policies needed to be considered from an extended perspective, beyond the administrative boundaries of sectoral ministries. The cluster model stimulated new forums for interaction and

> coordination between ministries, public and private units and companies (Solvell & Porter, 2011, p. 7).

The cluster approach for the development of ICT activities entailed a series of benefits, such as the development of formal and informal relationships with other SMEs, the existence of support institutions, the facilitation of cooperation and interactive learning. Furthermore, it provided a favorable environment for firms, characterized by synergies, real interactions, well-developed infrastructure, support mechanisms and human resources. As Pillay (2010) points out that:

> Spatial clustering and organizational networking of knowledge-based industries have been critical sources of productivity and competitiveness… and the Finnish experience shows the synergy that can be created from networking between different levels of government in the design of developmental public policy (Pillay, 2010, p. 35).

The advancement of education, the high investments in R&D, the institutional adjustments and the facilitation of the emergence of an ICT and communications cluster that would supply NOKIA scientific knowledge and a highly skilled labor force, can describe to some extend the government's total contribution. Public spending on education, relative to GDP, traditionally was beyond other Europeans countries, and contributed to Finland's sophisticated public education and university system which consists of 20 universities and other institutions of higher education (Solvell & Porter, 2011, p. 3). At this point it should also be stated that a great majority of *"public R&D funding to the private sector"* in Finland is channeled through TEKES, which was founded in 1983 and represents the principal organization for the implementation of technology policy (Ali-Yrkko & Hermans, 2004, pp. 107-10).

The National Technology Agency (TEKES) was established under the Ministry of Trade and Industry, and became the principal organization for the implementation of technology policy (Ali-Yrkko & Hermans, 2004, p. 107) (Miettinen, 2013, p. 78). It directed public funding to telecommunication projects in collaboration with universities, research institutes and telecom firms (Solvell & Porter, 2002, p.15) (Ali-Yrkko & Hermans, 2004, p. 107) (Miettinen, 2013, p. 78). TEKES facilitated the digital media industry's emergence through the promotion of interactions between firms, venture capitalists, universities, and research institutes as in the 1990s -when the political decision was made to focus on mobile technology- its funding entirely

geared towards the information and communication engaged companies (Ali-Yrkko & Hermans, 2004, pp. 107-9) (Lesser, 2008, p. 27). TEKES support aims at projects that create long-term economic and social benefits and, thus, it has been diachronically working with top innovative companies and research institutes in Finland (http://finland.org). As a consequence, it promoted a wide range of innovation activities in research communities, industry and service sectors and besides funding technological breakthroughs, and also supported service-related, design, business and social innovations (http://finland.org) (Ali-Yrkko & Hermans, 2004).

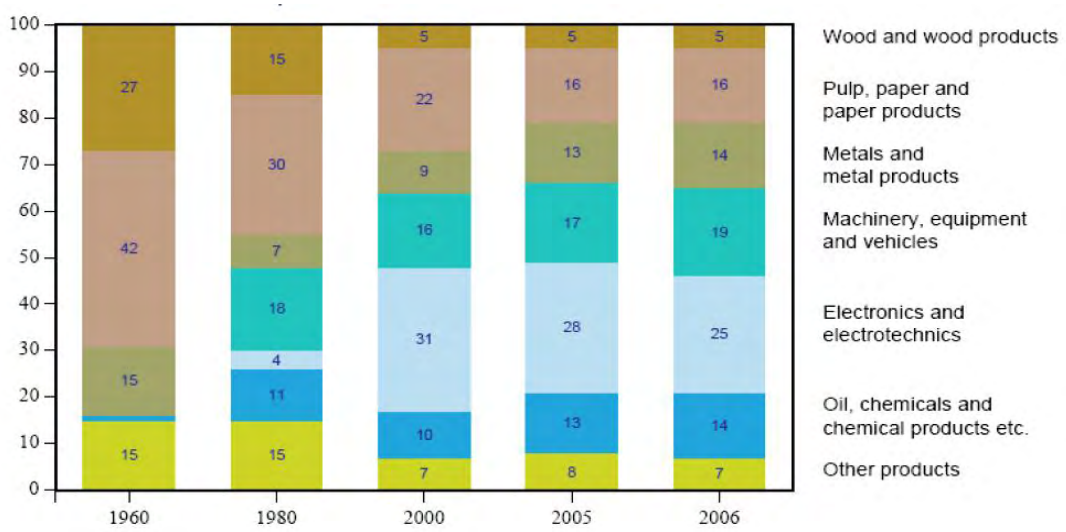
As an EU member (1995), the country also benefitted from "*the regional trade arrangements and the mutual recognition agreements concluded between the European Commission*" (Lesser, 2009, p. 6), which resulted in the decrease of Finland's institutional distance from third parties. As a result, trade between Finland and EU partners was facilitated "*due to the harmonization of essential product regulations and specifications and the introduction of the EU Suppliers' Declaration of Conformity for telecom and electrical equipment and parts among EU countries*" (Lesser, 2009, pp. 5-6). Moreover, the country bridged its institutional and social distance from the rest of the world by removing restrictions on foreign ownership of Finnish firms, promoting inflows of FDI[20] and facilitating access to more capital and knowledge especially in the ICT sector (Lesser, 2009, p. 6).

It is now clear that the country's restructuring has been a business-driven process in the sense that the development of *"strong sectoral specialization in the manufacturing and export of telecom equipment"* enabled the country to successfully transform its production base from a resource-driven economy to a knowledge one, as illustrated in Figure 2 (Lesser, 2009, p. 11) (Pillay, 2010, pp. 33-35). In the period of 1995 and 2003, the share of ICT manufacturing in total Finnish manufacturing increased by 13.4 percent, reflecting the highest increase among the OECD economies, in contrast to the share of ICT services in total Finnish services which rose by 3.3 percent over the same period (Lesser, 2009, p. 11). In the late 1990s, ICT and consumer electronics (including telecom equipment) conquered the dominant

[20]The main sources of inward FDI originated from other European countries (Lesser, 2009, p. 19).

position of the economy, accounting for 31 percent of total manufactured exports in 2002, followed by pulp, paper and paper products, which represented 22 percent of exports, and machinery, equipment and vehicles, reflecting 16 percent of exports (Lesser, 2009, p. 10).

Figure 2: Evolution of the Finnish export structure for manufactured goods, 1960-2006**,** Share of Goods Exports (%)



Source: Lesser, 2008, p. 10

NOKIA's development history

NOKIA entered the business sector in 1865, when engineer Fredik Idestam set up a wood and pulp mill in southern Finland and started paper manufacturing (Aluya, 2014, pp. 5-6) (www.nokia.com). The firm's name was inspired by the Nokianvirta river, on the banks of which Idestam established a second mill in 1871 (www.theguardian.com). In 1960 it entered the telecommunication sector when an electronics department was established at Finnish Cable Works, and together with NOKIA they focused on the production of *"radio-transmission equipment"* (www.nokia.com). The company's first venture into the industry occurred in 1963, when it developed the first radio telephones for the army (www.nokia.com), while in 1967 the NOKIA Corporation was formed as the result of the merger of Idestam's NOKIA, the Finnish Cable Works Ltd. and the Finnish Rubber Works (www.nokia.com) (Lesser, 2009, p. 26) and consisted of five businesses related to rubber, cable, forestry, electronics and power generation (Aluya, 2014, p. 8) (www.nokia.com).

The Finnish firm got in on the cellular industry's ground floor in the late 1970s, when it contributed to the design of the world's first international cellular system, the Nordic Mobile Telephone (NMT) network, which linked Sweden, Denmark, Norway, and Finland (www.fundinguniverse.com). In 1981 the Global System for Mobile communications (GSM) was adopted "*as the European standard for digital mobile technology*" (Lesser, 2009, p. 5) and the first GSM call was made with NOKIA equipment in 1991 (www.nokia.com). The engagement in the GSM system represents an achievement that is now marked as the beginning of its sovereignty. More specifically, by the 1970s Televa, a state-owned telecommunications company established in 1945 as the merger of the Finnish Cable Works with the R&D units of the PTT, and the NOKIA Corporation considered the Finnish home market as small and decided to combine their R&D and marketing efforts in digital technology (Solvell & Porter, 2011, p. 5). In 1967, NOKIA established a division which initially developed *"design and manufacturing capabilities in data processing, industrial automation and communications systems"* and then focused on the development of information systems (www.fundinguniverse.com). Moreover, in 1979, with the NMT under way, NOKIA and Salora created Mobira, a 50-50 owned joint venture, in order to market and develop radio technology. In 1982, the NOKIA Corporation, which had always been forward looking and particularly receptive to novelty, introduced the first car phone and the first digital telephone switch (www.nokia.com) (www.theguardian.com).

During the 1980s, the NOKIA Corporation expanded its operations by buying various companies, such as Luxor (a Sweden owned electronics and computer firm established in 1923), the PC and office electronics business of Ericson (1988) and Standard Elektrik Lorenz (a German manufacturer of TV sets and other electronics) (Solvell & Porter, 2011, p. 6) (Aluya, 2014, p. 8). These acquired units were mostly operating in the electronics industry and produced TV sets, monitors and videos. NOKIA combined Salora and Luxor into a single division and concentrated on stylish consumer electronic products, since style was a crucial factor in Scandinavian markets (www.fundinguniverse.com). Moreover, in combination with the Tandy Corporation (a leather goods company in Texas, established in 1919, which started the personal computer evolution in 1977), NOKIA established joint ventures in Korea and the US to manufacture mobile telephones (Solvell & Porter, 2011, p. 6).

In 1991 the NOKIA Corporation decided to focus its core business entirely on manufacturing mobile phones and telecommunications systems, by gradually selling off cable, rubber and consumer electronics divisions, while in 1998 it was a global leader in mobile phones for more than a decade (www.nokia.com). Although a market leader in Scandinavia, Nokia still lacked a degree of competitiveness in the European market, which was dominated by much larger Japanese and German companies, it became an original equipment manufacturer, to manufacture products for competitors, such as Hitachi in France, Ericsson in Sweden, Northern Telecom in Canada, and Granada and IBM in Britain. In 1992 NOKIA introduced a management approach, also known as the *"NOKIA way"*, constituting of *"customer satisfaction, respect for the individual, achievement and continuous learning"* (Solvell & Porter, 2011, p. 17) as well as of values, organizational competencies, operations and processes that sustain operational efficiency (answers.mheducation.com). This "NOKIA way" resulted in the creation of a flat and well-networked company that is fast and flexible in decision making.

Figure 3: The strategic locations of NOKIA Research Centers

Source: www.anrt.asso.fr/

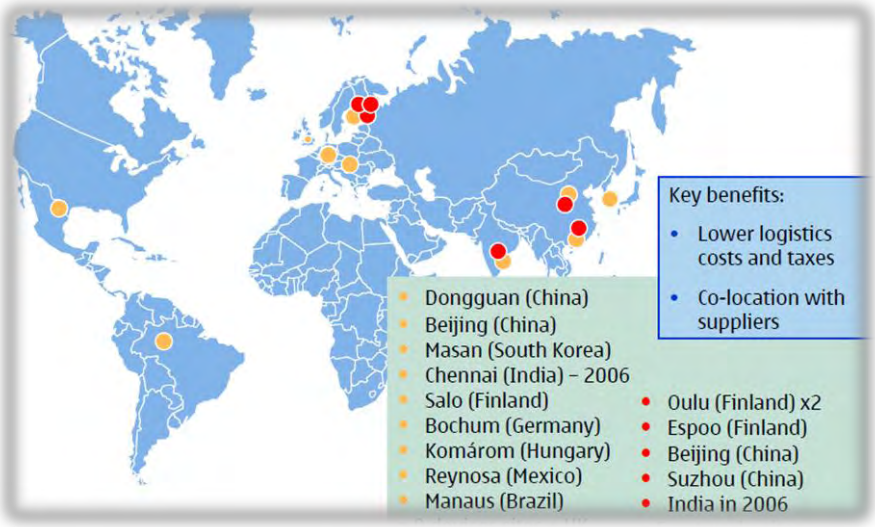
The contribution of important executives to NOKIA's development process

NOKIA itself made great efforts in order to overcome its initial limitations and transform itself into a key global player. Many CEOs shaped the Corporation's historical background and managed to lead it to all time significant successes and, thus, the most important of them are mentioned. In NOKIA's initial stages Kari Kairamo was the CEO that transformed the company by achieving the acquisition and expansion of *"80 subsidiary companies with an estimated 26.000 employees*

spreading over nine countries before his death in 1980" (Aluya, 2014, pp. 6-7). Kairamo was also active on the public education front, in the form of international student exchange programs, adult education, industry-academia collaboration efforts and other areas influencing to some degree Finland's national commitment to education competitiveness (www.jcer.or.jp/eng/pdf/kenho0902e.pdf). Simo Vuorilehto, the successor to Kari Kairamo in the seat of the CEO, led to the acquisition of Datachecker (USA Based) and the Unix-telecomms, Danish Company Regnecdentalen-ICL in the 1980s and focused on the liquidation of the *"unprofitable business ventures and subsidiaries"* (Aluya, 2014, p. 7).

In the 1990s Jorma Ollila (former CEO and later Chairman) made the strategic decision for the company to focus more on the telecommunications business (Aluya, 2014, p. 7) (www.nokia.com). After a critical examination of the company's capabilities he realized NOKIA's need for a stronger R&D basis, and led to the acquisition of the Matra Nortel Communications' GSM Terminals in Ulm, Germany, which was *"used as a stepping-stone to transform Nokia into one of the world's largest mobile phone suppliers".* All the above mentioned successful choices accelerated NOKIA's rise and set the bases for its remarkable progress. At its peak the firm managed to have operations in almost 150 countries with over a third of its net sales to originate from Europe and Asia, and the others from the USA, Middle East, and Africa (www.kauppapolitiikka.fi).

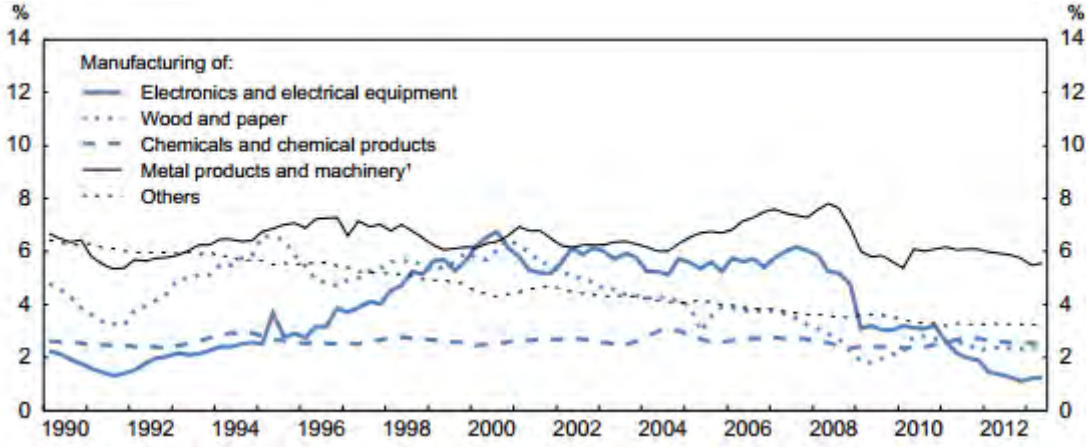
Figure 4: NOKIA's Global Manufacturing Network



Source: www.anrt.asso.fr/

However, in the recent years NOKIA faced some critical challenges and according to some researchers it lost some of its past glory, as it appeared to be unprepared for keeping up with global changes and demands (Lesser, 2009, pp. 7-8). More specifically, in 2011 the exports of electric and electronic industry's products represented 13.4 percent of total exports, while forestry products, and machinery and transport equipment reflected 19.6 percent and 33.4 percent of total exports respectively(www.tulli.fi/en/finnish_customs/statistics/publications/pocket_statistics/liitteet/pocket2003.pdf), with its top export partners for 2012 being Sweden, Russia, Germany, the Netherlands, US, UK and China (www.oecd.org). According to the OECD the electronic sector started collapsing in 2007 and was followed by the gradual erosion of the forestry sector, whereas the metal and chemicals sector appeared to be more resilient, as illustrated in Figure 5 (www.oecd.org/). The above mentioned data underscore that despite Finland's rapid concentration on the development of ICT and electronics in the 1990s, (Lesser, 2009, pp. 7-8), nowadays the national economy faces deep restructuring transformations.

Figure 5: The collapse of the electronic and forest products' share in output



Source: www.oecd.org/

Finally in 2013 it made an agreement, which was completed in 2014, and sold substantially all of its device and service businesses to Microsoft. However, the company excluded two facilities from the scope of the transaction to Microsoft: in Chennai, India due to Indian political restrictions, and Masan, Korea, which according to the firm will soon be closed (company.nokia.com).

The interplay between the Finnish government and NOKIA

After the examination of the NOKIA Corporation case, it could be argued that in Finland -which has evolved from a remote industrial state in the 1950s to a knowledge-based economy (Sahlberg, 2007, pp. 147-9)– the firm appeared to be a key contributor to the national transformation, as it performed a remarkable growth with widespread economic and social reflections all over the country. As it is stated, NOKIA *"has played a major role in the transformation of the Finnish economy and in the Finnish innovation system"* by producing innovation resources which were later diffused outside the company (Lesser, 2009, p. 7) and visibly contributed to the national economy's GDP growth (Ali-Yrkko & Hermans, 2004, pp. 106-7).

The firm embraced an open innovation approach for its development from its initial stages (Lesser, 2009, pp. 27-9) and aimed at the maintenance of strong global contacts, in order to monitor and influence worldwide technological processes and evolutions. Its strategy towards being forward looking and particularly attentive to global changes, preferences and trends led many people to believe that when it comes to globalization this firm is a category of its own. In other words, NOKIA's remarkable development has to a great extent been possible thanks to the expansion of its activities abroad, which usually operated as receivers of new demands on the market area. Additionally, the NOKIA case shows that the initial breakthrough in the telecommunications sector was achieved by the availability of specialized skills, largely built up as a result of the mix of technical solutions that were chosen by the firm (Roos et al., 2005, p. 10).

All the above mentioned could be summarized into this argument:

> Beyond developing an effective supply chain and logistics strategy, Nokia has heavily invested in R&D and adopted a collaborative and open innovation model characterized by close co-operation, interactions and knowledge spillovers with other firms, universities and research institutes, which enabled it to expand the scope of its long-term technology development (Lesser, 2009, p. 34).

The company acted as a catalyst in the information and communications technology sector's development by creating vertical relationships with suppliers and subcontractors, which covered not only production but also research and product development. Close collaborations in production and R&D with various players inside and outside the country, such as universities and research institutes as well as Increase

of R&D activities overseas in the 1990s, significantly contributed to the expansion of the firm's cognitive and social scope, while its persistence on the protection of property rights established a strong organizational base that safeguarded ownership and established the proper framework for future growth potential. Investments on specialized in-house training programs and continuous learning, sometimes in collaboration with Finnish universities, the recruitment of foreign R&D employees in Finland, the promotion of tightly knit teams and close co-operation between employees and various external partners and further organizational transformations combined with the breed of trust and real interactions among its partners, finally brought about greater creativity, a faster reaction to new customer needs eliminating the firm's cognitive, institutional and social gaps with the outside world.

This strategy enabled it to take advantage of foreign markets, foreign talents and new technology and contributed both to the enhancement of its competitive performance and commercialization, and the building of an integrated institutional, social, organizational and cognitive base, capable of reducing the problems related to its geographical distance from global markets. It also indicates that the firm's ultimate goal geared towards tapping knowledge from rivals, markets and universities around the globe, explaining why its R&D sites were systematically located in regional clusters of scientific excellence. Obviously, the firm managed to overcome its initial limitations and strengthen its capacities by developing a sufficient degree of closeness with its collaborators and reap the benefits from their effective cooperation by exploiting external expertise and technology.

In parallel, the government reinforced its development by implementing effective public policies, structuring a competitive market, ensuring market openness and establishing motivation and support networks for firm-level innovation. The adoption of Western European and Nordic patterns for the establishment of a certain framework for innovation in the 1980s, in combination with public financial support for GSM research, the promotion of a collaborative research-industry model for innovation and the increase of the R&D spending due to the political concentration on the development of the ICT and electronics sector, all contributed to the emergence of the Finnish communications cluster in the 1990s for the facilitation of NOKIA's development. In addition, the harmonization of essential product regulations and specifications between Finland and the EU partners as well as the intense technology

transfer between domestic and foreign companies, providers, academics, research institutions and standardization authorities in the 1990s and 2000s also set the bases for the firm's further future growth.

Obviously, NOKIA's occupation in the telecommunication industry has been assisted by the government's vision for a knowledge-based economy and its support for the development of a sustainable innovation model. Therefore, a common view argues that *"as NOKIA became an international success story, Finns came to see the mobile phone as a national symbol"* (Solvell & Porter, 2011, pp. 14-5). The firm's networking also was facilitated by TEKES -the principal organization for the implementation of technology policy under the Ministry of Trade and Industry- due to the co-finance of Nokia's research activities mostly in the 1990s, and enhanced by the cooperative long-term relations between the firm and the public authorities. Roos, et.al (2005) state that:

> The networked production paradigm, enhanced by cooperative long-term relations, can be seen behind much of the superior performance of Nokia and the Finnish information and communications technology sector in general. This is not only a feature of Nokia's operations: networking solutions have become increasingly common in the information and communications technology industry at large (Roos et al., 2005, p. 11).

An important question that arises is whether the political choice of Finland to focus on R&D and ICT affected NOKIA's strategy to exclusively aim at mobile telecommunications, or whether NOKIA's pioneering and ever increasing success at that field influenced governmental policies to direct their attention to technological education. After a closer examination of Finland and NOKIA's connection, the conclusion that derives is the existence of a bidirectional relationship between them, in the sense that the firm exploited the innovation system's resources, such as the skilled labor force, the sophisticated education system and the public R&D funding, whereas, simultaneously, Finland has been socially, economically and educationally benefited from NOKIA.

Overall, it is stated that "*the experience of Nokia illustrates well how businesses can contribute to the strengthening of national innovative capacity*" (Lesser, 2009, p. 34), as the firm has transmitted its knowledge and know-how to the Finnish universities as well as to several partners through its networking policies. As a result, NOKIA managed to improve its internal capabilities by developing social, organizational,

cognitive and institutional proximity to its partners, as well as to global markets, and finally contributed to the whole country's economic growth.

BACKGROUND FOR SAMSUNG AND SOUTH KOREA

South Korea's development history

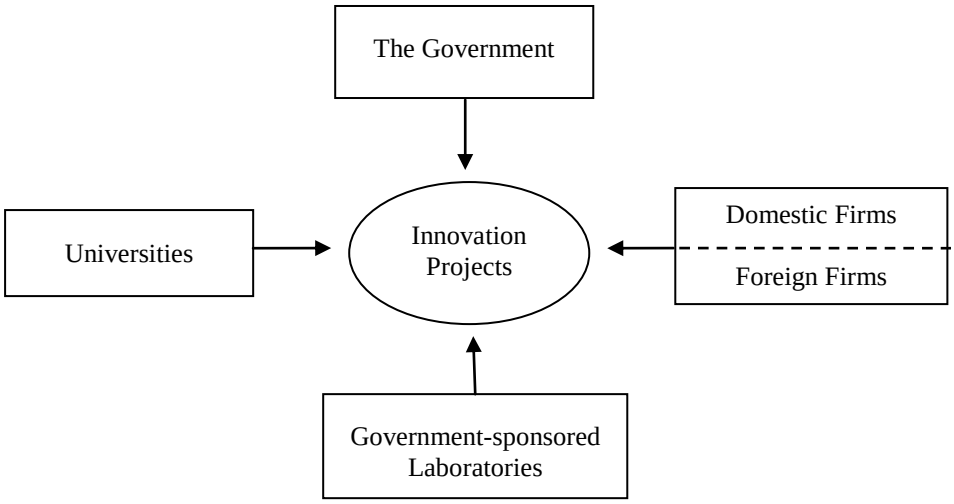
South Korea's economy is strictly connected to its political history, as plenty of invasions by neighboring countries, political and cultural factors were determinant of its introversion and "voluntary isolation" from the outside world's influence since the 20th century (www.ida.org/). Nonetheless, strategic public choices and successful private initiatives contributed to the widely known the "Korean miracle" (Chung S. , 2010, p. 334) and managed to transform South Korea into one of the four "Asian Tigers". In general, the country managed to evolve from a fast follower to a first mover (www.ida.org/) through the definition of strategic national policies towards the improvement of science, technology and innovation and the adoption of Western business practices (www.ida.org/) (ec.europa.eu/).

According to researchers one of the dominant factors for the country's remarkable growth -during the last forty years- has been the creation of a strong National Innovation System (Lee & Han, 2002, pp. 164-168) (ec.europa.eu/) based on *"a capacity to learn, produce, and implement high quality processes in order to produce high quality products*" (www.ida.org/). This system can be separated into two periods: the initial period which was government led and the later period which was private sector led (Sohn & Kenney, 2007, p. 993). In any case, continuous and massive investments in research and development resulted in the building of an exceptional innovation system that supported the Korean economy's sustainable growth (Chung S. , 2010, p. 333) and facilitated the transformation of large Korean firms (SAMSUNG, Hyundai, LG and POSCO), known as the chaebol, into some of the world's most competitive multi-nationals (Chung S. , 2010, p. 342) (www.ida.org/).

Ever since, *"the primacy of institutions over geography"* assisted the country to further overcome its initial technological disadvantages, reduce its distance -both in cognitive, social, institutional and organizational terms- from foreign markets and successfully transform itself from an agrarian economy into the world's key economic player (www.ida.org/). Nonetheless, despite the great public efforts for Korea's economic success, decentralization policies are responsible for the lack of high-

technology clusters in the country, in the sense that the government moved critical functions out of Seoul, targeting regions characterized by little possibility of developing significant technology intensive activities (Sohn & Kenney, 2007, pp. 1001-2).

Figure 6: Interactions in the National Innovation System of Korea



Source: Lee & Han, 2002, p. 165

The development of science and technology policies

The Korean economy has traditionally been a government-led export driven economy (Yoo et al., 2005, p. 335). In more detail, in the 1960s South Korea represented a typical developing country, poor of resources and production (Chung, 2010, p. 336) characterized by a protected economic environment -in the sense of *"import and FDI restrictions, direct credit, and tax relief"*- (www.ida.org/). In this period, agglomeration of manufacturing firms in specific activities was a key policy objective in order to prepare the base of strategic industries (Lee K. , 2003, p. 29). However, in the late 1960s public agents attempted to make some strategic efforts in order to reinforce the country's shift to more technology-intensive activities (Chung, 2010, p. 336). Due to the primitive knowledge base of the country, the development strategy focused on three principles in order to tackle new technological capabilities: *"foreign technology transfer through formal mechanisms, the recruitment of high-calibre human resources from abroad and local R&D efforts"* (Kim, 2004, pp. 345-61).

The Korean experience indicates that domestic firms were forced to accelerate learning by *"importing and rapidly assimilating production technology from abroad"* (Kim, 1998, p. 317). Foreign technologies were initially obtained from the USA and

Japan, and other western industrialized economies (Chung S. , 2010, pp. 334, 353) (www.ida.org/) related to "assembly processes, product specifications and production know-how" (Kim, 1998, p. 313). Korea's focus on the acquisition, assimilation and imitation of mature technologies resulted in the accumulation of technological capacity through learning by doing and enabled the creation of an integrated knowledge base (Kim, 2004, p. 345). The follow the leader practice, as well as the Korean receptiveness towards learning from outsiders enabled the country to incorporate western business practices and knowledge into their "Korean system" (www.ida.org/). The state also invited Korean skilled engineers that were working abroad to return (Choi, 1995, p. 74) and recruited Korean scientists engaged in academic institutions and R&D organizations, in order to encourage the private sector's development (Kim, 1998, p. 317). This pattern contributed to the reduction of Korea's cultural, institutional and cognitive distance from global markets, as the recruited skilled personnel was capable of transferring its experience of global markets and foreign knowledge into its home country (www.ida.org/).

In the early 1970s public policies initiated a gradual shift to more technology-intensive activities (Chung, 2010, p. 336). In this period the government facilitated exports by promoting a general trading company (GTC) system (Cho, 1996, p. 787), assisting global players to enter the protected Korean environment (Youngsoo, 1998, pp. 518-519) (www.ida.org/). As a result the traditional socioeconomic structure faced critical changes (www.ida.org/) in the sense that this outward oriented development strategy brought about a double impact. On the one hand it highlighted the need for Korean industries to invest heavily in R&D in order to survive from fierce competition, while on the other it drove them to enter international markets, in order to accumulate knowledge (Chung S. , 2010, p. 345). Consequently, Korean firms were forced to take initiatives for learning in order not to rely entirely on foreign knowledge sources (Kim, 1998, p. 317).

Aiming at the access of ideas, knowledge and technology generated outside the country, the reduction of its cognitive and social distance from the outside world, and the evolution from imitation to innovation, South Korea attempted to develop international interactions with foreign research centers and universities as well (Lee K. , 2003, p. 30). Another common practice, which was supported by several Korean organizations, was the funding of a number of students annually for 18-month

internships at U.S. firms, but nowadays the number of Korean students that travel overseas, mostly in the USA, China and Japan, has further increased (www.ida.org/). The government also created numerous research institutes, such as KIST and MOST- which diffused the political plans into the industry by providing information, implementing pilot R&D programs and transferring imported technologies to the private sector (Sohn & Kenney, 2007, pp. 997-8).

In the 1980s Korean firms were able to further concentrate from labor-intensive technologies on those focusing on more knowledge-intensive technologies across all the sectors (Kim, 2004, p. 356) (Sohn & Kenney, 2007, p. 1002) while in the 1990s the country introduced for the very first time a regional political system that recognized the importance of regional innovation activities (Chung S. , 2002, p. 487), and managed to reach the level of advanced countries as far as R&D is concerned (ec.europa.eu/). By the mid-1980s computers, semiconductor memory chips, video cassette recorders, electronic switching systems, automobiles, industrial plants and other technology intensive products represented Korea's dominant export items, whereas in the mid-1990s "Korea was working on the next generation products, such as multimedia technology, high-density television and personal communication systems" (Kim, 1998, p. 311).

After the engagement in more knowledge intensive activities, human development represented a basic foundation for the creation of a strong knowledge base and, thus, the government highly focused on the improvement of education. Korea faced the compelling need to prepare a pool of well educated human capital, capable of assimilating foreign knowledge in order to support and advance the country's innovative performance and as a result it tackled human capital as its biggest endowment (www.ida.org/) in order to produce a *"well-educated and well-disciplined workforce"* (Chung S. , 2010, p. 334). Despite the fact that several countries focus on the advancement of education for their development, the Korean case was unique in the sense that it initiated a *"well-balanced expansion at all levels of education early enough to support its economic development"* (Kim, 2004, p. 361).(Sohn & Kenney, 2007, p. 1002).

Particularly in the late 1990s, policy-makers and university administrators emphasized the importance of encouraging entrepreneurship (Sohn & Kenney, 2007, p. 1002). As a consequence, South Korea's vision geared towards the mix of an outward-looking

development strategy and a firm–oriented industrial policy (ec.europa.eu/) (Chung S. , 2010, p. 333) although bureaucratic, cultural, and social obstacles decelerated the increase of university-based research in entrepreneurship (Sohn & Kenney, 2007, p. 1002). In this period leading Korean firms had become technological frontiers and, thus, the government started to *"increase support to fundamental research probably carried out by universities"* (Lee K.-R. , 2014, p. 2). Universities in turn managed to train a large pool of talented scientists and engineers that:

> Became the workers upon which Korean firms have propelled themselves into the world's first rank and from whose work Korean living standards have advanced (Sohn & Kenney, 2007, pp. 1002-3).

However, they were and still are characterized by a strong sense of hierarchy and conservatism that brings about noteworthy difficulties to inter-institutional knowledge transfer and entrepreneurship (Sohn & Kenney, 2007, p. 1002).

The Korean experience highlights that:

> Over the past two decades the country has systematically built up a brain trust by strategic external sourcing and assimilation of knowledge at the university and workforce education levels (www.ida.org/).

As a late-industrializing country, its technological competences *"were far below world standards"* and as a result, it was inevitable that it would seek for foreign technologies (Pillay, 2010, p. 73). Nevertheless, it could be stated that South Korea has relied heavily on foreign technologies, but it has simultaneously made great efforts in order to accumulate knowledge and improve its capabilities in a rather rapid period of time (Pillay, 2010, p. 73). The above mentioned strategies emphasize the country's persistence in order to improve its capabilities, and also underline its remarkable efforts to understand consumer needs, rapidly respond to emerging trends, even if these demands were diametrically different from the Korean patterns, and finally dominate the market (www.ida.org/).

A brief report of SAMSUNG's engagement in semiconductors and telecommunications equipment

Samsung Group (Samsung) is a South Korean multinational conglomerate company headquartered in Samsung Town, Seoul and founded by Lee Byung-Chul in 1938. At first, it was a small trading company (selling noodles and dried seafood) (www.samsung.com) but it managed to evolve into a brand that resonates with global leadership in various industries including IT, shipbuilding and engineering and many

more (www.samsung.com). The Samsung Electric Industry was founded in 1969 and was renamed to Samsung Electronics in 1988. (www.samsungvillage.com). Since the 1990s Samsung has increasingly globalized its activities on electronics -particularly mobile phones and semiconductors- which have become its basic source of income (www.samsungvillage.com). Located in Suwon, South Korea, it is the flagship company of the Samsung Group, accounting for 70% of the group's revenue in 2012 (Lee & Slater, 2007, p. 247) (www.samsung.com). Moreover, it has been the world's largest information technology company by revenues since 2009, as it has plants and sales networks in 80 countries and employs around 370,000 people (www.samsung.com).

SAMSUNG started with few resources and, thus, it initially focused on the imitation of imported technologies (Lee & Slater, 2007, p. 250). South Korea's economic development and government support accelerated the company's development, but the latter made enormous efforts to evolve *"from a late starter to a technology leader"* (Gil et al., 2003, p. 338) (Lee & Slater, 2007, pp. 244, 253). The firm managed to "*access and tap into foreign technologies in global markets*" and finally improve its absorptive capacity (Lee & Slater, 2007, p. 247) due to its constant persistence for the assimilation of foreign know-how (Lee & Slater, 2007, p. 250) and the ability to seek, create and develop new knowledge (Baloh et al., 2008, p. 434). Towards this direction the company strategically chose to dispatch part of its specialists in foreign companies, in order to be trained to assimilate new technologies and gain familiarity to new products and processes (Lee & Slater, 2007, p. 251) (Choi, 1995, p. 77). These patterns in combination with the desire for speed and efficiency and the "*vertically integrated manufacturing supply chains*" finally enabled it to improve the innovation processes and move ahead of competitors (www.ida.org/).

More specifically, Samsung Electronics merged with Samsung Semiconductor in 1980, in order to create synergies for the production of both electronics and semiconductor parts (www.samsung.com) and the enormous investments in R&D in the 1980s pushed it to the forefront of the global electronics industry (www.samsungvillage.com). In 1984, Samsung achieved a great goal by introducing the s first 256K DRAM, just three months after it successfully developed the 64K DRAM (Sohn & Kenney, 2007, p. 993) (Choung et al., 2014, pp. 160-1) (www.samsung.com). Samsung searched around the globe, as part of its asset-

seeking and market-seeking strategy, for a company willing to license this technology and ultimately got chip designs and process technology from Micron (Lee & Slater, 2007, pp. 248-9). The production of the 256K DRAM was considered as a major technological breakthrough and marked a defining moment for Samsung in its growth as a leading semiconductor manufacturer (www.samsungvillage.com).

By the mid 1980s, Samsung Electronics built its first large manufacturing facility and set up two task forces in America and Korea with Korean–American Ph.D.s in the field of electronic engineering in order to develop its first cutting edge technology (Lee & Slater, 2007, pp. 248-50). Despite the DRAM technology's decline in 1994, Samsung Electronics continued investing in facilities and R&D and this commitment was finally paid off (Lee & Slater, 2007, pp. 248-9). However, its rise as an international innovation leader began in the 1990s, when, Lee Kun-Hee decided to sell some subsidiaries while the others concentrated on electronics, engineering, and chemicals (www.samsung.com).

After this strategic choice, a series of technological breakthroughs were introduced by the firm. More specifically, by 1992 it managed to become the largest producer of memory chips in the world, and the second-largest chipmaker after Intel, while in 1995 it created the first liquid-crystal display screen (LCD) (www.samsung.com). In 2005 SAMSUNG represented the world's largest manufacturer of liquid-crystal display panels and, thus, in this period Sony contacted Samsung to collaborate. Finally, in 2006, "*S-LCD was established as a joint venture between Samsung and Sony for the provision of a stable supply of LCD panels for both manufacturers*" (www.bbc.co.uk). S-LCD was established in Tangjung, South Korea and was owned 50% plus one share by SAMSUNG and 50% minus one share by Sony, but in 2011 the first acquired the whole company (www.bbc.co.uk).

Compared to other Korean firms, SAMSUNG survived the Asian financial crisis relatively unharmed (Chung S. , 2010, p. 343). As a result, in 2000 Samsung established a computer programming laboratory in Warsaw, Poland, to concentrate on digital TV and smart phones and by 2011 this base was Samsung's most important European R&D center (www.samsungvillage.com). Eventually in 2012, Samsung Electronics became the world's largest mobile phone producer, overtaking Nokia's leadership in sales since 1998 (www.samsungvillage.com).

Samsung Electronics success of becoming one of the most recognizable and pioneering company in the electronics sector is undoubtedly attributable to its persistent strategy and vision. After Lee's death in 1987 his son Kun-Hee Lee took over the company, shaped a whole new strategy and moved into new product categories (www.samsungvillage.com). *"Like other Korean conglomerates such as LG and Hyundai the first key step is to start small: make a key component for that industry"* (www.economist.com). As a consequence Samsung started selling its components to other companies, which offered it an insight into 'how the industry works" (www.samsungvillage.com). When it finally decided to expand its operations and start competing with the companies it had been supplying, it made massive investments in establishments and technologies (www.samsungvillage.com). Therefore, it constantly invested in new technologies, achieving more than double of its competitors' spending, and thus, has the leading start of everything new in the field (www.economist.com).

Except for its persistence on knowledge discovery, the company did not also hesitate to introduce organizational changes in the sense of novel strategies, structures and processes for its groups initiating "*operating teams, the flattening of hierarchy and networking*" (Cho, 1996, pp. 787-9). More specifically, it created the so-called Pro-Teams as part of the strategy "*to build internal atmosphere and culture, which would recognize and facilitate Communities of Practice (COPs)*" (Baloh et al., 2008, p. 434). These teams were characterized by a "*horizontal communication culture*" which enabled them to innovate individually, freed –to some degree- from hierarchical restrictions (Baloh et al., 2008, pp. 434-5), while the development of networks with Korean and non-Korean organizations, established some institutional, social, cognitive and organizational closeness to globalized markets.

The interplay between the South Korean government and SAMSUNG

Since the 1980s, due to the weak local technological capabilities, South Korea focused on the acquisition, assimilation and imitation of mature foreign technologies from industrially advanced countries (Kim, 2004, p. 345) (Sohn & Kenney, 2007, p. 993). Nevertheless, SAMSUNG Electronics represents a successful paradigm of a firm that started with a few resources but through persistence, determination and a strong receptiveness towards learning from outsiders, it managed to gain access to foreign companies and knowledge and finally move from imitation to innovation. Its

capacity for rapid "do-learn-improve" (www.ida.org/) and the capability to generate next generation products before its rivals enabled the company to maintain a high rate of market share and finally represent one of the key innovation players worldwide.

The case of SAMSUNG revealed a dynamic interaction between the firm's capabilities and international production networks, which is proved by the fact that in the early stages, when SAMSUNG geared towards the building of its technological capabilities, foreign linkages were used for marketing and technology. Towards this direction and aiming at the improvement of its capacities, the company diachronically invested heavily in R&D and never stopped seeking for new assets and markets so to successfully compete with foreign technology giants. As a result, the firm concentrated on the import of foreign technologies and the development of close relationships mostly with Japanese electronics companies during the 1960s and 1970s, due to the lack of previous experience in the electronics sector. Furthermore, SAMSUNG recruited Korean skilled engineers working abroad, mostly in the USA and Japan, in order to transfer the technologies they had obtained, collaborated with American and Japanese firms, expanded Korea-based R&D centers for the assimilation and adaptation of foreign technology in the 1980s, founded foreign-based R&D centers and created joint ventures with European and other Asian firms mostly in the 1990s. For the reduction of social distance from global markets and the advancement of its cognitive base SAMSUNG also established design centers in the main market regions for the development of products that suit to various needs, which might be different from these in Korea. Finally, organizational innovations, such as operating teams, flattening of hierarchies and networking, and the promotion of competence in English as a major criterion in job performance marked the firm's willingness for a more international orientation.

At this point it should be stated that "*even if there is low acceptance of outsiders (non ethnic Koreans) in corporate culture*", SAMSUNG attracted foreigners into its workforce, introduced changes to its organizational culture and was constantly adopting Western practices (www.ida.org/). The mix of organizational changes and technological solutions for the promotion of trust-based relations and the improvement of its capabilities finally led to the reduction of its cognitive, institutional, organizational and social distance from global markets and also proved that:

> It is not the static pool of resources, but the entrepreneurial dynamic development of capabilities that is central to the success of firms which not only catch up, but also overtake their counterparts from the developed economies. Subjective, heterogeneous expectations about production input costs and potential profits can lead to different outcomes even with the same domains of resources that different firms possess. Samsung Electronics' advancement into a top-tier innovative company was derived from the top management's anticipation of the market potential of semiconductor industry and the ensuing aggressive commitment to the seemingly high-risk investment. The competencies of the company were developed through the process of acquiring and deploying resources in a dynamic way to seek for entrepreneurial rents
>
> (Lee & Slater, 2007, p. 253).

The examination of this case revealed that public authorities soon realized SAMSUNG's capabilities for future growth potential and, thus, the government in combination with policy actors made intense efforts for the building of a national structure capable of further promoting SAMSUNG's development. In other words, the firm's aggressive performance in the electronics sector, forced the government to adjust the national socioeconomic environment to the needs of SAMSUNG and shape the adequate framework conditions for the facilitation of both its competitive performance and willingness to become a global innovation actor. This bidirectional relationship between the public authorities and SAMSUNG had a major impact on the firm's advancement, as the latter strategically exploited the country's long-term investments in science R&D, the education focused culture and the increasing emphasis on the creation of global collaborations which reflected Korea's vision for a knowledge-based economy.

The facilitation of exports by the Korean government in the early 1970s and the promotion of foreign technologies' inward transfer, the introduction of science and technology policies, the encouragement of Korean students to travel abroad for postgraduate education in order to later import their knowledge and experience to their home country as well as the promotion of R&D outsourcing from domestic and foreign universities to firms especially in the 1990s were important vehicles for the rapid improvement of SAMSUNG's development, which strategically exploited these public initiatives. Moreover, other longstanding government initiatives, such as state-led investments in R&D, the constant training and education of human capital and the creation of cooperative relationships with external knowledge sources, such as universities and foreign institutes, assisted the remarkable development of large Korean firms and mostly SAMSUNG. As Kogut and Zander (1993) point out the key

to successful international production is to recombine the knowledge acquired at home with the gradual accumulation of learning in the foreign market (Kogut & Zander, 1993, p. 636)**.** Therefore, the Korean experience illustrates that the three elements, that is, trained human resources, technology transfer and local R&D efforts, are complementary rather than substitutive.

BACKGROUND FOR SWEDEN AND THE SKANE REGION

The interplay between the Swedish government and the industries in the Skane Region

The case of Sweden illustrates that innovation has been constantly supported at all level of governance, as industries, universities and the government reflect the basic cooperative triptych in the country. Therefore, it could be stated that public initiatives for the creation of a well-functioned socioeconomic structure paved the way for Skane's successful development. The Lund University also represents a major contributor to Sweden's and Skane's development, as it provided a strong knowledge infrastructure by facilitating research and development, creating partnership bodies and external connections and participating in global projects. As a result, industries in Skane were crucially assisted by the government for the expansion of their cognitive, social, institutional and organizational scope which enabled them to transform into dynamic sectors with future growth potential.

More specifically, in the period of 1970s and 1980s, when Skane underwent a significant economic transformation of its production base by moving from "*heavy manufacturing and ship-building to more service-oriented activities"* (Roman & Moodysson, 2013, pp. 175-6), public agencies attempted to restructure the region's economy aiming at the advancement of the high-value-added and the development of service sectors. Towards this direction, and as analyzed in Chapter 2, government's initiatives and the Lund University crucially supported Skane's shift towards a service economy and contributed to its structural transformation, by providing the adequate institutional and organizational framework for innovation.

An important argument that derives from the examination of this case is that the Region Skane, which is the regional authority responsible for the coordination of the actors' activities in the RIS, strategically geared towards the adoption of an open innovation model, based on the attraction of foreign national and multinational

resources and focused on the improvement of cooperation and knowledge exchange between industry, university and government at the regional level. These strategies finally contributed to the encouragement of domestic firms towards developing international contacts and cooperation networks, and also facilitated extensive R&D by the public and the private sector within and outside from the Skane region.

Companies in the life science relied on knowledge stemming from academic research and seek for labor force from the higher education sector, while the food sector acquired knowledge and human capital from less formalized sources. Finally, knowledge sourcing for the food sector occurs mainly in globally organized networks, in contrast to the food sector, whose actors are principally concentrated in the Scania region. Moreover, the firms in the life science and the food industry also made important efforts in order to build their capabilities and improve their innovation potential. Towards this direction the first concentrated on the development of both cross-border collaborations between universities and private firms and nodes with excellent pharmaceutical mega centers from abroad, whereas the latter cooperated with foreign partners through the establishment of R&D facilities both inside and outside the region of Skane.

The open economy of Sweden and the severe competition from the outside world led to the need for changes in order for innovation in the country to be promoted. The government was particularly supportive to this venture by implementing strategic policies that created both a stable socioeconomic environment and the right framework conditions for innovation on the national and regional level. In other words, Sweden's "*specialization at the high end of global value chains*" (www.vinnova.se/), the fast-developing innovation services and the supportive business environment crucially contributed to the country's overall social and economic advance, whereas its robust institutional[21], political, social and economic characteristics provided the necessary framework conditions for future growth potential.

Technological development, political deregulations and co-operations with other companies and universities led to an ever increasing internationalization of industries which in turn facilitated the easier access to new markets and new knowledge

[21]Sweden's long tradition in technological innovation is reflected in its strong performance in international patenting (www.vinnova.se/).

generated outside the geographical borders of Sweden (Wise & Johansson, 2012, pp. 97-8). Moreover, public willingness for the adoption of modernized practices, the stimulation of interdisciplinary and multidisciplinary research through the creation of strategic alliances between the business and the public sector and the transparent institutional environment of the country, definitely played their role in the Swedish development process. Moreover, heavy investments in education, the constant attraction of top international researchers for the creation and diffusion of new knowledge, the exploitation of the skilled human capital, the massive investments in R&D, the participations in international academic and industrial networks and the country's capability to develop trust-based collaborative relationships with global innovation actors, reflect the pillars of Sweden's success story. As a result, the country effectively managed to adapt to the needs of globalized markets, overcome its initial limitations deriving from its small home market and the peripheral geographic location and evolve into a leading economic and innovation actor.

Sweden's openness to the outside world nowadays represents an important factor for its economic development, as it acted as the vehicle for the overcoming of its peripheral geographical location, the modernization of the economy and the society and the establishment of an international orientation. In parallel, the adopted political choices set the bases for innovation and reinforced the country's growth potential, as they finally managed to eliminate to some extent the cognitive, institutional, organizational and social gaps from global markets. These practices enabled the Swedish model to strategically respond to changes in the international environment and to related social, technological and economic challenges, by adopting an open economy and an open innovation character. As a consequence, except for a leading innovation player with one of the best innovation performances in the world, a position that undoubtedly highlights its technological capacities, the country also represents an advanced society that is receptive to industrial transformations and structural changes.

BACKGROUND FOR THE INDIAN PHARMACEUTICAL FIRMS

The interplay between the government and the Indian pharmaceutical firms

Prior to 1970, the Indian market was dominated by multinational companies, local production was minimal and private firms were focusing on the adaptation of foreign

technology through duplicative imitation and learning by doing. In this period, the building of local capabilities, was mostly based on in−house R&D, national research laboratories and informal purchase of technology from abroad. Nonetheless, the Indian pharmaceutical industry's emergence as a developer of pharmaceuticals is quite remarkable and the analysis on Chapter 2 suggests that the industrial policies adopted by the Indian government played a key role in the Indian pharmaceutical industry's growth. Towards this direction, the case of India shows that the government took important initiatives for the initial support of domestic firms' engagement in the pharmaceutical sector, whereas, after liberalization, the Indian pharmaceutical sector reflects a widely known success story due to the intense efforts made by the firms themselves in order to reduce their cognitive, institutional, social and organizational weaknesses and finally become global players.

As mentioned, the government policies had a major impact in the phenomenal growth of the industry as the public strategy concentrated on the two ends of the commercialization spectrum, that is, public research networks and final markets by funding public research and regulating the final market. One the other hand, various learning processes like duplicative imitation, creative imitation and collaborative R&D were used by the Indian pharmaceutical firms in order to move from basic capabilities to advanced capabilities

More specifically, the nature of the domestic market in combination with the industrial policies adopted by the Indian government influenced the development of capabilities in the Indian pharmaceutical industry in the sense that the highly competitive domestic market gave rise to different models and strategies that led growth in the Indian industry. More specifically, the development of a highly diversified network of R&D institutions since the 1950s for the reinforcement of the sector's capabilities, the establishment of numerous research institutes and public sector units for the encouragement of the domestic drug industry and the reduction of dependence on foreign MNCs, the advancement of education through the introduction of programs and continuous training for manpower development as well as the foundation of schemes and programs for the facilitation of collaborations between industry and academia, reflect some the most important public initiatives for the promotion of the pharmaceutical industry in the country.

However, the introduction of the Indian Patent Act in 1970 for legal access to process patents for pharmaceutical products and the market liberalization measures for the opening of the Indian pharmaceutical market in the 1990s, represent the two public initiatives with the most intense impact on the industry's remarkable growth. As it is argued, thanks to the medicines' weak patent protection, "*the colonial patent law enacted in 1911 which secured the Indian market to British industry*" and the "*large majority of drugs imported from abroad until the Patents Act in 1970*", India managed to build a highly efficient pharmaceutical industry (www.gersterconsulting.ch/). Additionally, India's World Trade Organization membership in 1995 for the integration in the world economy and its participation in the TRIPS agreement also reinforced the sector's future growth potential. Especially TRIPS has increased the focus on R&D in Indian pharmaceutical firms and accelerated the movement of Indian pharmaceutical firms towards the development of innovative R&D capabilities.

The weakening of patent laws played a crucial role in shaping and building the Indian pharmaceutical industry, as it reduced market entry barriers, legalized reverse engineering and created a competitive domestic market. Therefore, the evidence presented in Chapter 2 strongly suggests that the weak patent system was the dominant influence on the development of basic capabilities in the Indian pharmaceutical industry. All the above mentioned public models and strategies finally managed to fuel firm-based learning and assimilation of basic capabilities bringing about industrial transformation and development.

The period after liberalization was characterized by the domination of private initiatives in the pharmaceutical industry, in the form of drug exports in advanced countries and the concentration on foreign technology adoption and collaborations. More specifically, after independence India represents a mixed economy which concentrated on the encouragement of the private sector and the creation of an important role for the government through public sector companies. Towards this argument, it is stated that:

> The share of public sector in the Indian pharmaceutical industry has been minimal except in the form of government-owned R&D laboratories set up to encourage research and innovation (Chittoor et al., 2008, p. 264).

In this period onwards, Indian pharmaceutical firms also recruited Indian scientists experienced in drug discovery as well as scientists from foreign universities, firms

and research organizations, and developed research collaborations with Indian and overseas research institutes.

All the above mentioned strategies facilitated the building of a dynamic domestic pharmaceutical industry, capable of moving from knowledge assimilation and process imitation to incremental innovation, and competing with well known foreign pharmaceutical companies. In other words, the informal modes of imitation and reverse engineering that were adopted have played a significant role in the development of basic capabilities in the Indian pharmaceutical sector and local firms are now competing with well established generic pharmaceutical firms in markets all over world. Nevertheless, new rules of the game, which are mostly related to intellectual property rights, may now threaten India's achievements and economic growth attributable to pharmaceuticals. Therefore the country should pay great attention to the building of a strong organizational base in order to both ensure the monitoring and control of the exchanged pieces of information and guarantee ownership rights and rewards for investments in new technological fields.