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Social capital and cluster evolution: insights from an industrial region

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Chapter 1: Introduction

1.1. Research statement: social capital and clusters' evolution

"Clusters have become a key concept in economic geography, urban studies, regional economics and related disciplines; and policy-makers everywhere have seized on the notion as a tool for promoting regional growth and competitiveness" (Martin & Sunley, 2011 pp. 1300). Such a statement reflects the importance of clusters, as a unit of economic configuration, associated with the development of potential benefits such as: the exploitation of synergies for small and medium enterprises' (SME) competitiveness enhancement (Schmitz & Nadvi, 1999; Caniels & Romijn, 2003), the collective efficiency of the productive system (Schmitz, 1995), and the generation of a conducive atmosphere for knowledge diffusion and innovation (Maskell & Malmberg, 2002; Schmitz & Nadvi, 1999; Porter, 1998). However, the observation of complex settings of clusters and uneven trajectories, founded in permanent difficulties in sustaining competitive advantages, in combination with substantial changes in the economic scenario have demanded new conceptual approaches and practical evidence to trace the evolution of clusters (Boschma & Fornahl, 2011; Lorenzen, 2005) with an increased focus on the "combination of evolutionary and constructive forces" Solvell (2009 pp. 29). Considering that clusters are a "result of path-dependent, evolutionary, socio-political, historical and entrepreneurial processes" (Pitelis, 2012 pp. 1361), their evolution is conditioned by the degree of collective commitment at the local level. These conditions are usually linked with the concept of social capital, which has become enormously popular in the field of Social Science, as it places a renewed focus on the economic implications of social relations (e.g. Li, 2015; Putnam, 1993; Coleman, 1990; Bordieu, 1986; Granovetter & Swedberg, 1992). Therefore, the study of social capital as the underlying conditions of social values and norms to induce collective action and ultimately benefit clusters' performance is critical.

It is assumed that in the so-called 'knowledge economy' paradigm (Cooke, 2002), the resiliency of clusters presupposes a significant level of internal heterogeneity and knowledge diversity (Menzel & Fornahl, 2010; Ter Wal & Boschma, 2011). Such conditions are essential to addressing consumers' sophisticated demands, to diffuse innovations, and to maintain adequate levels of novelty. As mentioned before, such a setting is shaped by a social structure that leverages institutional coordination, integration of new resources, and collaboration for the achievement of shared goals (Wolfe, 2002). The characterization of that driver is the very concept of social capital; a concept that captures the effects of social relations within economic matters (Putnam, 1993; Bordieu, 1986; Coleman, 1990 among several other researchers). In the literature on clusters, it is suggested that the behavior of economic agents - individual and collective - is strongly governed by the system of values, norms and rules in a social system (Nadvi & Schmitz, 1994). Thus, the major underlying assumption of this thesis considers that social capital acts as a latent factor that

provides cognitive and normative support (i.e. values and norms) for driving collective adjustment processes and influencing the different agents' performance. Specifically, the meaning of social capital in the thesis follows Becattini's (1990) statement that 'local community' values and norms grounded in ethic of work, attitude to change and reciprocity have distinctive effects in shaping the dynamics of clusters'. Thus, the proactive role of such facets of social capital is seen through its impact on cultural, institutional and technical proceedings during the cluster's evolutionary stages, which, in turn, impacts the performance of firms.

A cluster is defined as a "geographic concentration of interconnected companies and institutions in a particular field…that compete and cooperate with one another" (Porter, 1998 pp. 78). The concept has been popular since the 1980's due, in part, to a renewed interest in linking economic development with the marshallian agglomeration economies in a positive light (i.e. specialization, skilled labor mobility, and knowledge dissemination). However, the use of the concept of agglomeration has received criticism because the definition of such a phenomenon is ambiguous or "fuzzy", as it is observed through the extent of numerous terminologies, analytic scope and operating parameters used (Moulaert & Sekia, 2003). Certain interconnected dimensions and functioning have been identified in the definitions of clusters contained in the literature (e.g. Capello, 2007; Cruz & Teixeira, 2010; Crespo, 2014). So, spatial proximity, knowledge spillovers, and coexistence of competition and cooperation are important aspects in understanding the functioning and development of clusters.

However, some conceptual and practical issues concerning the role of clusters in a thriving regional development (e.g. Li et al., 2012; Martin & Sunley, 2003; Fernández-Satto & Vigil-Greco, 2007) are still the subject of considerable debate. For instance, it is suggested that there is a bias toward the positive aspects of clusters, and too much of an emphasis on success stories, thus disregarding issues such as internal barriers to growth, and diagnosis failures in policy implementation (e.g. Navarro, 2003; Atherton & Johnston, 2008), which are pronounced in developing countries (Parrilli, 2004, 2007; Fernández-Satto & Vigil-Greco, 2007). Finally, the internal operating setting must be flexible enough to face external changes. So, a bidirectional relationship is established in which changes in demand, technology, competition, and regulations act as selection pressures which affect a cluster's trajectory (Martin & Sunley, 2011). These conditions have provided the basis for an in-depth analytical examination of the evolutionary features in order to shed light on the subject (Nadvi & Schmitz, 1994; Boschma & Fornahl, 2011; Lorenzen, 2005).

A diverse range of conceptual models has been proposed to address the evolution of clusters, including the life cycle (e.g. Swann, 1998), complex systems (e.g. Martin & Sunley, 2011) and eclectic models (e.g. Parrilli. 2004; Li & Bathelt, 2011). Among them, the cluster life cycle analysis (CLC) is the most widely used due to its methodological and interpretative advantages (Bergman, 2008; Capó-Vicedo, 2011). Early CLC studies provide useful theoretical and empirical insights regarding the basic features of growth

and decline (Swann, 1998; Van Klink & De Langen, 2001; Pouder & St. John, 1996; Maskell & Malmberg, 2007), and possibilities of renewal (e.g. Tappi, 2005). However, they were criticised for producing deterministic outcomes, and for subordinating cluster evolution to the industry and/or technology paths (Martin & Sunley, 2011). Recently, the cluster new life cycle strand (NCLC), which has roots in the field of Evolutionary Economic Geography (Boschma & Frenken, 2006), has gained recognition by highlighting heterogeneity and knowledge diversity as critical drivers of transformation in cluster trajectories (Menzen & Fornahl, 2010). Also, the co-evolutionary nature of clusters, institutions, and netwoks (Ter Wal & Boschma, 2011) is strongly dependent on external pressure, which therefore impacts the cluster's capacity to adapt.

In Social Sciences, the term social capital is defined as "features of social organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit" (Putnam, 1995 pp. 67). Since the 1980s, the term has been used extensively to explain extra-economic effects in the performance of economic agents (Li, 2015). In the literature on clusters, the concept of social capital has been considered a primary driver of critical cognitive and normative resources for economic action (Becattini, 1990; Putnam, 1993; Humphrey & Schmitz, 1999; Cooke, 2002; Parrilli, 2004). So, it captures the importance of historical and cultural patterns to function as the "missing ingredient" to stimulate cognitive and normative resources (Cooke, 2002; Larrea, 2000). The path-dependence line of argument, strongly emphasized by the Italian (neo-Marshallian) school on Industrial Districts (Becattini, 1990; Brusco, 1982), underlines the effect of a homogeneous ´local community' system of values and norms in influencing clusters' development. Such influence is made effective by means of social cohesion, trust and the subordination of individual interest to community interests (Wolfe, 2002), the promotion of self-realization through intense entrepreneurship (Parrilli, 2004, 2009), and the decline in transaction costs and an increase of efficiency in local institutions (Durston, 2000). However, the impact of social capital on the evolution of clusters and regions has been puzzling to conceptualize and measure (f.e. Staber, 2007; Westlund & Adam, 2010). For example, the function of clusters as a booster of innovation and coordination at earlier phases of the CLC is often cited, while their long-term impact remains unclear (e.g. Staber, 2007; Parrilli, 2012; Trigilia, 2001). Also, there is debate about the harmful effects of reproducing certain background cultural constraints (e.g., "exclusion of outsiders, limited mobility, poor socioeconomic advancement and lack of adaptability to change" OECD, 2002 pp. 4), or the inflexible decision-making processes derived from too homogenous social ties (i.e. cognitive lock-in effects: Anderson & Jack, 2002; Parrilli, 2012), exposing the cluster to the risk of over-embeddedness (Masciarelli, Laursen & Prencipe, 2009). Thus, these issues may lead to a reduction in technological development (Trigilia, 2003), and in the search for new business opportunities (i.e. lack of critical analysis) and may constrain the integration of foreigners or outsiders (Parrilli, 2012). Also, another topic of discussion refers to how social capital can be measured and characterized in order to examine its impact on cluster dynamics. This is derived from the general debate

that exists in Social Sciences between the instrumental and community perspectives on social capital, added to which is the lack of agreement on the indicators and the methodology to operationalize the concept. Therefore, the challenge is to incorporate the concept of social capital into clusters' dynamics (and thus firms' performances) bearing in mind external circumstances, and taking in account the claim that "studies of social capital that ignore the setting do not capture the many recursive links that exist between context and action" (Staber, 2007).

To sum up, the lack of homogeneity among clusters' evolving patterns requires a deeper analysis of their dynamic performance (Menzel & Fornahl, 2010). In particular, it is necessary to identify, understand and interpret the prevailing determinants of the processes of adaptation to an economic environment marked by patterns of increasing complexity and uncertainty. Related to this, there is the belief that social capital has the power to explain several evolutionary proceedings, but there are two puzzling features to analyze: how adaptation and change is propelled by the underlying facets of social capital, and, how important is social capital in confronting external pressures. This undertaking involves the development of a conceptual structure as well, and should be accompanied by the use of variegated empirical techniques (Boschma & Fornahl, 2011; Hassink et al. 2012).

1.2. Research questions and purpose statement

The two conceptual elements addressed in this thesis are social capital and the evolution of clusters. As noted before, both concepts are connected to the idea that the social capital has a supportive mode of action which is dependent on the stage of development of the cluster. So, it is worth characterizing the effect of social issues in the context of a historical analysis (Brusco, 1982, Popp & Wilson, 2007; Staber, 2007) as clusters evolve through stages that are difficult to avoid (Parrilli, 2007). Thus, the main research question of the thesis is:

What is the role of social capital in clusters' evolution?

To answer the primary research question, it is necessary to consider a dynamic framework and to insert into it an operating notion of social capital. First, there are different methodologies that examine the evolution of clusters. There are both advantages and disavantages to consider, but within the thesis, the new cluster life cycle approach is mainly adopted. This choice is justified with the following reasons: it is a simple framework of simple analysis (clear determination of stages) and it is widely adopted in the literature. Also, the focus on the sources of diversity, the performance of individual companies, the inclusion of transformation paths, and the coevolution with external factors are significant conceptual aspects to support the cluster life cycle approach use. Second, the characterization of the concept of social

capital must be outlined as there are competing views about its relevance and operating domain in Social Capital (and in local development studies). For instance, Barandarian & Korta (2011) point out a bias within the discussion of the role of social capital toward the analysis of objective characteristics of the networks; and thus, neglecting the study of the dimensions that underlie the formation of such networks. Thus, it is necessary to appropriately justify the adoption of a perspective about social capital and its meaning within the framework of study. These concerns are approached through the development of the following auxiliary research question:

How a notion of Social Capital operates within clusters' evolution?

In the literature on clusters, social capital is considered the "missing ingredient" which explains the uneven economic development on a spatial scale (van Staveren & Knorringa, 2006). However, it seems that as the new "knowledge economy" paradigm grows, the importance of social capital is relegated. Perhaps, a cause for that assumption lies in conceptual and methodological difficulties to characterize the nature and modes of intervention of social capital in clusters (Staber, 2007). So, it is essential to operationalize a measure of Social Capital (as an indirect means of 'local conditions') and to relate it with firms' performance under critical changes in the external circumstances (i.e. changes in the macroeconomy, technology, competition, regulations, etc.). Therefore, the following supplementary research question is proposed:

Does social capital have a differentiated influence in clusters' performance under external pressures?

The research goal of the thesis is to explore and evaluate the proactive role of Social Capital in the activation of growth mechanisms, through the stages of the cluster life cycle contingent to the conditions of the external environment. The critical argument is that social values and norms have a decisive role in determining the individual and collective decisions of economic agents, ultimately providing incentives and motivation to pursue economic action. In this vein, derived from Becattini (1990), a conceptualization of social capital based on ethic of work, attitude of change, and reciprocity are incorporated into the conceptual approach using the evolutionary insights provided by the so-called new clusters life cycle (NCLC) theory.

1.3. Justification and contribution

The research is justified on the grounds of suitability, theoretical contribution, and practicality, all of which are essential in the conducting of scientific research within social sciences (Hernandez-Sampieri et

al., 2010). In this thesis, the suitability condition is marked by the call in the clusters' literature to the study of factors involved in the clusters' complex evolutionary patterns (e.g. Nadvi & Schmitz, 1994; Boschma & Fornahl, 2011; Lorenzen, 2005; Belussi & Hervás-Oliver, 2017). In addition, the theoretical contribution is dedicated to the development of a conceptual approach, which presents the function of social capital based on three facets (ethic of work, attitude to change and reciprocity) regarding the activation of cultural, institutional and technical mechanisms. In addition, by adopting a pluralistic view and using qualitative and quantitative research methods, practical evidence is provided about the role of social capital in the evolutionary development of clusters.

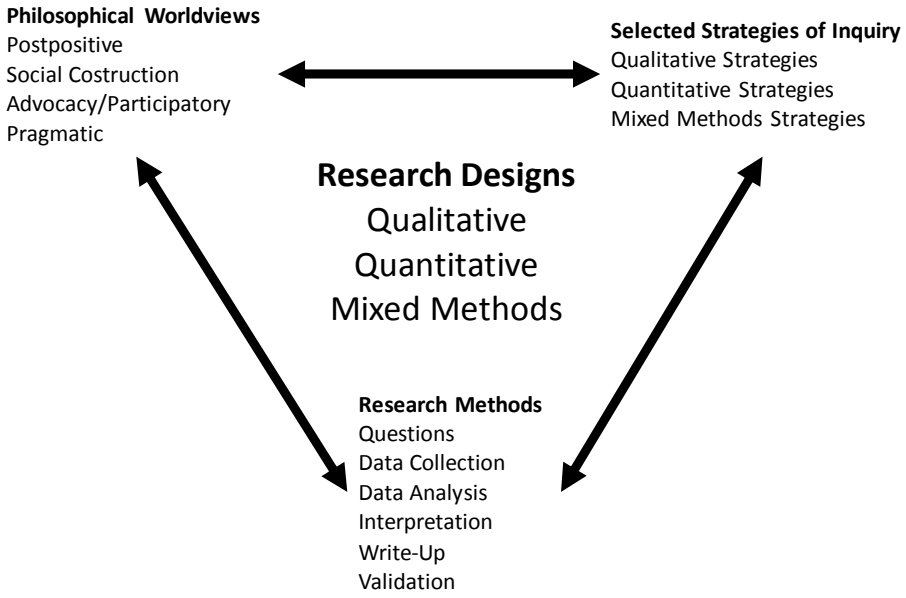
As subjects from three different fields of study (Economic Geography, Regional Science, and Business Economics) are addressed in this thesis, those who may be particularly interested and benefit from the conceptual development and the empirical results may fall into in three main areas: academic research, policymaking, and firms and local agencies. In the case of academia, this thesis represents an effort to provide an integrative view that addresses the influence of social capital on the complex phenomenon of cluster evolution. Secondly, this thesis may offer to policymakers interesting evidence regarding the need to shore up public policies with social processes when addressing the transformation of industrial territories. Finally, the research may encourage firms and local agencies to factor in the importance of collective action and coordination, and to adopt a more inclusive perspective.

1.4. Research guidelines

Creswell (2003) suggests that the "plan or proposal to conduct research" comprises three main features: philosophical worldviews, strategies of inquiry and research methods (Figure 1.1). First, the philosophical component refers to the ontological[1] perspective that the author has about the phenomenon, and the justification about methods of research selected. Second, the strategy of inquiry refers to the specific course of methodological action which is activated from a three-option scheme: qualitative, quantitative or mixed-methods. Third, the research methods component entails specific practices such as data collection, analysis, and validation used in the empirical research.

[1] Ontology: "A set of concepts and categories in a subject area or domain that shows their properties and the relations between them" Oxford Dictionary.

Figure 1.1: Creswell's framework for Research Design



Source: Creswell (2003).

The research query of this thesis is based on a pragmatic approach. The term pragmatic takes the name from the greek word *pragma* which means action; thus, the ontology of this perspective is grounded in the "emphasis on human beings as agents and their practical relations to the world" (Delanty & Stydom, 2003). So, the central focus is based on the idea that if a problem exists (requiring a conceptual development), the urging issue is to consider "its practical consequences" and to look for ways to solve it (Hammond & Wellington, 2013). There are four fundamental aspects within the pragmatic epistemological[2] stance which relate to the proposed object of study: problem-centered, consequences of actions, real-world practice oriented, and pluralistic approach (Creswell, 2003).

There is a significant amount of research to support the idea that the evolution of clusters is far from uniform due to their complex configuration, the difficulties of maintaining competitive advantages, and the damaging effects of the external conditions. Thus, the permanent state of economic and institutional transformation of clusters is shaped by the actors' strategic decisions that stem from their different historical and cultural roots. The study of this reality, from a pragmatic stance, should not be guided by "preconceived ideas" (Hammond & Wellington, 2013) to avoid Humphrey's (1995) warning against the risk of encapsulating trajectories into models. However, as research about clusters is basically located at the intersection of economic geography, regional science and strategic management fields of studies, the use of the pragmatic approach supports the evaluation of economic performance under the

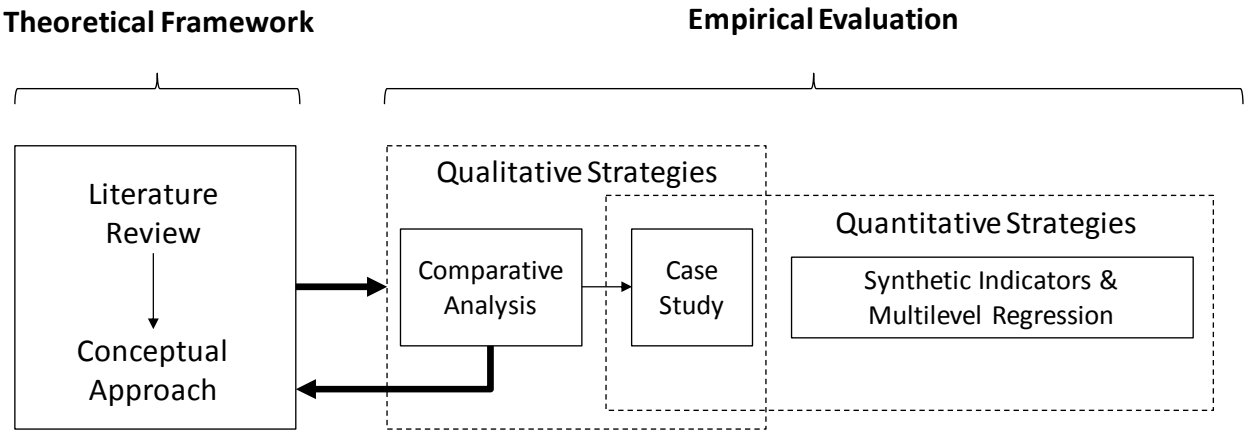
[2] Epistemology is "an area of philosophy concerned with the creation of knowledge; focuses on how we know what we know or what are the most valid ways to reach truth" (Neuman, 2011).

critical influence of social and cultural changing traits, differentiating it from the logical positivism posture (Moriarty, 1993). Also, it is worth noting that measuring the performance of clusters as well as the multidimensional nature of social capital poses operationalization challenges. In this sense, both concepts have been criticized for their ambiguous conceptual demarcation (e.g. Martin & Sunley, 2003; Staber, 2007); however, there remains the need to generate further empirical evidence to validate knowledge and turn to finding new ways of analyzing reality (to "find a solution that is fit for a particular context": Creswell 2003). Finally, an essential implication of a pragmatic perspective is that it "opens the doors for multiple methods" (Creswell, 2003) fitting with the call to study using a wide variety of methodological tools and techniques and to frame cases from different geographical areas and stages of development (Hassink et al. 2012).

The examination of the impact of social capital on the evolution of clusters is addressed by means of a combination of qualitative and quantitative methods. So, a sort of "modified mixed-methods" is adopted as the strategy of inquiry (Hernandez-Sampieri et al., 2010). This means that the methodological design does not strictly adhere to one of the "pure" variations of mixed-methods: concurrent and sequential (Creswell, 2003), but that, instead, it was decided to qualitatively and quantitatively validate the propositions emerging from the conceptual reflection (literature review discussion) and exploratory empirical analysis.

The research approach in the thesis is implemented in a recursive path of a two-block inquiry (Figure 1.2): theoretical frame (Chapters 2 & 3) and empirical evaluation (Chapters 5, 6, 7 & 8). This attempt is made through a deductive practice which refers to the process of conceptual development that starts by analyzing and relating abstract concepts and then focuses on the empirical evaluation of this conceptualization (Neuman, 2011).

Figure 1.2: Strategies of Inquiry Framework



Source: Own elaboration.

The research starts with the development of a theoretical framework that consists of two basic

elements: a literature review and the development of a conceptual approach. The development of the theoretical framework is made through a process that starts with the execution of a literature review, and later with the integration of critical contents in the conceptual approach.

First, the literature review (i.e. the selection of key topics, the search for documents and articles, the evaluation of the compiled material, and the planning and writing of the review: Neuman, 2011), focuses on presenting the highlights of the cluster concept, its evolutionary implications, and the inclusion of social capital in the process of transformation of clusters. The presentation style of the review is carried out using a descriptive and narrative style complemented by tables and figures summarizing key information.

Second, the development of the conceptual framework involves the consecutive development of several stages of work, such as the collection and analysis of key literature sources, the identification of critical concepts, and the integration of them into a synthetic schema (Jabareen, 2009). So, the conceptual approach developed in the thesis rests on the critical argument that social values and norms have a decisive role in determining the individual and collective decisions made by economic agents, providing incentives and motivations to pursue economic action. In this vein, derived from Becattini (1990), a notion of social capital based on the facets of ethic of work, attitude of change, and reciprocity are inserted into the dynamic frame provided by the so-called new clusters life cycle (NCLC) theory. Also, the relationships are distinguished in their validity, depending on the stage of the cycle. With this, propositions[3] to be evaluated empirically are established. This course is developed through an interactive process of discussion with the supervisors as well as the presentation of the conceptual scheme to different audiences for feedback. Thus, the conceptual approach and the exploratory analysis was presented at the 54th ERSA (European Regional Science Association) Congress in the Special Session about Cluster Evolution Reconsidered: Mechanisms, Knowledge (Re-)Combination and Network Dynamics (Saint Petersburg, Russia - 26-29/08/2014). Also, these contents are a chapter of the book “Resilient Territories - Innovation and Creativity for New Modes of Regional Development” by Pinto, H. (Editor). In addition, the conceptual approach and the case study analysis was presented at the 2nd workshop “The evolution of networks, industries and clusters (ENIC)” Organised by the Universities of Kassel, Hohenheim, Hanover and the Halle Institute of Economic Research (IWH) (Halle (Saale), Germany – 13-14/11/2014); and at the 55th ERSA Congress in the Special Session about Resilence, Crisis and innovation Dynamics (Lisbon, Portugal - 25-28/08/2015).

The empirical analysis is sequentially conducted using qualitative and quantitative research methods using the analytic scheme developed in the previous block.

First, qualitative nature studies have the advantage of deepening the enquiry into the working processes and the motivations that underlie complex processes (Neuman, 2011). In this thesis, the

[3] Proposition is a “theoretical statement about the relationship between two or more concepts” (Neuman, 2011).

application of two qualitative works was performed. Initially, a comparative study based on the secondary information of six case studies is conducted. The exploratory goal of the analysis is to validate the conceptual propositions as well as to gain a preliminary grasp of the operational functioning of social capital during the trajectories of clusters in different macroeconomic and industry contexts. With these results, valuable feedback the conceptual model is produced, and the need to investigate the operation of the propositions in a specific field context in greater detail is driven. Consequently, in the next step, a case study method is applied to explore the underlying motivations of the economic agents' behavior, the development of interactive actions, and their responses to the historical and social contextual changes. Yin (2003) notes that the adoption of the case study method is a way "of understanding complex social phenomena" and "retaining the holistic and meaningful characteristics of real-life events". For this thesis, the subject of the case study were the machine tool manufacturing firms located in the Bajo Deba district of the Basque Country (North of Spain). Next, a single case and holistic design was based on compliance with significance and representativeness requirements (Yin, 2003) such as the area's long history in the industry, having passed through different evolutionary stages, and classification as a local production system (Larrea, 2000; Boix & Galetto, 2006).

Second, the quantitative analysis focuses on the evaluation of the relationship between performance at the firm-level and some explanatory drivers. The decision to evaluate the performance of firms comes from the NCLC literature, which notes the need to overcome biased assumptions in the treatment of clusters' composition as homogenous entities. In addition, the conceptual approach makes sure to examine the effects of social capital as a territorial variable (community dimension). Thus, bearing in mind such characterization, it is necessary to deal with the operationalization issue to build representative indicators for the social capital facets. This task is approached by constructing composite indexes, dealing with a collection of different socioeconomic indicators at region-level (NUTS 2). Next, an econometric estimation, based on non-experimental designs, is also performed. A multilevel regression analysis is conducted to test the significance and the explanatory capacity of social capital to influence the firms' performance in the Spanish metalworking technology industry (in which the machine tool is included) following Ketels & Protsiv (2014) clusters' segmentation in Europe. The application of this technique is intrinsically connected to the idea that firms located in the same regions tends to have similar behavior and performance.

Chapter 2: Literature review

2.1. Introduction

Since its reappearance in the 1980s, there is a general consensus that the concept of clusters has gained significant weight both as a conceptual unit of study and as a tool in territorial policy design, as noted by Martin & Sunley (2003) and other researchers. The main appeal of the concept lies in the fact that, within clusters, the three components of the Marshallian agglomeration economies (i.e. specialization, skilled labour mobility, and knowledge dissemination) are found to interact and operate successfully (Capello, 2007). Consequently, clusters are believed to be conducive to collective efficiency (Schmitz, 1995), the diffusion of knowledge and innovation (Maskell & Malmberg, 2002; Caniels & Romijn, 2005), and the improvement of competitive opportunities for small and medium enterprises (Schmitz & Nadvi, 1999). Nevertheless, the inherent complexity and associated evolutionary implications of the cluster phenomenon remain open to analytical debate (Boschma & Fornahl, 2011; Lorenzen, 2005; Fornahl, Hassink & Menzel, 2015; Belussi & Hervás-Oliver, 2017). Therefore, an examination of the dynamic driving forces and the internal and external challenges which affect and determine the sustainability of clusters (Hassink et al. 2012), including the closely related effectiveness of cluster-based policies (Brenner & Schlump, 2011), are among the important issues which require further research. Finally, social aspects have also been considered central to the evolution of clusters, mainly in the Italian school of industrial districts; however, to date, the difficulty in conceptualizing these social aspects, and validating them with empirical evidence, has been responsible for these aspects not receiving the attention they deserve.

Three main interrelated aspects help to frame clusters according to Porter's (1998) definition: proximity, knowledge dissemination, and the coexistence of competition and cooperation. Proximity, in this context, is a multidimensional concept (Boschma, 2005) which refers to the existence of a critical number of economic agents within a specific geographical location, involved in complementary economic activities, the development of which are affected by cultural identity, traditions, and social practices. The second aspect relates to the benefits of an interactive environment, such as the sharing of knowledge and innovation through multiple channels. This positive effect is called 'local knowledge spillovers' (LKS) and is an important competitive driver in the contemporary "knowledge economy" paradigm (Caniels & Rojmin, 2005). The third aspect refers to two seemingly opposing elements but which work well in clusters, thanks to the multilayered production dimension (Porter, 1998; Schmitz, 1999) in which multiple skilled agents interact and collaborate horizontally favouring the achievement of common goals. These aspects are critical when conceptualizing how clusters operate and before attempting to substantiate their impact on reducing production and transaction costs, and increasing production efficiency and innovation capacity (Capello,

2007). However, it has also been emphasized that clusters have certain limitations which need to be examined (Trippl et al. 2015; Belussi & Hervás-Oliver, 2017).

Different methodologies have been used to study the dynamics of clusters, such as the life cycle approach, a complex systems approach, and further eclectic methodologies. Among them, the most popular approach is to examine the life cycle as its simplicity and comparability offer practical advantages (Bergman, 2008). In this approach, a simplified version of the facilities is established in order to be able to identify the different developmental stages and relevant associated factors and mechanisms. In this way, the stages and historical effects of different cases can be matched and compared. However, early CLC approaches have been called into question because of the deterministic nature of the resulting trajectory (Martin & Sunley, 2011), and the difficulty of measuring the clusters' aggregate performance (Bergman, 2008; Brown, 2000). The subsequent NCLC perspective was based on Evolutionary Economic Geography (EEG), which emphasized the influence of related variety, novelty generation and path dependency as key aspects in the economic spatial dynamics. Thus, it improved on the CLC view by highlighting several issues: the importance of internal heterogeneity and knowledge diversity as critical dynamical drivers, the need to observe transformative developmental paths, and the co-evolutionary nature of cluster development as essential drivers for adaptation (Menzel & Fornahl, 2010; Ter Wal & Boschma, 2011). Despite this progress, the life cycle approach still falls short when it comes to understanding the effects of context, multiscalability, and human agency issues (Trippl et al., 2015). Social capital has been considered a central driver in shaping the development of clusters; however, it has been largely ignored, or/and has only been taken into consideration when examining specific processes and phases in cluster development. This is due to the theoretical challenge of establishing the "shape" of its long-term effects, and also to the empirical contradictions in the relationship between social capital and performance (e.g. Westlund & Adam, 2010). Consequently, the challenge is to understand how social capital can be framed as a dynamic factor that generates systemic responses in the different stages of the CLC, and catalyzes the crucial destabilizing effects of external factors (e.g. changes in regulations, technology, and the macro-economy).

The literature review was carried out by selecting key topics, reviewing documents and articles, evaluating the compiled material, and planning and writing the review (Neuman, 2011). The review is presented in a narrative descriptive style and duly complemented with tables and figures summarising the key information.

The goal of this chapter is to analyse the relationship between the evolution of clusters and the concept of social capital. The chapter contains three sections. The following section (2.2) presents critical issues contained in the different definitions of clusters together with their evolutionary implications. A brief comparison of three perspectives on the dynamics of clusters (life cycle, complex systems, and eclectic) is presented. Section 2.3 focusses on the NCLC approach. The following section (2.4) reviews the connection

between the notion of social capital and clusters. Finally, the last section summarizes the gaps and conditions for the development of a conceptual approach.

2.2. The concept of clusters and some evolutionary aspects

2.2.1. Theoretical Features.

The Italian industrial districts, the film industry in Hollywood, the computer industry in Silicon Valley, and the mechanical enginnering in Germany are typical examples of successful economic development driven by a socioeconomic model of organization commonly known as 'local production systems' (LPS) (Moulaert & Sekia, 2003; Porter,1998; Malmberg & Maskell, 2002; Asheim, Cooke & Martin, 2006). LPS involve the exploitation of local skills in order to generate increasing returns by exploiting Marshall's agglomeration economies (i.e. specialization, skilled labour mobility, and knowledge transfer). It is suggested that research carried out by Becattini (1990, 2004) revived interest in the features which characterize the Marshallian external economies (Lazzaretti et al. 2013). Therefore, for analytical, technological, and institutional reasons (McCann, 2008)[4], the notion of space in the field of Regional Economics ceased to be understood as a simple container, and became a generator of vital economic resources for boosting regional competitiveness (Capello, 2007; McCann, 2008). In addition, this interpretation effectively meets the need for flexibility in rapid industrial transformation (Piore & Sabel, 1984), particularly when creating competitive advantages for SMEs (Parra-Requena et al. 2008). The potential effects of LPS are: a reduction in production and transaction costs, an increase in the efficiency of the factors of production, and an increase in innovation capacity (Capello, 2007). Therefore, in the last 30 years, the concept of LPS as triggers of regional competitiveness has been widely accepted and researched (Martin & Sunley, 2003; Asheim, Cooke & Martin, 2006; Morosini, 2004). However, while attention has primarily been given to examining how they actually operate (i.e. a static view), one of the main weaknesses in the vast array of cluster studies in the literature is the neglect shown to the evolutionary features (Trippl et al. 2015; Fornahl, Hassink, & Menzel, 2015).

There is agreement that the study of LPS is the result of the convergence of several research traditions (Baptista, 1998; Navarro, 2003; Schmitz, 1999), giving rise to multiple neologisms (Asheim, Cooke, & Martin, 2006). Moulaert & Sekia (2003) reviewed academic sources and came up with five terms (with interrelated theoretical links) associated with local production systems: regional systems of innovation, learning regions, innovative milieux, new industrial spaces, and clusters. It is therefore difficult to draw

[4] The first one refers to the growing importance of regions in driving economic scale and efficiency. The second one is the result of globalization and technological change which consider proximity as an important driver in processing the critical information and learning activities for competitiveness. The third one refers to the erosion of the scheme of tariffs and the growing importance of local economic structures when defining economic trade patterns.

theoretical boundaries for the purposes of validating conceptual propositions (Aranguren 2010; Henry & Pinch, 2006; Capó-Vicedo et al. 2011). This has led to the concept of cluster being characterized as "fuzzy"[5] (Blien & Maier, 2008) or "chaotic" (Martin & Sunley, 2003). Finally, McCann (2008) mentions that "the mixing, and sometimes rather liberal use, of technical terminology, has led to a certain amount of analytical overlapping, confusion and duplication".

Despite these concerns, this field of research is in a state of constant renewal (Henry & Pinch, 2006), which it is reflected in bibliometric studies on the subject (e.g. Lazzareti et al. 2013; Cruz & Teixeira, 2010; Martinez-Fernandez et al. 2012). Ultimately, as highlighted in Lazaretti et al. (2013), the study of clusters involves a multidisciplinary, cross-disciplinary, and global approach which, far from inhibiting further research, is an invitation to do so.

2.2.1.1. Definition of clusters and its components

From the wide range of terminology used to refer to LPS, two concepts which feature many similarities appear: clusters and industrial districts. Some authors, recognizing the existence of differences in criteria and assumptions between the concepts (Sforzi, 2015), prefer to adopt an "integrative approach" (Belussi, 2006), and use the terms mentioned interchangeably (e.g. Belussi & Hervás-Oliver, 2017). In line with this inclusive view, this research adopts the definition of Porter (1998) who states that clusters are:

"geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries and associated institutions…in particular fields that compete but also cooperate"

In Porter's representative definition, three associated elements[6] can be observed: spatial proximity, knowledge and networks, and the co-existence of cooperation and competition, all of which are also evidenced in the analysis of other definitions of clusters (see for example in Annex 1.1 the compilation of Cruz & Teixeira, 2010).

First of all, the characteristic of spatial proximity is supported by the synergic and potential positive effects derived from the placement of a critical mass of actors (firms, business associations, research centres, etc.) engaged in related economic activities in a given geographical location. Mainly, the potential advantages of proximity are: the reduction of uncertainty (e.g. via the reduction of transaction or search costs), and the resolution of coordination problems (Porter, 1998). Then, there is a trend towards the realization of economies of scale[7] and the convergence of the economic production content at local level (i.e. specialization). Also, this specialization process does not only refer to purely economic aspects but also

[5] Fuzzy: "Difficult to perceive; indistinct or vague" (www.oxforddictionaries.com)

[6] For example, Capello (2007) refers to the spatial proximity and the dissemination of knowledge as the genetic conditions of the IDs. Also, Crespo (2014) refers that clusters have three dimensions: spatial, industrial, and relational.

[7] A decrease in average cost due to an increase in the size of production (Capello, 2007).

includes the accomplishment of “collective efficiency”, defined as “the competitive advantage derived from local external economies and joint actions” (Schmitz, 1995). This is especially important for the SMEs (UNIDO, 2006), as coordination is necessary for them to be competitive (Schmidt & Nadvi, 1999; Arikan & Schilling, 2011). Meanwhile, the downside of specialization is that it leads to congestion costs, which impact land prices, transportation costs, machinery hire, and the average salary, among others (Swann, 1998; Press, 2006). It is important to note that the concept of proximity is broader and more multidimensional than simply a geographical attribute. It also embraces organizational, institutional, social and cognitive dimensions (Boschma, 2005). A distinctive dimension is the social aspect, which is linked to the concept of embeddedness, and refers to how economic outcomes are shaped by social traditions and practices (Boschma, 2005), and how close social proximity facilitates the transmission of learning and knowledge, and, therefore, innovation, within the cluster. However, the negative side of this close setting is greater exposure to the risk of over-embeddedness, meaning that only are the effect of the benefits of community closeness not permanent, but that the consolidation of strong local ties has harmful long-term effects which are graphically reflected in an inverted U curve (Boschma, 2005).

Secondly, clusters are considered to be fundamental structures in which the dissemination of knowledge flows[8] smoothly and innovation outcomes are obtained thereof. However, divergent positions are held regarding the so-called "local knowledge spillovers" (LKS), as reported by Caniëls & Rojmin (2005). Those who support the “optimistic” view consider knowledge and LKS the “primary force” in the current economic paradigm (e.g. Maskell & Malmberg, 2002; Maskell, 2001). According to this view, clusters contain an enabling environment for the exchange of knowledge, through “direct and repeated interaction” in formal or informal domains (e.g. Bathelt et al 2004), particularly in the case of tacit knowledge (Evers, Gerke, & Menkhoff, 2010). In this interpretation, knowledge acquires a "sticky" character (Ianmarino & MacCann, 2006) which is dependent on the dominant character of the industrial activity as well as the social capital of the territory (Cooke & Morgan, 1998). These knowledge transfer drivers contribute positively to the cluster in different ways, for example, by attracting the new companies to the area (Swann, 1998; Baptista & Swann, 1998), providing opportunities for infrastructure development, or by increasing the potential for knowledge intermediaries to operate (Cooke, 2002). For instance, the dynamics of such pro-knowledge environments has attracted foreign direct investment and MNEs; sometimes distorting the territory’s internal symmetry (De Propris & Driffield 2006). However, detractors maintain that “local knowledge spillovers” is just another name for cost-advantage achievements obtained through Marshallian externalities (e.g. Breschi & Lisoni, 2001). Indeed, the LKS effect has been disparagingly referred to as a mere "black box", suggesting that what really matters is to analyse "how" knowledge is spread. One way of

[8] There are four basic means of inter-firm knowledge flows: “high level of informal interaction”, “direct inter-firm links in cooperation networks”, “labour mobility”, and the “creation of spin-offs” (Ter Wal & Boschma, 2009).

reconciling this debate is to focus research on the decision-making level; in other words, at firm level where, ultimately, innovation and learning decisions are acted on, and the results reach meso levels (e.g. region) (Caniels & Rojmin, 2005).

Thirdly, clusters are defined as vital spaces in which the coexistence of competition and cooperation favours the development of competitive advantages. The argument behind this apparent dichotomy is that competition and cooperation not exclusive forms of market participation, but that a broader spectrum of relationships exists. Porter (1998), for instance, argues in favour of this coexistence because "they occur on different dimensions and among different players" and points to vertical cooperative relations which are favoured by the very multilayered nature of a cluster. There are also arguments which are based on the sense of identity arising from a "perceived shared objective or vision by clusters members" (Pitelis, 2012), but which is also nuanced by a culture of strong competition between neighbouring firms. A controversial aspect of this feature lies in the difficulty of reproducing its positive attributes in other territories (Parra-Requena et al., 2008), which may be due to exceptions rather than generalizations.

2.2.1.2. Evolutionary concerns (configuration, drivers, and policy)

There is a need to improve the evolutionary understanding of clusters due to the "risks, fallacies and harmful effects" (Trippl & Todtling, 2008) of holding a static view of the aforementioned characteristics. The existing bias in the characterization of clusters is one of the concerns that needs to be addressed. Another is the significant effect of external factors on the trajectory of the clusters. And, finally, the third important area that needs to be understood from an evolutionary point of view is the effectiveness of attempts at policymaking.

First of all, there is a "misleading view in academia" that clusters are isolated and pre-established structures whose success stories are never-ending (Crespo, 2011). Thus, the pursuit of an ideal or perfect cluster configuration fails to shed light on what exactly determines cluster reproduction or survival (Maskell & Malmberg, 2002) and also fails to assist in understanding the impact of historical changes (Li & Bathelt, 2011; Li, et al., 2012; Giuliani & Bell, 2008). So, it is important to recognize each cluster as a unique and complex phenomenon which is subject to an environment characterized by a specific "interpenetrated multiscalarity" (Fernandez & Vigil, 2007), and bound by decisions which are made by agents acting at multiple different levels, with different strategic orientation and developmental backgrounds, operating in different economic and social networks. One way of approaching this complexity is to attempt to describe

and define the LPS (Cook & Pandit, 2008). For example, Markusen (1996)[9], Ianmarino & McCann (2006)[10], and Altemburg & Meyer-Stamer (1999)[11] have produced three well-known classifications. The value of such classifications is that they provide conceptual insight that facilitates key aspects of comparison (e.g. strategic orientation and policy impact) as well as potential evolutionary paths; these attempts at classifications have nonetheless been called into question because they are difficult to generalize (Cook & Pandit, 2008). Therefore, different factors are understood to play different roles in the dynamics of clusters, depending on the context (economic stage, industry, traditions, etc.). This is evidenced in several studies, such as the one by Yamakawi (2001) who compares the evolution of 14 Japanese industrial clusters, or the meta-studies by Belussi & Sedita (2009) which analyse 12 industrial districts in Italy, and Elola et al. (2012) who examined four clusters in the Basque Country. To summarize, the evolutionary patterns of clusters are assumed to be non-homogenous and do not always follow a linear and successful path.

Secondly, another critical issue which causes clusters to evolve in different directions is the difficulty of maintaining the competitive advantage through time (Hassink et al. 2012), as "historical examples clearly tell us that even very successful clusters may have a limited lifespan" (Karlsson, Johansson and Stough, 2005). Thus, unfortunately, competitive levers which are successful at one stage can be detrimental at another (Ostergaard & Park, 2013; Martin & Sunley, 2006). This can be due to both internal and external factors (including the lack of resources to address them). For example, internally, the rigid behaviour of actors may lead to a conformism bias (Maskell & Malmberg, 2007; Pouder & St John, 1996) causing "myopic disequilibrium dynamics" to develop within the cluster. In a situation like this, the "gradual build-up of routines", which initially benefitted the cluster dynamics, eventually lead to competition restraints caused by over consolidation, mutual understanding, and even the formation of cartels (Karlsson, 2008). Thus, it is important to foster and encourage the development of new ideas throughout the entire growth and expansion process.

Furthermore, when it comes to modelling the effects of the external conditions which shape technological changes, i.e. competition from other clusters, demand based on changing consumer habits and incomes, and macroeconomic volatility and regulatory variations (Karlsson, et al., 2005), what is lacking is the right emphasis. This is of particular importance in the new economic reality of a post-industrial transition (Alberti, 2006) when a growth in economic uncertainty greatly affects the internal trajectory of clusters (Frenken, Cefis, & Stam, 2011; Li & Bathelt, 2011; Parrilli, 2012; Vicente & Suire, 2007). An example

[9] Four types of clusters are identified: Marshallian Industrial District, Hub-and-Spoke, Satellite Platform, and State-Anchored. The segmentation criteria are the size of the agents, the characteristics of relationships between firms, and their target markets (either internal or external) (Smith & Ibrahim, 2006).

[10] Based on a combination of the transaction costs approach and knowledge-based insights, three categories are determined: pure agglomeration, industrial complex and social network.

[11] In the case of developing countries, Altemburg & Meyer-Stamer (1999) divide clusters into three types in the most widely known classification: subsistence, Fordist, and transnational.

of this is the Italian districts which "since the beginning of the new millennium … have been hit by the crisis and are undergoing a phase of profound restructuring" (Dei Ottati, 2009). Another example is the effects of the changes at regulatory level on the production of surgical instruments in Sialkot (stricter FDA regulations have stopped exports to the USA) which led to the development of institutional arrangements and joint actions in order to maintain the competitive position (Nadvi, 1999). It is clear, therefore, that in a situation of radical change, it is necessary to shed more light on how internal responses and adjustment processes are triggered (Li & Bathelt, 2011; Ter Wal & Boschma, 2011; Boschma & Fornahl, 2011; Nadvi & Schmitz, 1994). To summarize, many questions need to be answered regarding the configuration of clusters, what drives their dynamical adjustment, and how they respond to external shocks.

Thirdly, for the concept of cluster to be successfully disseminated, it must be accepted in the field of industrial policy (Martin & Synley, 2003; Cumbers & MacKinnon, 2004; Navarro, 2003; Uyarra & Ramlogan, 2012). The two main arguments in favour of cluster-based policy implementation are that the concept is simple and marketable (Martin and Sunley, 2003; Fernandez & Vigil, 2007) and that it offers the potential to overcome market failures (Navarro, 2003). The dwindling reputation of 'traditional' policy approaches to industrial development based on national champions and public subsidies (Bianchi, 1997; Navarro, 2007), and the possibility of implementing industrial development policy in different layers of government administration (Duranton et al. 2010; Christense & Stoerring, 2012) both favour the implementation of cluster-based policies. However, failed implementation has been widely reported in the literature due to erroneous conceptual assumptions and inadequate prior diagnosis (Fernandez & Vigil, 2007[12]). Therefore, replicating successful cases or "one fits all" type of policies often fail because of inattention to context-sensitive differences (Atherton & Johnston, 2008) such as the type of industry (Chaminade & Vang, 2006), and the specific macroeconomic and institutional configuration of the cluster (Fernandez et al. 2010; Fernandez & Vigil, 2007). Of particular importance here is the fact that clusters tend to fail when there is pressure to grow rapidly "without passing the necessary [evolutionary] stages" (Parrilli, 2004). Therefore, two basic challenges have been identified at policy level in evolutionary terms (Uyarra & Ramlogan, 2012): on the one hand, policymaking proposals must be consistent, and on the other, appropriate ("flexibe and adapted intervention") evaluation methodologies need to be generated.

The framework for designing a cluster policy must respect and foster the participation of local actors, public-private coordination, and systemic cooperation (Aranguren 2010; Navarro 2003; Ybarra, 2006, Atherton & Johnston, 2008). Therefore, accurate diagnosis will reduce the biased results generated in the imitation of successful cases (Karlsson 2007), mitigating the "problem of reproducibility"[13]. The multiple

[12] These authors mention that the use of clusters as an 'imaginary' harmonic and homogeneous phenomenon but not account for the 'coordination failures' and 'transference problems'.

[13] This refers to the difficulties and risks that arise when trying to replicate successful industrial development experiences in other territories without counting on the same conditions.

combinations of arrangements which facilitate constructive interaction in one cluster can prove to be an impediment in another. For example, a major controversial aspect on the effectiveness of cluster policies is associated with the lack of certain pre-existing conditions, such as critical mass in the craft, industrial, or scientific traditions. This means that attempts to create or promote clustering from nowhere have generated poor results (Raines, 2002). It also means that identifying and building on "the unique strengths of their regions", "engaging in dialogue", and "developing different strategies for different clusters" (Corthright, 2006) are a must. Consequently, policies must be consistent in order to set achievable goals and to avoid duplicating objectives, resources, etc. in national and regional policies (Viesti, 2002; Aranguren et al. 2010), and must also take into account the stage of economic development of the area (Parrilli 2004, 2006) as well as the stage of the cluster (Brenner & Schlump, 2011; Elola et al. 2017). Therefore, policy must target three aspects: physical capital, human capital, and social capital (Christensen & Stoerring, 2012 based on Nauwelaers, 2001), but as these authors stress, the promotion of social capital though policy requires a proactive approach. They also point out that "active policies" help to reduce cluster development barriers, as in the case of the Nort Jutland biomedical tech cluster. Also, Aragón et al. (2012) point out the key role of social capital in the implementation of cluster policies (network) and in the facilitation of cooperation. Specifically, its relevance to influence the participatory learning process (design, data collection, and reflection) developed in the Basque cluster of aeronautics is highlighted. In the same vein, policy proposals should value social capital as it is a decisive factor underlying the differences in performance between the ICT (where it caused a positive effect) and the paper mill clusters in the Basque Country, where erosion in trust and reciprocity had a negative impact (Valdaliso et al. 2012).

The evaluation of cluster policies has also generated interest in the literature. In this regard, the research finds that there is no single recipe for success ("one fits all"), but rather that it is a continuous learning and participatory process (Aranguren 2010; Arangurenet al. 2010) involving intangible objectives and complex relations (Aragon et al. 2012). Therefore, it is necessary to analyze clusters case by case, using specific tools in the design of the evaluation process. Also, as mentioned before, given that social capital has critical implications for policy-making, provision must be made to assess it effectively in the evaluation stage. However, social capital is difficult to frame and measure (Christensen & Stoerring, 2012; Valdaliso et al. 2012). To summarize, there are different drivers and mechanisms involved in the developmental stages; thus, proper diagnosis and specific evaluation tools are necessary for the implementation of cluster-based development policies (Brenner & Mühlig, 2007; Brenner & Schlump, 2011; Maskell & Kebir, 2005, 2009; Handayani et al., 2012; Elola et al. 2017).

To sum up, the theory of clusters is based on a wide combination of theoretical contributions which point to the potential of clusters to capitalize on the advantages of spatial proximity, the flow of knowledge

and innovation, and the coexistence of competition and cooperation. This has made the field popular with researchers and policymakers; however, the evolutionary implications of clusters remain open to discussion. This is because they are complex systems with numerous potential interactions which are difficult to record and sustain. Also, there is a lack of consensus about which framework should be used to analyse the evolution of clusters (Belussi & Hervás- Oliver, 2017; Martinez-Fernandez, Capó-Vicedo & Vallet-Bellmunt, 2012). More importantly, the need for more empirical evidence for the purposes of comparison and systematization has been underlined (e.g. Boschma and Fornahl, 2011; Lorentzen, 2005; Martin & Sunley, 2006). Finally, a greater understanding of the role of social capital is necessary since "there is a strong interdependence between the economic structure and the social institutions in a cluster" (Wolfe & Gertler, 2004). In this vein, Cooke (2002) advises factoring in institutional factors such as social capital, state intervention (political regulations) and knowledge when assessing economic growth.

2.2.2. Evolutionary Models.

In order to study the evolution of clusters, the methodologies in the literature on clusters can be put into some sort of chronological order (Bergman, 2008; Hassink et al. 2012; Trippl et al. 2015). Initial attempts at evolutionary studies were developed based on the life cycle; however, this was subsequently criticized for producing deterministic outcomes, and consequently proposing complex adaptive systems (Martin & Sunley, 2011). At the same time, in the field of Economic Geography and Regional Economy, eclectic approaches have commonly been used (an intermediate position) as they are better suited for providing greater insight into the interactions between agents and the explanatory mechanisms of change. However, the absence of a predominant conceptual scheme is a drawback which makes it difficult to compare the conclusions of other studies. In addition, it must be borne in mind that the unique and complex paths of clusters are aligned with the concern to acquire an adequate understanding of specific trajectories rather than to reduce facts to models (Humphrey, 1995). The evolutionary features of the three basic schemes are presented below.

2.2.2.1. Life cycle.

The life cycle is represented by an "S-type" trajectory which is broken down into different stages: emergence, growth, maturity, and decline or transformation. This approach has become popular in the study of cluster dynamics because of the ease with which a "discussion template" can be created (Bergman, 2008). This has led to a "high frequency of stage-specific cases" (Isaksen, 2011), contributing a wealth of empirical evidence.

The application of the life-cycle approach to the phenomenon of clusters started in the mid-90s. Earlier cluster life cycle studies adopted an ecological point of view, analyzing the levels of entry and exit of firms (Swann, 1998) as critical measures of performance. In addition, this framework provided useful qualitative insight into key growth drivers such as: the effects of imitation and specialization (Pouder & St. John, 1996) on pathways for knowledge acquisition and transfer, and how firms' decisions to locate in a given cluster, thus strengthening its critical mass, are motivated by the cluster's competitive positioning (Swann, 1998). It is also worth pointing out that these studies have signalled myopic behaviour, the cognitive barrier which prevents the taking of subsequent decisions which would lead to improvement (Pouder & St. John, 1996), and congestion costs, seen in increases in wages, rents, land, etc. (Swann, 1998) as being responsible for the decline of clusters.

Notwithstanding the methodological advantages and insight offered by the life cycle approach, it has still been subject to criticism. This criticism is primarily aimed at the fact that, on the one hand, biological analogies inevitably lead to deterministic conclusions (Martin & Sunley, 2011; Press, 2006), and that, on the other, some studies link cluster trajectory to underlying factors such as the product, industry dynamics (Vernon, 1966 & Scott, 1983, cited in Crespo, 2011), or technological cycle (Dalum, et al., 2005). A second critique comes from the empirical contrast which shows that "very few clusters follow a rigid life cycle path from emergence to growth and decline" (Menzel & Fornahl, 2010). Moreover, while the CLC approach focusses heavily on stability, "discontinuities and regional crisis are rarely conceptualized" (Li & Bathelt, 2011). So, as Popp & Wilson (2007) suggest, it is important to analyse regularities "but these are continually subject to the contingency arising from unexpected events and decision-making under sets of constraints". Some of these concerns are addressed in the study by Knop and Olko (2011) who specifically model the incidence of different types of crises in order to configure the transitions between stages and the relative incidence of three critical drivers (i.e. trust, structure, and knowledge). Another shortfall in the life cycle approach is the failure to examine the links between the macro and micro levels (Martin & Sunley, 2011), which could help to explain different trajectories under similar conditions, e.g. divergent performance between two competing clusters, or why the evolutionary pattern of an industry could differ from that of the cluster (Hassink, et al., 2012). So, the impulse of an 'evolutionary turn' in economic geography (Boschma & Martin, 2007; Boschma & Martin, 2011) lays bare the need to explain the spatial evolution of economic units as an interaction between the historical development of business micro-routines and institutional structures (Boschma & Frenken, 2006).

A major success of the CLC approach is its extensive adoption as a methodological tool for empirical analysis. It is also flexible enough to incorporate the researcher's specific conceptual interests into the empirical contrast, as evidenced by Bergman (2008) and Knopp & Olko (2011). However, one disadvantage of such empirical evidence is that it is mostly based on case studies. Exceptions are found in Swann (1998),

Baptista & Swann (1999), or Maggioni & Riggi (2008) who use the number of firms as a dependent variable, or the meta-analytical approach used by Belussi & Sedita (2009), and Elola et al. (2012) who compare the trajectories of representative clusters in Italy and the Basque Country, respectively. Meanwhile, the quantitative focus is limited due to the lack of consensus on the appropriate measure of performance as well as the availability of longitudinal data sources (Bergman, 2008; McCann, 2008).

2.2.2.2. Complex Systems.

The theory of complex systems refers to the study of systems with many elements that interact in a non-linear way (Zhang, 2002). In Economics, Rosser (1999 pp. 169, following Arthur, Durlauf, & Lane, 1997) mentions that "complexity consists of six characteristics: 1) dispersed interaction among heterogeneous agents acting locally on each other in some space; 2) no global controller that can exploit all opportunities or interactions in the economy even though there might be some weak global interactions; 3) cross-cutting hierarchical organization with many tangled interactions; 4) continual adaptation by learning and evolving agents; 5) perpetual novelty as new markets, technologies, behaviours, and institutions create new niches in the "ecology" of the system; and 6) out-of-equilibrium dynamics with either zero or many equilibrium existing and the system unlikely to be near a global optimum". Therefore, according to Hamdouch (2011), the configuration of clusters meets this characterization because they "are the outcome of mixed, complex and uncertain dynamics, underlying at the same time 'visible hands' and 'invisible hands', strategic moves and chance factors, path-dependent constraints and path-creative processes, institutional building blocks and decentralized micro-decisions".

The major arguments in favour of using complex system methodological tools to address the dynamics of clusters are the possibility of examining a wider range of trajectories, and structuring the effects of complex interactions. Martin & Sunley (2011) argue that this framework can overcome the determinism of the life cycle approach. Therefore, these authors propose the use of an adaptive cycle model consisting of: a critical mass of elements with different capabilities, undefined boundaries between cluster and environment (i.e. open systems), and "non-linear dynamics resulting from various feedbacks and self-reinforcing interactions among components". In this way, there are four stages in evolutionary development: exploitation, conservation, release, and reorganization, with three "dimensions of change" each: accumulation of resources, internal connectedness, and resilience (Figures 3.3 & 3.4). Resilience is a "measure of system vulnerability to and recovery from shocks, disturbances and stresses", and connectedness reflects the tightness of the interactions in the systems. In the initial two stages, the three dimensions grow; while significant changes occur in the conservation stage where resilience is undermined by the secular stagnation of accumulation and connectivity. This means that stagnation weakens the bases

of competitive advantage. This approach enables potential pathways for the renewal and regeneration of clusters to be examined. Furthermore, this model takes into account the effects of individual "firms' decisions". However, some concerns about this conceptual framework are mentioned by the authors. First, the assumption of a four-stage sequence is somewhat restrictive and resembles the stage scheme of the life cycle model. Second, the need to put more emphasis on the "two-way nature of the interaction between a cluster and its external environment" calls for a co-evolutionary approach. Third, due to its ecological nature, "the microbehaviours – the agency -of individual system components (in our case, individuals and firms), are only highly significant for the course of cluster evolution during specific periods of rapid change and transition". Finally, it is worth mentioning (as a criticism) that, to date, a practical application of this proposal has not been carried out. Also, the evolutionary stage categories are very similar to those commonly found in life-cycle studies.

Figure 2.1: Cluster Phases and dimensions of change

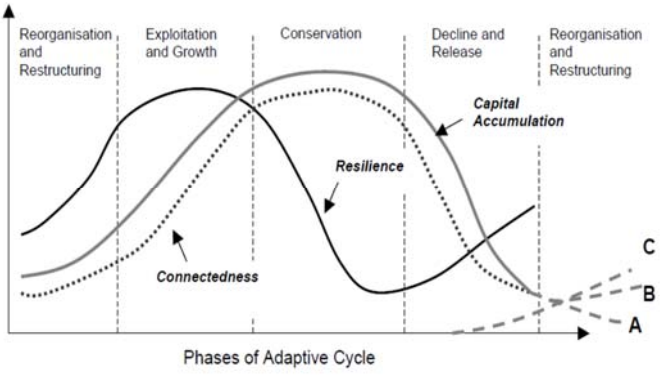
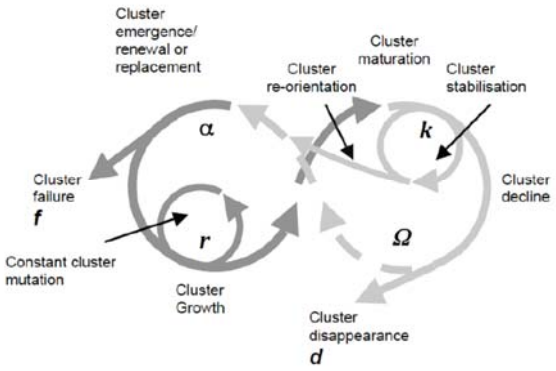


Figure 2.2: Cluster Evolution (CAS)



Source: Martin & Sunley, 2011

Technological advances have made it possible to carry out the large numbers of computations necessary to model these interactions, which has boosted the implementation of complex systems in Economics considerably (Zhang, 2002). However, implementing complex systems also has drawbacks which prevent their widespread use. For example, the operationalization of these structures requires the availability of large quantities of data and computing power. For this reason, applications derived from the evolutionary operation of clusters as complex systems generally use simulation models and social network analysis (SNA) tools to model coevolution and interconnections. For example, Albino, Carbonara & Giannocaro (2010) analyse the generation of adaptability (i.e. competitive advantages) in geographical clusters, emphasizing that adaptive capacity has three drivers: interconnectivity (network depth and strength), heterogeneity (diversity) and level of control (governance). The micro scale scheme establishes firms as nodes and interactions as links. Thus, using the network theory approach, the aim of their study was to observe and simulate the evolution of the salient elements that characterize networks, such as

density, homogeneity, and centrality in two geographical clusters in Italy (the agro-industrial district of Foggia, and the leather sofa district of Bari-Matera) in the development and maturity stages. The results validate that the medium density, high heterogeneity, and medium centrality of the networks are critical determinants of performance (they acknowledge the limitations of number of networks studied). Elsewhere, Canals, Boisot, & Mc Millan (2004) used an agent-based simulation approach to gain insight into knowledge flow mechanisms and spatial agglomeration patterns in two high-tech industrial clusters: Silicon Valley and Boston Route 128. They concluded that different spatial and knowledge transfer settings result in diverse cluster trajectories; they suggest that other specific aspects that influence knowledge transfer and spatial characteristics should be included in the study. Another study of interest is the one carried out by Brenner & Weigelt (2001) who simulated the evolution of the spatial structure of regions (the set-up, the entry, exit, and growth of firms) which gave rise to lock-ins ("independent of the parameters chosen"), which are not necessarily related to "a stable spatial distribution of industrial activity" which would suggest stagnation, but were rather the result of "a strong path-dependent" process.

2.2.2.3. Eclectic Approach.

The definition of eclectic is "deriving ideas, style, or taste from a broad and diverse range of sources"; and refers to those "denoting or belonging to a class of ancient philosophers who did not belong to or found any recognized school of thought but selected doctrines from various schools of thought"[14]. In the fields of Regional Science, Economic Geography and Strategic Management, the use of eclectic approaches is widespread. The reason for this is that they allow for more comprehensive explanations of complex issues (thus overcoming the limitations of deterministic approaches based on cause-effect explanations) and also for the combination and integration of different perspectives and methodological tools. The possibility of "customizing" methodological designs allows the factors and relationships that govern operations within the cluster to be studied in greater depth, and the reactions to external events can to be evaluated. Consequently, for the purposes of designing economic policy, an eclectic approach results in a more complete diagnosis which takes in the particulars of each case. Thus, for the purposes of empirical evaluation, research has been predominantly dominated by case analysis development which has the disadvantage of being limited in scope for generalization.

Examples of eclectic approaches to the analysis of the evolution of clusters include Parrilli (2004, 2009) and Li & Bathelt (2011). First of all, Parrilli (2004) expands Brusco's model of the evolution of the Italian industrial districts using a historical stage approach determined by three features: economic, political and social. So, Parrilli identifies a "sequence" of stages in the Italian district clusters (IDs): "initial

[14] http://www.oxforddictionaries.com/definition/english/eclectic

craft production; industrialization through large firms; the fragmentation of production followed by the growth of smaller specialized units; and, finally, new routes to innovation and competitiveness". The article is helpful because it analyses the development of the Italian IDs, which are prototypical examples of successful LPS development in the 80s; and also, and highlights the importance of considering "realistic" and "sequenced" cluster-based developmental stages when defining achievable goals based on the possibilities and conditions of the territory. This is a particularly important recommendation for developing economies and the design and implementation of policies. Parrilli (2009) uses specific economic, political, and social forces in the development of clusters: collective efficiency, policy inducement, and social embeddedness, and applies the model to the furniture production industry in Forli (Italy). The empirical evidence provides clues to the reasons for the current evolutionary difficulties the cluster is facing; also, it is emphasized the importace of social embeddedness and social capital as a key driver for cluster development, which represents a critical first content source of this dissertation. Finally, this approach was also applied in furniture production in Bukir (Indonesia), where it helped to identify the weakness of policy inducement in levering cluster development (Mawardi et al. 2011).

A second example is the so-called "tri-polar framework of cluster evolution", an integrated framework proposed by Li & Bathelt (2011), which consists of a cognitive-relational setting, founded on a micro-level, agent-based approach. As its name implies, it is based on three pillars: context, network and action. Context refers to the complete set of cultural, institutional and economic settings within a spatial structure and is a key input used by economic agents when making decisions (contingency concept). It is a dynamic feature which changes continuously, shaped by agents' strategic behaviour (it is never controlled by an individual agent). The network pillar refers to the understanding of how the links between economic and social agents are developed from a dynamic perspective. Thus, the contingent linkages as well as their quality/intensity (e.g. knowledge diffusion, "changes in values and belief systems", among others) are analyzed. Action refers to the decision-making process adopted by local agents, which influences and restricts the actions of other agents individually and collectively as well as how well the local agents adapt to a new context and network (flexibility). In this approach, the evolutionary "movement" is led by the interactions between the pillars, which can cause a virtuous or vicious dynamic. A vicious cycle is produced when the pillar connections "produce lock-ins and result in regional decline". For instance, when there is a negative impact on the context (a permanent change in the technological paradigm) and the social and institutional network is fragile (the lack of cooperation and technical skills when faced with a new paradigm produces a cognitive lock-in), a process of regional decline logically ensues. Meanwhile, a virtuous cycle is characterized by "expansive interactive movement" associated with the positive interaction of pillars at regional level. For example, an increase in the demand for the region/cluster's production, coupled with motivated entrepreneurs who cooperate and enhance the quality of their products (innovation), result in a

positive cluster trajectory. Empirically, this approach was applied to analyse the evolutionary traits of the aluminium extrusion industry in Dali (China) (Li, Bathelt & Wang, 2011).

To summarize, the study of the evolutionary patterns of clusters still remains a topic of keen interest. Furthermore, the need to address complex issues, coupled with the difficulty of keeping competitive advantages and coping with the pressure from the external environment, call for greater research into the trajectory of clusters. The range of different conceptual approaches, each with a different focus and empirical techniques, which have been used to address the dynamic aspects of clusters such as the life cycle, complex systems and eclectic approaches, lay bare the absence of one dominant approach (Table 2.1). The eclectic approach involves a wide variety of purposes and techniques whose use depends on the underlying theoretical and empirical goals, but somehow it still precludes comparison and systematization. The latter is best achieved by using the lifecycle approach. In recent years, the inclusion of complex systems has also generated considerable interest, but this approach lacks a concrete framework and is subject to the same criticism as the eclectic models. In addition, the difficulty of procuring longitudinal data with which to analyse causes and long-term effects seriously limits the scope of all these techniques. Also, the official statistics which are available for sector-specific classifications and/or geographic circumscriptions do not match the specific configuration of clusters.

Table 2.1: Comparative table of approaches to the dynamics of clusters

	Eclectic	Life Cycle	Complex Systems
Focus	Adapted to the research objectives	Characterization of stages & the underlying drivers	Networks & their evolutionry patterns
Advantages	Deepness / Macro Historical Influence	Simplicity / Comparability	Modelling of complex interactions
Disadvantages / Critics	Comparability	Determinism	Complex calculations & limited dimensions considered

Source: Own elaboration.

2.3. New cluster life cycle

The new cluster life cycle (NCLC) has been deemed capable of "distinguishing the cluster specific endogenous dynamics that drive the cluster through its life cycle from the processes that are exogenous but nevertheless influence the cluster's life cycle" (Hassink, et al., 2012). This approach to CLCs addresses the problematic issue of deterministic outcomes, providing explanations for the differentiation of the path

in a given cluster, industry or technology, and offers concrete guidelines concerning the drivers of cluster dynamics. The impact of the NCLC model in the literature on clusters has been significant, as revealed by the number of citations of the five main publications in Table 2.2.

Table 2.2: Key literature in the NCLC perspective

Author(s)	Year	Year and Journal	Title	Citations
Menzel, M. & Fornhal, D.	2010	Industrial and Corporate Change 19(1)	Cluster life cycles: dimensions and rationales of cluster evolution	82
Ter Wal, A. & Boschma, R.	2011	Regional Studies 45(7)	Co-evolution of firms, industries and networks in space	30
Suire, R. & Vicente, J.	2009	Journal of Economic Geography 9	Why do some places suceed when others decline? A social interaction model of cluster viability	32
Suire, R. & Vicente, J.	2011	Entrepreneurship & Regional Development	Clusters for life or life cycles of clusters: in search of the critical factors of clusters' resilience	
Maskell & Malberg, 2007	2007	Journal of Economic Geography, 7 (5)	Myopia, knowledge development and cluster evolution	97

Source: Web of Knowledge

2.3.1. Theoretical Background.

The NCLC is based on the general framework of Evolutionary Economic Geography (EEG). This relatively new strand of research, included within the so-called "evolutionary turn" in Economic Geography (Coe, 2010), focusses on related variety, novelty generation, and path-dependency as key aspects for defining the spatial dynamics of an economic activity. It is important to point out that it aims to explain the dynamics of spatial economic units by using a three-level aggregation scheme (Boschma & Frenken, 2006, 2011) (micro: firms, meso: sector and networks, and macro: spatial system), taking into account the role of culture, traditions, networking and institutionalization (path-dependence process). In this approach, the basic unit of analysis are firms who base their decisions regarding location and strategy on routines, past traditions, and limited information; therefore, context plays a critical role. In addition, how the firm behaves directly affects two meso-level aspects: i) the sector: the evolution of a specific economic activity (type of industry) affects and is affected by the dynamics of three potential dimensions: "agglomeration economies", "competition", and "opportunities for collective action", and ii) the networks, which refers to the relational dimension that favours the flow of knowledge and learning. Finally, the effects of former levels are aggregated producing economic outcomes at macro-level (cities, regions); so, the "dynamics of spatial systems" result from both sector (process of structural change) and network logics (insertion in trade networks). Operating this logic results in trajectories of sustained growth, or decline, as rigidities (cognitive, institutional, or lack of infrastructure) could harm a positive pathway. This new view has been criticised (e.g. MacKinnon et al. 2009) for downplaying the importance that actors attribute to the institutions and social processes, and for not integrating the EEG framework into the broader macro issues

such as “capital accumulation, social regulation, and uneven development”. This is all summarized in Coe (2010). Meanwhile, there is consensus on the need to adopt a pluralistic and open methodological approach, through the combination of qualitative and quantitative techniques (Coe, 2010).

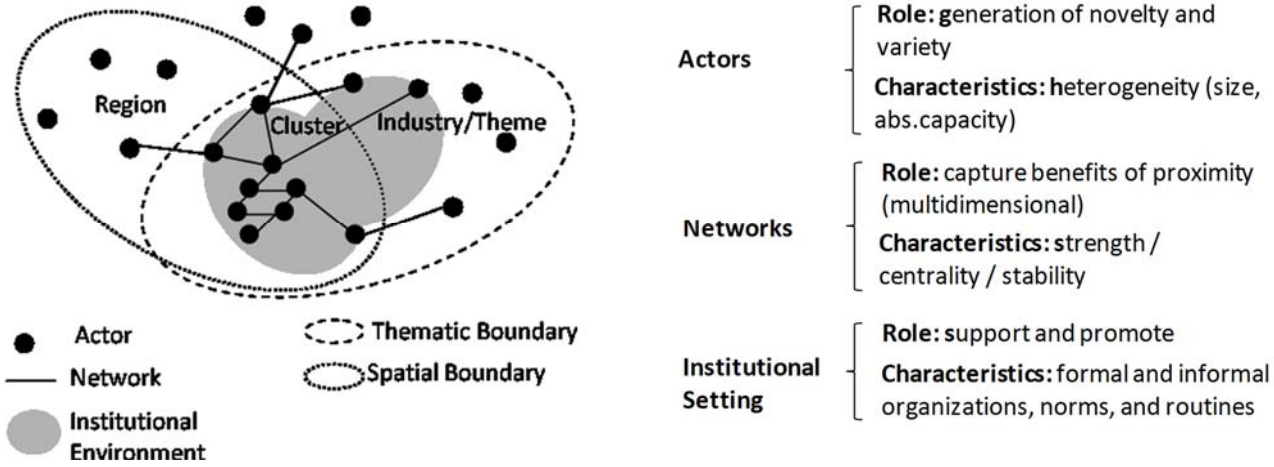
Within this theoretical framework, the evolution of clusters is essential as they are assumed to foster “the localized nature of innovation and technological change” (Coe, 2010). In this view, the cyclical movements and adaptation patterns of clusters are governed by the capacity of the cluster to promote knowledge diversity and heterogeneity, and the capacity of its firms, networks and industry to co-evolve. In the case of the diversity of knowledge, the main arguments focus on the idea that the trajectory of clusters is primarily influenced by the development of the cognitive ability of the economic agents, ensuring constant flows of new and diverse knowledge (Menzel & Fornahl, 2010). Consequently, cluster performance indicators are expanded to include not only direct and systemic quantitative indicators (i.e. number of firms and employees, and critical mass, respectively) but also the qualitative effects of diversity, such as knowledge capabilities and competencies (direct dimension), and how they are used to build networks and exploit synergies.

Furthermore, given the changing configuration of three key components (actors, networks, and institutions), the developmental stages of the clusters are also characterized. The key components of the NCLC are presented below. First, a brief description of the most important features is given, followed by the characterization and implications of the specific phases.

2.3.2. The Main Features of the NCLC.

In the NCLC, clusters are defined as “interconnected companies and institutions around a focal point within a spatial and thematic boundary” (Menzel & Fornahl, 2010). The meaning of "thematic boundary" is understood to be the availability of skilled resources (human, business, equipment, etc.) oriented towards a main economic activity (mainly industrial type). Meanwhile, the spatial boundary refers to the geographic dimension (in which such resources are concentrated) which is defined at different scales, such as city, district, or region. Therefore, clusters develops where boundaries, actors, networks and institutions intersect (Figure 3.7).

Figure 2.8: NCLC key elements



Source: Menzel & Fornahl, 2010.

To start with, clusters comprise a collection of heterogeneous actors with differing capabilities (e.g. size, age, absorptive capacity, or market power) (Ter Wal & Boschma, 2007). The inclusion of the micro-dynamics of these agents (firm level attributes) in the study provides greater insight into performance (Hassink, et al., 2012; Martin & Sunley, 2011) compared to previous studies, which assumed a homogenous make up. This inclusive approach also makes it possible to identify the agents that generate novelty and learning, two key aspects which contribute to resilience and flexibility in times of change. This is where cultural and technical factors are particularly relevant. A sense of identity and social cohesion are critical adaptive factors (Staber & Sautter, 2011). For instance, a strong sense of identity was key in the evolution of the Tuttlingen surgical instruments district, lending the cluster the flexibility it needed to develop peripheral sub-identities, thus renewing its social character and product portfolio (Staber & Sautter, 2011). The dissemination of technical knowledge within a given geographical context is conducted through different conduits (Ter Wal & Boschma, 2011). For instance, internally, imitation (positive effects at early stages) and inertia (negatives effects at maturity) lead to specialization (Maskell & Malmberg, 2007; Pouder & St. John, 1996; Vicente, Dalla Pria, & Suire, 2007). Also, positive internal dynamics attracts new players, but can also produce harmful collateral effects (e.g. congestion, exclusion). Decisions to join a cluster are motivated by the opportunity of enjoying external economy-of-scale benefits, such as the exchange of knowledge, legitimacy, and the capacity to manage in an uncertain environment (Suire & Vicente, 2009). The process of location decision-making is a substantial constraint on the whole path of the cluster (Crespo, 2011), and it precedes the development of knowledge transfer processes (Suire & Vicente, 2009). Finally, it is important to mention the role of key players in assuming leadership, and introducing novelty into the cluster. For instance, the role of leading firms whose agents carry out dynamical actions (i.e. those with a risk-adoption profile) can have a positive impact on the cluster, by acting as gatekeepers of critical

information and knowledge (Giuliani, 2005, 2007; Hervás-Oliver & Albors-Garrigos, 2014; Li & Bathelt, 2011), or as anchor tenants (Baglieri, Cinici, & Mangematin, 2012), but this role can also lead to significant distributional and asymmetric effects such as those seen in the Tuscan textile cluster, where the larger companies tend to determine the activities and strategic behaviour of the smaller ones (Randelli, 2012).

Secondly, the interactive nature of the clustering phenomenon involves the formation of diverse functional networks such as knowledge, learning and social networks (Boschma, 2005). For example, the collective learning process for actors (firms, universities and research centres) is shaped by the depth and size of the networks (McDonald, Tsagdis, & Huang, 2006). In fact, currently, the development of networks that extend beyond the local community are considered critical (Hervas & Albors, 2014). Bearing this in mind, the concept of proximity clearly needs to be redefined, and deviates from previous studies which consider clusters to be "closed" systems. In this vein, Ter Wal & Boschma (2011) warn of overemphasis on the benefits of geographical proximity given that, in order to be competitive on the current global market, what is needed is knowledge and innovation, which are not necessarily readily available in the local area. The study of networks/cluster interaction? is facilitated empirically by the development of social network analysis (SNA) tools, which enable the functionality and impact of the tangible characteristics of networks (strength, centrality, density, etc.) to be evaluated more accurately. Nevertheless, as it is difficult to obtain data and to model certain complex characteristics such as the demarcation of boundaries (internal and external) and interposition of different networks; this methodology is susceptible to criticism since it provides a limited view of the phenomenon.

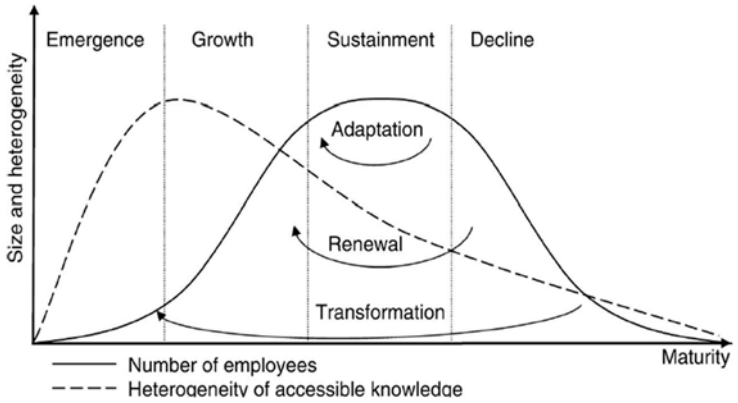
Thirdly, institutional development refers to coordination support and different forms of governance and control that emerge in the clusters (Arikan & Schilling, 2011). It is reflected in the regulatory policies and written and unwritten organizational rules which impact the routines of the firms directly. For instance, the institutional dimension, i.e. the reputation or regulatory framework, of a particular location is often decisive when firms choose to set up there (Crespo, 2011; Suire & Vicente, 2009). Similarly, differences in the degree of institutional development (e.g. between developed and developing countries) also influence the trajectory of clusters, thus a specific policy design is required for each evolutionary stage of the cluster (Parrilli, 2004; Brenner & Schlump, 2011).

2.3.3. Cluster's trajectory in the NCLC.

Within the NCLC evolutionary scheme, the possibility of transformation, adaptation and regeneration is of particular importance, as is co-evolution and the influence of external factors. Ter Wal & Boschma (2011) highlight the co-evolutionary nature of firms, networks, and industries within the cluster. It is worth noting that the NCLC approach offers a basis for differentiating between clusters and industries, as

it signals the possibility of cluster growth even when there is a relative decline in the related industry (Menzel & Fornahl, 2010; Crespo, 2011): at the beginning of a cluster there is a parallel progression with the industry, but in later stages, the trajectories can diverge due to the intervention of spatial context determinants, and/or dominant technologies (Suire & Vicente, 2011). Empirically, this proposal was validated by analysing the trajectories of six clusters[15] in the Basque Country (in-depth case studies) where deviations were observed and attributed to "three broad factors: the knowledge base and social capital of the cluster, and the region-level and public policies" (Valdaliso, Elola & Franco, 2016). In addition, there is a two-way relationship between the internal cluster path and the external environment (Menzel & Fornahl, 2010; Martin & Sunley, 2011). In one direction, the external environment acts as a selection pressure factor (Martin & Sunley, 2011). Current external threats include the changing world of technology which calls for new sets of products and/or systems, the reduction in "sunk costs advantages of old technology" (Karlsson, Johansson & Stough, 2005), and the changing dynamics of the technological sector (Suire and Vicente, 2009). The impact on competition is also important but not urgent, as these changes are "gradual in the medium term" (Karlsson et al. 2005). In the other direction, it is important to consider how adaptability capacities are developed in the cluster. For instance, Knop & Olko (2011) examine the ability of clusters to adapt to a crisis based on how three elements are interrelated in the different stages of the cluster: knowledge, structure, and trust. So, clusters are faced with different types of risks and critical situations at different stages and their ability to respond successfully to these threats are determined by these three elements (i.e. knowledge, structure, and trust).

Figure 2.9: NCLC Evolutionary Changes



Source: Menzel & Fornahl, 2010.

The configuration, the co-evolutionary forces, and the external factors have a differential impact on the cluster depending on what stage of the cycle the cluster is at. Thus, each stage possesses distinctive

[15] Paper, maritime, machine tool, energy, ICT, and aeronautics.

characteristics, which in turn require the development of specific policies (Brenner & Schlump, 2011; Borras & Tsagidis, 2008; Handayani et al., 2012; Elola et al.2017).

2.3.3.1. Cluster emergence

The emergence of the cluster is marked by the appearance of granular and disconnected economic agents who are eager to obtain economic benefit from new and diverse business ideas and technical innovations (Ter Wal & Boschma, 2011). There are no definitive arguments which provide the key to why a cluster emerges when and where it does. Marshallian externalities-type benefits are drivers of firms' entry decisions, but, ex-ante, it is difficult to know what structure will give rise to a successfully emergent cluster (Crespo, 2011). So, cluster emergence is considered a random process ("anecdotal evidence": Isaksen, 2011) and "hard to detect" (Menzel & Fonahl, 2010), or "a little arbitrary" (Swann, 1998). Nevertheless, it has been suggested that certain preconditions (or prerequisites) have a critical role in exploiting value and generating novelty at the initial stages. For instance, Hamdouch (2011) says that "the context and the conditions in which a cluster can emerge and develop are time-space contingent, sector-sensitive and institutionally embedded". Some of the pre-existing local conditions mentioned are connected with history, social values, entrepreneurial tradition in the region, or institutional (Ritvala & Kleymann, 2012), industrial (Boschma & Wenting, 2007), or scientific support bases. In the clusters in the Basque Country, for instance, tradition and cultural/ industrial heritage are critical features which shape the ability to take risks and the capacity to exploit tacit knowledge (Elola et al., 2012). Other examples of well-known cases of emergence are mentioned in Brenner and Weigeltz (2001), e.g. "in the case of Third Italy, historical aspects [that] led to an entrepreneurial spirit, a trustful atmosphere and helpful politics", as well as some strategic concerns such as the decentralization of multinational corporations (MNC) production plants or government support (Brenner & Mühlig, 2007; Brenner & Schlump, 2011). Given that the emergence of new agents is shaped by their motivation to achieve greater economic success, Cooke and Morgan (1998) point out that "clusters form because of a self-selection process on the part of firms which see advantages in exploiting their interdependences". One of the implications of this is the need to find ways to share information, because, in the words of Atherton and Johnston (2008) "cluster formations are emergent and iterative, in that they arise from the formation and emergence, and reinforcement of mutual understanding and trust between individuals". Also, novelty is leveraged by a critical spirit or a state of non-conformism which leads to greater creativity and imagination, and the generation of new knowledge.

Understanding the causes of emergence provides a basis for effective policy-making, and helps to anticipate and to determine the long-lasting effects that shape the entire trajectory of the cluster. The implications for the design of policies lie in to the problem of reproducibility, and the randomness of cluster

emergence render initiatives aimed at fostering cluster-policy development less effective (i.e. policies are a weak means of developing "non-natural" clusters). There is insufficient empirical evidence to demonstrate the possibility of the "artificial" creation of clusters (Martin & Sunley, 2003). Regarding the long-term effects of the start-up conditions in shaping the cluster trajectories, Crespo (2009, 2011) considers how the effect of decisions made at the time of the formation of the cluster last throughout the entire life cycle. He argues that the emergence and dynamics of clusters depend on i) certain conditions and moments in time (which are unique to each cluster) and ii) the competition between technological and regional processes which are transversed by three types of networks (social, industrial and R&D). Therefore, cluster dynamics are dependent on the structural conditions defined in the emergence stage.

2.3.3.2. Cluster growth

Secondly, the growth of the cluster is levered by a critical mass of economic agents who manage to harness the externalities (i.e. knowledge diffusion) from specialization and learning (Isaksen, 2011), and by the tendency of network patterns to become stable (Ter Wal & Boschma, 2011). It is a complex development process that some authors divide into two sub-stages (e.g. Bergman, 2008; Sonobe & Outsuka, 2006): exploration and exploitation. The exploration stage is characterized by the development of a helpful and hospitable environment (Bergman, 2008) in which the free disposal of inputs and flow of novelty are displayed in a virtuous circle, while the exploitative stage features progress towards specialization consolidation as well as some emergence of institutional initiatives.

Arguments which support reaching a high degree of specialization are based on the achievements of scale and scope economies. Therefore, processes involving intense imitation (Maskell & Malmbreg, 2007; Vicente, Dalla Pria & Suire, 2007, Pouder & St John, 1996), and spinoffs are evolutionary drivers which shape cognitive frameworks and routines (mental models), and consolidate institutional development (Pouder & St. John, 1996). Additionally, the evolution of the patterns of network interactions (Ter Wal & Boschma, 2011) is diverse. Within the cluster, there is a tendency for the links to stabilize, but externally, the clusters' involvement in global value chains improves (mainly large companies) and the clusters' boundaries grow accordingly (Smith & Brown, 2009). Also, other key agents in the cluster, such as university and research centres, are given strong incentives to collaborate with the firms in the cluster (Manian, 2012). The development of infrastructure to provide the developing businesses with support and knowledge, and assistance in opening new markets and distribution channels requires critical policy decisions to be made during the growth stage (Brenner & Schlump, 2011).

2.3.3.3. Cluster maturity

The maturity stage of clusters is characterized by stagnation in the number of new firms, stabilization of governance relations, and a rigid specialization pattern (Menzel & Fornahl, 2010). It is commonly argued that rigidities come from biased behaviour caused by the isolating mechanisms of myopia (Maskell & Malmberg, 2007). A “homogenous macroculture” (Pouder & St. John, 1996) tends to emerge, in which firms relax their efforts to produce innovations and address new business challenges (decreasing variety). In general, the existence of rigidities is referred to as a lock-in situation (Grabher, 1993; Hassink, 2010; Kanffeld-Monz & Fritsch, 2013) where these “factors diminish the clusters’ ability to recognize and make adjustments to changes in the environment” (Grabher, 1993). A lock-in is a multidimensional feature (functional, cognitive, and political: Boschma, 2005) because it includes technological, institutional, or cultural restrictions which are usually attributable to an excess of proximity (Popp & Wilson, 2007; Chapman, MacKinnon & Cumbers, 2004). The implications of lock-ins are diverse. Isaksen (2011) identifies two types of lock-ins where the cluster is unable to overcome "shocks events": structural or endogenous (non-cooperative), and exogenous (technological change). For example, the lack of strategic perspective of firms within a cluster could lead to a lock-in path, causing technological underdevelopment or a loss in the competitive advantage of a region (Kanfeld-Monz & Fristch, 2013). Thus, in order to maintain their competitive position, firms focus their attention on process efficiency (Ter Wal & Boschma, 2011) as a means of avoiding congestion (Swann, 2002; Maggioni, 2004) and the generation of negative externalities (Sorensen & Audia, 2000; Belussi, 2006; Enright, 2001; cited in Ostergaard & Park, 2013). Also, at community level, efforts are directed at making the system more stable by formalizing the regulatory framework, ensuring compliance with international standards, and developing and implementing strategic plans that align collective shared goals and efforts. On the positive side, a system of support institutions (or social capital), extra regional guidelines, and organizational capabilities in the region (Isaksen, 2011) are all developed. It is worth mentioning that maturity per se does not necessarily imply inevitable decline. Nevertheless, cluster weaknesses are highlighted when there is a critical change in the external conditions (e.g. technological disruption, or macroeconomic volatility), and this, combined with an inability to respond in a timely fashion, can affect the survival of the cluster. Therefore, how clusters react to these setbacks will effectively determine their trajectory as can be seen in the divergent paths of two clusters (the paper mills and ICT) in the Basque Country (Elola et al 2012), and also in a study by Skalholt & Thume (2015) using the data of a survey on cluster organizations in Norway .

Table 2.3: NCLC main features of the stages

Phases	Key elements				Internal Process	External Environment Pressures	Policy Role
	Actors	Networks	Institutional Setting	Knowledge Diversity			
Emergence	Low quantity / High Variety	Weak and unstable	Weak	Weak and diverse	▸ Generation of critical mass ▸ Product innovation	▸ Lack of investment, funding and reputation.	▸ Start-up promotion ▸ Provision of information ▸ Support (promotion of joint actions and trust)
Growth	Growing quantity & variety	Stable but open and flexible (towards core-periphery)	In construction	Growing and varied	▸ Spin-offs & Start-Ups Process ▸ Definition of a dominant technological mode (specialization) ▸ Knowledge Spillovers (mutual learning / absorptive capacity)	▸ Lack of qualified labour and funding. ▸ Sudden changes in market conditions, technology, etc	▸ Open new markets ▸ Open new distribution systems
Maturity	Quantity stabilization & decreasing variety	Highly stable and focused	Highly consolidated	Homogenous and codified	▸ Rigid specialization ▸ Appearance of Congestion effects ▸ Focus in efficiency (process-innovation) ▸ Path-dependence effects	▸ Increasing competition and external shocks vulnerability	▸ Enlarge variety of knowledge and technology ▸ Promotion of productive diversification ▸ Selective promotion of start-ups
Decline	Falling number & variety	Desintegrating connections (lock-in)	Disagreement and controversies	Homogenous and codified	▸ Lock-in (cognitive, functional and institutional) ▸ Resistance to change (lobbying)	▸ Increasing competition and external shocks vulnerability	
Revitalization	Stable or Low / Increasing variety	Unstable	Reconfiguration & reorganization	Weak and diverse	▸ Generation of a new heterogeneity of knowledge ▸ Involvement in global economy		▸ Stimulate new knowledge and technology ▸ Development of human capital ▸ Support services

Source: Menzel & Fornahl, 2010; Ter Wal & Boschma, 2011; Van Klink & De Langen, 2001; Brenner & Schlump, 2011; Vicente & Suire, 2007.

Policy recommendations at this stage are directed at mitigating lock-in effects with strategies aimed at diversifying knowledge and industrial production, and supporting new business. There are different ways to achieve these ends, e.g. by improving the local innovation system and its relationship with businesses, facilitating the funding of new business projects, supporting and / or promoting internationalization, and improving the quality of local learning centres (Handayani et al 2011; Brenner & Schlump, 2011).

2.3.3.4. Cluster revitalization

One of the distinctive characteristics of the 'NCLC' approach is that it contemplates the revitalization of trajectories, allowing for alternatives, such as "adaptation", "renewal" or "transformation" paths. Here, the whole process of transformation is highly dependent on the existence of appropriate conditions in an incremental adaptation process (Menzel & Fornahl, 2010). Thus, presumably, the chances of integrating local capacities (i.e. technology, skills, institutions, etc.) and a new technological paradigm or macroeconomic/regulatory framework would be better. It is argued that the transformation of clusters can be propelled by exploiting polyvalent technologies in related industries, exploiting the potential of regional science infrastructures, and by regenerating the local social (and institutional) context (Bergman, 2008; Todtl & Trippl, 2008). The exploitation of polyvalent technologies in related industries refers to production diversification which, in evolutionary terms, reflects the degree of convergence between old and new technologies (Swann, 1998). The second type of transformation refers to productive adjustments based the use of the available infrastructure, such as technology centres and universities, which are considered vital drivers of novelty and variety. The third type of transformation refers to the development of new organizational models or networks to ensure the diversity of knowledge. For this, the involvement of local agents is essential. Finally, the contribution of these way of adapting to internal and external changes will determine the resilience of the cluster. The concept of resilience refers to the ability of systems to react positively to events and shocks. According to Martin (2011), there are three types of resilience in Economic Geography: engineering, ecological, and adaptive; with four different dimensions: resistance, renewal, recovery, and re-orientation.

Policy recommendations are varied and aimed primarily at supporting a "new industrial path" (Isaksen & Trippl, 2016). They are implemented through the stimulation of new knowledge and technology, and the development of human capital (Brenner & Schlump, 2011).

The empirical evidence on cluster renewal seldom presents one of the aforementioned types as a single determinant of transformation, and tends to present them in combination. For example, evidence of technology relatedness and convergence is cited in the Marche music clusters where local specialist skills in

the production of music instruments were reconverted to satisfy a new demand (Tappi, 2005). Elsewhere, in the Sheffield metals cluster, the technology relatedness strategy proved effective (Potter & Watts, 2012). Elsewhere, a policy-driven initiative in Kobe (Japan) used the existing knowledge infrastructure of a cluster to revitalize a region (Collins, 2008) after the 1992 earthquake. Another example relates how a small group of local leaders (key players' initiative) were responsible for promoting the development of an international hub for biomedical research and innovation. Baglieri, Cinici & Mangematin (2012) focussed on the role of the anchor tenant when they studied scientific and technological diversity as a driver of cluster regeneration. In a study on the Aberdeen oil cluster, Chapman et al. (2004) examined diversification as a driver of change and contrasted the risk of adopting only one adjustment strategy. In a separate study, Randelli & Boschma (2012) studied cluster renewal through changes in the operation/behaviour of local agents, and observed how the behaviour of business groups can act as a transformation link when channelling local resources into global networks. The risk of this type of intervention is that it increases fragmentation among the firms in the cluster. Also, Alberti (2006) examines the decline of the textile industrial district in the city of Como (Italy) between 1980 and 2003. This district went through a serious crisis stemming from the effects of globalization and the post-transition period, but managed to change course by reconverting to the production of greater value-added products. Finally, an important study which identifies the sources of renovation in old industrial areas is the comparison of the evolution of the different transformation processes in the automotive and the metal clusters in Styria (Todtling & Trippl, 2004).

2.3.4. Critics to the NCLC.

The life cycle model has been criticised because of its limitations. For example, Trippl et al. (2015) point to three important aspects: context sensitivity, multi-scalar features, and human agency. The lack of context sensitivity considerations creates an implicit bias in the development of the theory by neglecting the importance of the economic, technological (knowledge base), and institutional context. It is also worth mentioning that Menzel & Fornahl (2010) specifically pointed out that the institutional dimension has not been properly examined in depth. In this respect, the contribution by Isaksen (2011) which examines the potential influence of regional innovation systems in generating different cluster paths is very valuable. The second object of criticism refers to the inherently complex internal configuration of the clusters which is caused by the actors' participation in multi-scalar networks, generating multiple feedbacks which can lead to non-linear trajectories. Human agency highlights the importance of individual decisions and activities in the development of a cluster. Finally, a complementary factor which affects the evolution of the different dimensions of clusters, and is also connected with the aforementioned criticism, is the concept of social

capital. There are two main reasons why its role in the evolution of clusters has been largely ignored. On the one hand, the priority given to internal heterogeneity and diversity of knowledge in the NCLC (thus favouring a network-based empirical analysis) tends to outweigh the importance and relevance of social capital. On the other, the difficulty of defining social capital concepts (nature, dominance, and results) and operational problems (how to measure abstract concepts) affects their theoretical and empirical applicability (with notable exceptions such as: Valdaliso, Elola, Aranguren, & López, 2012; Elola et al. 2017 among others).

Despite this criticism, in the study of the historical evolution of clusters, the life cycle model has been widely used for a variety of different evaluation purposes. For example, the CLC theory has been used to examine criteria such as internationalization (Amdam & Bjarnar, 2012), the role models of key players (Baglieri, Cinici, & Mangematin, 2012; Giuliani, 2011; Hervas-Oliver Albors-Garrigos, 2014), transformation trajectories (Chapman, et al., 2004; Press, 2006; Randelli & Boschma, 2012; Schiele, Hospers, & van der Zee, 2012; Sonderegger & Täube, 2010), technology changes (Staber & Sautter, 2011; Tappi, 2005; Trippl & Todtling, 2008), policy implications (Elola, Valdaliso, López, & Aranguren, 2012; Lopez, Valdaliso, Elola, & Franco, 2012; Shin & Hassink, 2011; van Klink & de Langen, 2001), and resilience to internal challenges and external threats (Lopes & Branco, 2013; Branco & Lopes, 2013; Ostergard & Park, 2013), among others.

To summarize, it could be considered that there are two challenging topics that motivate research on this subject. The first one aims suggests addressing the general call for greater in-depth research into the key drivers of cluster dynamics. Equally important here is the need to improve the empirical evidence by means of both qualitative and quantitative methods. The second line of thought ponders an examination of the effects of social capital or social embeddedness on the development of clusters' paths.

2.4. Social capital & cluster evolution

The concept of social capital has been around for at least 100 years (Portes, 1998, Tura Harmakorpi, 2005; Malecki, 2012), but has grown exponentially in use over the last 30 years (Li, 2015; Andriani, 2013; Yin & Chiang, 2010; Beujelsdijk & Van Schaik, 2005). This growth in popularity reflects a special interest in conceptualizing the effect of social practices on several economic fields (Li, 2015). The term 'social capital' was adopted to address "an ample variety of questions" (Ostrom & Ahn, 2003) such as the effect on household incomes (Narayan & Pritchett, 1999), organizational behaviour (Acquaah, 2007), government performance (Boix & Posner, 1998), industrialization (Miguel, Gertler, & Levine, 2005), innovation performance (Crescenzi, Gagliardi, & Percoco, 2013), and economic growth (Casey, 2004; Casey & Christ, 2005; Westlund & Adam, 2010). The underlying argument for such a wide range of applications lies in the general agreement that investments in social exchanges anchored in norms, values, cooperation and trust

create economic value (Bourdieu, 1986; Becattini, 1990; Coleman, 1990; Putnam, 1993; Granovetter & Swedberg, 1992; Parrilli, 2009, 2012; Glaeser, Laibson, & Sacerdote, 2002; Staber, 2007).

The three main benefits attributed to social capital are that it reduces transaction costs, produces public goods, and facilitates the establishment of effective social-based organizations (Durston, 2000). These are the significant advantages for the positive evolution of a local economic structure. While the notions of collaboration and cooperation do not figure significantly in neoclassical Economics (Esparcia, Escribano & Serrano, 2016), institutional and evolutionary strands of research (Camagni, 2003) have largely been responsible for introducing these two aspects into the field of study.

Despite the diversity of the discipline and the potential benefits outlined above, the concept of social capital has generated ample debate in terms of the delimitation of its conceptual features, and aroused concerns about operationalization measurement in the Social Sciences (e.g. Durston, 2000; Westlund & Adam, 2010; Camagni, 2003; Van Deth, 2003). These controversial issues have also cropped up in the study of social capital and the performance of clusters. Therefore, the following section presents an overview of the issues under debate and their implications in the study of the evolution of clusters.

2.4.1. Social capital: the conceptual debate and concerns.

The debate on the concept of social capital (Durston, 2000; Camagni, 2003, Li, 2015; Beujelsdijk & Van Schaik, 2005; Noya et al 2008) basically revolves around the differences between two opposing perspectives, the instrumental and the civic. The major differences between the two are related to: whether social capital is an individual or collective asset, and, what 'products' of social relationships have socio-economic outcomes.

In the instrumental perspective, social capital is viewed as the ability of individuals to obtain (or to enjoy) economic benefit from their position and size/scope of their network of relationships. Two definitions are connected with this view, the first of which purports that "social capital is defined by its function. It is not a single entity, but a variety of different entities having two characteristics in common: They all consist of some aspect of social structure, and facilitate certain actions of individuals within the structure" (Coleman, 1988). This individualistic approach links the social capital derived from norms and relationships with assumptions from rational economics (Camagni, 2003; Li, 2015); thus, it is criticized for considering social capital as another input to be included in the individual utility function (van Staveren & Knorringa, 2007) or as another individual attribute variable in regression models (i.e. a preference in the utility function, or as a risk reduction tool. For example, in Glaeser et al. (2002), social capital development is determined by the analysis of "individual investment decisions". Consequently, the individualistic approach fails to explain the reasons for the persistence of the imbalance in "power, conflict, and class", or

address the circularity issues (problems of causality) at the empirical level (van Staveren & Knorringa, 2007, Esparcia et al., 2016, Cooke, 2002). Also, another effect of collaboration and trust from an instrumental perspective is that their role is seen as functional inasmuch as social capital is only activated to mitigate situations involving risk. A second definition of social capital in this perspective refers to "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition, or in other words, to membership in a group which provides each of its members with the backing of the collectivity-owned capital, a credential which entitles them to credit, in the various senses of the word" (Bourdieu, 1986). Here, it is implied that social relationships are inherited, thus, facilitating the persistence of asymmetries and class differences (van Staveren & Knorringa, 2007).

The second, or civic, perspective associates social capital with a community factor, which is based on Putnam's (1995) definition where social capital comprises: "features of social organization, such as networks, norms, and social trust, which facilitate coordination and cooperation for mutual benefit". Therefore, this view relates to the development of cognitive features, such as shared values and norms, which embed habits and routines at community level, and are aimed at addressing "collective action" problems (Olstrom & Ahn, 2003). In addition, social capital works in two ways, by bonding and bridging. Bonding involves the development of strong links of trust and collaboration, typical of closed systems, while bridging involves the development of networks of cooperation with external sources. Unlike the instrumental perspective, in this view, social capital "is not an input that can be measured and added to other factors of production, (but) has features and functions of public goods and generates external economies for all the productive system" (Camagni, 2003). Empirically, this view is inclined to highlight how "deep-seated" cultural traits help to explain differences in regional or countries' performance (e.g. Putnam, 1993, 1995); nevertheless, the empirical evidence of a positive relation is not conclusive (Westlund & Adam, 2010). This view has attracted criticism because it tends to ignore the influence of institutions and public policy[16], the direction of causality is difficult to ascertain (Farrell & Knight 2003; Staber, 2007), and the negative consequences of social capital are not dealt with satisfactorily (i.e it is referred as a "public bad" in Portes & Landlot (1996) cited in Westlund, 2006). Among the negative effects, it seems that close social ties (what Putnam refers to as 'bonding social capital') lead to the "exclusion of outsiders, limited mobility, poor socioeconomic advancement and lack of adaptability to change" (OECD, 2002).

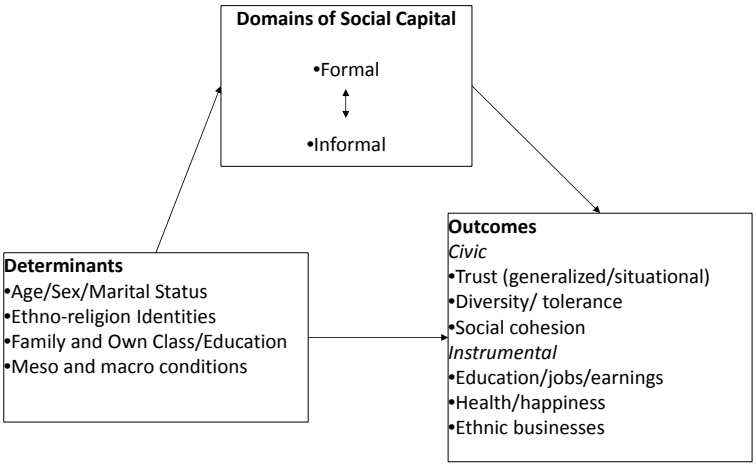
In addition to the differences in the two main approaches to social capital, other conceptual aspects which have been subject to criticism and have been identified in the literature can be grouped according to three features: (Castle, 2002; Olstrom & Ahn, 2003): 1) conceptual ambiguity due to overuse (Olstrom & Ahn, 2003), 2) a bias towards positivity in its effects, and 3) inaccuracy at determining

[16] According to Noya et al. (2008) this failure was corrected in Putnam (2003).

relationships between cause and effect (Farrell & Knight 2003; Staber, 2007) as well as the dearth of research into the different dimensions, modes of operation, and domains of social capital (Li, 2015; Camagni, 2003). Conceptual ambiguity relates to the risk of overgeneralizing (Li, 2015) and the lack of "a unified and coherent concept at all" (Haynes, 2009). Indeed, these concerns are difficult to address given the multidimensional, multidisciplinary, and intangible nature of social capital (Castle, 2002; Andriani & Karyampas, 2009). The bias towards positivity means that the negative evolutionary consequences of social capital are usually masked. Therefore, negative aspects of social capital which affect the evolution of a local system are ignored or played down, such as the exclusion, segregation, and/or threats that closed social systems pose to entrants (e.g. new entrepreneurs) (Arif & Sonobe, 2012). The consequences of this behaviour are deviations in the decision-making processes which hinder the search for new opportunities, business processes and technology options (Trigilia, 2003). The third aspect refers to the need for the different dimensions, elements, channels, and domains to be properly defined so as to prevent the term social capital from being used as a "catch-word" (Camagni, 2003). Malecki (2012) points out that this problem has driven the determination of typologies such as: bonding, bridging, and linking[17]. Additionally, Li (2015) offers an integrated framework for dealing with the subject of social capital in the Social Sciences (a similar framework is provided in Esparcia et al. 2016). In it, he identifies a direct connection between the underlying determinants and the outcomes, which is affected by formal and informal domains. First, he defines the connection based on some specific value-based aspects (which are shaped by the context) which produce both instrumental and civic outcomes. Second, the fact that the dual nature of the domains (a critical aspect in the history of the development of the social capital concept) is referenced is important because it lends weight to intangible issues ("athmosphera", Camagni, 2003) that have been sidelined in favour of quantifying effects (so, giving priority to the formal domain. E.g. Camagni, 2003). So, this simplified framework helps to demarcate three important features (i.e. determinants, moderator, and outcomes) about how social capital operates.

[17] "Bonding social capital: immediate family, friends, neighbours. Bridging social capital: more distant colleagues and associates. Linking social capital: connections to people in positions of authority." (Malecki, 2012).

Figure 2.11: An Integrative Approach to the study of Social Capital in Social Sciences



Source: Li (2015)

Theoretical concerns are exacerbated at the operational level when attempts are made to quantify the term social capital (Andriani & Christoforou, 2016) due to the "the lack of convergence both in definitions and in measurement" (Beujelsdijk & Van Schaik, 2005); thus, empirical evidence about its positive impact is not definitive/conclusive. Westlund & Adam (2010) performed a meta-study on 65 cases to examine the link between social capital and economic performance and found 'unambiguous' evidence of a positive impact at firm-level. This is also supported by the study carried out by Stam, Arzlonian & Elfring (2013), who, having performed a meta-analysis of 61 publications to test the link between social capital and entrepreneurship, were able to confirm a positive correlation. Nevertheless, at the higher spatial levels of regions and countries, the outcomes are not clearly satisfactory owing to "insufficient measures of the two main components of social capital: social networks and the norms and values that are being distributed in them" (Westlund & Adam, 2010). One of the few empirical studies that link the effects of social capital at the company level (with positive impact) to regional performance is from Cooke, Clifton & Oleaga (2005).

The problematic issue of measurement is caused by imperfections in the data structure and sampling procedures, and in the multiplicity of methods of measurement (OECD, 2002; Malecki, 2012; Beujelsdijk & Van Schaik, 2005). In this field of study, there is no clear definition about which indicators to use to measure a measure of social capital. Van Deth (2003) compiles the usual (and varied) measurements applied in studies on social capital by combining individual and collective approaches and the structural and cultural aspects (Annex 2.2). Andriani & Christoforou (2016) mention three methods for the operationalization: though the information of census from organizations, the use of survey data, and the use of proxies of social practices such as political participation and civic engagement. Popular one-dimensional indicators are civic participation (usually taken from secondary data) and trust (usually taken

from the Global Values Survey -GVS- or from the European Value Survey -EVS-Parts (2008)). For example, Beujelsdijk & Van Schaik (2005) develop a social capital index, using factor analysis, for 54 European regions (NUTS 1) based on the 1990 wave of the EVS. Meanwhile, some research studies, using both surveys and secondary data, employ data reduction techniques to produce different dimensions of social capital. For example, principal component analysis was used by Sabatini (2005) for the Italian regions, while Paxton (1999) and Oorst, Arts & Gelissen (2006) used confirmatory factor analysis (CFA) in) when studying European countries and regions. Elsewhere, Owen & Videras (2007) opted for the latent class model while BBVA-Ivie (2011) produced a synthetic index to examine the Spanish regions and provinces. The major concern about such operational difficulties is that generalizations are not guaranteed, leading to problems of external validity[18] (Stone & Hughes, 2002).

2.4.2. Social Capital and Clusters[19].

A significant feature in the role of social capital is that it facilitates access to extra-economic cognitive and normative resources (Becattini, 1990; Putnam, 1993; Humphrey and Schmitz, 1998; Cooke, 2002; Parrilli, 2004). This aspect has crucial implications for territorial development because, by "shaping inter-firm relationships" and "contributing to identity" (OECD, 2002), social capital helps to cover innovation gaps (e.g. Parrilli, Aranguren & Larrea, 2010) and governance issues (e.g. Aranguren, Larrea, & Wilson, 2010), and to propulse innovation (e.g. Parrilli, 2004; Casson & Della Giusta, 2007). Therefore, it is argued that the positive synergies between social embeddedness and economic action (Nadvi & Schmitz, 1994; Fromhold-Eisebith, 2002) represent the "missing link" which can help to explain the differences in regional competitiveness (Knorringa & van Staveren, 2006).

The use of the concept of social capital in the field of clusters is a by-product of the social capital research program as mentioned before. Also, there is an important debate in the lack of consistent empirical evidence.

2.4.2.1. Social capital and clusters: theoretical features.

The first point refers to the scope of the social capital concept use. In the Italian school of industrial districts, Becattini (1990, 2004) and Brusco (1982, 1990) stressed the importance of the influence of social issues on the clustering process. In their study on the so-called neo-Marshallian industrial districts (Tappi,

[18] External validation refers to the generalizability of the results of a study or experiment to other contexts (Neuman, 2011).

[19] There are few literature reviews specifically devoted to addressing this relationship, among which we can highlight Vejzagic-Ramhorst, Huggins, & Ketikidis, 2009; Redzepagic & Stubbs, 2006.

2001), 'local conditions' were seen to have a decisive reproductive purpose in facilitating and encouraging collaborative actions (Becattini, 1990) which were anchored in values and the 'system of institutions and rules'. This value-based approach fits in with path-dependent evolutionary arguments that stress how the historical accumulation of values, norms, and routines impact the behaviour of socioeconomic agents favourably (Martin & Sunley, 2006). A vital outcome of this accumulation process is the generation of generalized trust based on a network or structure of relationships (BBVA-Ivie, 2011). Furthermore, network-based conceptualizations of social capital have also been developed such as the one developed by Nahapiet & Goshal (1998) who divide social capital into three dimensions: structural, relational and cognitive. The structural type entails the general setting or the architecture of the connections in a network. Here, characteristics such as the size and density of ties determine the potential flow of resources (e.g. information, business prospects, and financing opportunities). The relational attribute involves examining how the benefits of belonging to a network develop as the continuous process of interaction and exchange is leveraged as reciprocity and trust grow. Finally, cognitive categorization refers to the convergence of mental processes derived from shared norms and conventions. Even though it is a widely-used definition of social capital, especially when working with data based on surveys at firm-level and supported with the development of social network analysis software, it is questionable whether network configuration parameters could be applied successfully to interpret the normative guidelines (and the "quality" of the social relations) that guide collective action. So, Malecki (2012) warns that "the importance of social capital for developent and growth requires a focus on the group rather than on the individual, it is not clear the scale", and he suggests that "intermediate or meso-scale" level produces greater direct effects. Also, on the subject of local development, Barandarian & Korta (2011) point out that there is a bias in the discussion on the role of social capital towards analysing the objective characteristics in interaction networks; and therefore, a tendency to neglect the dimensions (i.e. values) that underlie the formation of such networks. In the same vein, Anderson & Jack (2002) call for more investigation into "the value of the various types of capital and less into the structure of the relations " and encourage the field to "examine the nature of social capital that is said to be both glue, and at the same time the lubricant that facilitates the operations of the networks". This position clearly implies a preference for the community vision of social capital, as outlined above in the salient aspects of the social capital research program in Social Sciences.

According to van Staveren & Knorringa (2007) and Rosenfeld (2011), in order to investigate the relationship between social capital and cluster evolution, it is necessary to look beyond the instrumental view and the circular reasoning it involves. Therefore, two key issues need to be examined: the desired and undesired effects, and the flaws associated with empirical operationalization. The leading hypothesis expresses the effects of social capital as an "inverted U", pointing out that there are benefits from social capital at the early stages, but in the long run these benefits do not last. So, at a certain point, a lack of

dynamism (e.g. new innovations, markets, or firms) may prevail over the initial constructive effects (Antoci, Sabatini & Sodini, 2011). It is therefore assumed that in the initial stages, the role of social capital is to foster "the conditions that enhance the benefits derived from more tangible investments in physical and human capital" (Wolfe, 2002). While this U-inverted hypothesis is attractive, it has been modelled on microeconomic foundations (Antoci Sabatini Sodini 2011). An important implication of this evolutionary aspect is the incorporation of harmful consequences into the competitiveness of clusters (thus avoiding a positive bias) such as the so-called risk of over-embeddedness (Masciarelli et al 2009). This refers to the cultural constraints and rigid decision-making processes (or cognitive lock-in effects) which develop in settings with strong and homogenous social ties, and can lead to a reduction in the exploration of new demand opportunities, business and technology (Trigilia, 2003; Parrilli, 2012; Anderson & Jack, 2002).

Another important aspect of the debate is the lack of consistent empirical evidence. This is another by-product of the social capital research program as mentioned before. Staber (2007) mentions significant failures in operationalization caused by the fact that the literature on the social capital of clusters is likely to be interpreted from multiple perspectives (institutions, network activity, shared identity, etc.), rendering its effects "highly variable and difficult to predict" (Staber, 2007 pp. 507). So, interpretations on the degree and type of social capital intervention tend to differ greatly, generating complex implications which are difficult to generalize.

Thus, Staber (2007) points out that it may be necessary to contextualize[20] social capital in terms of time, space, and situation So, he proposes that research into cluster social capital must include the five critical issues: "(1) thick description of the research setting; (2) a context-sensitive sampling plan; (3) a focus on processes and events; (4) attention to co-evolutionary processes at multiple levels; and (5) attention to the social mechanisms that link actions at multiple levels" (pp. 513).

2.4.2.2. Social capital and clusters: empirical features.

The second feature of social capital into clusters refers to the emprirical approach. As it is mentioned before, contextualization requires a description of the process and events; the contribution of social capital is usually associated with certain processes which, in turn, impact on the stages of the life cycle. There are three areas where social capital is considered to have the greatest impact: coordination, entrepreneurship, and innovation.

Firstly, the literature underlines the importance of coordination platforms at local level (Foss & Lorenzen, 2003; Tomlimson 2011; Rodriguez-Clare et al. 2005), especially for SMEs (Schmitz and Nadvi,

[20] Contextualization is defined as: to place (as a word or activity) in a context / to think about or provide information about the situation in which something happens / to consider an idea, event, activity, etc together with everything relating to it in order to understand it better (McMillan dictionary).

1999; Solvell et al. 2003), and of balancing the "distribution of power and wealth in a region" (Rosenfeld, 2011). This need is critical due to the combined effects of complexity and imperfect separability; thus, "members must actively interact to manage their interdependencies" (Arikan & Schilling, 2011), and to overcome (through formal and informal means) internal conflicts and external tensions (i.e. to reduce opportunistic behaviour). It is clear that the exploitation of such resources is not automatic but rather the consequence of an historical construction. On this subject, there is evidence of the contribution of social capital in achieving consensus in the development of common responses (Dei Ottati, 2009) and for improving "collective action" (Casey, 2004). Thus, Sanders & Nee (1996) mention three mechanisms of intervention based on the coordination of social relationships: institutional support, productive information (i.e. knowledge transfer), and psychological aid. The positive view stresses that social capital has a "role facilitating collective action, economic growth and development by complementing other forms of capital (Grootaert, 1998). Then, civic participation and associations are important outcomes which impact on cluster evolution (Wolfe & Nelles, 2006). Also, Aranguren, Karrlsen & Larrea (2012) highlight the fact that the benefits of collaborative advantage have been critical in two counterintuitive cases, the Basque Country and Norway. Annen (2000) stresses the role of social capital as a specific form of governance and points out the importance of informal regulatory mechanisms. In turn, attention has also focussed on the need for leadership in uniting interests and achieving community involvement when working to attain common objectives. For instance, Waite & Williams (2009) provide evidence of positive links between higher levels of social capital in clusters and SMEs exports' performance, in three Australian clusters, due to "the ability to develop long-term trusting relationships, with common export goals, open communication channels, a commitment to information sharing and a will to work together for mutual benefit". Finally, Solari (2005) points out that it is important to distinguish value-based aspects (eg ethical standards) from the role of institutions. Though, he states that adding heterogeneous instruments into a stock variable is not useful when operationalizing social capital.

Secondly, the influence of social capital in fostering entrepreneurship has been widely debated in the literature (e.g. Casson & Della Giusta, 2007). It is assumed that the existence, influence, and development of social values helps to break the fear and inertia and provides a platform to spur risk adoption based on prior skills and relationship networks with innovation system agents, and also attracts new actors to the region. This influence is made effective by means of two interdependent forces which, in these cases, traditionally produced a 'positive sum game', i.e. social cohesion/trust (including 'the subordination of individual interest to the larger interests of the community', see Wolfe, 2002), and the encouragement of self-realization through entrepreneurship (Parrilli, 2004; 2009). A cohesive cluster, therefore, provides an adequate platform for the owners of new ideas to access key resources such as financial means (Arif, 2012; Molina-Morales & Martinez-Fernandez, 2009), skilled workers, learning

infrastructure, and craft traditions. Empirical studies addressing this relationship have focused largely on examining social capital from a network perspective using attributes at the individual and firm levels. For example, Boari & Presutti (2004) examine the existence of relational resources (embedded in ties) that are used to develop new initiatives over time. Also, Pirolo & Presutti (2010) examine the influence of social capital on the performance of start-ups at an inter-organizational level (relational and resource perspective), observing mainly reduction in information costs. Elsewhere, Lizo & Walsh (2005) examine the relationship between social capital and entrepreneurship at two levels: company and the individual. The limitations of these works lie in the excessive focus on the minority role of the structural component (networks) regardless of the context.

Thirdly, the generation of a trusting context is pivotal for the process of "knowledge diffusion" (Cooke, 2002). It contributes to resource mobility by easing "coordinated action and collective learning" (Staber, 2007; Malecki, 2012[21]). The empirical evidence is varied. Positive relationships, innovations considered as performance indicators and social capital as an input, are found in the study by Daniel, Huang, Rathnappulige & Neale (2013) on the emerging biotech cluster in Australia, Patton & Kenney (2003) in Silicon Valley, Padilla-Menendez et al. (2012) in Andalucía (Spain). Also, Valdaliso, Elola, Aranguren, and Lopez (2012) used the the Porter diamond framework to examine the importance of social capital for learning (core for knowledge spillover) in two clusters of the Basque Country (ICT & Paper) and found it difficult to measure. Molina-Morales & Expósito-Langa (2009) evidenced that a saturation point (the inverted-u paradigm) exists, and that the focus on innovation arises from the need to understand the "difficulties in coping with external challenges in a globalized world". The breakpoint is also observed in Casanueva & Rocha (2010) who work with a concept of social capital based on the instrumental paradigm (using social network analysis). Meanwhile, Cainelli, Mancinielli & Mazantini (2005), study the case of the biomedical district of Mirandola in Modena (Emilia Romagna - Italy), asserting that social capital (and networking) are complementary driving forces for innovation outputs. So, as they work with the communitarian paradigm of social capital, the role of policy is essential for targeting "both market and non-market characteristics taken together, rather than solely the production of (local) public goods inputs as independent elements of firm processes". Thus, this evidence is consistent with the idea that social capital alone is not so decisive but operates in a complementary role; i.e. a necessary but not sufficient condition (OECD, 2002). One of the reasons for the problems in the quantification of the relationship between social capital and innovation in a cluster is the use of patents as a representative of innovation, since this variable is only relevant in certain sectors (Rosenfeld, 2011). Finally, it could be contrasted with the argument of the OECD (2002), which validates the relationship, but is spatially manifest in those clusters that have

[21] "the primary relevance of social capital to the process of economic growth derives from its prescence in interactive learning" (Malecki, 2012).

external links and are internationalized. Also, there is an underlying policymaking challenge to harmonize both of these demands. For example, their influence on the generation of policies is clear, bearing in mind that a cluster policy divorced from the consideration of social effects tends to exacerbate inequality and asymmetry (van Staveren & Knorringa, 2007). On this point, Woolcock (2012, p.30 p.19) mentions that a top priority in a policy agenda must be given to anticipating and resolving problems of social inequality and exploitation.

To conclude, there is general agreement about the importance of social capital in influencing cluster development, but there is no clear evidence about the direction (positive or negative) or domains where it impacts in the different stages of the life cycle. Thus, in Economics, "the challenge of social capital theory is to give a meaningful and pragmatic content to the rich notion of social capital, and define and measure suitable indicators across a variety of social economic context" (Christoforou & Davis, 2014). The literature stresses that social capital should be treated as a "situational and dynamic" (Piselli, 2003) force. This means that it should not be restricted or associated with a strict configuration, but as actors' interactions, settings and their meanings, and the specific context (Staber, 2007). The review of different studies reveals a wide heterogeneity about what, when and how social capital affects clusters' performance, be it positively or negatively. The second issue is associated with the need for contextualization (Staber, 2007), thus, it is necessary to insert a notion of social capital into the evolutionary approach to clusters by differentiating its functions, related actions and the developmental stage of the cluster. Associated with this, it is also necessary to look for causality based on a pluralistic way of measuring it. This could be achieved by using a combination of different measures or indicators and exploring the information contained in case studies.

2.5. Conclusions

The aim of this chapter is to review the literature about the major conceptual aspects considered in this thesis: the evolutionary characteristics of clusters and the influence of social capital in the process.

Firstly, the concept of clusters has achieved significant recognition as a conceptual and policy tool for economic and industrial development (Martin & Sunley, 2003). Nevertheless, there is a need to deepen the understanding of the evolutionary factors of the clusters. Different theoretical approaches have been used to study this phenomenon such as eclectic, life cycle, and complex system models. The most popular approach is the so-called cluster life cycle (CLC). However, while it does not trace a definite pattern, it serves as a template (Bergman, 2008) for providing a framework for examining historical contexts (path-dependence mechanisms), internal cluster heterogeneity, and diversity of knowledge as critical adaptive

drivers (Menzel & Fornahl, 2010). Empirical observations of cluster evolution stress the fact that they “do not follow homogeneous evolutionary paths” due to their different intrinsic characteristics and conditions as well as their “different responses to the same external factors (e.g. international demand, global competition, etc). Therefore, cluster policy must be designed and implemented attending to the specific circumstances of the cluster stage (Brenner & Schlump, 2011).

Secondly, the general notion of Social Capital, as social relationships based on values, norms and cooperation networks, is connected to the generation of economic benefits in clusters. Replicating the debate in Social Sciences, there is a double perspective analysis on the character of social capital (individual and community-based) and there are difficulties and lack of agreement in its operationalization. On the question of cluster development, the evidence is not yet conclusive regarding the relationship between social capital and economic performance of regions, firms, or individuals. In general, the literature has identified the process of entrepreneurship, diffusion of knowledge and innovation, and coordination matters as the main areas where social capital impacts the performance of clusters.

There are still several contentious issues regarding the evolutionary patterns of clusters. Among them, recent research has identified the systemic significance of heterogenity and diversity of knowledge (Menzel & Fornahl, 2010) in sustainable cluster dynamics, along with the co-evolutionary industry and network pressures (Ter Wal & Boschma, 2011). Apart from this, some of the criticism which is levelled at the NCLC approach (and to the EEG) includes the exclusion or neglect of institutional and social environment issues which could be addressed by using the concept of social capital. Specifically, since the earliest literature on the subject, it has been taken for granted that social capital has the latent power (a multifaceted and transforming concept: Trigilia, 2001; Parrilli, 2012) to impact on/interfere with evolutionary proceedings. There is a wide range of different interpretations of the concept of social capital which has produced contrasting connotations about its role and effects. One interpretation which relates closely to the conceptual origins of LPS is the notion that emphasizes the underlying importance of values and norms in affecting collective decisions in the territory (Barandarian & Korta, 2011). The focus on "values" is critical as they are essential guides about what makes sense (Barandiaran & Korta, 2011), and it represents a way of connecting the individual and society. While this approach has the virtue of taking into consideration the motives that drive the behaviour of agents in a cluster, it also poses an important methodological challenge. On the one hand, there is the difficulty of developing indicators worthy of quantitative analysis. On the other hand, social capital is not as a constant (unchangeable) factor and needs to be framed as a factor with varying types and degrees of intervention depending on the contextual circumstances (Staber, 2007). Thus, the concept of social capital in the evolution of clusters should not be analysed from a mono-causal perspective, nor should its effects be considered constant over time (Kilkeny, 2010). In addition, there are some destabilizing external factors which condition the view of social capital as

a powerful tool for boosting internal working mechanisms. Thus, evolutionary analyses of clusters should provide explanatory guidelines and examples of how social capital contributes to catalysing these external changes. Also, a pluralistic view requires empirical evidence using both qualitative and quantitative methods to support the conceptual developments.

Chapter 3: Social capital & mechanisms for growth in the cluster life cycle: conceptual approach

3.1. Introduction

The observation of complex and uneven trajectories, founded in permanent difficulties in sustaining competitive advantage and adapting to changes in the external environment, promotes the study of the determining factors in the evolution of clusters (Lorentzen, 2005; Hassink et al 2012). In the literature review, the degree of social commitment is identified as a critical determinant for change (Becattini, 1990). Specifically, the concept of social capital is considered a critical driver that stimulates collective learning and helps to differentiate in competitiveness between regions (e.g. Cooke, 2002; Knorringa & van Staveren, 2006). Therefore, it is assumed that there is a latent explanatory power of social capital to impact in clusters' evolutionary proceedings, but there are two puzzling features to analyze: How do the facets underlying social capital drive change and adaptation? and do internal and external circumstances impact this influence? First, social capital is considered an essential element which supports and complements the activation of clusters' internal working "mechanisms"[22], categorized in different ways in the literature (e.g. Benner, 2009; Morosini, 2004). Second, the supportive mode of action of social capital is dependent upon the stage of development of the cluster and the need to generate systemic responses to offset the destabilizing external factors. So, it is worth characterizing the impact of social capital in the context of historical analysis (Popp & Wilson, 2007; Staber, 2007) as clusters evolve through stages that are difficult to avoid (Parrilli, 2004, 2007).

Cluster evolution is framed using the insights from the NCLC setting (Menzel & Fornahl, 2010; Ter Wal & Boschma, 2011; Suire & Vicente, 2009). Meanwhile, social capital is defined by Putnam (1993) as: "the features of social organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit". So, this community-driven perspective is adopted by Becattini's (1990) socioeconomic facets of ethic of work, attitude of change, and reciprocity to drive cluster dynamics.

The major argument in the development of this conceptual approach establishes that these facets of social capital have a proactive role seen through their influence on cultural, institutional and technical mechanisms during the evolutionary stages of the cluster, which, in turn, impacts the performance of firms. Therefore, social capital acts as a balancing driver in shaping the cognitive and normative frames in the production of collective responses for addressing critical internal and external pressures.

The objective of this chapter is to develop a conceptual approach that connects the role of social capital during the stages of the cluster life cycle. The chapter is divided into four sections. The next section (3.2) explores a value-based notion of social capital. Section 3.3 presents an effort to explain how facets of

[22] The use of the term mechanism is established to identify and categorize a set of operations in the operation characteristics of clusters.

social capital act within growth inducing mechanisms. Section 3.4 illustrates how the cluster evolutionary phases and the mechanisms at work fit together. And finally, some concluding remarks are presented.

3.2. A notion of social capital

In the literature review chapter, we explored the need to focus on a value-based viewpoint (Barandiaran & Korta, 2011) due to the social capital underlying role in shaping collective behavior. So, it is necessary to adopt a notion of social capital focusing on the meaning of values and norms (following Putnam's definition), and to link this view with the means through which social capital can execute its influence.

In this work, social capital constructs are demarcated in accordance with Becattini's view (1990) regarding the operation of a "homogenous system of values and views, which is an expression of an ethic of work, the family, reciprocity, and change… [that] constitutes one of the preliminary requirements for the development of a district, and one of the essential conditions of its reproduction". These four underlying collective values offer a basis for discussion on how longstanding social structure conditions affect the cluster trajectory.

We argue that these four underlying values perform a mediating role in differentiating the local basis of competitive advantages vis-à-vis other regions and LPS, and to influence individual business decisions and collective interactions. Based on this functional specification, three[23] salient facets are selected:

- Ethic of work: Sense of responsibility and discipline that is committed towards a business and socio-economic aim.
- Attitude to change: Willingness to change (and to take risks), individually and collectively, in order to improve both business and territorial competitiveness.
- Reciprocity: Attitude towards sharing benefits and sacrifices within the local community as a means to produce an all-encompassing development.

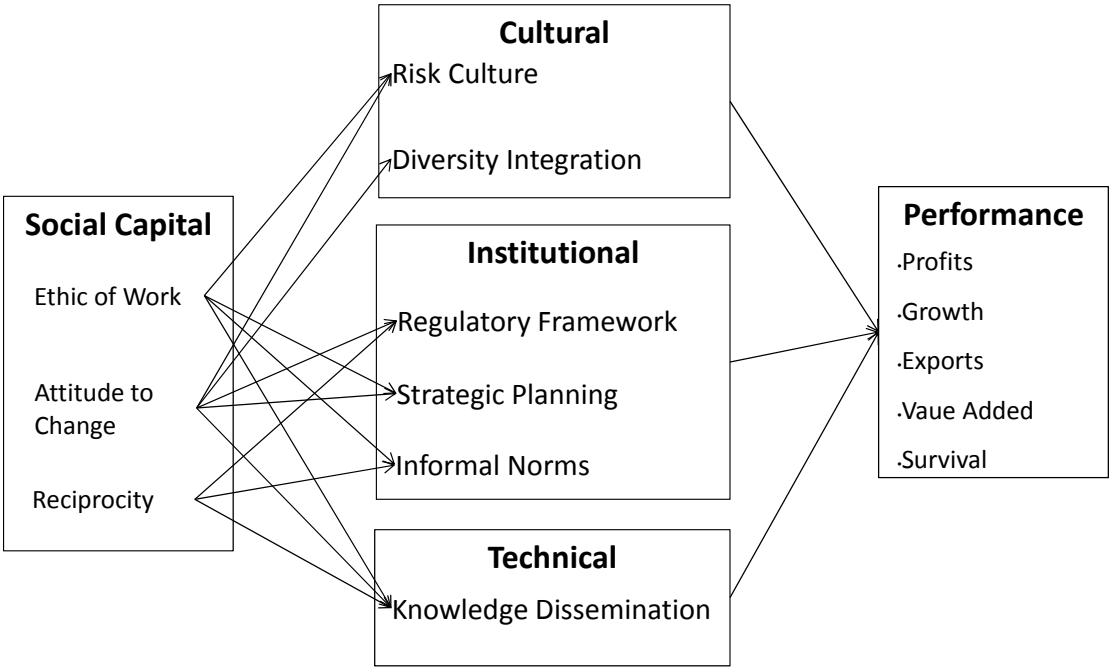
The work ethic is associated with the importance ascribed to the hard and constant effort devoted to the generation of economic value. Accordingly, this fact is grounded in religious beliefs and/or cultural characteristics (Nadvi & Schmitz, 1994). The attitude to change entails a community readiness to improve and adapt in a context of transformations (e.g. technological, organizational, and cultural) in the socioeconomic environment. This characterizes a social context that is likely to foster learning capabilities and to encourage new initiatives. Finally, reciprocity is an ingrained cultural norm which "literally means

[23]Becattini also mentions the facet of family values, but it has been removed as it was considered of particular importance in the specific case of the Italian industrial districts, but may be less of a critical condition in other cluster typologies (Markusen, 1996).

'returning forward' and implies a process of action, then reaction" (Weinstein, 2005). So, the density of the interactions leads to "generalized reciprocity" which reinforces the development of collective action and shared goals (Castaño-Martinez, 2005). In turn, actions that impair other local actors establish limits and erode the general level of trust and the identity of a local system.

On this basis, the aim of the proposed framework is to connect these three "structural" facets of social capital with specific cluster development mechanisms (Figure 3.1).

Figure 3.1: Scopes of Influence of Social Capital in inducing mechanisms in the clustering process



Source: Own elaboration.

3.3. Growth-inducing mechanisms

Within the literature, a vast amount of research has identified the critical proceedings for cluster success. For instance, Morosini (2004) argues that clusters' success is highly dependent upon the development of five key capabilities: leadership, building blocks, communication rituals, knowledge interactions, and professional rotations. Also, Benner (2009) reviews and analyzes how clusters' potentialities, based on efficiency, creativity, and uncertainty reduction, are materialized through different mechanisms such as "recruitment of qualified new staff", "labor mobility", "Spin-off formation", "availability of venture capital", cooperation among education and research institutions as well as between firms, and "cafeteria effects" among others. Also, Brenner & Weigelt (2001) refer to cluster development mechanisms and, more specifically, in their simulation research, they use knowledge spillover and local aspects that influence the formation of companies. Thus, for the purpose of this research, we decided on the term

"mechanisms" and grouped them into three areas of impact: Cultural, Institutional, and Technical (Table 3.1).

Table 3.1: Mechanisms Resume

	Mechanisms	Explanation
Cultural	Risk Culture	Local identity which favors entrepreneurship and spin-offs. Provision of ways to fund risky business prospects.
	Cultural Integration	Integration of people with other cultural and skills backgrounds.
Institutional	Local Regulatory Framework	Collective governance rules.
	Strategic Planning	Concensus about local strategic plans & infraestructure development.
	Informal Norms	Informal rules and routines.
Technical	Knowledge Dissemination	Facilitation the sharing of new knowledge. Raising and preserving a training framework for agents' capabilities.

Source: own elaboration.

3.3.1. Cultural Mechanisms

The first scope of influence (work ethic) takes into account cultural attributes that leverage open and proactive attitudes toward the assumption of risk as well as toward the integration of people with different cultural backgrounds and skills.

The risk culture is influenced by the work ethic which lends legitimacy to the use of personal commitment and know-how in business growth. In turn, the influence of a proactive attitude to change enables the generation of a context that fosters creativity and tolerance to errors. The existence of a homogeneous social capital anchored to these values promotes non-risk averse behaviors towards the encouragement of self-realization through entrepreneurship (Brusco, 1982; Becattini, 1990; Parrilli, 2009; Noseleit, 2008; Capelleras et al., 2010; Myint et al.,2005), the provision of legitimizing incentives for co-location (Pouder & St. John, 1996; Suire & Vicente, 2009), and the overall enhancement of collective

identity (Staber & Sautter, 2011; Beebe, Haque, Jarnus, Keeney & Patton, 2013). So, new ideas are encouraged and the "industrial cluster permits new enterprises to take small and calculabre risks to enter in the industry" (Arif & Asadi, 2011 citing Schmitz & Nadvi, 1999). In addition, the availability of financial sources is another key institutional feature that may be promoted by some social capital facets. An attitude to change combined with a system of reciprocal social relations may lead to the creation of a "local network of business credit" (Russo & Rossi, 2001). At the beginning of clustering expansion, 'risk credit' is obtained through family links, and friends. For instance, it is argued that, in China's rapid industrialization, agglomeration plays a significant role in diminishing the barrier of the initial capital needed to start up new businesses (Ruan & Zhang, 2009). Also, there is a residence effect in which it argued that financing is more achievable by the "long-time residence in a community" (Westlund, 2006, citing Glaeser et al. 2002).

A sense of 'local community' anchored in a positive attitude to change favours the integration of people with different cultural backgrounds and skills, which in turn promotes the socio-economic system's ability to adapt (Parrilli, 2012). So, at firm-level, the management of diversity (i.e. ethnic, gender, migrants, etc.) involves not only an ethic challenge, but also a business challenge that must be engrained as a cohesive and inclusive perspective. In a broader perspective, Rodriguez-Pose & Hardy (2014) find a positive correlation between cultural diversity (measured by ethnic roots and birthplace) and entrepreneurship (start-up rates) in regions of England and Wales; also, a stronger association is found between birthplace and knowledge-intensive industries. The risk associated with diversity absorption is the potential decrease/failure in social trust. However, different studies (e.g. Herreros & Criado, 2009; Lupo, 2010) do not find support for such a hypothesis. The example of the capacity of Silicon Valley to absorb Chinese and Indian ethnic and business communities and to benefit from their capabilities and social values and norms seems to justify this interpretation (Saxenian, 1994, 1996). According to Parrilli (2004; 2009), the weak spot in the current stage of development of Italian IDs is strongly related to social and economic aspects of migration flows and the failure to integrate this new heterogeneous social capital. For instance, in the Prato textile cluster, there is an increasing amount of business conducted by the Chinese business community which "has given rise to a clothing ethnic system that, paradoxically, has little contact with the textile system and is perceived by the local population as a "parallel district" whose growth causes increasing social alarm" (Dei Ottati, 2009).

3.3.2. Institutional Mechanisms

In the Institutional literature, it is stated that "institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction", North (1990). Consequently, extensive research is devoted to connecting the institutional incidence in economic

development, however, results show heterogenous effects that are dependent on institutional dimensions, contexts, and cultural values, among others (Casson et al., 2010; Aixalá-Pastó & Fabro-Esteban, 2011; Witt & Redding, 2013). Accordingly, this perspective differs from an institutional approach that assigns institutions the role of establishing a basis for the creation of Social Capital. While acknowledging a bidirectional influence, the proposed approach considers that values are the primary influence in determining collaborative and cooperative behavior (the social agreement needed to establish, engage and address long-term collective goals: Dei Ottati, 2002) with further materialization through the intervention of formal or informal institutions. Thus, institutional mechanisms refer to local collaborative patterns such as regulations, organizations and routines that shape formal and informal socioeconomic interactions. Three mechanisms are considered here: the regulatory framework, strategic planning, and informal norms.

First, the 'regulatory framework' is understood as a formal set of local regulations, institutions and practices that support the coordination of production activities, e.g. the creation of credit consortia, production cooperatives and cluster associations (Nadvi & Schmitz, 1994). In this respect, the value of reciprocity offsets divided interests and local competition; thus, a cooperative behavior for cluster competitiveness is favored (Putnam, 1993; Amin & Thrift, 1994; Parrilli, 2004; Castaño Martinez, 2005). For instance, a positive qualitative impact of cluster associations has been assessed in the Basque Country case (Aranguren 2010; Aragon et al, 2010; Aranguren et al. 2012), in connection with the concept of institutional distance (Lopez-Posada & Calderón-Hernández, 2005), and in Brazil for governance facilitation (Palma-Lima & Ribeiro-Carpinetti, 2011). Quantitatively, using a sample of Basque Country firms' database, a positive mediation link between belonging to a cluster association and firms' innovation performance is reported in De la Maza et al., (2012). Simultaneously, the attitude to change is acting on the collective efforts aimed at strengthening the cluster competitive position by incorporating standards like quality, safety, and environmental regulations. This factor becomes particularly important in developing economies that aim to be successful breaking into foreign markets (Nadvi & Waltring, 2004).

Second, an overall system of values based on a consolidated identity, traditions and history helps in the process of building locally-shared *strategic planning*. The commitment toward shared goals may lead, among other things, to the identification of common interests and the reduction of asymmetries in negotiations between agents and the lowering of information costs (Dei Ottati, 2002). This mechanism is observed in operation in the definition of a development agenda, the creation of specific infrastructures (e.g. trade fairs, science parks), the development of private-public alliances in critical circumstances (Devlin & Moguillansky, 2009), or the development of joint action activities associated to the concept of collective efficiency[24] (Arif & Asidi, 2011). For example, Belis-Bergounin (2011) reports the positive effects of joint activities and collective involvement in the infrastructure development in the Bordeaux wine cluster. Also,

[24] Schmitz, 1995; Scmitz and Nadvi, 1999.

examples of public-private intervention efforts can be materialized in different ways such as regional innovation systems[25](Navarro, 2009) and regional competitiveness plans (Aranguren et al. 2012). Finally, a critical element for the attainment of strategic goals is the presence of solid leadership capable of identifying new business prospects (e.g. market niches, or product innovations), and of convincing other agents effectively to approach them (Wolfe, 2002).

Third, the informal norms mechanism considers the presence of an implicit code of behavior based on communitarian 'informal norms' and sanctions which are influenced by a shared work ethic and reciprocity (Nadvi & Schmitz, 1994). It is also called a 'community mechanism' (Arif & Sonobe, 2012) and contains guidelines for local conflict resolution and also serves as a coercive device in terms of social sanctions with economic consequences (i.e. social and economic exclusion: 'high exit costs'). Thus, for Glaeser et al. (2002) the creation of trust is the outcome of a "repeated game". For instance, sanctions arise if local agents detect that "some firms attempt to over-utilize asymmetric information, or deliver low-quality goods, or create hold-ups in order to exploit market shortages" (Arif, 2012 based on Sonobe & Otsuka, 2006)). In Dos Irmaos, which belongs to the Sinos Valley Brazilian footwear cluster, Bazan and Schmitz (1997) find that social identity and reputation based upon shared ethnic roots and work ethic exert a strong persuasive effect on (honest) business behavior. Also, Beebe et al. 2013 note the importance of identity and sanctions as a matter of internal and external validation in the case of the Paso Robles (USA) wine cluster.

3.3.3. Technical mechanisms

Considering that knowledge is a fundamental driver for current economic competitiveness (Malmberg & Maskell, 2002), technical mechanisms are concerned with how the social capital facets help to generate and exploit such a resource. In the case of clusters, a major argument for their existence rests in the intrinsic value of a local atmosphere providing incentives for knowledge sharing (Malmberg & Power 2003; Arif & Asidi, 2011).

In this framework, the 'Knowledge dissemination' mechanism denotes the transfer of valuable information to firms that are not able to absorb new and advanced knowledge in a fast-changing environment. There are four ways of encouraging such knowledge flows and collective learning: through informal networks associated with the local 'buzz' (Bathelt et al., 2004) and external partners, formal cooperation networks, labor mobility, and spin-offs formation (Ter Wal & Boschma, 2011). These scholars note that such means are enhanced not only by physical proximity, but also through network development. For instance, Agrawal, Cockburn, & Mc Hale (2003) observe "that patent citations occur disproportionately

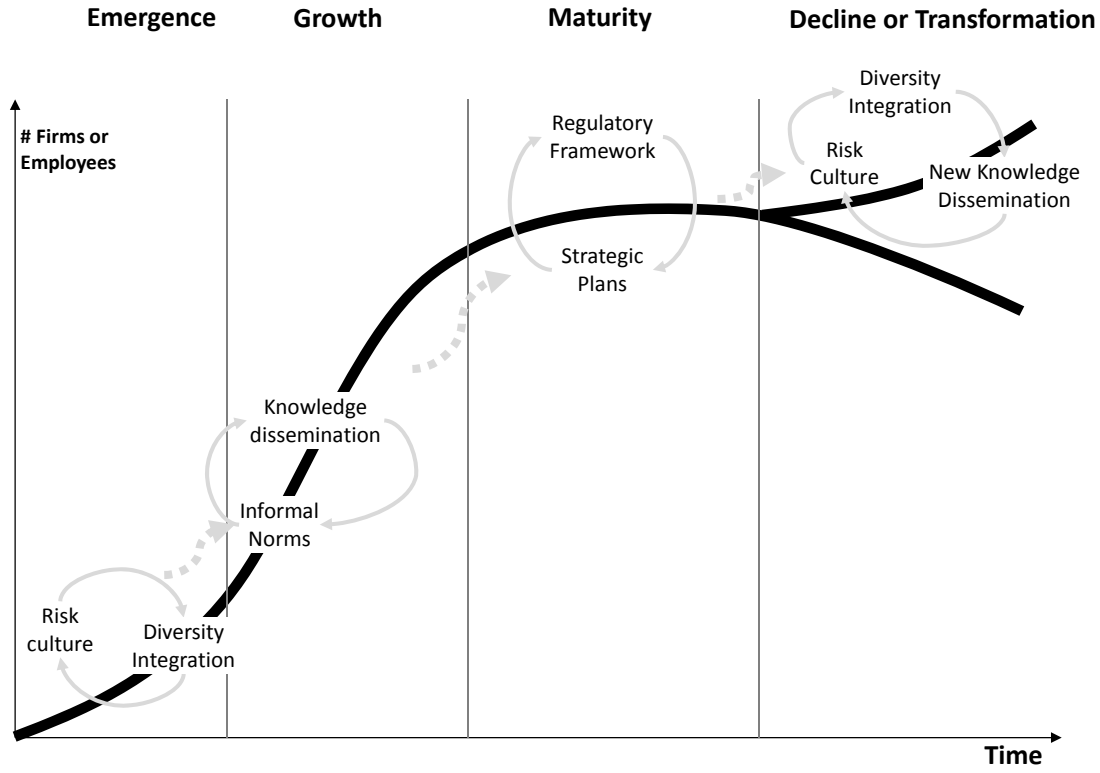
[25] For a complete RIS literature review see Navarro (2009). A typology of RIS is developed in Gibaja & Navarro (2009).

between patents issued to inventors living in the same location, which has been taken as evidence of geographically localized knowledge spillovers" and " that patent citations also occur disproportionately often in locations where the cited inventor was living prior to being issued the patent in question, which we interpret as evidence of a significant role played by social capital in promoting knowledge spillovers." In addition, the values of reciprocity and ethic of work secure a trustful environment that facilitates the sharing of information among the different agents (Noteboom, 2000). Additionally, social capital promotes deliberate actions that give rise to specific training schemes and infrastructure, both of which are critical elements of the *diamond* factor conditions (Porter, 1990), and in the intervention of public policies (Arif & Asadi, 2011). So, driven by the attitude to change, knowledge inputs are made in accordance with the cluster production needs. The role of universities, professional schools, and research centers is critical to integrating current knowledge demands with clusters' capacities in order to keep up the innovation pace (Tantau et al. 2011). In sum, it is essential to elevate the level of the local human capital (through the development of codified knowledge) along with "interpersonal networking" (McCann, 2008) in order to produce community gains.

3.4. Cluster evolutionary phases and mechanisms at work

Here the proposed framework is applied to each phase in order to verify how these different social capital mechanisms are activated and represent a source of dynamism in cluster development trajectories. Meanwhile, the activation of the different combination of facets-mechanisms schema is dependent upon the endogenous dynamic guidelines framed in the cluster life cycle stages as well as the conditions of the external scenario. It might be safe to assume that "monocausal explanations rarely succeed" (Schmitz, 1999); thus, there is no single mechanism that explains the evolution in each stage of the process. Rather, a correct explanation implies a combination of mechanisms.

Figure 3.2: Cluster evolutionary phases and mechanisms at work



Source: own elaboration.

The emergence of the clustering process is marked by the appearance of granular and disconnected groups of economic agents who are eager to obtain economic value from new and diverse business ideas and technical innovations (Ter Wal & Boschma, 2011). At this stage, traditions and historical heritage represent critical preconditions (Elola et al., 2012) in fostering the capacity of taking risks, and in the exploitation of tacit knowledge through the integration of new human and social resources. On these bases, we establish the following proposition:

P.1: Throughout the emergence of clusters, social capital is likely to activate growth by promoting risk culture and the integration of cultural diversity.

The following cluster growth is based on intense imitation and numerous spinoffs; specialization arises with the consequent achievement of economies of scale and scope. Additionally, there is a tendency to stabilize the patterns of network interactions (Ter Wal & Boschma, 2011). Here, social capital acts as a lever for promoting a trustful collaboration for knowledge transfer and dissemination, encouraging the development of formal training organizations that secure a good supply of skilled labor and the application

of informal norms (e.g. trust and reputation-based). Such actions are expected to lead to the substantial upgrading of the performance of clusters. Therefore, the following proposition is established:

P. 2: In the growth phase of clusters, social capital activates growth mechanisms such as knowledge dissemination and informal norms.

The maturity phase of clusters is characterized by stagnation in firm creation rates, stabilization of governance relations, and a rigid specialization pattern (Menzel & Fornahl, 2010). Consequently, the knowledge flows are well established and firms focus on process efficiency (Ter Wal & Boschma, 2011), which limits the assumption of risks. Therefore, community efforts are directed at making the system more stable by formalizing the regulatory framework and the compliance of international standards, and developing and implementing strategic plans that align collective shared goals and efforts. On these bases, the following proposition can be established:

P. 3: In mature clusters, social capital activates growth by means of strategic planning and regulatory framework mechanisms.

Finally, the transformation of clusters can be driven by the regeneration of the local social context (including new organizational models or the generation of new networks to avoid excessive knowledge homogeneity, i.e. cognitive proximity), the exploitation of polyvalent technologies in related industries, and the exploitation of the potential of regional science infrastructures (Bergman, 2008). Social capital-based factors help to break cluster inertia by providing a platform to spur risk adoption based on prior skills and effective links to innovation system agents, as well as through the integration of new actors in the region. On these bases, a fourth proposition can be set up:

P. 4: Social capital helps the transformation of clusters by means of activating risk culture, knowledge dissemination and cultural integration.

3.5. Conclusion

In conclusion, the core argument of this research lies in Becattini's view that the longstanding values of ethic of work, attitude to change and reciprocity provide crucial bases to interpret the development trajectories of clusters. An analytical framework was set up centered on a set of cultural, institutional and technical mechanisms activated by a given social capital, which is transformed - but always determined - at

each stage of the cluster life cycle. The novelty of this research is the attempt to contribute to the current renewed academic debate on cluster evolution by paying special attention to the proactive role of social capital.

Chapter 4. Research methods

4.1. Introduction

The thesis follows a deductive direction[26]; so, guided by the analytic scheme of the previous chapter, the empirical analysis is conducted combining qualitative and quantitative research methods.

The qualitative analysis of this thesis is composed by a comparative analysis and a case study analysis. Initially, a comparative and exploratory study of six case studies is conducted. The goal of this analysis is to validate the manifestation of the conceptual propositions as well as to gain a preliminary grasp of the operational functioning of social capital during clusters' trajectories in different macroeconomic and industry contexts. Next, a case study method is applied to explore the underlying motivations of economic agents' behavior, the development of interactive actions, and their responses to the historical and social contextual changes. The selected case is the analysis of the evolution of machine tools manufacturing firms in the Bajo Deba district in the Basque Country (North of Spain). Such district has a long historical evolution, it surpassed different evolutionary stages, and it is identified as a local production system focused on the production of metalworking technology (Larrea, 2000; Boix & Galetto, 2006; Ketels & Protsiv, 2014a,b).

The quantitative analysis is performed through a multilevel regression technique (coupled with the construction of synthetic indexes). The decision to evaluate the performance of firms comes from the NCLC literature, which notes the need to overcome biased assumptions in the treatment of clusters' composition as homogenous entities. A multilevel regression analysis is conducted to test the significance and the explanatory capacity of social capital to influence firms' performance in the Spanish machine tool industry. The application of this technique is intrinsically connected to the adoption of a community view of social capital. Taking in mind such characterization, it is necessary to deal with the operationalization problem to build representative indicators for social capital facets. This task is approached using the development of composite (or synthetic) indexes, treating a collection of different socioeconomic indicators at region-level. Finally, the indexes and the individual-level indicators (firms' characteristics) are regressed to firms' performance measures.

The objective of this chapter is to describe the research methods used to produce the empirical evidence. The chapter is divided in two sections. The next one (4.2) is dedicated to provide details about the specific practices like data collection, analysis, and validation regarding applied studies of the enquiry. Section 4.3 illustrates about conceptual and methodological limitations. Finally, some concluding remarks are presented.

[26] "Deductive direction: An approach to developing or confirming a theory that begins with abstract concepts and theoretical relationships and works toward more concrete empirical evidence." (Neuman, 2011)

4.2. Methods applied

4.2.1. Qualitative methods

Two qualitative methods are applied in the empirical part of this thesis. The first one is the development of a comparative study that has the exploratory purpose to find patterns of the conceptual approach propositions. Then, the second one, a case study analysis is applied to make an in deep inquire about the evolution of a specific cluster (machine tool production in Bajo Deba – Basque Country) along with the incidence of social capital into it. In the following, the specific tools of each technique as well as the explanation of the best practices are briefly offered.

4.2.1.a. Comparative analysis.

The comparative analysis is carried out with the purpose of exploring the presence of the conceptual propositions enunciated in the conceptual approach developed in the previous chapter.

Specifically, historical-comparative analysis is a qualitative research technique widely used in social research (Neuman, 2011) in which "two or more cases are explicitily contrasted to each other regards to specific phenomenon or along certain dimensions" (Azarian, 2011, p. 113). This method of research has advantages and disadvantages (Ibid.). Among the former, its reflexive functionality (that allows to continuously think and to find new research questions in the comparative process), the ability to discern similarities and differences, and to develop inferences of causality are mentioned. Among the disadvantages, the difficulties to generalize the results, the problems of asymmetry among cases (derived from the limited knowledge of the investigator on the specificities -historical, social, and institutional- of each context), and the lack of autonomy of the cases (there are a lot of interactions not considered in any comparative study) are considered. Within the framework of this thesis, the comparative analysis was used with an exploratory character[27] since its use responds to the need to evaluate the reasonableness of the proposed conceptual approach through the observation of propositions in the available empirical evidence. The activities were carried out between June 2014 and March 2014. The procedures are summarized in three steps: the data collection, the data analysis, and the presentation of the results.

First, the process of collecting data on the cases to be compared has been based on the consideration of three basic criteria: productive activity, location, and data availability. The cases are well documented in the literature of Regional Science and Economic Geography and thus it is possible to find sufficient information to explore studies coming from a variety of perspectives. The cases selected are: IT

[27] "Exploratory research is a research whose primary purpose is to examine a little understood issue or phenomenon and to develop preliminary ideas about it and move toward refined research questions" (Neuman, 2011)

(Silicon Valley - US), surgical instruments manufacturing (Tuttlingen - Germany), metal mechanic (Rafaela - Argentina), textile (Carpi - Italy), and machine tools (Taichung – Taiwan, and Bajo Deba – Basque Country).

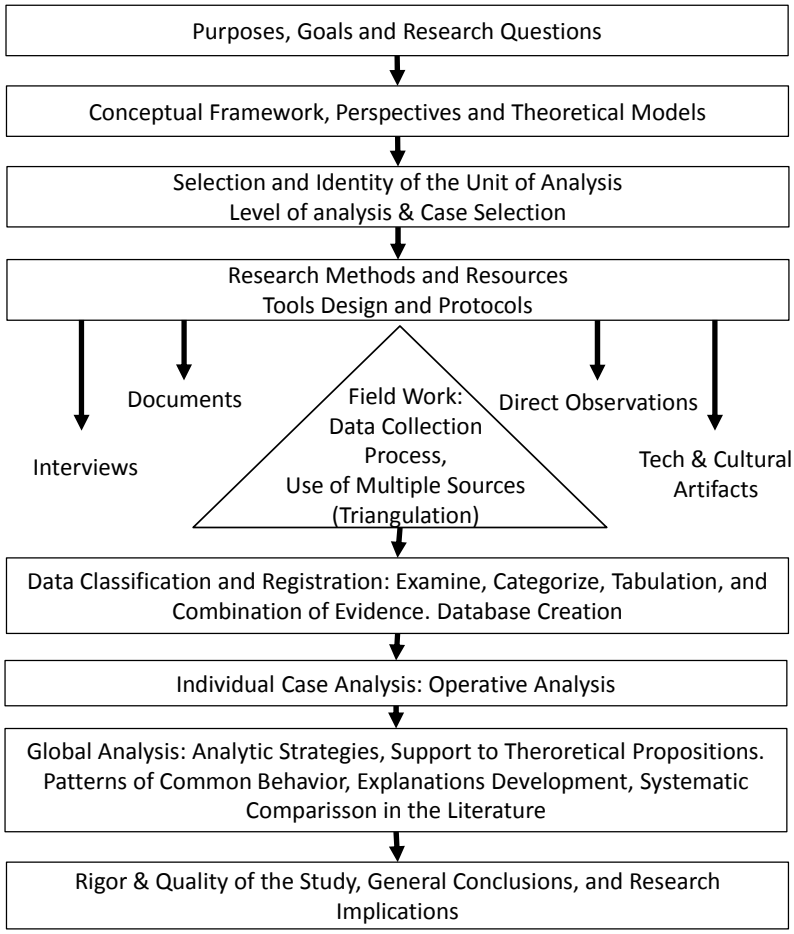
Second, the comparative analysis consists in arranging the compiled data in a systematic and homogeneous way to check the suitability of common patterns of functioning and development (Azarian, 2011). Then, the cases have been reviewed and historical stages of evolution have been established, using the time frames that have been defined in secondary sources; and within each stage, the development mechanisms are identified and interpreted which of the facets of social capital have leveraged them.

Finally, results are presented in a narrative and descriptive mode. Usually, in the comparative analysis "the main goal is to arrive at a typology based on the observed differences and similarities among cases" (Azarian, 2011) which is done through the typification of developmental patterns among clusters. One conclusion of the exploratory study is to accept the feasibility, as it is one of the purposes of exploratory research (Neuman, 2011), to research the incidence of social capital in the evolution of clusters toward an in-depth case study.

4.2.1.b. Case study

Case-study research is defined as "research that is an in-depth examination of an extensive amount of information about very few units or cases for oone period or across multiple periods of time" (Neuman, 2011). Among the advantages of this research method are highlighted: "conceptual validity" to identify critical variables and their meanings, "heuristic impact" to construct and explore new research avenues, "causal mechanisms identification" to understand the processes and the interconnections among variables, "ability to capture complexity and trace processes" to deal with difficult issues and phenomenons, "calibration" to translate intangible/abstract issues into material features of analysis, and the holistic elaboration that allows for multiple approximations of a problem (Neuman, 2011). However, some other disadvantages have been remarked such as the limitations for generalizations, the bias inferences form subjective preconceived ideas, the lack of statistical inference, and the collection of many and varied data makes difficult to integrate and interpret (Villarreal & Landeta, 2010; Monroy-Cornejo, 2009). Several authors suggest that to assure the soundness of case study outcomes is necessary to follow clear methodological guidelines in terms of data selection, systematization, and analysis (e.g. Villareal & Landeta, 2010; Yin, 2003). In this thesis, the implementation of case study research follows Villarreal and Landeta's (2010) five parts guidelines (Figure 4.1): the alignment between goals and a theoretical foundation, the selection of the unit of analysis, the choice of resources and tools for the data collection, the conversion of data into information for analysis, and the validation and communication of the case study findings. The activities were carried out between April 2014 and April 2015.

Figure 4.1: Outline of case study methodology



Source: Villarreal & Landeta (2010) based on Eisenhardt (1989), Yin (1989, 1994, 1998), Maxwell (1996, 1998), Rialp (1998), Shaw (1999), Fong (2002), Rialp et al. (2005b).

First, there are several objectives to conduct a case study such as to describe a phenomenon, to study a problem that has not been theorized, or to validate theoretical proposals (Villareal & Landeta, 2010). Also, the choice among those objectives should be aligned/linked with previous theoretical and practical developments as they are references for conceptual positioning and they help in the design of research. In this thesis, the purpose of implementing a case study focused on the Bajo Deba machine tool production is to validate of the conceptual approach developed in the previous chapter (Chapter 3).

Second, it is necessary to define the unit of analysis and the definition of the case in order to delimit the context, the situation, the agents, and the "boundaries" of the study. In this respect, the selected unit of analysis is the historical development of the machine tool cluster in the Bajo Deba (Basque Country). The reasons for choosing the case are that this geographical area has evolved as a cluster-type configuration

(Boix & Galetto, 2006; Larrea, 2000) and has witnessed a significant productive, economic, and institutional transformation in the last 100 years.

Third, the data collection task considers both primary and secondary sources. The primary data is collected through the execution of semi-structured interviews. The selection criterion for interviews is to have a representation of people who have experienced the changes, and who have been involved in this industry from different perspectives such as business chambers, training institutes, technology centers, academic researchers, local development agencies, firms. The goal is to allow the interviewees to describe in their own words, following a specific questionnaire (Annex 4.1), how evolution occurred and the reasons behind the actions taken in the historical conditions of the context. The logic of using different people benefits the assessment of the aggregation of different perspectives as well as the contextualization of the key issues in discussion (Neuman, 2011). So, 12 semi-structured interviews were carried out. Initially, a first round of semi-structured interviews with academic experts in the cluster are conducted. This helps us to test the methodological strengths and flaws in the theoretical framework and to identify the key actors to plan the next methodological step. Consequently, a second round of interviews will be pursued with firms, technological centers, and educational and governmental actors. Thus, the people interviewed included owners and ex-managers of MT producers, local historians, policy experts, training organizations' managers, and tech centre coordinators (Table 4.1). Also, direct observation of the activities and operations in business trade fairs (Bilbao) and other cluster actors is included in the research plan. The secondary data compilation includes Caja Laboral Popular annual economic reports about the Basque economy, the CCING (1987) report, different documents from the AFM (Asociación de Fabricantes de Máquinas Herramientas) and diverse statistical (EUSTAT, INE) and other academic sources.

Table 4.1: List of Interviews

#	Function	Date	Duration
1	Vocational Training Center	30/04/2014	1h 22m
2	Academic Researcher	06/05/2014	1h 03m
3	Academic Researcher	28/05/2014	31m
4	Local Economist & Ex-MT Manager	02/05/2014	59m
5	Local Historian +Ex-MT Manager	13/06/2014	2h 46m
6	Business Association	20/06/2014	38m
7	ExManager (Coop.)	23/06/2014	1h 40m
8	Owner & Manager (Private)	25/06/2014	45m
9	Tech Center	03/07/2014	35m
10	Tech Center	03/07/2014	52m
11	Local Development Agency	04/09/2014	1h 39m
12	Tech Center	08/10/2014	49m
13	Carmelo Urdangarín	Secondary sources: Estudio sobre los "Valores de la Persona Emprendedora en Debarrena" (2007) Debegesa	
14	Iñaki Alberdi		
15	Manolo Iraolagoitia		
16	Fernando Serrano		

Source: Own elaboration.

Fourth, the comments obtained from interviews are analyzed through thematic analysis (Boyatzis, 1998; Braun & Clarke, 2006). This technique of analysis consists in the evaluation of a data corpus to look for a pattern responses following a six-stage analysis suggested in Braun & Clarke (2006) (Annex 4.2). The application of this technique is of the type "theoretical", this means that it is guided by the conceptual approach (deductive), and the level of analysis is of semantic type, that is the data are organized to show content in relation to the specific interest of the researcher (Ibid.). Meanwhile, the systematization of the secondary data outline the trends in the number of firms, employment, production, exports, etc. helping to define the different phases of the Bajo Deba's cluster historical evolution. The outcome of this step is that some key themes have been identified in relation to how social capital values of work ethic, attitude to change, and reciprocity has fostered significant effects in the different stages of the district evolution.

Finally, the last phase of the case analysis has two parts: the validation of results, and the communication of results. To the validity and reliability of information, four aspects are considered: the validity of the model or constructs, the internal validity, the external validity, and the reliability (Yin, 2003; Castro-Monge, 2010). The validity of the constructs used has tried to avoid the appearance of subjective judgments in data collection. So, to avoid judgement bias, it is required to collect of diverse sources of information, to provide an adequate chain of evidence, and to present preliminary results. In this thesis, specific questionnaire has been developed trying not to bias the responses of respondents, the conceptual framework was submitted to review in different audiences, and an important amount of secondary data was collected. Regarding the internal validity, it is made a triangulation of data and opinions expressed to find similarities and differences. Thus, the patterns identified as significant (they are seen in several sources) are considered for interpretation. So, the transcripts of the interviews have been compared and they have been identified as thematic patterns that are repeated in the opinions of the different interviewees. In turn, these patterns of responses are contrasted with the secondary data available whenever possible and pertinent. the validation of the information obtained comes from the comparison of opinions in the interviews, the literature reviewed and the secondary data compiled (triangulation). Also, the external validity is partially assured as it is a single case study and there are limitations for generalization (Castro-Monge, 2010; Beebe et al. 2013). Finally, reliability refers to that if the same research procedures are followed the same results are obtained. In the regard of the presentation of the results, the case has been exposed to two research forums: the 2nd workshop "The evolution of networks, industries and clusters (ENIC)" Organised by the Universities of Kassel, Hohenheim, Hanover and the Halle Institute of Economic Research (IWH) (Halle (Saale), Germany – 13-14/11/2014), and the 55th ERSA (European Regional Science Association) Congress in the Special Session about Resilence, Crisis and innovation Dynamics (Lisbon, Portugal - 25-28/08/2015). Finally, the communication of the results in Chapter 6 is structured

through the determination of the evolutionary stages (based on bibliographic sources); then, in each phase a description of the internal processes of the cluster, the external factors, and the operation of the predominant mechanisms are presented.

4.2.2. Quantitative methods

The quantitative methods applied follows a two-step frame. The first step is committed to the construction of synthetic indexes for the Spanish regions (NUTS 2) that represents the social capital facets and mechanisms by the selection of socioeconomic indicators. Then, in a second step, a multilevel model is applied to examine the influence in firm's performance (dependent variable) of some explanatory variables such as firm-level attributes and the region-leve synthetic indexes.

4.2.2.1. Synthetic Indexes

Giving that the social capital facets & operational mechanisms used in the conceptual approach are not directly measurable, it is necessary to produce constructs that represent them. This task is addressed using the methodology of composite (or synthetic) indicators. This approach is used to "provide simple comparison of countries [or regions, provinces, individuals] that can be used to illustrate complex and sometimes elusive issues in wide-ranging fields, e.g. environment, economy, society, or technological development" (OECD, 2008) based on a set of proxy indicators (simple measures).

The construction of a composite index is not a simple aggregation of simple indicators, though, it contains some basic methodological procedures that ensure efficiency, quality and transparency for the interpretation of results (Pérez-García et al. 2008; Schuschny & Soto, 2009; OECD, 2008). In the field of Economic Geography and Regional Economics, the use of composite index is well accepted due to it helps to characterize complex dimensions of concepts as well as to provide comparative measures that support policymaking decisions. For example, others researchers have resorted to this analytical tool to represent the socioeconomic attributes of a territory that are later applied to a hierarchical data structure. For example, Fazio and Piacentino (2009), in their study of the influence of regional differences in productivity of a sample of Italian firms run a factor analysis (principal components) to compose a proxy of provincial socioeconomic status.

The advantages to use this technique are based on its ability to summarize in a single indicator a complex concept, it is easy to interpret and communicate results, therefore, it improves the effectiveness in the comparison of complex dimensions. On the other hand, the technique has also received critics: the possibility of erroneous inferences if the indicators are poorly constructed or misinterpreted, the

construction process may be non-transparent and/or lacking statistical principles, the selection of indicators and their weights may be subjective (thus, the conclusions could be erroneous if dimensions difficult to quantify are ignored) (OECD, 2008).

The methodological procedures for the construction of a composite index follow a sequential ten-step scheme of the OECD (2008). Every step is summarized in Table 4.2.

Table 4.2: OECD's ten-steps methodology

Step	Meaning	Why it is needed
1. Theoretical framework	Provides the basis for the selection and combination of variables into a meaningful composite indicator under a fitness-for-purpose principle (involvement of experts and stakeholders is envisaged at this step).	• To get a clear understanding and definition of the multidimensional phenomenon to be measured. • To structure the various sub-groups of the phenomenon (if needed). • To compile a list of selection criteria for the underlying variables, e.g.,input, output, process.
2. Data selection	Should be based on the analytical soundness, measurability, country coverage, and relevance of the indicators to the phenomenon being measured and relationship to each other. The use of proxy variables should be considered when data are scarce (involvement of experts and stakeholders is envisaged at this step).	• To check the quality of the available indicators. • To discuss the strengths and weaknesses of each selected indicator. • To create a summary table on data characteristics, e.g., availability (across country, time), source, type (hard, soft or input, output, process).
3. Imputation of missing data	Is needed in order to provide a complete dataset (e.g. by means ofsingle or multiple imputation).	• To estimate missing values. • To provide a measure of the reliability of each imputed value, so as to assess the impact of theimputation on the composite indicator results. • To discuss the presence of outliersin the dataset.
4. Multivariate analysis	Should be used to study the overall structure of the dataset, assess its suitability, and guide subsequent methodological choices (e.g., weighting, aggregation).	• To check the underlying structure of the data along the two maindimensions, namely individual indicators and countries (by means of suitable multivariate methods, e.g., principal components analysis,cluster analysis). • To identify groups of indicators or groups of countries that are statistically "similar" and provide aninterpretation of the results. • To compare the statistically determined structure of the data set to the theoretical framework and discuss possible differences.
5. Normalisation	Should be carried out to render the variables comparable.	• To select suitable normalisation procedure(s) that respect both the theoretical framework and the data properties. • To discuss the presence of outliersin the dataset as they may become unintended benchmarks. • To make scale adjustments, if necessary. • To transform highly skewedindicators, if necessary.
6. Weighting and aggregation	Should be done along the lines of the underlying theoretical framework.	• To select appropiate weighting and aggregation procedure(s) thatrespect both the theoreticalframework and the data properties. • To discuss whether correlationissues among indicators should beaccounted for. • To discuss whether compensabilityamong indicators should be allowed.
7. Uncertainty and sensitivity analysis	Should be undertaken to assess the robustness of the compositeindicator in terms of e.g., the mechanism for including or excludingan indicator, the normalisation scheme, the imputation of missingdata, the choice of weights, the aggregation method.	• To consider a multi-modelling approach to build the compositen indicator, and if available, alternative conceptual scenarios for the selection of the underlying indicators. • To identify all possible sources of uncertainty in the development of the composite indicator and accompany the composite scores and ranks with uncertainty bounds. • To conduct sensitivity analysis of the inference (assumptions) and determine what sources of uncertainty are more influential in the scores and/or ranks.
8. Back to the data	Is needed to reveal the main drivers for an overall good or bad performance. Transparency is primordial to good analysis and policymaking.	• To profile country performance at the indicator level so as to reveal what is driving the composite indicator results. • To check for correlation and causality (if possible). • To identify if the composite indicator results are overly dominated by few indicators and to explain the relative importance of the sub-components
9. Links to other indicators	Should be made to correlate the composite indicator (or its dimensions) with existing (simple or composite) indicators as well as to identify linkages through regressions.	• To correlate the composite indicator with other relevant measures, taking into consideration the results of sensitivity analysis. • To develop data-driven narratives based on the results.
10. Visualisation of the results	Should receive proper attention, given that the visualisation can influence (or help to enhance) interpretability	• To identify a coherent set of presentational tools for the targeted audience. • To select the visualisation technique which communicates the most information. • To present the composite indicator results in a clear and accurate manner.

Source: OECD (2008).

Within the framework of this thesis, the OECD (2008) guidelines have been followed for the construction of three indexes representative of the facets of social capital, which are then added into an indicator of social capital, and six indexes of the operative mechanisms mentioned in the conceptual approach. The territorial area to construct the indexes is the Spanish regions (i.e. autonomous communities), this choice is aligned with a perspective of social capital as multidimensional and community-driven. An extensive database containing different socio-economic indicators has been compiled (Annex 7.1). Subsequently, these individual indicators were assigned to different conceptual units (facets and mechanisms) based on antecedents in social capital theory, and a process of discussion, selection, and analysis with the supervisors.

The synthetic indicators for the social capital and the operating mechanisms which will be later applied to test their influence, in combination with other certain individual characteristics, on the performance of firms.

4.2.2.2. Multilevel regression analysis (MLM)[28]

Multilevel models are applied when the interest is focused on distinguishing the complex effects of context (location, groups, etc.), and its interaction with individual characteristics to determine individual outcomes (e.g. pupils, firms, etc.). The key issue is that it is expected that individuals (or firms) should have similar behavior and performance to others located in the same group of location. So, this means that "in the real world, data are often hirarchical" (Field, 2009). Statistically, in this technique the same assumptions as in the ordinary least squares (OLS) regression[29] apply. Though, the MLM is considered an improvement from classical regression in terms of prediction, data reduction and causal inference (Gelman, 2006; Kline, 2011; Heck, Thomas, & Tabata, 2014). This means that MLM helps to "cast aside the assumption of the homogenity of slopes", to manage the "assumption of the independence [of the residual errors] and manage missing data" (Field, 2009). Another benefit of this technique is that it allows to deal with validation drawbacks mentioned in the Regional Science literature, such as the ecological fallacy (i.e. when "takes the estimate obtained of grouped data and uses it to infer an individual level relationship": Haining, 2003: Beujelsdijk, 2007), and the atomistic fallacy (i.e. "drawing inferences regarding variability across groups based on individual level data": Diez-Roux, 2002). These techniques also have limitations such as the reliability of individual and group explanatory variables, and difficulties in model configuration to "specify a

[28] This is a summary of many authors such as Hox, 2002; Kreft & De Leeuw, 1998; Heck, Thomas & Tabata, 2014; Field, 2009; Haynes, 2006, Ringdal, 2013; Albright & Marinova, 2010; Andreu-Abela, 2011; Oliver et al. 2000 among others).
[29] "The residuals should have a mean (expected value) of zero in the population. The residuals should have equal variance for subgroups of all x-variables (homoscedasticity). The residuals are uncorrelated with each other and with the x-variables. The residuals should be normally distributed. The x-variables should not be perfectly correlated, pairwise or group-wise (no multicollinearity)" (Ringdal, 2013: http://essedunet.nsd.uib.no/cms/topics/multilevel/)

measurement model", to discriminate between direct and indirect effects (Kline, 2011), and to communicate the results (Aparicio-Llanos & Morera-Salas, 2007). Also, there is concern about the multilevel view as it may entail an endogeneity problem which is a common problem in economic geography studies. This is related to the difficulties to infer the causal direction from the context effects to the individual agents; however, sometimes the attributed effects of the context may result from actions of agents/firms that make up a "spatial selection process" (Raspe, 2009).

In the field of Economic Geography and Regional Science, the use of this analytical tool is increasing (Vanoutrive & Parenti, 2008). The hierarchical condition is framed into the so-called "dilemma between individuality and context" (or multilevel approach) which contains three distinctive concerns (Raspe, 2009): the analysis heterogeneity between individuals (firms in this case), the consideration of differences between context factors (territories in this case), and the attention to the interaction between individual determinants and the context factors. However, the technique offers adequate possibilities for measuring the effects of contextual conditions, which are widely considered in different theoretical perspectives to influence the economic performance of micro-level units. In addition, in this field of study it is important to emphasize the use of spatial econometrics techniques as a way to deal with the "spatial dependence in observations" (Sleutjes et al. 2012). According to Venoutrive & Parenti (2008), both techniques produce consistent results.

Table 4.4 presents examples of the use of MLM technique in Regional Economics. Fazio & Piacentino (2009), by means of a Cobb-Douglas function, estimate the determinants of productivity in Italian SMEs using as explanatory variables firm-level capital intensity and a latent construct of the territorial socio-economic indicator (province-level). Kahl & Hundt (2015) test the resilience (employment growth) in 266 German biotech firms before and after the crisis years framing context-related variables at network and regional level. In the Spanish background, Ruiz Fuensanta (2010) evaluate productivity differences derived from clusters' location in a sample of 2600 firms of Castilla-La Mancha Region. Meanwhile, other studies are focused in the evaluation of the spatial implications of the innovation performance of firms (e.g. Srholec, 2010; Zuluaga-Jimenez et al. 2012; Aartstad et al. 2016). So, based on the national surveys of innovation they examine the influence of knowledge related regional characteristics (e.g. I&D expenditures, I&D intensity, I&D networks, etc,).

A common feature in these studies is the relatively low incidence of regional factors. However, this fact does not invalidate the conceptual approaches that emphasize the importance of territorial factors, since in terms of innovation and performance the reality is that the effects of agglomeration are in place (Beugelsdijk, 2007). Among the drawbacks of using this technique have been mentioned the complexities in terms of "highly demanding on the scale, scope, and quality of data" for the validity in interpreting the results (Scrolec, 2010).

Table 4.3: Resume of Selected Studies using Multilevel Analysis in Economic Geography

Author(s)	Title	Source	Focus of Analysis	Sample	Model	Level 1 Variables	Level 2 Variables	Findings
Fazio & Piacentino (2009)	A spatial multilevel analysis of Italian SMEs Productivity	Spatial Economic Analysis 5(3) 299-316	Spatial variability of SMEs productivity across the Italian territory	Sample of 7097 Italian manufacturing firms	Linear Hierarchical Model (several configurations) / Cobb-Douglas production function	**Dependent**: Output per worker **Independent**: Capital stock per employee (one-year lag)	Synthetic indicator of socioeconomic territorial context (	Social decay has the expected negative impact, but effects depends on size of the firms
Aarstad, Kvitastein & Jacobsen (2016)	Related and unrelated variety as regional drivers of enterprise productivity and innovation: A multilevel study	Research Policy 45 844-856	Evaluation of the influence of regional characteristics (concepts of related and unrelated variety) to affect firms' productivity and innovation	6595 firms in Norway / Survey "Innovation in the enterprise sector, 2010" by Statistics Norway	Linear Hierarchical Model / Logistic regression	**Dependent**: Productivity (Sales / Employment) / Innovation (dummy) **Independent**: Multidivisional Enterprises (dummy) / Size / R&D intensity	89 economic-geographical regions in Norway (Statistcs Norway) -Population Density -Unrelated industrial variety -Related industrial variety	Related variety positive driver for innovation / Unrealted variety negative driver for productivity
Kahl & Hundt (2015)	Employment performance in times of crisis	Competitiveness Review 25(4) 371-391	Determinants of economic resilience at regional clustering level	266 biotechnology firms in Germany / 2007-2010	Linear Hierarchical Model (several configurations)	**Dependent**: Employment Performance (resilience) **Independent**: Network related variables (5)	NUTS-2: regions: Concentration / Density	Differentiated effects of specialization and diversity before and after the crisis
Raspe (2009)	Firm Performance in Knowledge Regions	The Regional Knowledge Economy: A Multilevel Perspective on Firm Performance (Doctoral Thesis)	Influence of spatial knowledge and learning characteristics on firms' performance	2.009 manufacturing and business service firms in 2005 (Netherland)	Linear Hierarchical Model (several configurations)	**Dependent**: Labor Productivity **Independent**: Size / Age / Sector (dummies) / Products specifics / % jobs consulting / % physical contacts / % ICT contacts	Municipalities: Localization economies (4 types) / Urbanization economies (density indicator) / Jacob's externalities (Gini) / Regional Growth / Knowledeg-related externalities (Knowledge workers / R&D / Innovativeness: Factors Analysis)	Context-level factors have importance but it is minor in comparisson with firm-level attributes
Ruiz Fuensanta (2009)	Influence of district external economies on firm productivity: a multilevel approach	Investigaciones Regionales 18, pp.61-82	Productivity of firms located in industrial districts	1.968 manufacturing firms in 45 industrial districts the Spanish region of Castilla-La Mancha	/ Cobb-Douglas production function	**Dependent**: Labor Productivity **Independent**: Capital Stock / Stock I+D / Size / Age / Leverage	Three classic Marshallian sources of external economies: economies	District external economies explain a large amount of the between-districts variation in labour productivity.
Srholec (2010)	A Multilevel Approach to Geography of Innovation	Regional Studies 44,9, pp.1207-1220	Influence of regional innovation systems on firms 'innovation behavior	3801 industrial & services firms in Czech Republic 1999-2001 (Innovation activities survey from Czech Statistical Office)	Binomial Model (logit transformation)	**Dependent**: intruduction of new product or process (dummy) **Independent**: Size / Age / Ownership (dummy: foreign or local) / Sector (dummy: industry or services)	Region: NUTS-4 77 regions RIS / Unemployment / Crime (Factor Analysis)	Firm-level attributes and context variables matters for innovation & localized learning. Also, some firm-level incidence is affected by regional factors. RIS more important for small firms.
Zuluaga-Jimenez et al (2012)	Ambiente regional y desempeño innovador de las firmas. Una propuesta de análisis multinivel	Estudios Gerenciales, Vol. 28, edición especial, 169-189	Effects of regional context on the innovation performance of firms	6.670 manufacturing firms in Colombia 2003-2004 (Second Survey: Innov. & Development - EDIT II)	Multilevel Poisson	**Dependent**: number of product innovation weighted by objectives (Count) **Independent**: Formal Networks part. / Informal Networks part. / Internal Coord. Innov / I&D Investment / Size / # Technical Employees / # Proffes. Employees	Region: GDPpc / # graduate scholars / I&D Investment / # superior education institutions / # active researchers / Exports	Partially confirm that regional variables has direct influence on firms' innovation.

Source: Own elaboration.

According to the review of Dedrick et al. (2008) there are four basic methodological issues of MLM technique: model development and specification, data considerations, estimation procedures, and hypothesis testing and statistical inference. These aspects are briefly explained in the following.

Model development and specification. This technique works with hierarchical data sets in which one dependent variable measured at the lower level (e.g. firm, student, etc.) is regressed over a set of explanatory variables at same level and at higher levels of aggregation. In the MLM, it is determined fixed effects (intercepts and slopes) and random effects which means "wheter intercepts and slopes vary across groups: variances" (Heck, 2011).

A database for multilevel analysis has a hierarchical nature composed by i Level-1 agents and j Level-2 groups. The goal of the technique is to examine the behavior of a Level-1 dependent variable (Y_{ij}) at as a function of some Level-1 and some Level-2 explanatory variables.

At Level-1 the following equation is defined:

$$Y_{ij} = \beta_{0j} + \beta_{1j}X_{ij} + e_{ij}$$

where i= 1,…, n (i: agents); j=1,…,n (j: groups); and e=agent-level error residuals which is assumed that are normally distributed with constant variance. The existence of the subscript j indicates that each group has its own intersection (β_{0j}) and slope (β_{1j}). This issue is the major feature of multilevel models. So, (β_{0j}) and (β_{1j}) are not interpreted as fixed parameters like in OLS, but as values that can change from within groups.

At Level-2, the coefficients (intercepts and slopes) of Llevel-1 are regressed by Level-2 attributes:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}Z_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}Z_j + u_{1j}$$

So, both parameters (β_{0j} and β_{1j}) have a fixed or systemic component (γ_{00} and γ_{10} respectively), and a random component (u_{0j} and u_{1j}). In particular, γ_{00} is mean value of the response variable for the entire sample, and γ_{10} is the shows the variability of each group from the sample mean. Meanwhile, (γ_{10}) is the mean slope in the relation of X and the response variable Y, and (u_{1j}) is the variability in the slopes among the different groups. It is assumed that (γ_{00}) and (u_{0j}) are independent as well as (γ_{10}) and (u_{1j}). But between (β_{0j}) and (β_{1j}) is not assumed independence and their relation are given by:

$$\rho\,(\beta_{0j}\,,\,\beta_{1j}) = cov\,(\beta_{0j}\,,\,\beta_{1j}) \,/\, (\sigma_{u0}\sigma_{u1})$$

Then, replacing Level-2 equations into the Level-1 functional form, the combined model is set as:

$$Y_{ij} = \gamma_{00} + \gamma_{01}Z_j + \gamma_{10}\,X_{ij} + \gamma_{11}\,X_{ij}\,Z_j + u_{0j} + u_{0j}\,X_{ij} + e_{ij}$$

Where γ_{00}, γ_{10}, and γ_{01} are the fixed coefficients, and $\gamma_{00} + \gamma_{01}Z_j + \gamma_{10}\,X_{ij} + \gamma_{11}\,X_{ij}\,Z_j$ is the fixed part of the model. Meanwhile, $u_{0j} + u_{0j}\,X_{ij} + e_{ij}$ is the random part of the model. Into this setting is not possible to assume independence among the residuals and equality of variance among the groups.

Selection of predictors. The explanatory variables of first level are selected according to common use in corporate finance and industrial economics. Thus, age, size, leverage, exports are key features to

delineate the characteristics of the firms. The second-level variables, which is the core of our conceptual interest, are developed by means of synthetic indicators

Centering: Certain variables need to be centered in order "to obtain common metrics and to ascertain that the regression constant is interpretable" (Ringdal, 2013). So, grand-mean-centering procedure is performed by subtracting the sample mean to each value. The variables that are centered in this research are: age, size, leverage, and the indexes of mechanisms and social capital.

Covariance structure. The "covariance structure specifies the form of the variance-covariance matrix (a matrix in which the diagonal elements are variances and the off-diagonal elements are cavariances)" (Field, 2009). One major advantage of the MLM is that it "allows the variance and covariance components to be partitioned across the levels of the data" (O'Dwyer & Parker, 2014). Así, una de las ventajas de la MLM es que se evita el sesgo debido a la influencia de los grupos en la OLS común.

Fit indices. There are some important statistical indicators that measure the statistical fitting significance of the model; thus, they help to compara and select models: a) Deviance indicators such as the -2 log likelihood (-2LL) which has not a direct interpretation but it helps to compare subsequent models to the "null" model. The difference among two models is tested the variance gaining by the chi-square distribution with degrees of freedom the number of parameters in which the two models differ. The null hypothesis for the test is that the variance of the random intercept components is zero. B) Interclass Correlation Coefficient (ICC). This statistic measure the percentage of the variance in the outcome variable (dependent variable) explained by context-level random effect. Then, 1- ρ is the percentage of variance attributable to firms. The ICC is calculated as:

$\rho = \tau^{00} / (\tau^{00} + \sigma^2)$ being τ^{00}=variance of u_{0j} and σ^2=variance of e_{ij}

Data considerations. In the context of this thesis, the nature of the conceptual approach implies a hard work of *data collection* and there are many difficulties in compiling a longitudinal database. Boschma and Frenken (2006) mention that "one needs to collect time-series data of evolving populations, be it from technologies, sectors, networks, cities or regions, and to apply appropriate methodologies to analyze the data collected". The source of information about firm-specific data comes from the SABI database.

Missing data & outliers. The firm-level database is managed to select cases that met some criteria such as if the date of creation is before 2008, if that until 2013 has an "Active" status, and if it has available data (Annex 4.3). Also, to avoid biased results the continuous dependent variables are analyzed and extreme cases are dropped if the value of the variable does not in the range of ± 2.2 times the Interquartile Range (IQR) ± the percentile 75 and 25 respectively. The second-level variables do not present missing data.

Estimation procedures. The estimation is conducted with the SPSS Mixed and Generalized Linear Model (GLMM) procedure and calculated random intercept models using REML (Residual maximun Likelihood Estimation)

Finally, the MLM technique is complex, but popular, and it has been identified some "misuse and confusion" due to the heterogeneity of its implementation (Dedrick et al. 2008). So, it is important to provide detailed explanations about the procedures performed to improve the evaluation and proper interpretation of the results for external reviewers and readers. Dedrick et al. (2008) provide 7 reporting guidelines to show results in MLM analysis:

1. Clear description of the procedures implemented (process selection of explanatory variables, structure of covariance choice, and "statement of how many models were examined").
2. Details of in the use of centering.
3. Specification checks and management of outliers.
4. Clear description of data collection and selection (missing values and their potential effects).
5. Methods of analysis (method of estimation, convergence attainment, admission of variance, software used).
6. Complete list of all parameter estimates.
7. Standard errors or confidence intervals of estimates.

4.3. Limitations and conclusions

The proposed research has limitations that may affect the validity (i.e., internal or external) of its outcomes. First, there are conceptual concerns derived from implicit assumptions and operationalization of the concepts. Second, some data restrictions impede the appropriate development of a complete database to test the propositions. Third, there are methodological restrictions that should be taken into account with regard to some inferences.

There are some conceptual limitations due to most of the concepts adopted in this research have been criticized for their ambiguity regarding their conceptual definitions. In the case of social capital, its use and operationalization has been wide and very heterogenous (Staber, 2007; Van Deth, 2003; Malecki, 2012).

All the empirical evaluations conducted have limitations on the collection and classification of the data. For example, the comparative analysis, although of an exploratory character, because we are working with secondary sources, the heterogeneity of the objectives when implementing the case study analysis precludes the possibility of having structured and homogeneous data. The case study encounters limitations based upon the availability or lack of time and resources to conduct interviews. In turn, a common limitation mentioned in the literature about this type of long-term analysis is the presence of bias within interviews as we are asking about issues from the past. Finally, the quantitative analysis is limited to the most recent time periods due to lack of appropriate longitudinal data to quantitatively evaluate a complete evolutionary frame.

Finally, there are methodological restrictions which are important to mention. Despite the advantages of the case study research method, Yin (2003) recognizes that there are some concerns regarding this research strategy, including lack of rigor -problems of systematization mentioned in Yin (2003) and in Villarreal and Landeta (2010)-, little basis for scientific generalizations, and that they are too long to be readable. The risks assumed with this methodological choice (i.e. single case study) are the possibility of "misrepresentation", failure in data collection, and limited external validity (Yin, 2003; Villarreal and Landeta, 2010). Then, some causal connections and propositions that we make in terms of direction of influence and time of effect could be criticized. As a matter of the quantitive techniques applied as it was mentioned before the synthetic indexes have been criticized due to the possibility of misinterpretation of the outcomes. The MLM regression presents the limitation of the number of groups (Ringdal, 2013).

Chapter 5. Exploratory analysis of social capital & cluster trajectories

5.1. Introduction

Based on Becattini's (1990) social drivers of ethic of work, the attitude to change and reciprocity as means to reinforce the effective working of some critical mechanisms a conceptual approach on the evolution of clusters was developed. The challenge of this chapter is to explore if those propositions can be observed in the trajectories of some clusters, using a qualitative comparative technique.

The goal of this chapter is to explore the validity of the conceptual framework, which establishes certain propositions regarding the proactive role of social capital for regional development by means of activating various critical mechanisms of growth through the different stages of the cluster life cycle. The chapter is organized into three sections. The second section includes a review of the methodology and the data used. Subsequently, the results of the comparative analysis are presented. The cases were categorized into three typological groups that arise from common evolutionary traits. An ongoing discussion of these results is proposed in the final section.

5.2. Method and data

The aim of this chapter is accomplished through an exploratory analysis of the different working mechanisms activation using a comparative method. The use of this methodology requires an adequate definition of its scope for research purposes. Firstly, the exploratory character is in line with the argument that the comparative method in social sciences has a "reflective function", an arguably critical advantage to understanding the operation of the basic guidelines of a conceptual framework (Azarian, 2011). Secondly, in the case of the clusters' evolution studies, an added value of the advantages of the comparative analysis is reinforced by the possibility to incorporate life cycle stages concerns (Bergman, 2008).

There are certain requirements for the implementation and process development of a comparative analysis to be executed. Then, the development of a comparative analysis involves three basic steps: selection of cases, data collection, and data analysis. First, we have selected six case studies from a few international well-known clusters. The first of these criteria relates to cultural and historical differences in the places where they are located. Secondly, with the basic intent of avoiding biased conclusions, our focus includes cases from developed economies, as well as select economies in developing economies. Such a constitution aims to achieve a significant geographical dispersion. Thirdly, the cases include a variety of productive activities including ICT, Machine Tool, Metalworking, Textile and Surgical Instruments. The basic criteria of selection include profiles coming from different historic, economic, and industrial backgrounds. The six cases are: Silicon Valley (USA), Taichung (Taiwan), Carpi (Italy), Rafaela (Argentina), Bajo Deba

(Basque Country), and Tuttlingen (Germany). Then, data collection was restricted to the collection of academic papers or books related to the evolutionary activities of those cases. Additionally, it is worth noting that the availability of relevant data and studies that allow for comparison has also been an important factor in the selection of cases. Finally, data analysis procedures are directed at exploring the similarities and divergences in the way that social capital (and its specific mechanisms) affects the structural changes that these clusters underwent since their inception.

Table 5.1: Cases Overview

Industry	Name (City)	Region (Country)	Size (# firms)	Employment (# workers)
ICT	Sillicon Valley	California (USA)	7.000	500.000
Machine Tool	Taichung	Central Taiwan (Taiwan)	1.500 manufacturers 10.000 satellite	
	Bajo Deba	Basque Country (Spain)	105	5.600
Metalworking	Rafaela	Santa Fe (Argentina)	500	8.700
Textile	Carpi	Emilia-Romagna (Italy)	1.900	10.850
Surgical Instruments	Tuttlingen	South (Germany)	500 manufactures 200 subcontractors	7.500

Source: Several authors.

5.3. Results

The selected clusters are grouped depending upon their current development stage. Three groups are considered: those that continue to grow at a good pace, those that are going through a phase of maturity, and those that have renewed their competitive capabilities. First, clusters which are in an ongoing growth process, such as the software industry clusters of Silicon Valley (USA) and the machine-tool industry of Taichung (Taiwan). Second, mature clusters such as the metal-mechanic cluster of Rafaela (Argentina) and the textile cluster of Carpi (Italy). And third, clusters that have been able to transform as in the case of the machine-tool cluster in the Basque Country, Spain, and the surgical instruments cluster of Tuttlingen, Germany. In the following the

1st Group: Prolonged-Growth

Case 1. Taichung

Taiwan's machine-tool industry emergence in the 1940s was historically associated to local mechanics that started to use skills obtained during the Japanese colonial period to satisfy local demand (Chen, 2009). Until the 1950s, there were small family units of production grounded in a Chinese style of *risk culture* inclined to "autocratic patriarchal management, fast response to changing market niches and overseas family connections (guanxi)" (Hobday, 2002). Importantly, a strong entrepreneurial impulse to be one's own boss is another important cultural feature identified in relevant studies (Desai, Lautier & Chayra, 1999; Hobday, 2002). Accordingly, the *risk financing* mechanism was also grounded in family relations as they "relied on profits for investments, and when profits were not enough, they turned to close groups of kin of family for funds" (Desai et al. 1999).

From 1976 to the mid-1990s, the cluster experienced an impressive five-fold growth in the number of firms[30] (Brookfield, 2008). High spin-off rates (promoted by the intense local entrepreneurial culture) and an intense subcontracting activity helped to promote *knowledge dissemination* (Yeh and Chen, 2003; Chen, 2009). For instance, in the early 1980s two new enterprises, owned by managers who worked before for the pioneer companies, were among the first to produce numerically-controlled machines; they also introduced a new outsourcing model based on subcontracting which led to sharp cost reductions (Otsuka 2006). In addition, Yeh and Chang (2003) observe that long-term commitment between core plants and subcontracting firms are based on reciprocal interactions within personal networks (e.g. Victor Taichung, one of the pioneer and biggest company in the cluster, has relations with ten satellite plants owned by former employees). Technological networks (e.g. projects with innovation agents to address technological concerns), as well as informational (e.g. information systems that satellite plants have access to in order to learn the core manufacturer demand and needs), and financial (e.g. incentives for compliance) interactions were also observed in this phase (Yeh and Chang, 2003).

Regarding the *learning infrastructure,* the deficiencies in the links between businesses and Taiwan academic system were known (i.e. due to its "theory-oriented nature"). Efforts to solve such problems included on-the-job training and government initiatives to encourage professors to develop technologies jointly with businesses. For instance, a number of joint projects between the Tonghai University and machine-tool firms for technology transfer and guidance were developed. Additionally, due to the increasing quality of life, there were difficulties in recruiting skilled employees, therefore, "Taiwan's machine-tool plants proactively engaged in co-operative programs with local schools, with the hope to

[30]Chen (2009) shows that the value of production in 1969 was USS 9 million and in 2006 was USS 3.7 billion.

attract graduated students“ (Yeh & Chang, 2003). *Informal norms* were also at work, thus business practices rarely led to the establishment of written contracts. An example of reciprocal informal practices is the mutual help subcontractors gave to one another to achieve delivery deadlines or to solve technological problems (Yeh & Chang, 2003).

This growing cluster is still comprised of many small-scale firms (Brookfield, 2008; Chen, 2009) led by local businessmen. Chen & Lin (2012) report that geographical concentration still has a positive influence for the adjustment and coordination of firms' behavior. Notwithstanding the high dependence on macroeconomic changes and constraints, the cluster has been able to maintain high growth figures. In 2011, Taiwan occupies the third position in the export of machine tools in the world and it has maintained its reputation thanks to its capacity to "efficiently and flexibly manufacture low-cost but good quality MT products" (Chen & Lin, 2012). Such capacities enable the cluster to delay its own entry in the maturity phase.

Case 2. Silicon Valley

This case is portrayed as the exemplary case of the positive effects of clustering and adaptation to changes of technological paradigms. According to several authors, two critical elements contribute to the emergence of the semiconductor industry in the 1950s and 1960s: the military spending in strategic industries (i.e. telecommunications), and the relevant university-based research (Leslie, 2000; Sturgeon, 2000, Saxenian, 1996). The *risk culture* that promotes the commercial exploitation of novel scientific research is rooted in the influence of Stanford University on business incubation efforts. For instance, such a synergetic environment allowed the development of Shockley Semiconductors and, later on, Fairchild Semiconductors with its 'family tree' of 129 spin-offs (Ritcher, 2006). In terms of *risk financing,* Kenney & Florida (2000) stress the parallel development of the venture capitalist industry in Silicon Valley. This concept was developed by Arthur Rock who, in 1957, financed one of the first successful Silicon Valley firms when scientists (one of them using family connections to contact Rock) left Shockley Labs to create Fairchild Semiconductor (Ritcher, 2006). According to Kenney & Florida (2000), the organic development of venture capital in Silicon Valley driven by a "combination of division and incessant networking process" is a distinguished path-dependent feature of the evolution of this cluster. A constructive, 'generative dance' between financiers and entrepreneurs facilitates a virtuous process of growth. Simultaneously, the positive role played by the *integration* of people from different cultures (mostly Indians and Chinese) endowed with relevant knowledge pools (Saxenian, 1994) is also noted.

In a following phase, the cluster continuous growth was (and is) based upon the capacities and abilities of its agents to adapt their business practices to changing technological patterns (e.g. personal

computers in the 1980s, Internet in the 1990s, smartphones and tablets in the 2000s). Even though, it was affected in the late 1980s by the semiconductors crisis, the cluster was able to create 150.000 new technological jobs between 1975 and 1990 (Saxenian, 1996). Within this context, *knowledge dissemination* is promoted. An open attitude toward informal sharing of knowledge and a high level of labor mobility reinforce the network strength (Saxenian, 1996; Ritcher, 2006). For instance, a 1987 survey on labor mobility in Silicon Valley established a pattern of hiring experienced workers which provided the new start-ups with novel technological knowledge as well as with the flexibility to adopt relevant changes (Angel, 2000). In addition, Angel stresses that labor mobility is also supported by "informal contacts and collaborations among workers…across the borders of individual firms" in "a local industrial culture in which the allegiance of engineers and scientists is not so much to any individual firm but to the production complex as a whole". Similarly, Saxenian (2000) mentions the presence in Silicon Valley of inter-firm networks that produce a decentralized system of production that is based on "long-standing traditions of informal information exchange, interfirm mobility and networking". As mentioned before, a huge part of the cluster cultural character is still assigned to the proximity and interaction with advanced *learning infrastructure,* such as the universities of Stanford and Berkeley. They provide the businesses with the high design, engineering and marketing knowledge capabilities that help to maintain this cluster in an ongoing expansion process.

These two cases represent clusters that have been successful at developing and maintaining solid competitive advantages. Specifically, they show high capacities to adapt to the increasing global competition through constant upgrading of products, processes, and technology (e.g. Taichung), and through dynamic responses to waves of technological innovation (e.g. Silicon Valley). However, in both cases, the aforementioned mechanisms of social capital have also been active and have helped these clusters to maintain their social and economic dynamism and competitiveness.

2nd Group: Mature Clusters

Case 3. Carpi

The emergence of this Tuscan cluster is a commendable example of a cluster that grew out of a tradition of craft knowledge, based on the early production of hats. Later, local firms moved to the manufacture of artisan sweaters and ready-to-use shirts. After WW II, an impressive growth of firms was experienced; in 1965 there were already 89 shirt and 138 knitwear factories (Mariotti & Ziriula, 2008). A family-business' model led to the creation of an ecosystem of related industries through further division

and specialization of labor within the district, and with the emergence of additional entrepreneurial initiatives such as trading, hammering, and ironing (Mariotti & Ziriulia, 2008). The small scale of businesses implied low capital requirements (Ibid.), often funded through family finance. The growing demand for a labor force was managed by subcontracting work in neighboring communities and promoting migrations from southern Italy in a way that allowed a good integration of cultural diversity between these new people and existing communities[31].

During the 1960s and 1970s, Carpi showed a strong employment creation, i.e. from 6,400 employees in 1961 to 15,000 in 1981 (Bigarelli & Solinas, 2003). In a context of specialized SMEs, close social relations among them encouraged an intense *knowledge dissemination* that was even furthered by the growing subcontracting network (Mariotti & Ziriula, 2008). The '*learning infrastructure*' mechanism is associated to an adequate combination of private and public collaborative efforts in the Emilia-Romagna region (Larrea et al., 2007). Examples of this are the regional technology agency Aster, which has "the aim to sustain, coordinate and valorize research and technology transfer throughout the territory". The textile association of local firms CITER (1980) also provides key information inputs about fashion trends, markets evolution, technological advances and sub-contractors accessibility (Clara, 1999). Carpiformazione is a public organization that organizes training courses, research and learning activities since the 1980s. Every year, approximately 300 firms support training initiatives (Mariotti & Ziriula, 2008).

Since the mid-1980s, the district showed a declining trend in the number of firms and employees (from 2,258 firms and 14,005 in 1990 to 1,158 firms and 7,278 employees in 2006), though the turnover was maintained (Bigarelli & Solinas, 2003). Stronger global competition and changes in technology were approached through *strategic planning* focused on the promotion of product differentiation and the identification of new market niches. For instance, a new model of business organization, called Pronto-Moda, was also developed. It was based on effective partnership focused on achieving decreased times in production together with strong marketing campaign aimed at generating additional demand. These efforts have helped the cluster to sustain global competition and go through the hard maturity stage.

Currently, this cluster shows the importance of the *diversity Integration* mechanism, which might represent a lever for the much needed cluster transformation. According to Barberis & Aureli (2010), the growing presence of Chinese entrepreneurs in the textile and clothing sector in the area is an important issue to consider. As a consequence, changes in the social composition open a debate on the importance of promoting the absorption of different and novel human and social capital resources that challenge - but also enrich - the local set of practices, norms and values (Parrilli, 2012). These foreign cultures might contribute their work attitude that serves to guarantee skilled labor supply in a context in which a failure in

[31]"the persisting success of some Italian districts since the last war is partly explained by their strong capacity of assimilation, and by the fact that - at least at the outset - immigration was a short distance phenomenon." (Becattini, 1990)

the transmission of social capital values is led by the "changing attitudes of young Italians to manual work" (Dei Ottati, 2009). These cultures also introduce new practices (e.g. irregular or semi irregular labor), and thereby change the former district identity (Bigarelli & Solinas, 2003). According to Parrilli (2004), within the current transformation of Italian IDs, it is important to understand new necessary forms of cooperation and joint actions that can be activated "to coagulate people [new waves of immigration] and SMEs around shared and complementary objectives." These represent the new challenge for ID economic systems (and clusters) and a new borderline issue between competitive and declining IDs".

Case 4. Rafaela

This case presents an example of a regional development which lacked previous artisan capabilities, but where the *risk culture* mechanism still triggered intense entrepreneurship. In particular, migration flows based on a *cultural diversity* mix of Swiss-German and Piedmont origins, in 1880-1930, introduced a strict ethic of responsible work accompanied by a desire to achieve a better collective quality of life (Tonon, 2011). From an almost inexistent industrial platform, 35 metal-mechanic factories opened up in the city in the 1960s (Quintar et al., 1993). The emergence of these establishments was the result of a progressive industrialization process (Tonon, 2011). Simultaneously, the influence of family relationships and the related financial support, (particularly important as seed funding--*risk financing*), promoted a willingness to establish new businesses in Rafaela (Quintar, et al. 1993).

The development of a '*learning infrastructure*' was conceived as a critical element of social commitment (attitude to change) from the early phase of cluster emergence (e.g. the creation in 1912 of the technical school). Moreover, it is in the growth phase, when it becomes relevant with the opening of a branch of the National Technological University (UTN) in 1972, which was propelled by a pro-development commission formed by key local players and the business association (Alburquerque, 2007).

In the late 1980s, after the observed decline in firm creation, the activation of *strategic planning* initiatives is observed by the community recognition of the need to transform its territorial economic development strategy (Costamagna, 2000; Alburquerque, 2007). Representatives from different sectors of civil society endowed with better formal capacities (than prior generations) seek new growth opportunities for the city (Costamagna, 2000). As a result, several initiatives show the community involvement for the development of a better institutional basis, such as the 1996 strategic plan aimed at promoting an "open space for public discussion" (Costamagna, 2000). Simultaneously, in this phase Rafaela businesses tackle new '*regulatory standards*' due to the growing market requirements in terms of international certifications (i.e. ISO standards). In 1997, as a result of the collective effort to increase the exports of the cluster, the INTI

(National Institute of Industrial Technology) opened a program oriented at support the adoption of ISO norms by the local firms.

These two cases represent clusters that are struggling to identify new ways forward and out of economic stagnation. The increasing global competition reduces the competitive advantage of such clusters; they are setting up collective 'strategic planning' and 'regulatory regimes' that help to fortify their competitive position, but have not yet found the capacity (and drivers) to reactivate growth along novel development trajectories. In this sense, *risk culture, risk financing* and *diversity integration* are likely to surface as crucial challenges for the cluster in the next decade.

3rd GROUP: The transformers

Case 5. Bajo Deba

In this case, the existence of a previous artisan culture centered on firearms, iron and steel industry creates the conditions to support new business undertakings (Valdaliso et al, 2011). A significant transformation took place between 1910 and 1945 with the creation of 22 new machine-tool firms (out of 66 in the whole of Spain) in the Gipuzkoa Province (Urdangarin & Aldabaldetrecu, 1982). As in the case of Italian industrial districts, industrial workers exteriorized their tacit entrepreneurial spirit (*risk culture*) and applied it in commercial and manufacturing activities, in the replication of imported technology (Valdaliso, 2004; Urdangarin & Aldabaldetrecu, 1982). This social capital value-based characteristic helped to trigger a national policy support oriented to promote imports substitution. New risky endeavors were financed by family links (*risk financing*) and facilitated by "the region's small size, close proximity of industries, relatively concentrated financial system, and close associative network" (Valdaliso et al. 2013). In this first stage, *cultural diversity* was also promoted on the basis of significant waves of migration from other Spanish communities, such as Extremadura and Castille-La Mancha.

From 1950 to the mid-1970s a strong growth was observed in terms of the number of firm spin-offs. A managerial style of deep involvement shaped family-business or production cooperatives. This type of management favored the *knowledge dissemination* via intergenerational technical know-how transfers (Calabrese, 1993), and production subcontracting (through spin-offs) across local firms. Accordingly, the development of *learning infrastructure* helped to form/train the necessary human capital. This mechanism was supported by the local government as in the cases of Eibar and IMH Elgoibar Schools (Calabrese, 1993:

Valdaliso et. al, 2013), and the research center INVEMA, which was set up by the Spanish Association of Machine-Tools (AFM) in 1968.

Between 1976 and 1981, the employment level fell by 21% (Urdangarin & Aldabaldatrecu, 1982). Such difficulties were primarily approached through joint public and private efforts (i.e. *strategic planning*) and industrial restructuring (Valdaliso et al, 2004). Examples include the AFM business association Reconversion Plan, which led to the creation of the training institute IMH (Machine-tool Institute) in 1991. In terms of local *regulatory frameworks*, a cluster association was created in 1992 through the impulse of firms, AFM, the Basque Government and training and research centers. Already in 1993, the cluster association grouped 140 firms and 8,000 employees (Calabrese, 1993).

The cluster showed an important sales growth between 1991 and 2008 (+126%), which was driven by export growth (+175%, Otero, 2010), whilst the number of firms and employees slightly declined. Such performance has been supported by leveraging an existent *risk culture* based on a "strong network and trust developed between the machine-tool companies and related industries" (Ecoris, 2009). On this basis, and due to the regional importance of the sector (nature of silo-technology – Bergman, 2008), the Basque Country government intervention also represents a critical driver to promoting the cluster growth. Policy initiatives that encourage education and provide technological support (e.g. CICs – Centers for Collaborative Research or the NanoBasque strategy in 2008) are examples of such public efforts (Valdaliso et al. 2013).

Case 6. Tuttlingen

The early development of the Tuttlingen cluster of surgical instruments was rooted in artisanal knife-forging production of the XIX century (Nadvi & Halder, 2002). The *risk culture* framed within a Protestant work ethic, and the growing demand expressed by the rising cities incentivized this handicraft production, i.e. cutlery (Staber & Sautter, 2011). Consequently, in the first half of the XX century, industrial firms grew from 3 to 23 and craft shops from 77 to 126 (Halder, 2002).

From 1955 to 1995, the cluster exhibited a strong expansion (84%) in the number of firms (Halder, 2002). In this phase, many firms oriented their production to the manufacturing of surgical instruments that were demanded by the growing health sector (hospitals and clinics). The mechanism of *knowledge dissemination* supported this growth through several channels, including copying and improving new products (Welter & Kolb, 2003). Another important avenue of growth was grounded in the ethic of work and reciprocity that was developed between doctors and surgical instrument producers. In this context, an informal cooperative arrangement connects medical needs and producers' abilities to fulfill the high quality requirements of such sensitive demand[32]. In addition, CEDEFOP (2012) points out that supportive *learning*

[32]'Cooperative Partnership' scheme - www.chirurgiemechanik.de

infrastructures have been critical through “application-oriented centers for innovative medical technology”. Such successful institutions are based on the commitment of the local actors to a ‘culture of cooperation’. Examples of training and research centers financed by the local Chamber of Commerce and Trade and the Chamber of Crafts are: The Vocational Training Centre (BBT: created in 1978) and the Competence Centre for minimal invasive medicine (MITT) (Welter & Kolb, 2003; Nadvi & Halder, 2002; Halder, 2002). As mentioned before, the mechanism of ‘*informal norms*’ based on ‘reciprocity’ is also present. Staber & Sauter (2011) observe the interpersonal trust at work in the supply chain, whereas high distrust exists among local competitors that check on each other’s business strategies.

During the late 1980s and 1990s the cluster entered its maturity stage, which was catalyzed by the rising market pressure due to fierce global competition. The main industry associations helped to develop joint actions to raise quality controls and creativity (Nadvi & Halder, 2002). A ‘local regulatory framework’ that encouraged continuous improvements, such as with the program ‘Tuttlingen Quality Products (TPQ)’ (Staber & Sautter, 2011), promoted higher product standards and a reputation for quality production.

More recently, the cluster has been ‘transforming’ thanks to a renewed *risk culture* that offers ways to adapt to a new market context. Its strong identity, rooted in a hard work ethic, encourages the development of new products and the opening of novel markets by new cluster agents (*cultural diversity*) (Staber & Sautter, 2011). Such a change is observed through the growing number of medical technology services and brokers; meanwhile craft and manufacturing firms are decreasing (Staber & Sautter, 2011). Consequently, a wider portfolio of medical-technological products and a deeper specialization in non-invasive surgery products (in cooperation with university hospitals in Tubingen and Stuttgart) can be observed (CEDEFOP, 2012).

The cases presented have shown the capacity (and drivers) to reactivate growth along novel development trajectories. Accordingly, their strong risk culture has been critical to influencing the novel transformation process by enabling the integration of new knowledge and new agents in the cluster. Additionally, in both cases, government intervention has been positively influencing this transformation process on the basis of prior social and institutional capital embedded in the cluster.

5.4. Conclusions

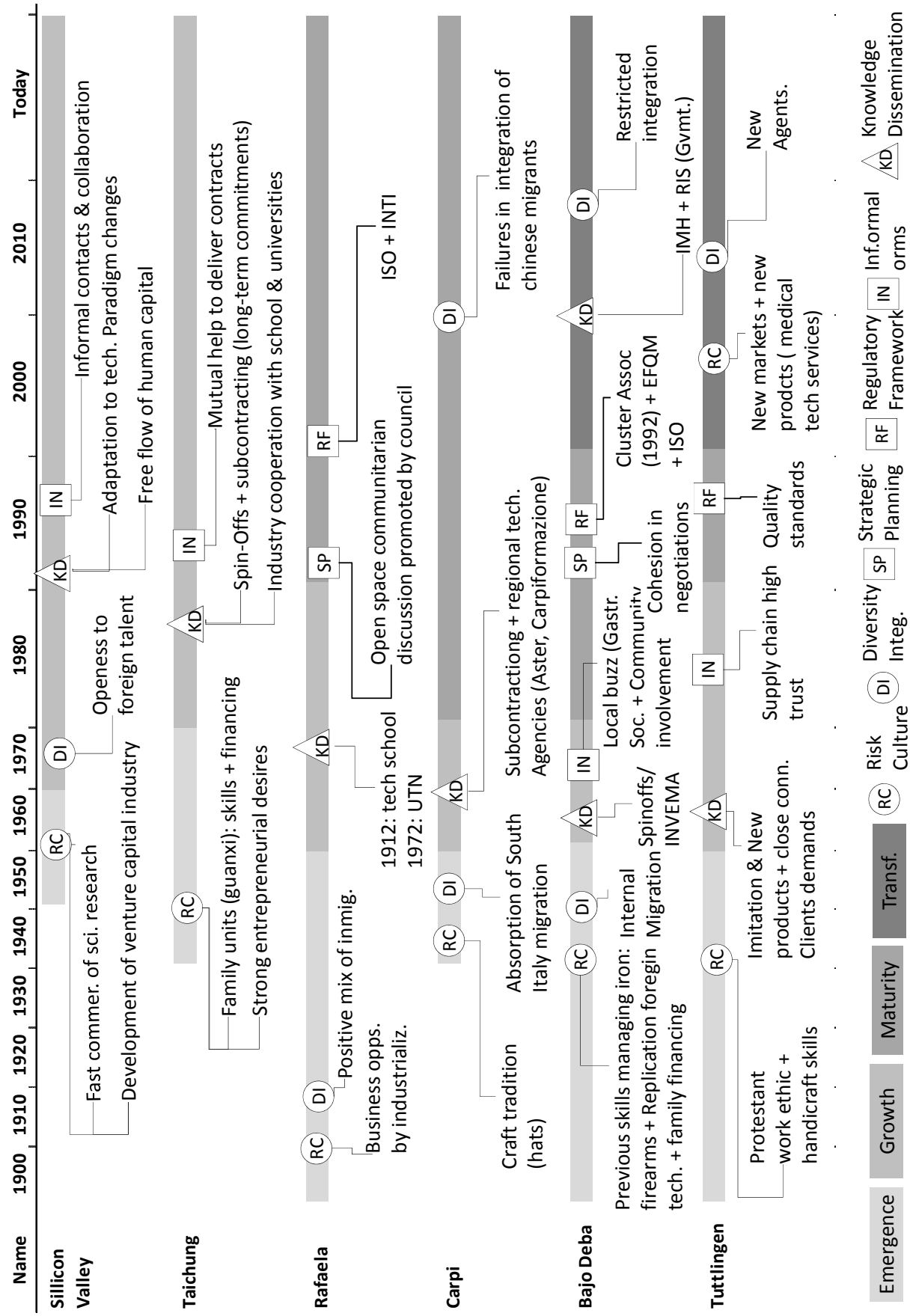
This empirical exploration is focused on six clusters that represent different historical, cultural, economic, and industrial activity backgrounds. It is possible to find evidence about the social capital incidence into the the historical trajectory of the clusters analyzed. Moreover, this incidence is not monotonous but it is "activated" according to the needs of each evolutionary stage of the clusters. So, this exploratory approach helps to categorize some common evolutionary patterns among clusters, to enrich

the conceptual approach, and to provide guidelines that may be tested in further empirical analyses (e.g. on in deep case study, or survey bases).

For the group of ‘prolonged growth’ clusters, their success has centered on their capacity to provide flexible adaptation to demand, competition, and technology changes. In these cases, social capital has been essential to the identification of novel paths. The second group reflects a ‘maturity’ stage, that has been challenged by the changing competitive conditions. Social capital has served here to activate strategic and regulatory mechanisms that help to identify new ways forward and out of economic stagnation. Nevertheless, they have not yet found the capacity (and drivers) to reactivate growth along novel development trajectories. Finally, the third group of clusters has been able to pursue a ‘transformation’ path. In these cases, social capital has served to strengthen prior collective social and institutional capacities in order to integrate new knowledge and new heterogeneous agents in the cluster.

This study faces the limitation of relying on a set of case studies investigated on the basis of secondary data alone. For further development, nested case study research might be developed as a means to inquire more directly (and also to provide quantitative evidence) about the effective power of social capital on the selected growth mechanisms.

Figure 5.1: Exploratory Analysis Resume



Source: Own Elaboration.

Chapter 6. Machine tool production in Bajo Deba (Basque Country)

6.1. Introduction

The evolution of the process of spatial agglomeration of firms is a complex phenomenon, and each of its developmental stages responds to different internal factors subject to external pressures. There are some examples of clusters that have shown critical capacities to survive, to be transformed, and to absorb the competitive changes of the external scenario like Silicon Valley (US) or the surgical instruments clusetrs in Tuttlingen (Germany). These cases present of a significant level of social interconnection manifested through civic participation, new knowledge sharing, infrastructure development, and openess among others. It is then worth to evaluate the argument that there are longstanding social values which provide a crucial basis for the evolution of clusters through the development of internal collective responses to external pressures.

The exploratory analysis of the previous chapter showed the evolution of the Bajo Deba district as one of transformation where the importance of social capital was clearly distinguished. For this reason, due to the interest in the literature to understand and analyze clusters' transformation processes, especially in old industrial areas, it is considered justified to analyze the operation of the facets of social capital and mechanisms in this location. This is related to the second of the auxiliary research question of the thesis: Does social capital have a differentiated influence in clusters' performance under external pressures? Likewise, the case meets the most significant criteria parameters for the testing of the propositions suggested in our conceptual approach: its configuration, and its historical evolution which has passed critical circumstances. At this matter, the area is identified as one of the local production systems in Spain due to its specialized concentration of machinery production, the predominant presence of SMEs, qualified human capital resourced and the marked evolutionary influence of the local idiosyncrasy (Boix & Galetto, 2006; Larrea, 2000; Allaez-Aller et al. 2000).

The empirical analysis is conducted using the case study qualitative research design. This choice is based on the advantages it provides for reasoning about the operation of the complex connections (Yin, 2003) as those made in our conceptual approach. The implementation of a case study research follows Villarreal & Landeta's (2010) guidelines (see Chapter 4). Then, data collection includes primary (interviews) and secondary sources. Also, the systematization of that information helps to outline the historical stages and the clusters endogenous responses to the external forces.

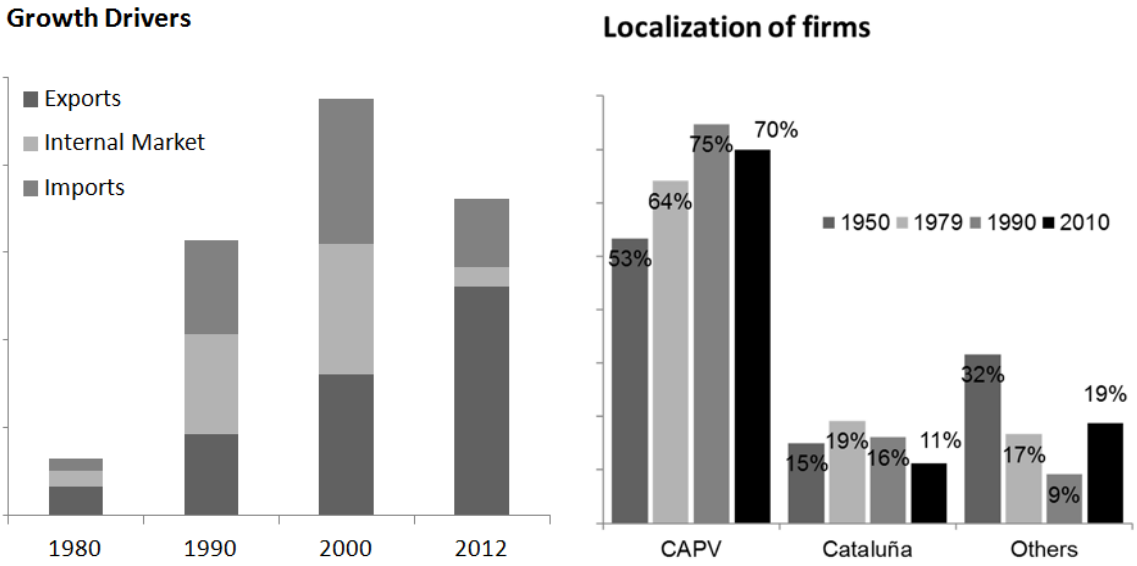
The results show that it has been possible to value the positive effects of the operation of the facets of social capital. Thus, these aspects have played a role as a driving force and channel of collective initiatives (i.e. labeled as mechanisms), which in turn responded to internal (depending on the cycle phase) and external constraints.

The objective of this research is to examine the proactive role of social capital in the case of Bajo Deba (Basque Country) machine tool production by means of activating various critical mechanisms of growth; special interest is also taken in differentiating its operating mode through different cluster life cycle stages. The chapter is organized in four sections. The next section explores the importance of the case. Then, a summary of the research methods procedures is provided. Subsequently, the review of Bajo Deba evolutionary phases is presented with a focus upon the observation of the connection between selected social capital facets and some critical mechanisms. Finally, conclusions are presented.

6.2. Importance of the case

The development of machine tool production has a strategic impact on industrial development due to its capacity to connect with all of the other industries exerting a 'multiplier effect' which means to serve as an agent of technology, and thus to affect users' efficiency (Plaza & Gonzalez, 1994; Sanchez-Robles et al., 1995; Andersen, 1990; CLP, 1980; Otero, 2010). The Spanish MT industry is the third European producer and exporter and the ninth in the World (Gardner, 2014). Its hallmarks are strong internationalization (i.e. average of exports-to-production ratio 2000-2013: 67%), technology generating capacity. and high participation of SMEs (AFM several issues). In this context, it is particularly representative of the MT production in the Basque Country's (BC) as its represents approximately 75% of sales and firms of Spain, and it is also representative in Europe, considering statistcs of productivity and specialization (location quotient) of the metalworking technology activities[33] (Figure 6.2).

Figure 6.1: Spanish Machine Tools Industry key figures

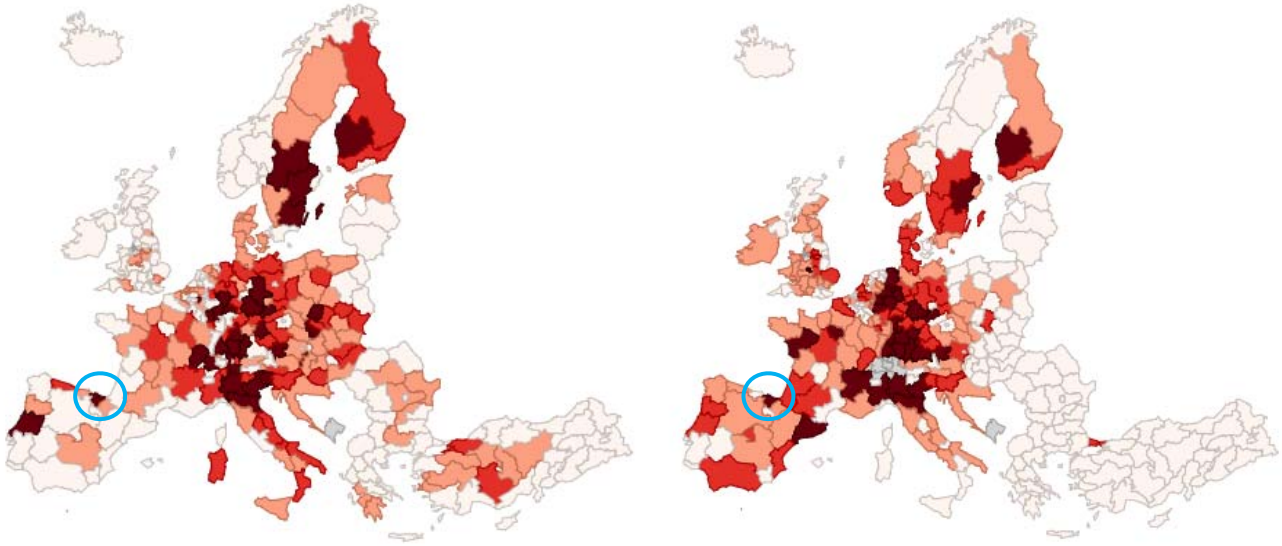


Source: Own elaboration base on several sources (AFM).

[33] According to the classification of the European Cluster Observatory (Ketels & Protsiv, 2014) the manufacturing activity of machine tools is incorporated into the cluster classification of metalworking technology.

Figure 6.2: Metalworking technology in Europe (2013)

Specialisation (Location Quotient) Wages and Salaries (as a proxy for productivity)

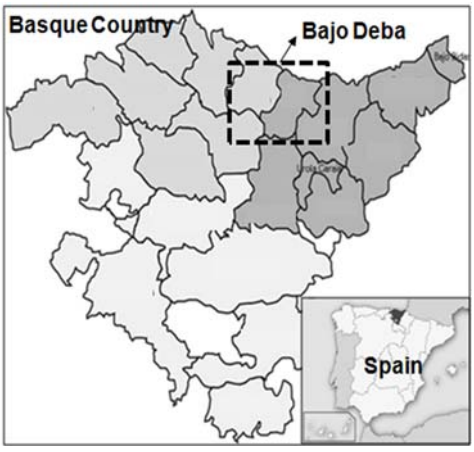


Source: EUROSTAT – European Cluster Observatory. The greater darkness means more specialization.

The Bajo Deba district was identified as one of the local production systems in Spain due to its specialized concentration of machinery production, the predominant presence of SMEs, qualified human capital resourced and the marked evolutionary influence of the local idiosyncrasy (Boix & Galetto, 2006; Larrea, 2000; Allaez-Aller et al. 2000). Located in the Basque Country, the district area includes 8 towns[34] in the provinces of Guipuzkoa and Bizkaia. This area has approximately 73,000 inhabitants, an area of 213 km2, and the standard of living is higher than that of other Spanish areas (Figure 6.3).

Figure 6.3: Geographic Location of the Bajo Deba Area & its economic overview

District	Population (ths.)	Area (km2)	Density (inhab./km2)	PIBpc 2010	Unempl-oyment 2013 (%)	Industry Value-Added 2010 (%)
Eibar	27	25	1.107	24.574	11,8	19
Elgoibar	12	39	295	37.947	13,8	52
Deba	5	52	105	34.147	11,8	50
Mutriku	5	28	189	15.393	12,7	24
Soraluze	4	14	283	21.939	19,6	41
Mendaro	2	25	78	56.679	12,5	42
Ermua	16	6	2.633	20.755	17,7	35
Mallabia	1	24	51	93.896	10,8	74
	73	**213**	**344**	**38.166**	**13,9**	**42**
CAPV	**2.177**	**7.235**	**301**	**29.988**	**15,3**	**21,3**
Spain	**46.728**	**504.782**	**93**	**22.700**	**25,1**	**16**
EU27	**501.404**	**4.454.237**	**113**	**24.400**	**10,9**	**17**

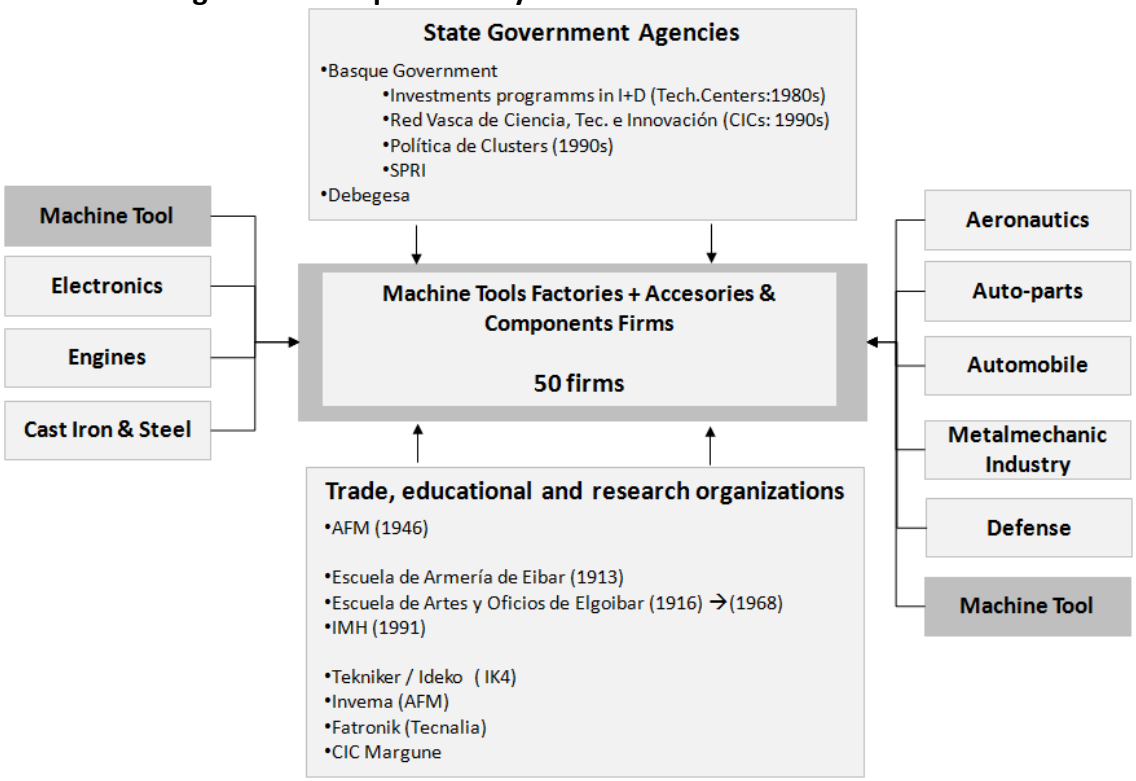


Source: Own elaboration based on Eustat, BDE, Eurostat, INE, Lanbide.

[34]Eibar, Elgoibar, Deba, Mutriku, Soraluze, Mendaro, Ermua and Mallabia

According to data from the Basque Country Industrial Catalogue[35] (Basque Government), in Debabarrena there are 19 final product manufacturers and 31 auxiliary firms, employing a total of 2,000 people (average size: 40 people per firm). It should also be considered that the local business infrastructure includes two major types of firms differentiated by their ownership structures (cooperatives and limited companies). Important trade, educational, and research organizations characterize the area and its surroundings, specifically in terms of machinery production. In addition, the cluster is strategically important in terms of government policy support, and its policymaking influence includes Cluster Competitiveness policies, and the recurrent plans of R&D development that the government supports. It is important to stress the role of the local agency Debegesa, which operates as an essential agent in the channeling of public participation and involvement.

Figure 6.4: Basque Country Machine Tool Cluster's structure



Source: Based on Porter's format for describing industry-based clusters.

6.3. Method and data

The objective of this research is to examine the validity of the propositions presented in the conceptual approach in the context of the Bajo Deba machine tool production historical stages. These propositions are related to the proactive role of social capital by means of activating various critical mechanisms of growth through the different cluster life cycle stages. The criteria to focus in this case is related

[35]Included into the codes 2862: Interchangeable tools for machine tools, and 294: Machine Tools.

to its historical development that evidence transit through different stages of the life cycle, and the interesting task to observe the generated and the potential answers at the challenging effects posed by the current socioeconomic situation.

The empirical analysis is conducted using a case study qualitative research design. The process of analysis is made following the guidelines provided in Villareal & Landeta (2010) as it is summarized in the case study technical file. (Table 6.1).

Table 6.1: Case study technical file

Purpose of Research	To test the validity of the proposed conceptual approach to analyze the influence of social capital in the different stages of the life cycle of the clusters.
Research Methodology	Holistic case study (simple analysis unit). Purpose : descriptive and explanatory.
Unit of Analysis	Bajo Deba machine tool cluster
Geographic Scope	Bajo Deba district (Basque Country)
Sample	Agents related to the activity of the machine tool manufacturing.
Sampling Method	Logic and theoretical sample
Methods of Collecting Evidence	Collection of statistics and academic publications + 12 semi -structured interviews + direct observation (Assistance to the International Machine-Tool Exhibition - Bilbao 2014)
Sources of Information	Internal: reports and studies from the AFM + 12 interviews . External: Academic papers / press / books.
Methods of Analysis of Evidence	Qualitative: Thematic Analysis (theoretical and semantic) Quantitative: Main production, exports and employment trends.
Scientific approaches	Deductive
Assessment of methodological rigor and quality	The validity of the model was prevented with the use of the largest amount of information available. Internal validation is performed by triangulation of data.
Date Period	April 2014 - April 2015

Source: Own elaboration, based on Vilareal & Landeta (2010 p.37) guidelines.

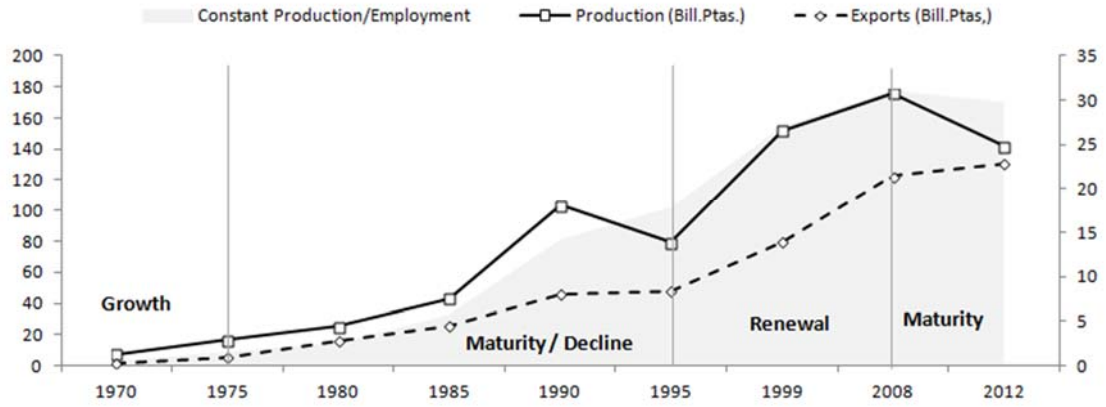
6.4. Results

Among experts of the historical development of this cluster, there is some consensus regarding the determination of certain turning points in the evolution of the industry of machine tools in the region in the last 100 years (Valdaliso et al. 2013; Andonegi & Arrieta, 2014; Urdangarín & Aldabaldetrecu, 1982). These time frames can be categorized in five stages (Figures 6.5 & 6.6):

- Emergence (1914-1959)
- Growth (1960-1974)
- Maturity (1975-1994)
- Renewal (1995-2008)
- Maturity (2009-today)

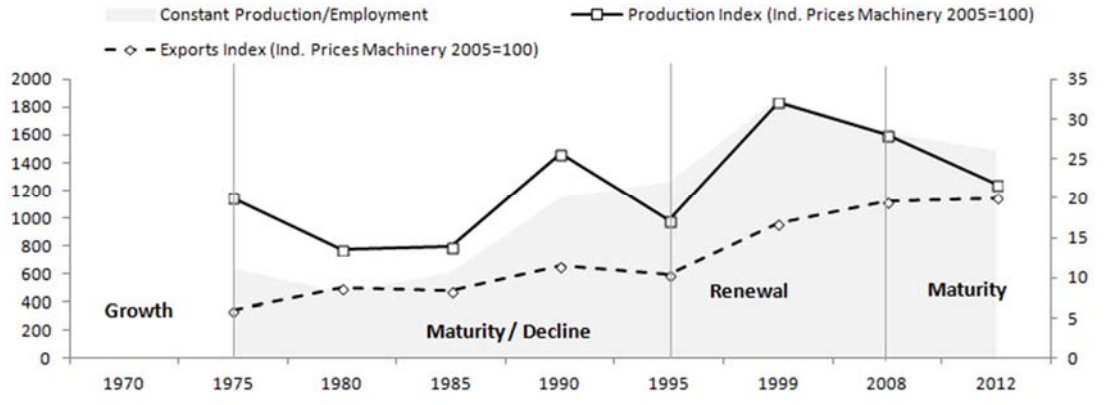
First, a period of *emergence* (1914-1959) was characterized by a protective macro context and high Spanish industrial demand that boosted local producers to develop business strategies in the machine tool field. Second, a *growth* phase (1960-1974) was favored by an expansionary industrial context (global and local), that allowed for major business creation and specialization in the machine tool production. Third, a *maturity* stage (1975-1994) was characterized by a stable stock of firms (unlike the rest of Spain) and a decline in production (constant terms) until the entrance of Spain in the European Union (1986). That fact boosted a recovery in the activities but was interrupted by a severe decline during 1990-1994 (Gulf Crisis). Fourth, a stage of renewal was driven by the consolidation of the local innovation system, the positioning in specific niches of products and a high growth of external sales. Finally, the 2008 crisis highlights critical challenges (the development of greater scale of production, technological capacities and the level of sales abroad) for the cluster to overcome a *maturity* stage (2009-today). In the following, for each of these stages the contribution of social capital to activating specific clustering mechanisms (endogenous) and its response to external pressures are examined.

Figure 6.5: Spanish MT Production & Exports (current prices)



Sources: AFM, AIIMH (1971), CLP.

Figure 6.6: Spanish MT Production & Exports (constant prices)



Sources: AFM, AIIMH (1971), CLP, INE.

Emergence (1914-1959)

Autarky policies and intervention (started in the late 19th Century and expanded upon during the Civil War: 1936-1939) determined the character of Spanish industrialization in the first 50 years of the 20th Century (Aldabaldetrecu & Urdangarin, 1982). In the postwar period, the Spanish economy showed poor macroeconomic performance compared to strong industrial expansion in other European countries (García-Delgado, 1987). However, protection, reinforced after the Spanish Civil War, favoured the emergence of local MT manufacturers to meet the local market demands (spare parts factories, small workshops, automobile industry, etc.). Thus, between 1910 and 1959, 189 new MT companies were founded in Spain of which 124 were in the BC (Urdangarín & Aldabaldetrecu, 1982). Such outstanding emergence of MT producers was critically influenced by the intrinsic values and customs of the territory.

The activation of the *culture of risk*, based on the competitive and communitarian character of Basque society, as well as through expertise in the transformation of metals[36] (Aldabaldetrecu, 2000; Encenarro 1996; Aláez-Aller et al., 2000), gave way to the generation of new business challenges which were mainly financed through the economic support of close relations. The embedded desire to take on risks (to achieve a status as "the owners of their own future") led relevant actors to setting up small workshops in their homes, replicating the simple designs of foreign machines (Valdaliso, 2004; Urdangarin & Aldabaldetrecu, 1982). The setting-up of Encenarro & Estarta factory (Elgoibar) was decisive as it provided a place where future entrepreneurs could gain skills in working with metal. Furthermore, the imposition of a strict discipline of long working hours, in business and at home, in order to be able to become independent was generalized (Andonegi & Arrieta, 2014). Complementary to such an appetite for risk, the people of Elgoibar were noted for their creativity (a widespread attitude among local people to say "I can improve this") in finding innovative solutions to various mechanical problems. The majority of new risky endeavors were financed by family and friends (Andonegi & Arrieta, 2014), exemplifying an arguably collective Basque societal view toward "close associative networks" (Valdaliso et al. 2013) and a high level of cooperation (Innobasque, 2010). Importantly, the founding of companies responded more to a contribution of work skills than to contributions of financial capital. So, the pioneers made great sacrifices, and were austere in their way of life, with the full reinvestment of profits to meet their financial commitments.

At the end of this period (1950-1960), a significant migration flow (mainly concentrated in Elgoibar-Eibar-Placencia) was observed (Gurruchaga-Abad et al. 1990). In the 1950s, people migrated from the neighbouring Spanish regions to satisfy the demand for industrial workers, with this process reaching its peak in Debabarrena during the 1960's (in our growth phase) and including workers from southern Spanish regions,

[36]Artisan culture centered on firearms, ironworks and the steel industry. Firearms industry was especially important so that Goñi-Mendizabal (2008) argues for the composition of an industrial district in Eibar at early 20th Century.

such as Extremadura, Andalusia, and Castille-La Mancha. These people were promptly integrated in the productive system doing very basic tasks, as most of them lacked mechanical skills. Modesty and the work ethic manifested by immigrants were considered fundamental characteristics for social integration, apart from a lack of cultural bias towards them.

In summary, under a protective macroeconomic scenario, the initial phase was characterized by enhancement of distinctive cultural patterns such as a propensity towards innovation, hard work (founded on previous craft skills), and social openness to generate a critical mass in MT business.

Table 6.2: Emergence Phase Key Trends (1914-1959)

Macro Trend	Cluster Trend	Risk Culture	Diversity Integration
Autarky & Intervention	Emergence of pioneers entrepreneurs	Risk Appetite	Receptive attitude towards migrants
		High Creativity & tolerance to error	Modesty and hard-work as key features for integration
	Replication of foreign technology	Family and close friends financial support	
		Positive role of Estarta & Ecenarro.	

Source: Own elaboration

Growth (1960-1974)

Following poor macroeconomic performance in the two decades after the Civil War, macroeconomic policy was mildly geared toward economic liberalization (e.g., the trade agreement with the United States, 1953 and 1959 Stabilization Plan). Then, a period of significant industrial growth was observed due to a positive international context and local synergies derived from external financing, acquisition of foreign technology and availability of labor (Garcia-Delgado, 1987) and entrepreneurs' improvements in organizational capabilities (Valdaliso, 2004). In the MT industry, the number of companies in the sector grew considerably noting that 33 of 79 new businesses created between 1960 and 1975 belonged to the province of Guipuzkoa. Also, there was a process of specialization involving growing technological complexity making big companies which owned their own MT workshops gradually abandon this activity (AIMH, 1971; Urdangarin & Aldabaldetrecu, 1982). In this framework, social capital's input served to sustain collective dynamics in the flow of information and for social coordination by means of informal rules.

Change in attitudes and dynamic reciprocity facilitated the *dissemination of knowledge* and training infrastructure upgrade. The first operating characteristic of this mechanism can be seen in the founding, by groups of two or three people with complementary skills, of many related companies due to the people's “desires to have their own business” (Urdangarin & Aldabaldetrecu, 1982). Also, a managerial style of close

involvement in every productive activity (Calabrese, 1993), typical of family businesses, was another central technical feature. This favoured in-depth know-how of the activity, the needs and the intergenerational transfer of technical abilities and business leadership. There was also a boost in the implementation of cooperative systems, which involved a strong commitment and dedication to social and community development. In fact, it is argued that the inception of the globally recognized Basque cooperative movements can be attributed to prior initiatives in Eibar city. The cooperative movement within such a system, represents a common example of labor interaction was the existence of master-disciple relationship type which was not only beneficial for the technical training of novices but also in order to transfer the sense of discipline and collective commitment. An additional feature in the dissemination of knowledge was the widespread adoption of a dual apprenticeship system (both voluntary and mandatory), characterized by the interaction between business and training center, which generated an appropriate environment for personal and professional growth (Calabrese, 1993; Valdaliso et al, 2013: Andonegi & Arrieta, 2014).

A crucial technical aspect was a strong collective action to improve the development of local learning centres and their corresponding courses of study. These facilities were crucial in order to provide support for apprenticeship in the factories and to channel their aspirations for professional growth (Aldabaldetrecu, 2000; Calabrese, 1993; Valdaliso et. al, 2013: Andonegi & Arrieta, 2014). For instance, the Elgoibar School of Arts and Crafts (1916) was transformed in 1968, by the leadership of key actors in the business community, into a vocational school but prioritizing the “local way of doing things”. This shows the determined local commitment towards professional training as a key aspect of differentiation in the context of Spain that still stands today.

The influence of certain features of local culture (informal rules) favoured openness in the resolution of technical, organizational and community issues. For example, it was common practice that manufacturers shared their time and technical issues/expertise with colleagues. A prototypical space for interaction of Basque culture were the so called "gastronomic societies" (privately owned community spaces) which contributed to ease social and economic differences, address common interests, and also as place to receive foreign visitors.

Another key feature of local MT firms’ managers was their widespread commitment to compensate workers well, which was sometimes supplemented with employee participation in profits sharing--even before the emergence of the cooperative movement (Andonegi & Arrieta, 2014). A sense of reciprocity was observed in the participation of MH entrepreneurs in a wide range of community activities such as participation in the creation of local Ikastolas (schools teaching in Basque) and youth centers, and cultural associations (e.g. Kultur Elkartean, Grupo de Ciencias Aranzadi in Deba). As a consequence of this commitment, the district award "Our Values" (Gure Balioak) of the last three years has been assigned to outstanding representatives[37] of integrity, respect, entrepreneurship and cooperation development in Bajo Deba who are also strongly related to the MT evolution.

[37]Carmelo Urdangarín, Jesús Bilbao &Sabin Osoro.

In short, a context of greater economic openness (although general protectionist scheme was still in place) and industrial development created the opportunity to launch production initiatives that fostered values and community standards. Nevertheless, at the beginning of the 1970s industry players started to advocate the need to adapt to "new circumstances" characterized by internal market volatility and structural changes in the international markets because of new technical demands and the emergence of new players (AIIMH, 1971).

Table 6.3: Growth Phase Key Trends (1960-1974)

Macro Trend	Cluster Trend	Knowledge Dissemination	Informal Norms
Spanish Industrial Growth		Extended spin-offs process (self-determination)	Open off-work technical discussions(gastronomic societies)
	Step Rate of Firms' Creation	Cooperative Partnerships	Benefits sharing schemes
Openning Attempts		Dual Apprenticeship system (Work & School)	Widespread involvement in community issues
		Collective commitment for training schemes update	

Source: Own elaboration

Maturity (1975-1994)

After 15 years (1960-1975) of positive conditions in the macroeconomic environment, since the mid-1970s, the macro context began to exert significant pressure from the convergence of political, economic and technical reasons. Firstly, political uncertainty was caused by the transition to democracy and an increase in union demands. Later, the integration of Spain into the CEE meant the removal of many tariffs, which was expected to harm local firms' sales. Secondly, a drop in industrial demand was observed due to the oil crises of 1973 and 1979; then there was internal macroeconomic instability with high inflation and unemployment (Rojo, 1987). Thirdly, the widespread implementation of numerical control (CN) innovation in machines had a revolutionary effect for product quality and the sophistication of MT demand (Andersen, 1990; Otero, 2010; Chen, 2009). These features led to the need for fast technological and organizational adaptations into an industry composition typified by small size, low productivity, wide range of products, basic technology (AFM, 1983; Urdangarin & Aldabaldatrecu, 1982), and a very poor financial situation[38] (AIIMH, 1971).

The viability of the Spanish MT companies was under question, and a general tendency to destroy firms and jobs became evident. In Gipuzkoa the number of companies declined from 65 in 1979 to 48 in 1995. However, this process did not show a linear trend and thus their development can be subdivided into two sub-phases. The first showed a severe crisis period (1976-1983) in which some firms directed their efforts to sell in

[38]As of 1981, the Spanish machine tool sector firms showed a high level of inventories (41.9% of Assets), debts (debt-to-equity ratio: 1.5x), negative returns, and low assets rotation (sales/assets: 0.96x) (Urdangarin & Aldabaldetrecu, 1982).

foreign markets (CLP 1984); then, a recovery period (1987-1990) was evident in which the manufacturers enjoyed the 4-fold demand increase triggered by investment in equipment upgrades (CLP, 1990). The second sub-phase (1990-1993) was marked by the Gulf Crisis, and implied a major shock to the survival of businesses employment and firms. It was a critical moment because the various joint initiatives for adaptation at the technological level had not matured, and because some firms had not made the technical and managerial adjustments to accommodate the new circumstances. Within this framework, social capital played a critical role in the activation of institutional mechanisms based on the attainment of a cohesive view for coordinating initiatives to address the complex situation.

The presence of common values and challenges was decisive to promoting participatory strategic initiatives aimed at improving efficiency and systemic survival in the medium and long term.

Firstly, the crisis made apparent the need for joint work to address the structural problems of the industry discussed above and based on a shared view about the need for renewal generating (strategic planning) for the medium and long term. Nevertheless, it must be recognized that collective action was directed initially at improving companies' critical financial positions and at solving the problem of adjustments in the size of the workforce.

Secondly, the sector (lead by AFM[39]) acted as a joint unit to request participation in plans for restructuring proposed by different governmental organizations. As a consequence, the sector was included in the " Exceptional Restructuring Plan" (PRE) released in 1986 by the regional government which included programs of technological advancement, workforce adjustments, and the development of joint marketing activities (CLP, 1985). In this sense, a distinctive feature of Basque government involvement was its decided orientation towards an active industrial policy which had positive results in MT.

Thirdly, an important feature of collaborative efforts was seen in the support of new technology development infrastructure. For instance, Tekniker (which was initially a laboratory inside the Eibar Armoury School) was created in 1981 with 67 companies taking part in it; Ideko was created in 1986 fr om cooperative firms and Fatronik was created in 1987 from a group of private companies. Such initiatives were mutually exclusive, but they helped to enrich platforms for the generation and transfer of knowledge. Also, companies devoted a remarkably 5% of its turnover in R & D (CLP, 1990). Finally, it is worth underlining the founding of the Machine Tool Institute (Instituto de la Máquina-Herramienta - IMH) in the mid-1980s, which led professional training and was supported by local MT firms and by the Basque government (Aranguren et al. 2012). It is an exemplary case of social capital as a latent factor for collective involvement (AFM, companies and public institutions) to address not only their own business expectations, but also the undesirable effects of unemployment in their district.

[39]Spanish association of Machine Tools producers (Aranguren & Navarro, 2003 explains current operation of the association).

The second institutional aspect of social capital in this phase concerned the role of the industry association, the creation of the cluster association and the engagement into normalization and quality standards achievement. Since its origins, the AFM operated as a private entity (due to political restrictions to creating associations) with the major aim to press the Government for the maintenance of protective barriers and financial help (Aldabaldetrecu, 2000). Since mid-1970s, the leadership of Gipuzkoan businessmen was critical to shift the focus of the AFM toward support for international competitiveness, the improvement of technological capacity and organizational management. This change was critical in order to take collective decisions for adaptation and survival and to increase its reputation among other business groupings and with the Basque Government. A major feature of the strategic value of this industry in the Basque Country was the creation of a cluster association by the Basque Government and the AFM (Spanish association of MT producers) in 1992, based on the recognition of its evolution as a natural agglomeration. Finally, concerns about normalization and standardization were at the top of the agenda, which was mainly driven by clients' high quality requirements (e.g. the automobile industry) and by imitation, due to intense local competition. Public administration also contributed to incentivize the attainment of quality parameters so that the Basque Country stands out as one of the European areas with a higher intensity (certifications/PIB) of ISO 9000 certificates and greater implementation of the EFQM excellence model (Heras et al. 2008). In addition, the response of the industry to tech changes is related to the inrush of CN which was addressed with the ample use government aid by MT firms as part of the CN-100, 1000 programs. As a result, production with the use of numerical control technology went from 9% in 1981 to 37.4 % in 1985 and 70 % in 1991 (Andersen, 1990; SPRI, 1995).

During this critical period, the cluster was able to manage the combination of paradigmatic political, economic and technological modifications through proactive participation by activating institutional mechanisms. Guided by a shared view, coordinated actions allowed the intervention of the cluster in industrial restructuring plans, the creation of a cluster association, a greater strength in its negotiating position, and the improvement of standardization, quality, and security standards. These actions have subsequently served to provide a solid basis for a later renewal.

Table 6.4: Maturity Phase Key Trends (1975-1994)

Macro Trend	Cluster Trend	Strategic Planning	Regulatory Framework
Oil Crisis		Shared view about long-run needs	Renewal of the AFM role
Transition to democracy	Cohesion & coordination to enhance strategic ways of adaptation	Joint action for negotiations	Creation of cluster association
CN Introduction		Collective support for technological infrastructura development	Engagement into standarization and tech quality upgrade
Gulf Crisis			

Source: Own elaboration

Renewal (1995-2008)

Since the second half of the 1990s, a positive systemic demand for industrial goods (an expansionary business cycle in developed countries and a fast industrialization process in emerging economies) and the introduction of TIC was observed. In terms of cluster performance, there was stagnation in the number of firms (in Guipuzkoa, there were 48 firms in 1995 and 47 in 2008). But, more jobs were created with the significant feature of possessing higher qualifications. Thus, leveraged by actions in the previous stage, a consolidation of technological capabilities, training and internationalization was observed. For instance, there was a strong increase in productivity and in the period 1991-2008 export growth was +175% (Otero, 2010). In this framework, social values contributed into the activation of risk culture and knowledge dissemination.

The characteristics of work ethics have changed from those of the cluster's pioneers as a result of improvements in income and wealth levels, a growing preference towards leisure (Setién, 2002), and a devaluation of the businessmen reputation in the society. However, the idea of discipline and social commitment remains as part of the "ethic of innovation" (Innobasque 2010). In addition, due to the scale and complexity (technological & financial) required, the exploration of new productive projects was incubated together in conjunction with technology centres (e.g. GMTK in 2007), or, in cooperatives that had sufficient financial and organizational strength (they own companies outside Spain) to be able to withstand errors. Examples of new initiatives include cooperatives consolidating their position as providers to the aviation industry (Danobat), Goimek (2004), Danobat Railway (2005) and Danofiber (2009). However, there are concerns about the erosion of traditional cooperative values, and the sense of individual security over collective interests tends to prevail. A manifestation of the regeneration of risk culture was seen in diversification efforts in the healthcare industry that were restricted after the advent of the financial crisis of 2008. Beyond that, these initiatives did not mature, as they needed gradual adaptation within medium and long-term new value chains (quality and reputation requirements). Finally, risk financing is not as important as during the emergence phase because risk is calculated and there are market mechanisms to fund innovative ideas. Also, the size of the investment required to compete globally requires the intervention of external agents with greater financial power (government, venture capitalists).

Another major factor that characterized cluster renewal was its constructive adaptation to new technological paradigms that helps to preserve the identity and reputation of Debarrena MT firms. Local firms were able to absorb new knowledge and deal with the sophisticated demands of its customers. Knowledge also flows strongly depending on the setting of different user-producer relationships, which is critical due to the impact on users' efficiency (MT is a vehicle that provides technology to them) and the preservation of identity and reputation of Debabarrena firms. The current diffusion of new knowledge is strongly influenced by the mediating role of the technological centres and the gradual consolidation of a competitive regional

innovation system. The role of the Basque Government in this period was critical in terms the impulse of technological update coupled with the capacity of the firms to influence policy design. Policy initiatives oriented toward encouraging education and providing technological support (e.g. CICs – Centers for Collaborative Research or the NanoBasque strategy in 2008, IK4, Basque Network of Technology and Science) are examples of such public efforts (Valdaliso et al. 2013).

A critical aspect within a process of change is the effect of migratory flows (*diversity integration*). During the period 2001-2010 the Debabarrena area showed a progressive increment in foreign inhabitants (in 2012 4,5% of local inhabitants were foreigners mostly come from Morocco, Portugal and Latin America). Importantly, there is awareness of this reflected migration in developing diagnostic and implementation of concrete actions to promote their integration at the district level (Debegesa, 2008; 2010). However, the high level of technical requirements (and possibly the language) obstructs their incorporation into the MT labor market. A sense of openness and change was to be seen on recruitment attempts before the beginning of current crisis (2008) to look for skilled workers in Eastern Europe. Thus, the quantitative impact of these migratory flows is seemingly not as important as once thought; however, a qualitative aspect, closely related to the mechanism of knowledge dissemination, is revealed by positive receptivity of specialized human resources from abroad (UK, Germany, China and India) to acquire new skills and to be positioned in new markets.

To sum up, the cluster showed a solid capacity to reactivate growth and to achieve a highly competitive international stance based on a *risk culture* centered in the development of innovation and the exploitation of niche markets. Also, technological capabilities achieved a significant improvement and benefited from participation in the Basque system of innovation and from connection to and attraction of external knowledge (*knowledge dissemination*). Finally, it is important to highlight the positive impact of synergies arising from the industrial policy of the regional government.

Table 6.5: Renewal Phase Key Trends (1995-2008)

Macro Trend	Cluster Trend	Risk Culture	Knowledge Dissemination	Diversity Integration
Expansionary phase of the global economic cycle	Consolidation of technology development and training capacities	Ethics of Innovation	Knowledge transfer mediated by the regional system of innovation	Skills limitations for integration
Introduction of TIC	Internationalization	Diversification attempts (niches)		Openess to attract external talent

Source: Own elaboration

Maturity (2009-Today)

Because of the financial crisis that began in 2008, the world economy suffered a significant reduction in trade and industrial goods production (and, thus, in the demand for MT). Within the cluster, this challenging scenario has affected its performance (and the territorial development model) as evidenced by a process of firms' creation stagnation but remains adequate the level of productivity and exports' positioning (90% of production is exported, and their international market share is stable). At the beginning of the crisis, the MT firms were in a good financial position that made them able to retain their highly qualified human resources. Currently, a situation of economic instability is preserved, while the presence of certain industry challenges such as maintaining close relations with sophisticated clients, producing unique technology, and enlarging the international position remains (AFM, 2014). The cluster legitimacy as a fundamental driver of local development is unquestionable, but the competitive scenario for the cluster is complex and this casts doubt on the influence of social capital.

Tensions are generated due to the increase in heterogeneity among firms. While some companies are large (although medium in comparison to German and Japanese) and world-class competitors, others have serious restrictions to access new markets, and to take the latest technological advances (that are more dependent on the domestic market). For instance, the success cooperative associations have demonstrated the importance of the internationalization and the efforts to keep the innovation pace. However, as a negative aspect of social capital, there is still an idiosyncratic tendency (especially among the smaller firms) to retain power and control, and thereby, restricting firm size and growth potential thereof (e.g. trhough mergers).

Regarding the technological link between the clusters' agents, a constraint for SMEs is their low absorption and adaptation process and a weak connection with technological centers. Thus, the use of the important knowledge infrastructure, developed in the last 30 years, increases the differences among firms as some companies are reluctant to carry out innovative projects. An additional issue is that the overall progress made in terms of efficiency and innovation has not been accompanied by a similar evolution of values; on the contrary, a deterioration of them is suggested. For example, it seems that the ethic of work is changed as young people do not want to be entrepreneurs, and the figure of the entrepreneur/businessman does not have the same social ascendancy as in the past (risk culture decay).

The facts mentioned are essential conditions to meet the challenge of reinvigorate the adaptive capacity towards the exploration of new competitive avenues and/or resources. In this regard, the role of social capital would be fundamental to recall long-range collective commitments by strengthening institutional mechanisms and to reinforce risk culture and knowledge dissemination.

The *strategic planning* mechanism is critical for the generation of agreements related to common goals and criteria for action. The view on how to address the challenges is unambiguous: it aims to "enable all kinds of collaborative initiatives, preferably at the structural level, to be stronger and face the future with

confidence" (President AFM). It also promises an acquired capacity to compete internationally (e.g. leveraged by AFM international promotion programs) and to take advantage of an important regional innovation system. The AFM Strategic Planning was directed at coping with geographical expansion in terms of sales, growth in niches and improvement of competitiveness and profitability (AFM-SPRI). So, strategic thinking is directed at adjusting paths for improving the operational scale (i.e. to have bigger firms) and the transference of the R+D+I outcomes, that must be reinforced in trust. An example of a strategic initiative to solve those concerns is the creation of a Centre for Innovation and Technology Transfer for SMEs (ASNAOLA) emerged in 2010 as a collaborative project led by IMH (Navarro, 2014)[40]. Tech centers are currently so relevant because they reduce gaps (a pathway to pass a status of followers, in terms of innovation tech generation, to a status of first adopters or appliers). Finally, the industrial employment in developed countries recorded a downward trend while services related to industrial production gain relevance; thus, there is a great confront for integration (Baró-Tomas, 2013). The few studies regarding servitization in the MT industry highlights its strategic importance to the competitive challenges confronting emerging economies based on cost reduction (Copani et al. 2010; Hsiao-Chen et al. 2014). In the case of Europe, a significant fragmentation among large companies based on an established culture for innovation and export orientation have quickly adopted these innovative practices, and smaller companies that continue with conservative and reactive policies only to specific requirements are observed (Copani et al. 2010). Thus, due to the significant participation of SMEs in the cluster, it should appeal to Social Capital to activate common strategic actions as it attempts to address this major challenge.

At the same time, a current vital exogenous determinant is the responsiveness to a *regulatory framework* that is being strongly determined by the requirements of quality, security (there is already a consolidated situation in those aspects), and environmental protection. Thus, quick positioning at the later through collaboration will boost widespread adaptation and improve machine tool builders' reputation. An example of this type of initiative is the "CENIT Project: Advanced Technologies for manufacturing equipment and processes 2015" conducted between 2006-2010 with the participation of 20 companies and 17 other industry players (led by the 4 most important MT firms). The purpose of the project is to promote product leadership in terms of eco-efficiency, accuracy and productivity, while incorporating smart technologies and process integration.

In brief, the development of institutional mechanisms will help to encourage collective action to deal with the cluster competitive strengths and weaknesses. In this process, the exploitation of the value system (Social Capital) in the Bajo Deba is considered a cornerstone in the supporting of the districts socioeconomic future *(*Andonegi and Arrieta, 2014), the stimulation of citizen participation aimed at reinvigorating the spirit of entrepreneurship, respect, integrity and cooperation (Debegesa[41]), and the management of local

40

[41]Project Gure Balioak: Our Values (Debegesa - Local Development Agency)

governance and social network development (Barandarian & Korta, 2011[42]). Though, there is a recovery from the crisis but it still does not represent a qualitative shifting to a new growth phase.

Table 6.6: Maturity Phase Key Trends (2009-today)

Macro Trend	Cluster Trend	Strategic Planning	Regulatory Framework
Global Crisis(2008)	Challenge to maintain high productivity, reputation with clients and external positioning.	Challenge for the structural increase in scale of production Customers' demands of integration of products and their associated services Need to improve the technological linkages of SMEs with the regional innovation system	Adaptation to Environmental Concerns

Source: Own elaboration

6.5. Conclusions

Social capital's view based on longstanding values (work ethic, attitude to change and reciprocity) provides a crucial basis for interpreting the development of clusters through the development of internal collective responses to prosper despite external pressures. Thus, this work helps increase understanding of the role of social capital to enhance the generation of different adaptive options (and support the design of regional policies) and fits into the literature of the life cycle of the clusters. Moreover, the focus on the historical process provides an opportunity to observe differentiated behavioral patterns (based on specific local idiosyncratic characteristics) into clusters and their development.

The empirical analysis of the machine tool cluster in the Debabarrena area is schematized by the analysis of successive developmental stages to interpret the effective role of social capital in order to enable different developmental mechanisms of growth. It is worth to say that, at different critical moments, social capital has been a major factor for ensuring a sustainable path.

At the initial stage, Basque society's propensity to strong competition, hard work and a sound sense of community served to encourage pioneering manufacturers to channel their business risk attempts and to provide the necessary funding needs. The exploitation of previously existing skills and the deep sense of creativity in the field of metal processing were used to satisfy a strong demand for industrial goods in the Spanish market after the Civil War. In turn, an open attitude towards migratory flows was conditioned by modesty and dedication to work as valuable guides in such process of integration.

After that, a period of sustained Spanish industrial development (1960-1975) was accompanied by a significant expansion in the founding of MT companies. The imprint of social values facilitated the openness for the transfer of knowledge which was carried out in different ways such as enterprises set up by workers

[42]Gipuzkoa Sarean Project - Social Capital and Value in Gipuzkoa.

from the pioneer factories (spin-offs), the promotion of cooperative schemes and a positive link between companies and local schools. In addition, MT managers had prominent involvement in adapting the training infrastructure to local idiosyncrasies. Complementarily, the existence of implicit codes and practices helped to frame a favorable scenario for discussion and community integration.

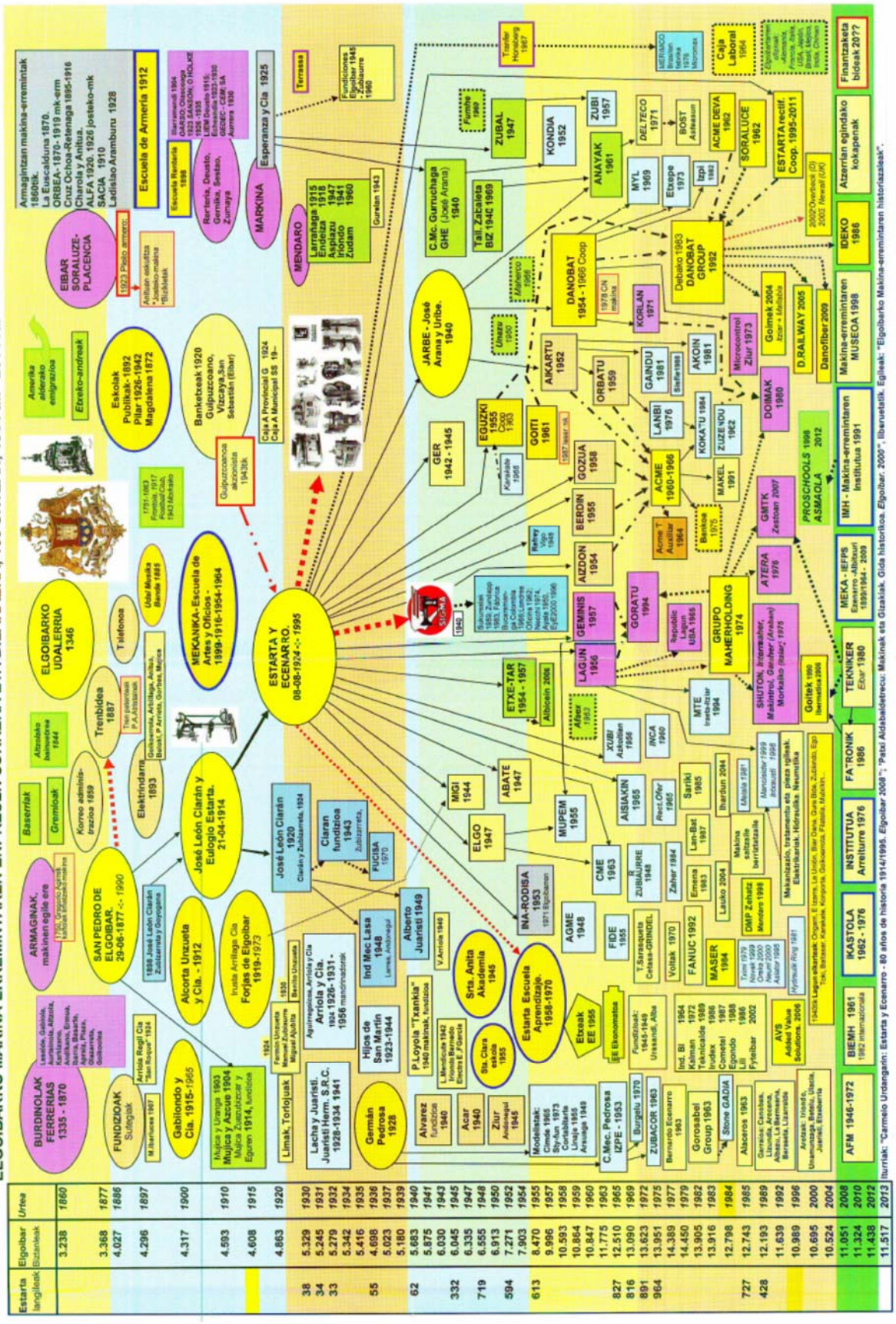
By the mid-1970's, the previous process of expansion began to show signs of tension affected by structural changes in political, economic and technological spheres. Thus, against a background of stagnation in entrepreneurship and strong foreign competition, social capital contributed to find sufficient cohesion for strategic planning initiatives, action and regulation (institutional arrangements). The creation of the vocational training institutes, the technology centres, and the cluster association are examples of such collective commitment.

Subsequently, grounded in the foundations of the previous step, the cluster has undergone a growth path (1994-2008) in which social capital has served to reinforce the exploitation of culture of risk mechanism and technology upgrades. The sustained strengthening of foreign sales and the generation of competitive technological development has been the core for transformation. Additionally, government intervention has been positive to complement the collaborative nature of the Basque society.

The crisis of 2008 highlighted the need for local manufacturers to adapt, based on the collaboration of the local productive system, to a global context that demands mandatory conditions of productivity, flexibility and environmental compliance. Thus, the need to reactivate the forces of growth is manifested; therefore, the role of social capital (supported on characteristic values of Basque society and Debabarrena) will be crucial to fostering joint action and local leadership. For instance, with the current challenges, the development of institutional mechanisms helps to create incentives for action based in the consolidated regional system of innovation and capacity of economic value generation. On the contrary, two factors of alarm, for the long-term sustainability of the cluster, are the decline in the rate of creation of enterprises and the smaller capacity of integration of immigrants which are clear evidences of the changes in local values.

Finally, there are certain possibilities of analysis that would enrich the study performed. For example, the study would benefit by conducting a quantitative study that complements and corroborates the connections observed at qualitative level. Also, by conducting interviews with MT manufacturers from other parts of Spain and the Basque Country would provide a platform for a qualitative comparison.

Figure 6.7. Andonegi & Arrieta's Elgoibar Machine Tool Production Network Evolution



Source: Andonegi & Arrieta, 2014

Chapter 7. Construction of synthetic indicators of the social capital facets and mechanisms

7.1. Introduction

One of the major controversies regarding the concept of social capital refers to its measurement due the diversity of methods and indicators used as it is not directly observable (Van Deth, 2003; Malecki, 2012; Beugelsdijk & Van Schaik, 2005). This is a consequence of the complex, dynamic, and multifaceted character of the concept (Woolcock & Narayan, 2000). So, there is a significant operational challenge to study the role of social capital in clusters (Staber, 2007). The starting point to approach such issue is to choose a conceptual character, the dimensions of interest, and the methods of operationalization. In this work, a community social capital perspective is adopted, and the dimensions of social capital are referenced to social values of ethic of work, attitude to change, and reciprocity (Becattini, 1990). In addition, from the extensive literature about the functioning of clusters, some cultural, institutional and technical mechanisms have been labeled to picture their role in the stages of clusters' evolution.

The quantification of the abstract features/dimensions of social capital and the mechanisms of development could be addressed through various data reduction techniques such as factor analysis, discriminant analysis, or the construction of synthetic indicators (OECD, 2008). The methodology adopted in this study to represent these conceptual units is the construction of composite indexes which consists of summarize the information of several simple indicators in a synthetic indicator (Paredes-Gazquez et al., 2016). This aggregation is obtained through some sequential steps that assure the efficiency, the quality, and the transparency of the results (OECD, 2008; Pérez-García et al., 2008; Schuschny & Soto, 2009; Paredes- Gazquez et al., 2016). So, this methodology is applied to a dataset of indicators of the Spanish regions. The use of this technique is justified by the small sample size (17 regions), and by the need to use a full set of representative indicators. Otherwise, they are discarded in other data reduction methods because they do not present sufficient correlation, or do not contribute sufficiently to the variance (OECD, 2008). Also, the advantages of using this technique are: the ability to summarize in a unique indicator a complex concept, and the easy interpretation and communication of the results; and therefore, the improvement in the effectiveness of comparison among regions of complex factors (OECD, 2008).

The goal of this chapter is to develop composite indexes (or synthetic indexes) to represent the social capital facets and the inducing mechanisms at regional level in Spain following the "ten-steps" methodology of the OECD (2008). Next, section 7.2 briefly relates the conceptual framework developed in chapter 3, which supports the construction of synthetic indicators, together with the rational of the selection of indicators. Then, section 7.3 presents the techniques of transformation, normalization and weighting of the indicators. In section 7.4, the results are discussed. Finally, the relevant conclusions are presented.

7.2. Theoretical framework and selection of indicators

The conceptual basis for the construction of synthetic indicators follows a community perspective of social capital. Three social values, which are suggested as key determinants for the evolution of clusters, are considered as salient facets of social capital: ethic of work, attitude to change, and reciprocity (Becattini, 1990). They have been determined as follows: a) ethic of work: the sense of responsibility and discipline that is committed towards a business and socio-economic aim, b) attitude to change: willingness to change (and to take risks), individually and collectively, to improve both business and territorial competitiveness, c) reciprocity: attitude towards sharing benefits and sacrifices within the local community to produce an all-encompassing development. On the other hand, from the extensive literature about the functioning of clusters it has been labelling some basic operating mechanisms that drive their development in their evolutionary stages: risk culture, diversity integration, strategic planning, regulatory framework, informal norms and dissemination of knowledge. With these conceptual bases, the process of compilation and selection of indicators to be used in the construction of the synthetic indicators associated with these complex concepts is described below.

7.2.1. Representative Indicators of Social Capital Facets

According to the guidelines of the OECD (2008) the selected representative indicators of a construct should have four requirements to comply: "analytical soundness, measurability, [country] coverage, relevance to the phenomenon". Thus, using a variety of secondary data sources, an extensive database of 51 socio-economic indicators of the Spanish regions[43] has been compiled (Annex 7.1). To be objective and to avoid size bias in the comparisons, the indicators have been transformed into relative measures (Schuschny & Soto, 2009) by adjustments for the number of firms, active population, employed population, or area (sq-km). For the construction of the composite indicators of social capital facets, 11 simple indicators have been selected (Table 7.1), and the rational of selection is presented below.

7.2.1.1. Representative Indicators of Ethic of Work.

Four variables are assumed as indicators of the ethic of work: work stability, unemployment, work productivity, and strikes. The first one is the percentage of permanent work contracts in the region; it is assumed that it measures the propensity to establish long-term relations between firms and workers. The second one is the rate of unemployment, which relates to the level of overall economic performance (e.g. Fazio & Piacentino, 2010) as well as the level of rigidity of the regional labour market as it is included in

[43] Ceuta and Melilla are not considered due to lack of data in some indicators.

Rodriguez-Pose & Crescenci (2008) to represent a social filter[44] indicator. The third indicator is the work or labour productivity which is considered a proxy of progress achievement as well as a measure of labour competitiveness (Fazio & Piacentino, 2010; Espejo-Benitez & Hidalgo-Pérez, 2011). In addition, it is worth to mention that this indicator has an inverse relationship with the indicator of effective working hours (e.g. Adeco-IESE). At the territorial level, this aspect shows that the richer territories work fewer hours, which is a consequence of differences in regulatory affairs, social behavior, and work effectiveness. Finally, the indicator of strikes could be interpreted in different meanings, which prevents to assign an expected sign. On the one hand, it refers to the degree of labor (and social) conflict which typically arises during the downward phase of a business cycle. On the other hand, it means the cohesion of workers to change and to intervene for the safeguard of their regulatory affairs (e.g. Yamada & Salgado, 2006). In this study, the second view is adopted.

Table 7.1: Social capital facets selected indicators

	Cod.Vble.	Variable Name	Description	Initial Date	End Date	Unit	Exp. Sign	Source
Ethic of Work	z1	Work Stability	Indefinite Registered Contracts / Total Registered Contracts	2000	2010	%	+	Fundación Encuentro (MEySS: Anuario de Estadísticas)
	z2	Unemployment	Unemployment Rate	2000	2010	%	-	INE - Encuesta Población Activa
	z3	Work Productivity	GDP at market prices / Occupied Population (1991-2010)	2000	2010	%	+	INE / Fund.Encuentro
	z4	Strikes	Participation / Workers affiliates to Social Security (SSN)	2000	2010	%	+/-	INE (Social Indicators 2011); Min. Empleo y Seg.Soc.
Attitude of Change	z5	Exports Sophistication (Manufactures)	Exports sophistication value (manufactured products)	CAGR 1995-2005		Index	+	Minondo (2008)
	z6	High Tech Patents	High tech sectors patents applications to the EPO (Every million of inhabs.)	2000	2010	Index	+	Eurostat
	z7	Innovation	Expenditure in Tech Innovation (Euros per inhabitant)	2005	2010	Index	+	Bergua-Amores et al. (2016)
Reciprocity	z8	Coops+Associations	(Cooperatives + Associations) / Surface area (Sq-km)	2000	2010	Index	+	Fundación Encuentro (INE - DIRCE)
	z9	Blood donations	Absolute Index	2011	2011	Index	+	Casado-Neira (2013)
	z10	Electoral participation	Participation in Autonomic Elections	1995	2008	%	+	Observatorio Social de España
	z11	Crime Rates (Arrested)	Detained persons every 1000 inhabitants (By Civil Guard & National Police)	2000	2010	Index	-	INE - Indicadores Sociales 2011

Source: Own elaboration

[44] This means "the combination of social and structural conditions in every territory" (Rodriguez-Posse & Crescenci, 2008).

7.2.1.2. Representative Indicators of Attitude to Change.

The attitude for change is represented using three measures: exports sophistication, high tech patents' applications to the European Office of Patents (EPO), and an innovation technology index. First, a measure of exports sophistication of manufactures shows the regional specialization patterns as well as the degree of change and adaptation (Minondo, 2007, 2008). So, a higher level of exports sophistication is the result of long-term efforts to participate in competitive external markets. Second, high tech patent applications to the European Patents Office is used as a proxy indicator of the territorial capacity to be positioned in the technological frontier. Finally, the innovation indicator is used to capture the regional differences of the level of resources devoted to technological innovation as "innovation is the critical component of long-term economic prosperity, driving productivity growth and (if spread across key sectors of the economy) ensuring broad-based economic growth." (Sallet, Paisley, & Masterman, 2009).

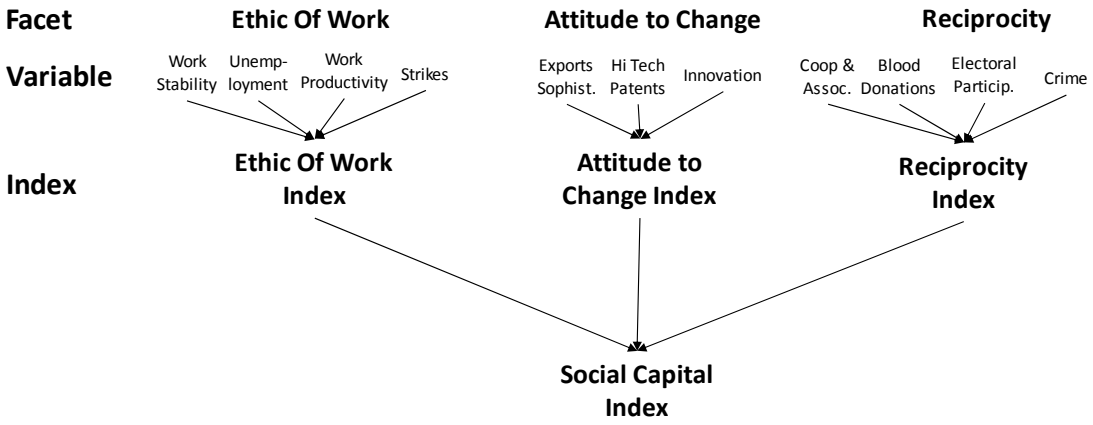
7.2.1.3. Representative Indicators of Reciprocity.

Reciprocity is approached using four indicators: cooperativity and asociativity, blood donations, electoral participation, and crime rates. The number of associations (non for profit) per sq-km captures the level of altruism and social involvement towards "fostering networks of civic engagement … and pro-social behaviour" (Crescenzi, Gagliardi & Perocco, 2013). Also, the development of cooperatives refers to the presence of a kind of economic organization whose mainstay principles are "the use of democratic methods in its organisation, job creation, promotion of its workers in human and professional terms and commitment to the development of its social environmentis" (Errasti et al. 2003)[45]. The indicator of blood donations also means pro-social behavior and it shows the interest to contribute with such valuable resources into the community as it is used in Crescenzi & Perocco (2013). The electoral participation indicator is a common measure used in different studies about Social Capital (Van Deth, 2003) and it refers to the interest of the people to be involved in the political decisions. Finally, crime rates are also used in the community view of social capital (Van Deth, 2003), and it is assumed that societies with lower crime rates are more prone to conduct reciprocal relations (i.e. trust-based rationale).

The basic scheme for the construction of the social capital facets composite indicators is presented in Figure 7.1.

[45] While the authors refer specifically to the cooperative movement of Mondragon, the aforementioned is representative of the general principles of cooperativity.

Figure 7.1: Social capital facets composite indexes basic scheme



Source: Own elaboration based on IDH template.

7.2.2. Representative Indicators of the Mechanisms.

From the database of 51 socio-economic indicators compiled (Annex 7.1), 11 have been selected to compose the synthetic indicators of mechanisms (Table 7.2).

Table 7.2: Indicators used for mechanisms composite indexes

	Cod_Vble	Variable Name	Description	Initial Date	Last Date	Scale	Exp. Sign	Sources
Risk Culture	z13	New Firms (Capital)	New firms capital / New Firms	2000	2010	%	+	Fundación Encuentro (Bank of Spain Data)
	z14	Net balance of firms Stock	(New Firms - Death Firms) / Total Firms (1999-2013)	2000	2010	%	+	INE - Estadística Sociedades Mercantiles
Diversity integration	z16	Unemployment Gap	Spanish people unemployment rate - Foreign people unemployment rate	2002	2010	Index	-	INE - Encuesta Población Activa
	z17	Tolerance	Tolerance to Inmigrants	2011	2011	Index	-	Bergua-Amores et al. (2016)
Strategic Planning	z19	Financial Support for Local Development	Funds to support employment & R&D (2003-2013) / Active Population	2003	2010	Index	+	MEySS - Anuario Estadístico / Ayudas para
	z20	Gross Investment per capita	Gross Investment / Active Population	1990	2010	Index	+	IVIE
Regulatory framework	z22	Quality Certifications	Firms with quality certifications (Average 2000-2007 every 1000 firms)	2007	2007	%	+	Fundación BBVA
	z23	Work Accidents	Incidence Index (every 100 th. workers at risk)	2000	2010	Index	-	INE – Indicadores Sociales 2011
Informal Norms	z24	Conflict Resolution	Labor conflict resolution by extrajudicial way / Active Population	2003	2010	%	+	MEySS - Anuario Estadístico
Knowledge disseminati	z25	Industry Employment	(FP I + FP II + Superiores) / Ocuppied population	2000	2010	%	+	IVIE
	z26	People in R&D	Employment R&D / Occupied Population	2000	2006	%	+	Fundación Encuentro - INE / Estadística sobre

Source: Own elaboration.

7.2.2.1. Representative Indicators of Risk Culture.

Two variables are associated with the culture of risk issue. The first one refers to the ratio of new firms' net worth per capita and it is assumed to capture the predisposition to assume new risks (proxy of the value of the entrepreneurial efforts). The interesting issue is that the indicator not only measure the number of new firms but also it considers the amount of money exposed to risk. The second one is the net value of entry and exit of firms to existing firms approximates the business dynamism in the region.

7.2.2.2. Representative Indicators of Diversity Integration.

Two measures are used to approximate the meaning of diversity integration. The gap in the unemployment rate among the native and the inmigrants is a direct measure of the level of integration (e.g. Guzi et al. 2015). Also, it is included an indicator of tolerance to the inmigration which captures the degree of opening to receive foreigners in the local community (Bergua-Amores et al. 2016).

7.2.2.3. Representative Indicators of Strategic Planning.

First, a measure of financial support to the enhacement of employment programs and entrepreneurial outcomes at local / municipality level. Second, the public gross fixed capital formation is used as a proxy of the public level of investment (or economic resources) devoted to infrastructure development.

7.2.2.4. Representative Indicators of Regulatory Framework.

Two indicators are used to construct the regulatory framework index. First, the degree of compliance of quality standards. As there is no time series of this indicator, it is made an aggregation of the level of firms' quality achievement in the largest territorial agglomerations of each region from a study by the BBVA Foundation. Second, an index of work accidentally is used as the regulatory framework assuming that lower accidentally is reflected in better prevention programs and safety regulations.

7.2.2.5. Representative Indicators of Informal Norms.

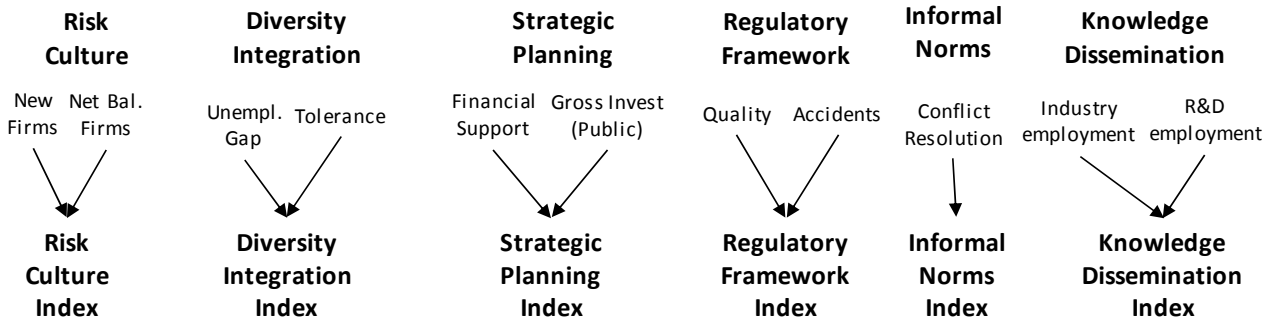
It is very difficult to find a proxy indicator of informal norms; so, the measure of labor conflict resolution via extrajudicial way is used as indirect mean of the existence of "informal" procedures to resolve problems.

7.2.2.6. Representative Indicators of Knowledge Dissemination.

The knowledge dissemination mechanism is approximated using two measures. First, the educational level employed in the industry shows the availability of a pool of skilled resources able to absorb new knowledge (used in Espejo-Benitez & Hidalgo-Pérez, 2011). Second, the level of R&D, which is assumed an indicator for the capability to absorb and to spread knowledge, is associated to the number of people in private firms involved in R&D activities.

In Figure 7.2 is presented the basic outline of the construction of composite indicators to be performed for the operational mechanisms.

Figure 7.2: Outline of indicators for mechanisms composte indexes



Source: Own elaboration based on IDH template.

7.3. Methodology

With the data compiled and selected in the previous section, a data matrix is composed containing in rows, the autonomous communities, and in columns, the simple indicators (see Annex 7.2 & Annex 7.3). Most indicators are averages for the 2000-2010 period, otherwise information available of a shorter period has been used due to they are considered critical variables and they are mostly structural variables which is expected do not exhibit severe volatility. The choice of the the time interval (2000-2010), and the calculation of the average is supported in different reasons. First, it is conceptually assumed that facets and mechanisms are the result of path-dependent processes; so, they reflect long-term structural patterns. Second, to take until 2010 is to reduce problems of reverse causality (endogenity). Third, the use of average figures responds to the need to establish levels of social capital facets and to reduce the effect of extreme cases.

7.3.1. Data transformation.

Once the simple indicators have been selected, according to their theoretical justification, and adjusted to relative measures, to make sense of comparison, a transformation of them is made in such a way that they become "the greater their value, the better " (Idem to Pérez-García et al. 2008). The indicators that are transformed to their inverse vale are: unemployment, crime rate (arrested), unemployment gap, tolerance, and work accidents.

7.3.2. Multivariate Analysis.

These techniques are used to know about the data structure, its suitability, and "the understanding of the implications of the methodological choices" (OECD, 2008). However, as pointed out by Schuschny & Soto (2009), “it should be noted that if the sample of information contained in the variables (number of data) is small compared to the number of variables selected, it should be avoided to use these techniques Since the results will not, of course, be representative". In that case, they advise "to resort to simple exploratory analysis, contemplating tables of frequencies and simple averages, as well as tables of correlation coefficients or graphs of two and three dimensions." Table 7.3 presents the descriptive statistics of indicators to be used which are all continuos.

Table 7.3: Indicators descriptive statistics (social capital)

	Average	Std.Dev.	Max.	Min.	Kurtossis	Assimetry
Work Stability	9,54	2,74	15,40	4,42	1,18	0,10
Unemployment	-11,45	3,44	-6,53	-19,39	0,86	-1,02
Labour Productivity	48119,64	8226,55	64198,00	30911,39	0,14	0,00
Strikes	3,06	3,49	13,16	0,22	3,61	1,91
Exports Sophistication	0,88	0,86	2,44	-0,72	-0,11	-0,27
High TecH Patents App.	6,62	6,28	25,96	1,41	5,05	2,13
Innovation Index	322,71	255,02	963,71	74,68	1,18	1,35
Coops. + Assoc.	0,07	0,06	0,22	0,01	0,60	1,22
Blood Donations	7,88	6,54	20,73	1,32	-0,73	0,78
Electoral Participation	68,87	5,08	76,18	60,33	-1,13	-0,35
Crime	-6,02	1,82	-3,59	-9,34	-0,80	-0,43

Source: Own elaboration.

Table 7.4: Indicators descriptive statistics (mechanisms)

	Average	Std.Dev.	Max.	Min.	Kurtossis	Assimetry
New Firms' Investment	77,81	38,58	182,11	41,74	3,65	2,01
Net Stock of Firms	3,13	0,81	4,61	2,03	-1,36	0,22
Unemployment Gap	-7,73	2,92	-2,62	-13,91	0,37	0,12
Tolerance to Inmigrants	52,16	24,39	100,00	17,36	-0,95	0,13
Financial Support R&D / employment	3986,11	2252,20	9020,12	542,65	0,83	0,84
Gross Investment pc	2278,39	493,98	3105,81	1546,18	-1,14	0,27
Quality Certif.	9,63	2,27	14,36	5,89	0,51	0,80
Work Accidents Index	-5255,22	616,04	-4443,70	-6614,10	0,21	-0,91
Conflict E xtrajud.	0,23	0,12	0,54	0,06	2,07	1,22
Industry Employment (qualifications)	62,22	35,17	138,83	18,06	0,03	0,73
People in R&D	0,73	0,36	1,47	0,21	-0,05	0,78

Source: Own elaboration.

7.3.3. Normalisation.

Due to heterogeneity in the scales of the compiled data, it is necessary to implement a standardization procedure to avoid scale biases (Pérez-García et al., 2008). The simplest method of normalization is the ranking (OECD, 2008), used for example, in Broto & Lamas (2016), and consists of ordering the values and assign them a ranking, in this case between 1 and 17 (i.e. the number of regions). The advantage of this method is that it is not affected by extreme cases like in min-max normalization procedures (OECD, 2008; Broto & Lamas, 2016). Next, the score for each region is obtained by dividing its ranking with respect to the highest position (17); so, the range of the values are between 0.06 and 1 (i.e. 1 is the best best score).

7.3.4. Weighting and Aggregation.

For the calculation of the weights of each index of the social capital and of the mechanisms' indexes, the principal component technique is used which is one of the procedures recommended by the OECD (2008). For example, this weighting technique is used in Broto & Lamas (2016) for the calculation of a financial liquidity index. The procedure consists in squaring the factorial loads; then, the partial weighting is calculated as the ratio of the maximum factor load of each indicator to the sum of the maximum loads in that component (in bold in table 7.5). The final weighting results from multiplying the partial weight of each indicator by the percentage of variance explained by the component (Table 7.5). Subsequently, to compose the index of social capital, the indexes of the facets are added, with a weighting of 33% in each case since

there are no theoretical or practical reasons to assign a greater or lesser weighting between facets. For their part, in the case of the mechanisms, they are exposed as individual indexes.

Table 7.5: Calculation of the social capital facets indexes weights

	Vble.	Component					
Ethic of work	**Code**	**1**	**2**	**Squared**	**Squared**	**Partial**	**Final**
Work Stability	z_n_1	-,793	,467	**0,628**	0,219	0,317	**0,077**
Unemployment	z_n_2	,934	,073	**0,873**	0,005	0,440	**0,107**
Work Productivity	z_n_3	-,158	,931	0,025	**0,867**	1,000	**0,758**
Strikes	z_n_4	,694	,647	**0,481**	0,419	0,243	**0,059**
		,678	2,119				
		24%	76%				

	Vble.	Component					
Attitude to change	**Code**	**1**	**2**	**Squared**	**Squared**	**Partial**	**Final**
Exports Sophistication (Manufactures)	z_n_5	,088	,995	0,008	**0,990**	1,000	**0,310**
High Tech Patents Applic.	z_n_6	,967	,046	**0,936**	0,002	0,504	**0,348**
Innovation	z_n_7	,959	-,138	**0,920**	0,019	0,496	**0,342**
		2,015	,903				
		69%	31%				

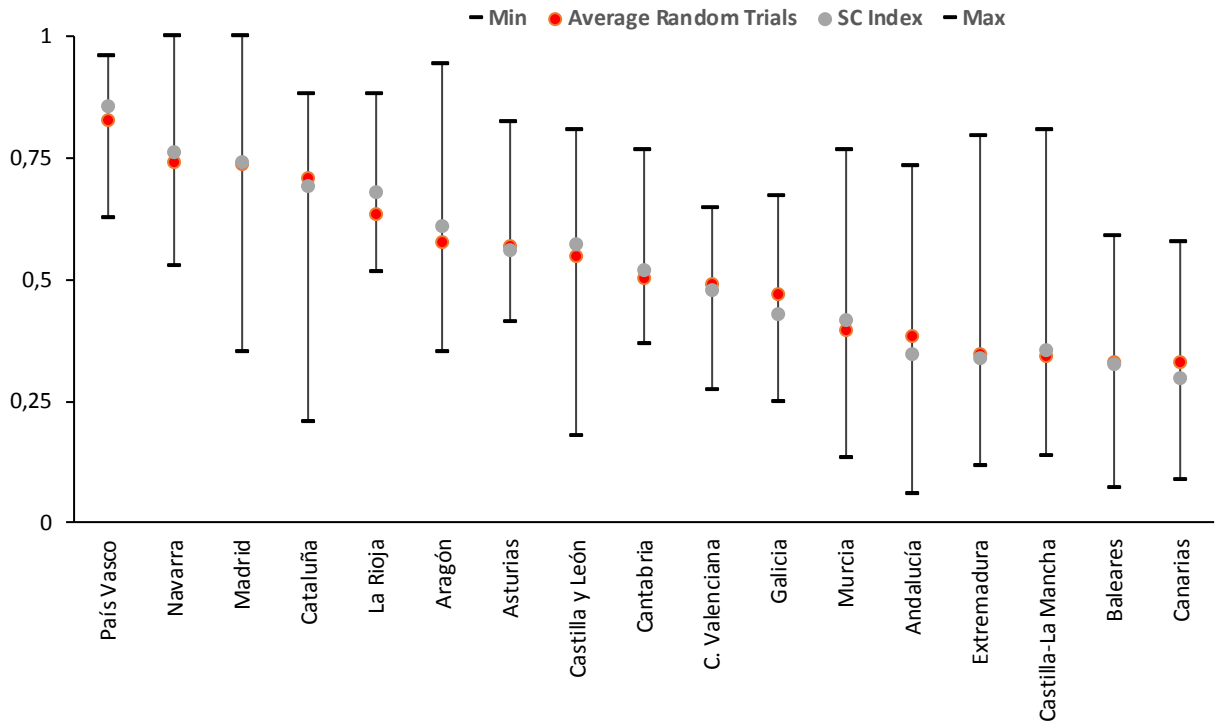
	Vble.	Component					
Reciprocity	**Code**	**1**	**2**	**Squared**	**Squared**	**Partial**	**Final**
Coops + Assoc per sq-km	z_n_8	-,660	,526	**0,435**	0,277	0,255	**0,176**
Blood Donations	z_n_9	,746	,524	**0,556**	0,274	0,325	**0,224**
Electoral Participation	z_n_10	,417	-,770	0,174	**0,593**	1,000	**0,310**
Crime (arrested)	z_n_11	,847	,328	**0,717**	0,107	0,420	**0,289**
		1,349	,608				
		69%	31%				

Source: Own elaboration.

7.3.5. Robustness and sensitivity.

To assure the quality of the outcomes, a sensitivity analysis should be carried out through the determination of the sources of uncertainty and the evaluation of the changes in the results. The sources of uncertainty usually considered are: inclusion / exclusion of indicators, changes in the method of transformation and normalization, and changes in weights and / or aggregation method (OECD, 2008 p.34). In this thesis, an exercise of simulation has been performed considering that the weights of each indicator of the facets, and the aggregation weights of the social capital index are the uncertainty sources. For this, 10.000 trials were generated, assigning randomness to different distribution of weights. The results of the obtained distributions are shown in Figure 7.3. The correlation between the average of the 10.000 random trials and the index of social capital is 0.9.

Figure 7.3: Uncertainty analysis (Social Capital Index)

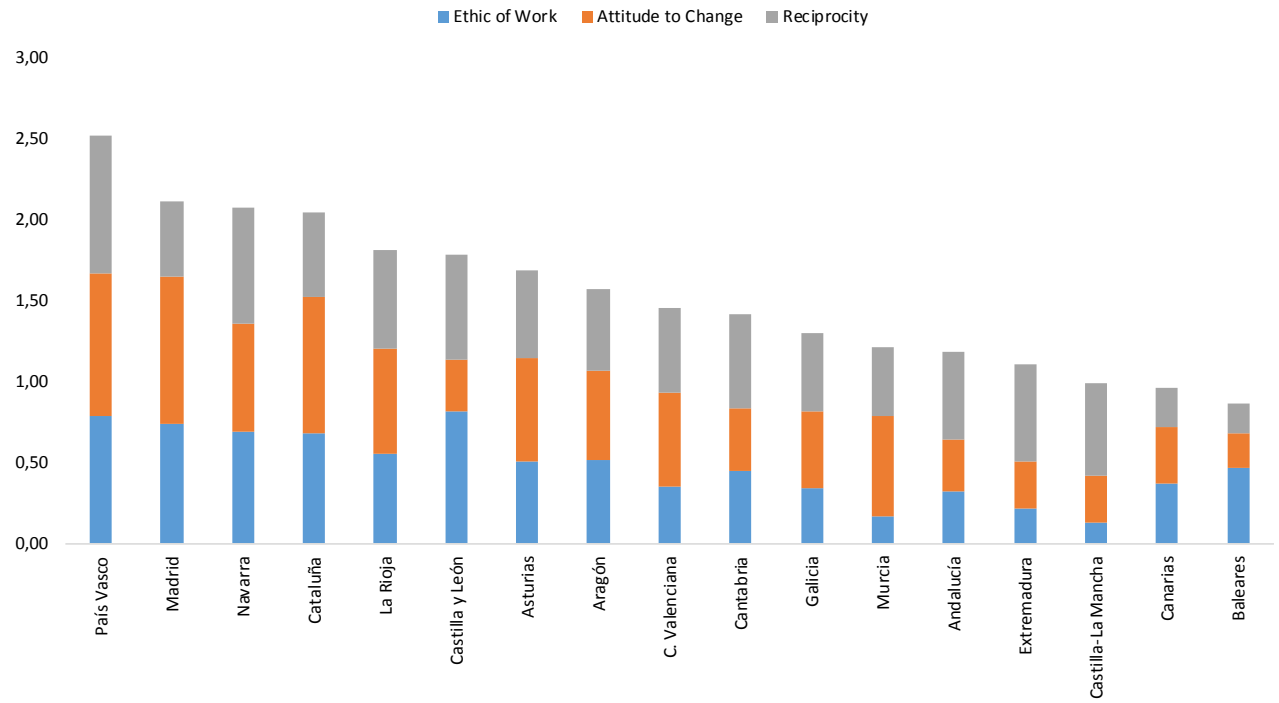


Source: Own elaboration.

7.3.6. Back to the real data.

The construction of synthetic indexes is performed to compare the level of social capital among the Spanish regions which could help to shape economic policies; thus, it is recommended to evaluate how "transparent and fit" are the index by its decomposition "into the underlying indicators or values" (OECD, 2008). In the Figure 7.4, the participation of each facet in the score of each region is presented. Positively, it can be seen that there is not a dominant factor affecting the overall social capital index, and that in turn regional differences can be identified in the different facets.

Figure 7.4: Decomposition of social capital facets indexes



Source: Own elaboration.

7.3.7. Links to other values.

It is suggested that it is necessary to "correlate the composite indicator with other published indicators, as well as to identify linkages through regressions" to gain grater insight about the quality of the index obtained. In this case, the computed social capital index is compared with three measures: the social progress[46] index in 2016, the new index of human development[47] (average 2000-2010), and the average of stock of social capital per capita calculated by the IVIE (Instituto Valenciano de Investigaciones Económicas).

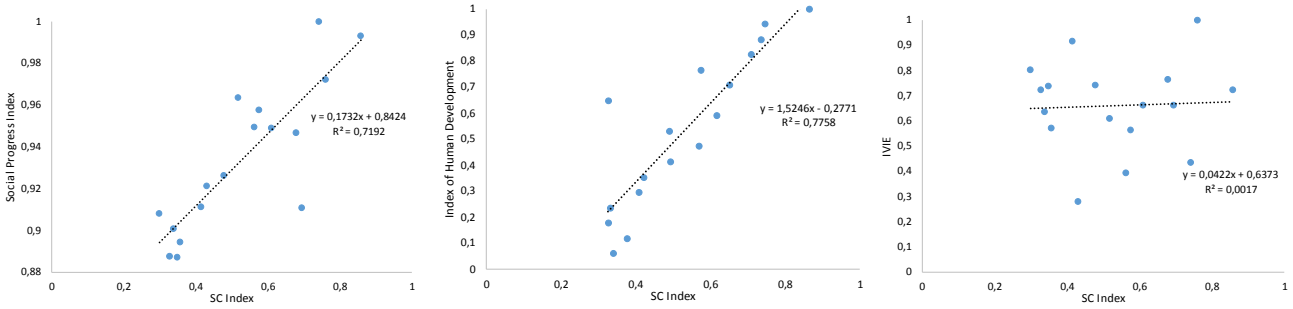
Figure 7.5 shows that the social capital index presents an adequate adjustment with the social progress index and the index of human development. However, the relationship with the IVIE's social capital per cápita is not clear. Significant differences are observed in the case of the autonomous communities of the Baleares, Murcia and Canarias, which receive a higher score in IVIE; while, in the case of Galicia, Asturias, País Vasco and Madrid the IVIE assigned them a relatively score significantly lower than our calculation. A reason that could explain these differences resides in the methodological approach since the IVIE makes an economic valuation of social capital as an asset under the assumption that investment in social capital is made if the

[46] This is an index "based on a range of social and environmental outcome indicators organized within three dimensions of social progress: Basic Human Needs, Foundations of Wellbeing, and Opportunity." http://www.socialprogressimperative.org/social-progress-indexes/

[47] This index "is an indicator of the level of economic development in countries that combines health, education and income measures." http://www.ivie.es/es/banco/desarrollo_humano.php

future payments of such investments are greater than the costs involved (see Fernandez de Guevara et al. 2015).

Figure 7.5: SC Index vs. other measures

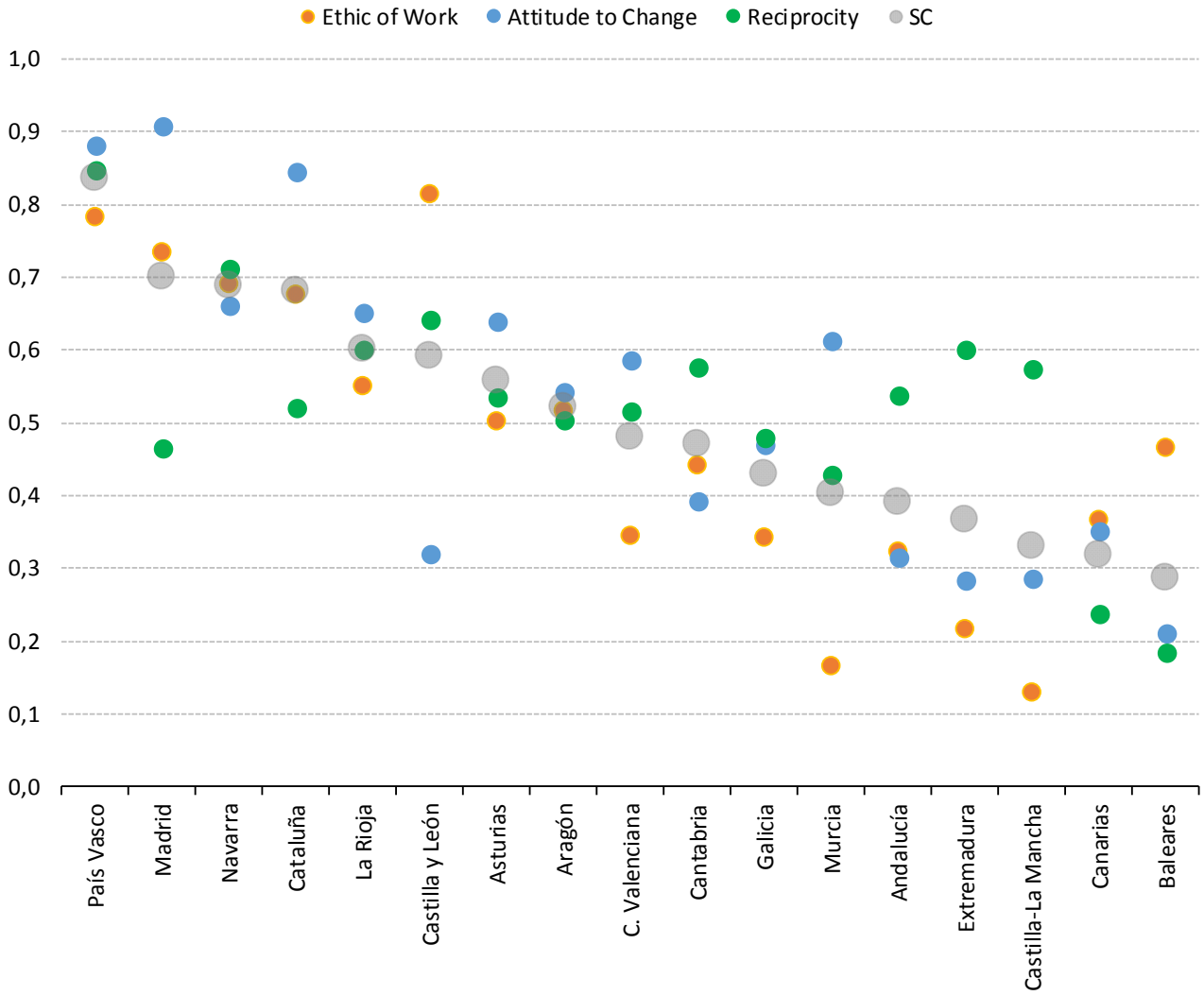


Source: Own elaboration.

7.4. Results

The results show that the overall index of social capital presents better scores in two largest urban and economic Spainsh conglomerates (Madrid and Catalonia), and in the northern regions (Basque Country, Navarra, La Rioja, Castilla y León, and Asturias). So, a neighbouring effect it seems to be observable. The reciprocity index shows the lowest regional divergences (standard deviation of 0.15); while, the work ethic index presents greater divergences among regions (standard deviation of 0.27). While the Basque Country, Navarra and La Rioja do not show major differences in the contribution of each facet; in Madrid and Catalonia, the attitude to change is predominant.

Figure 7.6: Social capital index and facets

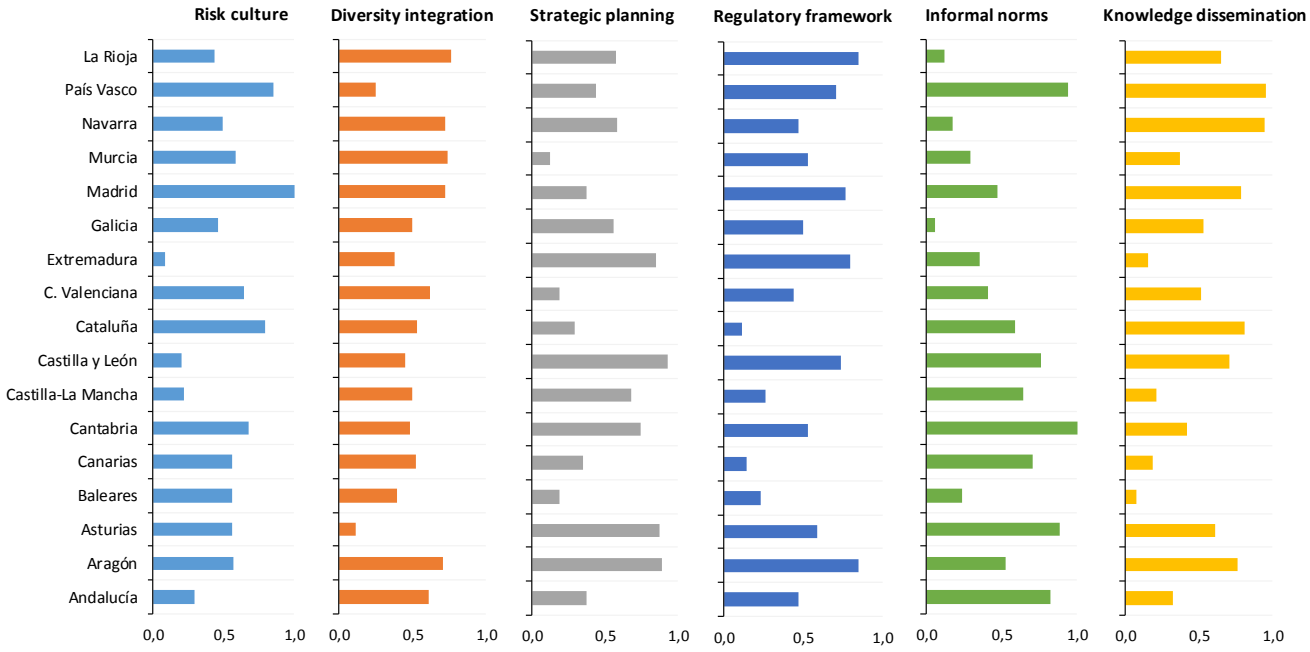


Source: Own Elaboration

The results for the development mechanisms are presented in Figure 7.8. In relation to risk culture, the regions with the most positive business and investment dynamics are the Basque Country, Catalonia and Madrid; meanwhile, the regions of Extremadura, Castile and Leon and Extremadura show an unfavorable dynamic in this regard. The integration of diversity seems to be stronger in La Rioja, Navarra and Murcia, while the Basque Country and Asturias present the worst indicators. The strategic planning of the communities of Castilla y León, Aragón and Asturias present a better relative positioning, while Baleares, Comunidad Valenciana and Murcia show a relative delay at this matter. The regulatory framework mechanism favorably positions Aragón, La Rioja and Extremadura, and with an unprofitable indicator in the Canarias, Catalonia and Castilla-La Mancha. The presence of informal norms is positive in Cantabria, Basque Country, Asturias and Andalucía, while Galicia, Navarre and La Rioja have shown a weak indicator. Finally, in the dissemination of

knowledge, the Basque Country, Navarre, Catalonia and Madrid predominate over the rest, and among the most lagged are the Baleares, Canarias and Extremadura.

Figure 7.7: Mechanisms' indexes



Source: Own elaboration

Finally, as a matter of the links between the facets of social capital and the indexes of the mechanisms, the analysis of the correlation matrix shows clear relationships patterns (Table 7.8). First, considering the mechanisms between them, the risk culture index has a positive and significant relation with the knowledge dissemination index. This is surprising due to it assumed that, in Europe, spending in R&D is not related to firms' creation (i.e. the "knowledge paradox" e.g. Audretsch & Keilbach, 2008). Also, regulatory framework is high with knowledge dissemination (but statistically insignificant) which is logical due to the institutional interlinkages. Another significant and with negative relation is between diversity integration and the informal norms that seems to validate the argument that in highly homogenous societies, the propensity to integrate inmigrants is low (at least in the short term). Second, the analysis of the correlation among facets of social capital and mechanisms shows a high relation (and positive) between the ethic of work and the attitude of change with the risk culture, the regulatory framework and the knowledge dissemination.

Table 7.8: Correlation matrix

#		1	2	3	4	5	6	7	8	9	10
1	Risk Culture	1									
2	Diversity Integration	0,454	1								
3	Strategic Planning	-,575*	-,558*	1							
4	Regulatory Framewor	0,318	0,158	-0,115	1						
5	Informal Norms	-0,126	-0,398	0,289	-0,032	1					
6	Knowledge Dissemina	0,466	-0,339	-0,066	0,392	0,062	1				
7	Ethic of Work	0,350	-0,200	-0,157	0,265	0,109	,776**	1			
8	Attitude to change	,714**	-0,018	-0,442	0,473	-0,015	,784**	,572*	1		
9	Reciprocity	-0,023	-,614**	0,285	0,362	0,251	,657**	0,307	0,389	1	
10	Social Capital	,483*	-0,296	-0,187	0,450	0,126	,939**	,860**	,845**	,627**	1

Source: Own elaboration

7.5. Conclusions

The purpose of this chapter is to develop composite indexes (or synthetic indexes) to represent the social capital facets and the inducing mechanisms at the Spanish regional level following the "ten-steps" methodology of the OECD (2008).

The achievement of representative measures of complex concepts, which are not directly observable and represent a major operational challenge in the literature (e.g. Staber, 2007; Malecki, 2012; Beugelsdijk & Van Schaik, 2005), signifies a major contribution.

Two major conclusions are worth to mention. First, in relation to the index of social capital and the facets, the outcomes reveal a rather logical order with higher values assigned to the northern regions and those with greater economic and demographic power (e.g. Madrid and Cataluña). Also, the regional ranking of the social capital index scores is appropriately adjusted with other indicators of the level of social cohesion. Second, as a matter of the links between the facets of social capital and the indexes of the mechanisms, the analysis of the correlation matrix shows clear relationships patterns (Table 7.8). First, considering the mechanisms between them, the risk culture index has a positive and significant relation with the knowledge dissemination index. This is surprising due to it assumed that, in Europe, spending in R&D is not related to firms' creation (i.e. the "knowledge paradox" e.g. Audretsch & Keilbach, 2008). Also, regulatory framework is high with knowledge dissemination (but statistically insignificant) which is logical due to the institutional interlinks effects. Another significant and with negative relation is between diversity integration and the informal norms that seems to validate the argument that in highly homogenous regions the propensity to integrate inmigrants is low (at least in the short term). Second, the analysis of the correlation among facets of social capital and mechanisms shows a high relation (and positive) between the ethic of work and the attitude of change with the risk culture, the regulatory framework and the knowledge dissemination.

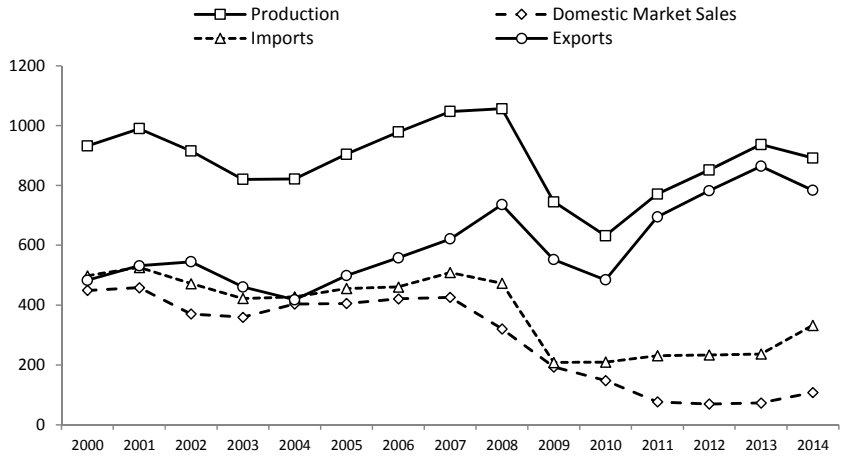
The performed study has some limitations. First, one widely noted disadvantage of the methodology of construction of synthetic indexes is related to data availability, and the subjectivity involved in the choices made by the analyst. Therefore, indicators may have presented a potential bias due to the omission of variables as well as due to the criterias adopted by the analyst to deal with the selection of proxy indicators. Also, another controversial issue, in the social capital theory, is to make a proper differentiation between inputs variables and outputs variables. Second, these indicators will be used later in multilevel analysis (MLM) as second-level explanatory variables; thus, the high correlations between some mechanisms and the index of social capital (and the facets) could arise problems of multcollinearity.

Chapter 8. Social Capital in the Spanish metalworking technology industry during the crisis

8.1. Introduction

The effects of the overall economic turmoil initiated in 2008 have seriously affected the evolution of the Spanish industry. For example, in the machine tool (MT) industry between 2008 and 2010, a drop of 40 %, 35 % and 55 % in production, exports and domestic consumption respectively are strong indicators to magnify the effects of the crisis effects (Figure 8.1). While a recovery trend in 2011-2013 can be seen, it is not fully affirmed as the trend breaks in 2014 and pre-crisis levels of production are not reached yet. Therefore, the crisis highlights a stage of stagnation and the need to approach some critical challenges such as the need for a greater scale of production and the improvement of technological capacities. In this context, it is assumed that some companies have been able to maintain an adequate competitive position, while others have been severely affected by the crisis. The determinants of these heterogeneous performance is determined by firms' individual characteristics and strategic choices, and by spatial-level socioeconomic conditions (e.g. Burger et al. 2011; Porter, 1990, among others). Among the latter, social capital is considered an effective tool for the enhancement of risk, the exploitation of the knowledge, and the boost of institutional proceedings which should be key growth levers to enhance the current evolutionary state of the industry and to confront with the economic and financial crisis during 2009-2013. Thus, this research is connected to the following research question: Does social capital have a differentiated influence in clusters' performance under external pressures?

Figure 8.1: Spanish machine tool (2000-2014)



Source: AFM (Note: Provisional Figures in 2014).

To carry out the empirical analysis, the firms belonging to the cluster of metalworking technology manufacturing sector, as it is defined in Ketels & Protsiv (2014), have been selected. This choice is based on conceptual and operational reasons. First, Porter's definition of clusters does not restrict its borders to unique

classifications of economic activities (NACE codes), but considers a set of related activities in a complex configuration. Second, even though the qualitative analysis is focused on the machine tool manufacturing companies (that shows high concentration in some specific regions), maintaining this segmentation would prevent the analysis of the differential impact of social capital by regions.

There is a challenge to examine the influence of social capital on firms' performance with the focus on its capacity to activate distinctive cultural, institutional, and technical mechanisms. To this end, a multilevel model analysis is applied to deal with such individual and contextual effects which is a recommended approach in Economic Geography and Regional Science (Raspe, 2009; Srholec, 2010; Beugelsdijk, 2007) supported in the assumption that firms located in the same environment are not independent of each other and have similarities of behavior and performance. Hence, the firm-level of analysis contains as dependent variables some indicators of firms' performance, and as control variables some individual attributes. Meanwhile, the territorial characteristics of interest (i.e. social capital facets and mechanisms) are located at the higher level (region-level). Thus, the attention is directed to evaluate the general working hypotheses regarding that firms' performance variability is positively associated with the territory social capital and mechanisms interactions.

The goal of this research is to evaluate the effects of social capital facets and mechanisms on firms' performance during the period of economic crisis. Then, a multilevel method (Hox, 2002; Goldstein, 1999; Kreft & De Leeuw, 1998; Heck, Thomas, & Tabata, 2012, 2014) is applied to explain three indicators of performance at the firm-level: a) employment growth, b) labour productivity growth, and c) survival (binary variable). as a function of firm-level attributes and indicators of social capital and mechanisms measured at regional-level (i.e. NUTS 2 statistical regions). As it was mentioned above, the sample is composed by 6.951 firms belonging to the metalworking technology cluster (Ketels & Protsiv, 2014b) in Spain.

The research performed is the first exploratory attempt, at least from the reach of our knowledge, to measure in the Spanish context the impact of social capital (i.e. regional perspective) on the performance of firms using the multilevel regression technique[48]. As it is expected, the results show that that the firms' internal features are the key factors to explain their performance. At the same time, the influence of the location presents is minor (in line to other studies employing multilevel analysis in this field of research). In addition, partial evidence is obtained about the influence of social capital and its interactions with the mechanisms. Social capital is highly correlated with risk culture and knowledge dissemination factors; so, as social capital is statistically significant it is possible to assume that both mechanisms are significat as well. On the other hand, the effect of social capital to boost the rest of the mechanisms is not significant enough.

[48] Two working papers have been found in this area. First, Lorenz (2014) finds a positive impact of social capital in the innovation of companies belonging to 23 countries, and he confirms the validity of the moderating effect of social capital (country level) on "R & D expenditures and employee training". Second, Nerozzi, Pipitone & Ricchuti (2014) carry out an analysis of the effect of social capital (province level) on business productivity (calculated using the DEA method) in Italy.

The chapter is divided in four sections. Section 8.2 presents the conceptual frame of the research. Section 8.3 describes the procedures performed for the compilation of databases, and the variables sequential methodological steps implemented. Section 8.4 presents the results of the econometric estimation. Section 8.5 is devoted to discuss the results. Finally, some concluding remarks are presented.

8.2. Firms' performance and social capital

Regarding the performance of firms in an industry, two main approaches provide arguments about the key determinants (Hawawini et al. 2003; Hansen & Wernerfelt, 1989). On one side, in the field of Industrial Organization it is argued that firms' performance depends on the structural market conditions (i.e. industry-level). The Structure-Conduct-Performance (SCP) perspective points out that there is a strong link between the level of concentration (structure) in the industry to shape firms' strategic decisions (conduct) directed to maintain a dominant position (performance). Then, the major variables commonly included in this perspective are age, size, and market share among others. The criticism to this approach lies in its failure to clarify the "intra-industry heterogeneity in the performance" (Hawawini et al. 2003). On the other side, the resource-based view (Jovanovic, 1982; Caroll & Hannan, 2000) emphasizes that there are distinctive organizational capacities are the major drivers to explain firms' performance variability. So, this view uses path-dependency arguments explain the accumulative development of critical skills over time that further determines firms' heterogeneous outcomes. Then, there is consensus about the need to approach the study of firms' performance using a "balanced position" (Bridoux, 2010). This means that performance is determined not only by firms' individual configuration and their strategic choices but also, and importantly, by industry dynamics as well as spatial-level socioeconomic conditions (f.e. Burger et al. 2011; Porter, 1990, among others). At this matter, there is interest to examine the influence of social capital into firms' performance.

Popularized in the last 20 years, the idea of social capital was developed as part of a wide research program and is associated with values, norms and practices which determine the construction of social relations as a means of economic value generation (Bordieu, 1986; Becattini, 1990; Coleman, 1990; Putnam, 1993; Granovetter & Swedberg, 1992; Malmberg & Maskell, 2002; Parrilli, 2009, 2012; Staber, 2007). This strand of research includes diverse definitions, perspectives and ways of measurement derived from its 'elastic' (Patton & Kenney, 2003) character, all of which prevents the achievement of a unique and agreed view (Durston, 2000). In the clusters' literature, social capital importance is discussed in terms of its effcts to capture historical cultural patterns, along with its functionality as the "missing link" (van Staveren & Knorringa, 2007) to stimulate cognitive and normative resources (Cooke, 2001; Larrea, 2000; Barandarian & Korta, 2011). Subsequently, it provides important clues for understanding differences in competitiveness between regions.

The path-dependence line of argument, strongly emphasized by the Italian (neo-Marshallian) school on Industrial Districts (Becattini, 1990; Brusco, 1982), underlines the effect of a homogeneous ´local

community' system of values and norms in influencing clusters' development. Such influence is made effective by means of social cohesion, trust and the subordination of individual interest to community interests (Wolfe, 2002). For instance, one implication of this influence can be seen in the promotion of self-realization through intense entrepreneurship (Parrilli, 2004, 2009), the decline in transaction costs and an increase of efficiency in local institutions (Durston, 2000). However, the influence of social capital on the competitiveness of clusters is not always positive. There is debate about the harmful effects of reproducing certain background cultural constraints (e.g., "exclusion of outsiders, limited mobility, poor socioeconomic advancement and lack of adaptability to change" OECD, 2002), or the inflexible decision-making processes derived from too homogenous social ties (i.e. cognitive lock-in effects: Anderson & Jack, 2002; Parrilli, 2012). So, those relational issues may lead to reduction of research into new demand opportunities, business processes and technology options (Trigilia, 2003). In this general context, the interpretation of social capital used in this work considers different facets (social values) which activate several mechanisms which have evolutionary implications for cluster development.

Social capital values and norms can be defined by the statement that the "homogenous system of values and views, which are an expression of a work ethic, the family, reciprocity, and change…(that) constitutes one of the preliminary requirements for the development of a district, and one of the essential conditions of its reproduction" (Becattini, 1990). This view is robust enough to be used to evaluate the dynamic capacity of long duration social values (historically and culturally determined) as underlying features which influence collective action in critical circumstances. Barandarian & Korta (2011) mention that "in the literature of Social Capital, the values are 'given' and have seldom been analyzed" as other approaches are focused into norms, organizations, institutions and/or networks structure as critical ways of explaining the role of social capital. So, considering the selection of three salient facets: ethic of work, attitude of change, and reciprocity. The work ethic is a sense of responsibility and discipline that is orientated towards a business and socio-economic aim. It is associated with the importance given to hard and constant effort for the generation of economic value. Accordingly, this feature is based on religious beliefs and/or cultural characteristics (Nadvi & Schmitz, 1994). The attitude to change is a willingness to change (and to take risks), individually and collectively, to improve both business and territorial competitiveness. It entails a community readiness to improve and adapt in a context of transformations (e.g. technological, organizational, and cultural) in the socioeconomic environment. This influences the characteristics of a social context that is likely to foster learning capabilities and to encourage new initiatives. Finally, reciprocity represents an attitude towards sharing benefits and sacrifices within the local community as a means of producing an all-encompassing development. Such value is an ingrained cultural norm which "literally means 'returning forward' and implies a process of action, then reaction" (Weinstein, 2005). In turn, actions that produce impairment to other local actors set limits and erode the general level of trust and the identity of a local system.

The framework of analysis is designed to connect these three facets of social capital to specific cluster development mechanisms.

The first field of influence (work ethic) considers cultural factor which lever open and proactive attitudes towards the assumption of risk as well as towards the integration of people with different cultural backgrounds and skills. The work ethic legitimizes personal commitment and know-how in business growth. In turn, the influence of a proactive attitude to change allows the generation of a context that fosters creativity and error tolerance. So, anchored to these values it is promoted non-risk averse behavior towards the encouragement of self-realization through entrepreneurship (Brusco, 1982; Becattini, 1990; Parrilli, 2009), legitimizing incentives for co-location (Pouder & St. John, 1996; Suire & Vicente, 2009) and the overall enhancement of collective identity (Staber & Sautter, 2011). Finally, the availability of financial sources is another key cultural feature. An attitude to change combined with a system of reciprocal social relations may lead to create a "local network of business credit" (Russo & Rossi, 2001).

Hypothesis 1: Risk Culture is positively related to firm performance in a territory.

Similarly, a 'local community' sense anchored to a positive attitude to change favours the integration of people with different cultural backgrounds and skills, which in turn promotes the socio-economic system's ability to adapt (Parrilli, 2012). The capacity of the Silicon Valley to absorb Chinese and Indian ethnic and business communities and to benefit from their capabilities and social values and norms seems to justify this interpretation (Saxenian, 1994, 1996). According to Parrilli (2004; 2009), the weak spot in the current stage of development of Italian IDs is strongly related to social and economic aspects of migration flows and the failure to integrate such new heterogeneous social capital.

Hypothesis 2: Diversity integration is positively related to firm performance in a territory.

Additionally, the approach considers the primary influence of values to determine collaborative and cooperative behavior (the social agreement needed to establish, engage and address long term collective goals: Dei Ottati, 2002) with further materialization through the intervention of formal or informal institutions. Hence these interactive patterns encompass regulations, routines and organizations. In the literature, it is stated that, "institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction." (North, 1990). Thus, in this frame, three institutional mechanisms are considered: regulatory framework, strategic planning and informal norms.

The 'regulatory framework' is understood as a formal set of local regulations, institutions and practices that support the coordination of production activities, e.g. the creation of credit consortia, production cooperatives and cluster associations (Nadvi & Schmitz, 1994). In this respect, the value of reciprocity

counterbalances divided interests and local competition, whilst a cooperative behavior for cluster competitiveness is favoured (Putnam, 1993; Amin & Thrift, 1994; Parrilli, 2004). At the same time, the attitude to change influences the collective efforts aimed at strengthening the cluster competitive position by incorporating standards such as quality, safety, and environmental regulations (f.e. Nadvi & Waltring, 2004).

Hypothesis 3: Improvement in local regulations is positively related to firm performance in a territory.

Meanwhile, the overall system of values based on a consolidated identity, traditions and history helps in the process of building locally-shared strategic planning. The commitment towards shared goals may lead, among other things, to the identification of common interests and the reduction of asymmetries of negotiations between agents and the lowering of information costs (Dei Ottati, 2002). Examples of this mechanism operation are: the definition of a development agenda or the creation of specific infrastructures (e.g. trade fairs, science parks).

Hypothesis 4: New Strategic Planning is positively related to firm performance in a territory.

Likewise, the informal norms mechanism considers the presence of an implicit code of behavior based on communitarian 'informal norms' and sanctions which are influenced by a shared work ethic and reciprocity (Nadvi & Schmitz, 1994). It is also called a 'community mechanism' (Arif & Sonobe, 2012) and contains a coercive device in terms of social sanctions with economic consequences (i.e. social and economic exclusion: 'high exit costs').

Hypothesis 5: Informal Norms is positively related to firm performance in a territory.

Furthermore, considering that knowledge and know-how are fundamental drivers for economic competitiveness (Malmberg & Maskell, 2002), technical mechanisms are concerned with how the social capital facets help to generate, exploit and share such crucial resources. Two features are considered. The first one involves the issue of how knowledge flows[49] (mostly by tacit and informal means) and the effects of agents' interactions. The values of reciprocity and the work ethic ensure an environment of trust which facilitates the participation of the different agents (Noteboom, 2000). The second feature is about how collective efforts are structured in the development of local infrastructure to increase the stock of skilled resources. A strong sense of attitude to change and reciprocity promote collective action aimed at creating

[49] There are four ways of encouraging such knowledge flows and collective learning: informal networks associated to the local 'buzz' (Bathelt et al., 2004) and to external partners; formal cooperation networks; labour mobility; and the creation of spin-offs (Ter Wal & Boschma, 2011).

and / or updating the training infrastructure to support LPS needs for skilled people (e.g. in the Porter diamond model (1990)).

Hypothesis 6: Knowledge Dissemination is positively related to firm performance in a territory.

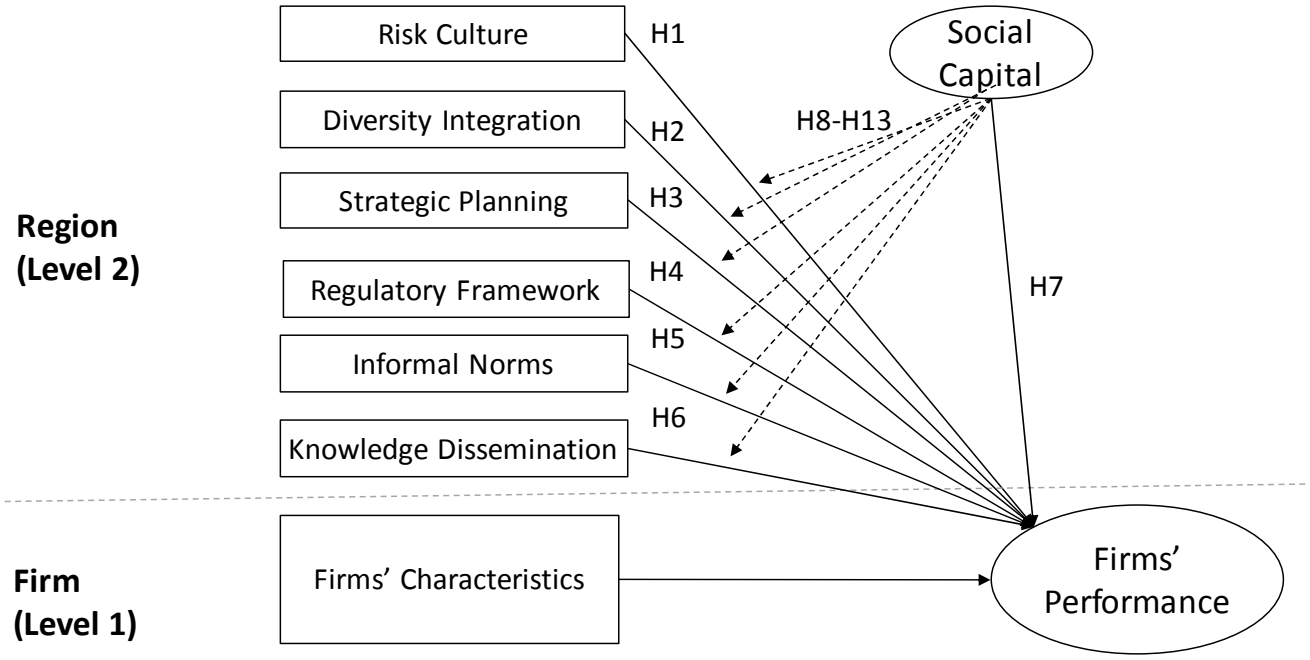
Finally, social capital has a direct impact on the performance of firms as a means of differentiation from other regions or clusters. Also, it has a moderating effect[50] on the mechanisms. That is, the effect of the mechanisms (direction and magnitude) is conditioned by the incidence of social capital. This is based in the assumption that social capital has a latent role to determine collective action in critical moments and, in this way, can alter the cluster trajectory. So, the following hypothesis are proposed:

Hypothesis 7: Social Capital is positively related to firm performance in a territory.

Hypothesis 8-13: The positive relation between the mechanisms of risk culture, strategic planning, informal norms, and knowledge dissemination and firm performance in a territory is positively moderated by the social capital.

To sum up, the framework of analysis has a hierarchical nature composed by two levels of analysis (Figure 8.2).

Figure 8.2: Frame of mechanisms and social capital influence on firms' performance



Source: Own Elaboration

[50] See details of interaction effects in Andersson et al. (2014).

8.3. Data & methods

8.3.1. Data

The tasks of data collection are focused on finding secondary data aimed to compose the two databases that the multilevel (i.e. hierarchical) specification demands. First, the firm-specific data is obtained from the SABI-Informa dataset. This source collects economic and financial information from the annual accounts of more than one million four hundred and fifty thousand companies domiciled in Spain, and has the advantage of having relatively recent data, as well as having a wide range of companies. For the research purposes, firms belonging to the metalworking technology cluster[51] in Spain are selected. The database contains a total of 22.397 cases. However, by selecting firms with "Active" status of activity and filtering cases with no available data in 2008 and 2013, the sample is reduced to 6.709 cases (Annex 4.3). Second, considering that the second-level variables (social capital facets & operational mechanisms) of the conceptual approach are not directly measurable, based on a set of proxy indicators at regional-level (i.e. NUTS 2 statistical units), some composite indicators are produced to represent them. This spatial domain (i.e. region) has a preferable suitability for measuring community social capital (e.g. Malecki, 2012).

8.3.2. Variables

8.3.2.1. Dependent Variables.

Three measures of performance are used as dependent variables are: the compound annual growth rate (CAGR[52]) of employment, the CAGR of labour productivity, and a binary indicator of survival (binary).

CAGR employment 2008-2013. The growth in employment is representative indicator of resilience and performance of the firms (Khal & Hundt, 2014; Sleutjes et al. 2012).

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[51] In Ketels & Protsiv (2014) the metalworking technology includes the following activities (NACE 2009 codes): 23.91 Production of abrasive products, 25.11 Manufacture of metal structures and parts of structures, 25.12 Manufacture of doors and windows of metal, 25.61 Treatment and coating of metals, 25.62 Machining, 25.73 Manufacture of tools, 25.94 Manufacture of fasteners and screw machine products, 28.41 Manufacture of metal forming machinery, 28.91 Manufacture of machinery for metallurgy. Also, 28.49 Manufacture of other machine tool is included in sample (though Ketels & Protsiv (2014) is in Heavy Machinery cluster).

[52] "The compound annual growth rate (CAGR) is the mean annual growth rate of a variable over a specified period of time longer than one year. To calculate compound annual growth rate, divide the value of a variable at the end of the period in question by its value at the beginning of that period, raise the result to the power of one divided by the period length, and subtract one from the subsequent result". (www.investopedia.com).

$$CAGR = \left(\frac{\text{Ending Value}}{\text{Beginning Value}}\right)^{\left(\frac{1}{\#\text{ of years}}\right)} - 1$$

CAGR productivity 2008-2013. This is the growth rate of the ratio value added-to-employment, so it is an indicator of growth in labour productivity (used in Raspe, 2009).

To isolate extreme cases in these continuos dependent variables, a selection of cases falling between percentil 25 minus 2.2 times the interquartile range (IQR) and percentil 75 plus 2.2 times the IQR is made (Hoaglin & Iglewicz, 1987).

Survival. This is binary dependent variable that equals 1 when a firm was created before 2008 and it has an "active" operative status, and 0 if the firm was created before 2008, is "not active" and has changed its operative status between 2008 and 2013. It is used in Sleutjes et al. (2012) to capture the survival effects.

Table 8.1: Description of variables

Variable name	Description	Type	Level
CAGR Employment 2008-2013	Growth rate of employment level	Dependent	1
CAGR Productivity 2008-2013	Growth rate of the ratio value added-to-employment	Dependent	1
Survival	Binary variable that equals 1 if the firm is active and 0 if it is not operating.	Dependent	1
Age	2014 - date of birth	Explanatory (Control)	1
Age²	Age squared	Explanatory (Control)	1
Leverage	Debt-To-Networth (%)	Explanatory (Control)	1
Assets	Logarithm of assets in 2008	Explanatory (Control)	1
Return on Assets (ROA)	Net Income / Assets (%)	Explanatory (Control)	1
Exports	Dummy variable that equals 1 if the 30% or more of firm sales come from external markets and 0 if not.	Explanatory (Control)	1
País Vasco	Binary variable that equals 1 if the firm is active and 0 if it is not operating.	Explanatory (Control)	1
Risk Culture	Composite Index	Explanatory	2
Diversity Integration	Composite Index	Explanatory	2
Strategic Planning	Composite Index	Explanatory	2
Regulatory Framework	Composite Index	Explanatory	2
Informal Norms	Composite Index	Explanatory	2
Knowledge Dissemination	Composite Index	Explanatory	2
Social Capital	Composite Index	Explanatory	2
Population Density	Inhabitans per km-sqared	Explanatory (Control)	2

Source: Own elaboration.

8.3.2.2. Explanatory Variables.

Regional-level explanatory variables are the synthetic index of social capital and the mechanisms of risk culture, diversity integration, regulatory framework, informal norms, and knowledge dissemination for each region that were calculated in the precedent chapter. The social capital index is a composite indicator that assembled (equally weighted) the average level of facets of ethic of work, attitude to change, and reciprocity between 2000-2010. All the above-mentioned indicators are measured in the range of values between 0 and 1 (Table 8.3).

8.3.2.3. Control Variables.

At region-level, the indicator of population density is used to controlling as it is used in Fritsch & Falck (2007 pp.159) to mean a "proxy for all kinds of regional influences". At firm-level, the variables are included: Age[53], Age squared (the intuition to incorporate this squared age indicator is that as firms are older the effects are diferent, they have more expiernce and more survival chances), Assets (proxy of size), Leverage (i.e. the capital structure of the firm), Exports (dummy 1: firms with exports > 30% of sales), and País Vasco (i.e. a dummy variable that distinguish among firms belonging of Basque Country to control due to the importance and tradition in metallurgical production in this region: Boix & Galetto, 2006; Larrea, 2000).

Table 8.2: Social capital and mechanisms indexes

Region	Ethic of work	Attitude to change	Reciprocity	Social Capital	Risk culture	Diversity Integration	Strategic planning	Regulatory framework	Informal norms	Knowledge dissemination
Andalucía	0,19	0,32	0,54	0,35	0,50	0,71	0,56	0,59	0,82	0,32
Aragón	0,78	0,54	0,51	0,61	0,65	0,50	0,74	0,76	0,53	0,79
Asturias	0,51	0,64	0,54	0,56	0,41	0,15	0,65	0,50	0,88	0,62
Baleares	0,58	0,21	0,19	0,33	0,44	0,65	0,21	0,24	0,24	0,09
Canarias	0,30	0,35	0,24	0,30	0,41	0,79	0,47	0,21	0,71	0,18
Cantabria	0,58	0,39	0,58	0,52	0,50	0,44	0,68	0,47	1,00	0,47
Castilla-La M	0,20	0,29	0,57	0,36	0,44	0,38	0,79	0,18	0,65	0,21
Castilla y Leó	0,76	0,32	0,64	0,57	0,26	0,32	0,91	0,53	0,76	0,68
Cataluña	0,71	0,85	0,52	0,69	0,68	0,50	0,47	0,38	0,59	0,79
C. Valencian	0,33	0,59	0,52	0,48	0,62	0,74	0,26	0,68	0,41	0,53
Extremadura	0,12	0,28	0,60	0,34	0,15	0,41	0,91	0,76	0,35	0,18
Galicia	0,34	0,47	0,48	0,43	0,50	0,47	0,68	0,21	0,06	0,53
Madrid	0,85	0,91	0,47	0,74	1,00	0,82	0,38	0,94	0,47	0,71
Murcia	0,20	0,61	0,43	0,42	0,74	0,82	0,15	0,68	0,29	0,35
Navarra	0,90	0,66	0,71	0,76	0,71	0,50	0,44	0,47	0,18	0,94
País Vasco	0,85	0,88	0,85	0,86	0,59	0,21	0,32	0,65	0,94	0,94
La Rioja	0,78	0,65	0,60	0,68	0,41	0,59	0,38	0,76	0,12	0,68

Source: Own elaboration.

[53] Age is calculated by the rest of 2014 minus the date of birth, and if the firms is not "Active" (a variable status about the state of the firm) the formula is data of change minus the date of birth.

8.3.3. Estimation strategy

The MLM technique works with hierarchical data sets in which one dependent variable measured at the lowest level (e.g. firm, student, etc.) is regressed over a set of explanatory variables at individual level and at higher levels of aggregation. Basically, multilevel models are applied when the interest is focused on distinguishing the complex effects of context (location, groups, etc.), and the interaction thereof with the individual characteristics to determine their performance (Hox, 2002; Kreft & De Leeuw, 1998). Statistically, it is considered an improvement from classical regression in terms of prediction, data reduction and causal inference (Gelman, 2006; Kline, 2011; Heck, Thomas, & Tabata, 2014). Another benefit of this technique is that it allows to deal with validation drawbacks mentioned in the Regional Science literature such as the ecological fallacy (i.e. when "takes the estimate obtained of grouped data and uses it to infer an individual level relationship": Haining, 2003), and the atomistic fallacy (i.e. "drawing inferences regarding variability across groups based on individual level data": Diez-Roux, 2002). Though, there is concern about the multilevel view as it may entail the endogeneity problem which is a common problem in economic geography studies. This is related to the difficulties to infer causal direction from context effects to individual agents, however sometimes context attributed effects may result from actions of agents' (firms) that make up a "spatial selection process" (Raspe, 2009).

The aim of this research is to evaluate the role of social capital facets and mechanisms of development to influence firms' performance into the Spanish metalworking technology activities during the recent crisis. In the conceptual framework section, the social capital facets and the mechanisms are considered attributes which reside in the "territory"; thus, they are considered context-level drivers. Then, the following system of equations form is proposed:

Level 1: $$Y_{ij} = \beta_{0j} + \beta_{1j} X_{ij} + e_{ij}$$

Level 2: $$\beta_{0j} = \gamma_{00} + \gamma_{01} Z_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

By sustituting level 2 equations into level 1 equation, one can get a mixed-effects form:

$$Y_{ij} = [\gamma_{00} + \gamma_{01} Z_j + \gamma_{10} X_{ij}] + [u_{0j} + e_{ij}]$$

where the i subscripts mean firm, and the j subscripts mean context. The Y represents the vector of performance indicators for firm i into j region. In the case of employment and productivity growth, as they are continuos variables, the model is specified as a multilevel linear configuration. Meanwhile, in the case of the survival indicator, as it is a binary outcome, the model is specified as a multilevel logistic analysis. Then, the dependent variable is the log [p_{ij}/ (1-p_{ij})]. Also, X is the matrix of firm-level explanatory variables (x_1, …, x_n) being $\boldsymbol{\gamma_{10}}$ the vector of the parameters of such variables; and Z is the matrix of the context-level indicators (z_1, …, z_n) with $\boldsymbol{\gamma_{01}}$ as the vector of parameters. Finally, e is the vector of the residuals at firm-level, and u is the vector of the residuals at context-level.

Three multilevel random intercept configurations are used (Annex 8.2) for the examination of the mentioned response variables following the procedures suggested in Heck, Thomas & Tabata (2012, 2014). Thus, for each of the dependent variables a sequence of the following models is performed: null model (Model 1), model with variables of level 1 (Model 2), the model adding variables of level 2 (Model 3), and the model adding variables and interacions at level 2 (Model 4). For this purpose, the SPSS linear mixed and generalized linear mixed models are used with the REML (Residual Maximun Likelihood Estimation) estimation method. Variables leverage, size, and the indexes of second-level are mean centered.

8.4. Results

8.4.1. Descriptive statistics.

Table 8.3 provides the descriptive statistics for the variables used in the analyisis and the matrix of correlations. The dependent variable related to employment growth shows an average annual decrease of 6.24% between 2008 and 2013, putting in evidence the persistence of harmful effects of the crisis in this sector in terms of employment resilience. On the other hand, the dependent variable of the labor productivity growth shows an average annual decrease of 2.04%. Meanwhile, the average age of the companies in the cluster is 21 years showing the relative maturity of the firms operating in this economic activity. In relation to financial aspects, at the beginning of the crisis (2008), the sector presents an average leverage of 64.69%, and an average economic return (ROA) of 3.52%. At the same time, only 2% of companies report that at least 30% of their sales come from exports. Finally, 12% of the database corresponds to companies located in the Basque Country. It appears that firms in this location have, at the beginning of the crisis, lower leverage, are bigger and are more exporter than firms in other locations. The correlations between the mechanisms and the index of social capital show a high correlation between the mechanisms of risk culture and knowledge dissemination and social capital respectively. Therefore, to avoid problems of multicollinearity, they are not incorporated together in the regressions.

Table 8.3: Descriptive statistics

#	Variable name	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	CAGR Employment 2008-2013	1																
2	CAGR Productivity 2008-2013	-,284**	1															
3	Age	-,050**	-0,013	1														
4	Age²	-0,018	-0,004	,930**	1													
5	Leverage	-0,015	,105**	-,272**	-,215**	1												
6	Assets	,028*	-0,007	,159**	,162**	-,039**	1											
7	Return on Assets (ROA)	,082**	-,216**	-0,003	-0,002	-,239**	0,020	1										
8	Exports (=1)	,063**	0,014	,167**	,187**	-,027*	,332**	0,011	1									
9	País Vasco (=1)	,117**	0,018	,111**	,118**	-,076**	,054**	0,013	,083**	1								
10	Risk Culture	0,010	0,017	,121**	,100**	-,045**	0,022	-,062**	0,008	-0,022	1							
11	Diversity Integration	-,103**	-0,020	-,040**	-,052**	,071**	-,037**	-,080**	-,075**	-,584**	,511**	1						
12	Strategic Planning	-,028*	-,028*	-,096**	-,088**	,064**	-0,022	,057**	-0,021	-,333**	-,586**	-,373**	1					
13	Regulatory Framework	0,013	-,030*	,090**	,078**	-0,023	0,022	-,034**	0,011	,192**	,508**	,356**	-,379**	1				
14	Informal Norms	,050**	-0,007	,045**	,056**	-0,016	,032**	0,014	,052**	,537**	-,198**	-,460**	,072**	,136**	1			
15	Knowledge Dissemination	,105**	,042**	,168**	,158**	-,141**	,050**	0,014	,080**	,486**	,419**	-,382**	-,256**	,301**	,188**	1		
16	Social Capital	,108**	,042**	,179**	,170**	-,138**	,058**	0,006	,083**	,577**	,516**	-,347**	-,356**	,383**	,273**	,943**	1	
17	Population Density	0,016	0,019	,114**	,095**	-0,020	,027*	-,070**	0,009	,166**	,813**	,399**	-,521**	,585**	0,006	,318**	,517**	1
	Mean	-6	-2	21	542,0	64,7	1777,5	3,5	0,0	0,1	0,6	0,5	0,5	0,5	0,6	0,6	0,6	207
	S.D.	11	11	9	560,2	37,9	8383,4	14,0	0,1	0,3	0,2	0,2	0,2	0,2	0,2	0,2	0,2	192

Source: Own elaboration.

8.4.2. Multilevel results.

As mentioned previously, the results presented below relate to the three dependent variables examined.

8.4.2.1. Results for employment growth. Using as dependent variable the CAGR of employment (Table 8.4), the null model (Model 1) is used to test if there is the evidence of differences in the average employment growth between the regions. The variance of level 2 is statistically significant (Wald p<0,05; LR[54] p<0,001). And, the intraclass correlation indicator (ICC) measures the percentaje of annual employment growth resides at region level which is only 2.3%.

Model 2 incorporates the level 1 explanatory variables. The sign and the magnitude of the intercept shows the hardness of the crisis (-8,2%, p<,001). The interpretation of the parameters of age (negative) and age squared (positive), which are statistically significant, mean that older firms display more resilience in employment. The size, the profitability, the exporter character, and the localization in the Basque Country have a positive and statistically significant effects. Among them, size effect is greater than profitability. A significant impact is accounted for the dummy variable of exports since export firms (i.e. 30% or more of its sales are produced in foreign markets) has a +2.3% annual employment growth, evidencing the importance of the internationalization of production. In addition, location seems to be critical as the basque firms dummy variable shows a positive and statistically significant coefficient. Model 2b the regression is executed considering only the significant level 1 variables, and the model improves its performance considering the comparison of its deviance with the null one (LR p<0,001).

[54] Likelihood Ratio is calculated comparing deviances between model and checking checking chi-square distribution with a single degree of freedom under the null hypothesis that the variance of the random intercept components is zero (Heck, Tabata & Thomas, 2014; Haynes, 2006).

Table 8.4: Results (CAGR Employment Growth)

Vble. Dep.: Employment Growth (CAGR)

	2008-2013 - 6,631 fims					
Model	**1**	**2**	**2b**	**3**	**3b**	**4**
Fixed Components						
Intercept	-7,045 ***	-7,367 ***	-7,367 ***	-6,889 ***	-7,053 ***	-6,948
	0,37	*0,27*	*0,27*	*0,16*	*0,17*	*0,15*
Level 1						
Age		-0,266 ***	-0,261 ***	-0,262 ***	-0,261 ***	-0,264 ***
		0,04	*0,04*	*0,04*	*0,04*	*0,04*
Age²		0,003 ***	0,003 ***	0,003 ***	0,003 ***	0,003 ***
		0,00	*0,00*	*0,00*	*0,00*	*0,00*
Leverage		-0,131				
		0,23				
Assets		0,389 ***	0,390 ***	0,367 ***	0,372 ***	0,387 ***
		0,11	*0,11*	*0,11*	*0,11*	*0,11*
ROA		0,051 ***	0,052 ***	0,051 ***	0,052 ***	0,052 ***
		0,01	*0,01*	*0,01*	*0,01*	*0,01*
Exports (dummy)		2,410 ***	2,392 ***	2,373 **	2,391 ***	2,337 **
		0,92	*0,92*	*0,92*	*0,92*	*0,92*
País Vasco (dummy)		3,582 ***	3,591 ***	1,366	2,584 *	0,928
		0,97	*0,97*	*0,84*	*0,69*	*1,77*
Level 2						
Diversity Integration				-3,555 **		
				1,77		
Strategic Planning				0,005	1,109	0,081
				1,23	*1,23*	*2,11*
Regulatory Framework				0,268	-0,914	-0,808
				0,90	*0,74*	*0,69*
Informal Norms				-1,414 **	-1,151	-0,326
				0,64	*0,69*	*1,16*
Social Capital Index				3,662 ***	5,510 **	5,634
				1,39	*1,20*	*1,32*
Strategic Planning*Social Capital Index						-8,059
						8,24
Regulatory Framework*Social Capital Index						-6,045
						4,43
Informal Norms*Social Capital Index						8,796
						6,54
Population Density				0,176	-0,074	-0,135
				0,26	*0,25*	*0,34*
Variance of Random Components						
Deviance (-2LL)	49334	49236	49236	49205	49212	49191
ICC	1,9%	0,7%	0,1%		0,1%	0,0%
Wald Test	2,303 **	1,614	1,619		0,239	0,971 ***
Likelihood Ratio (Chi-Square)	89 ***	98 ***	99 ***	30 ***	23 ***	21 ***

*p<.1, **p<.05, ***p<.01

Source: Own Elaboration.

Model 3 include the explanatory variables of level 2. The results show that level 1 control variables maintain the significance and direction of their influence. Meanwhile, the mechanisms of diversity integration and informal norms are statistical significance, though they show negative incidence (p<,05 respectively). The social capital index has a positive and statistically significative incidence (p<,001), but it seems that there are

signs of multicolineality as the model does not converge. Then, a test of VIF (variance inflation factor) multicolineality is performed; as a result, the mechanism of diversity integration is removed in Model 3b. The results show that at level 2 only the social capital index has a positive and statistically significant incidence (p,05); so, H7 is accepted. In addition, this is indirectly provinding support to accept the hypotheses of risk culture (H1) and knowledge dissemination (H6), and the interaction hypothesis H8 and H13. Meanwhile, it is rejected the hypothesis that diversity integration (H2), strategic planning (H3), regulatory framework (H4), and informal norms (H5) as well as their interactions with the social capital index (H9 to H12) as they are non-significant. Meanwhile, Model 4 considers a setting of interactions (among level 2 variables). As it is explained before, none of the level 2 proposed interactions present stistical significance.

8.4.2.2. Results for labour productivity growth. Using the CAGR of productivity index as the dependent variables (Table 8.5), the null model (Model 1) allow us to infer that there is statistical significant evidence of the differences in productivity among firms in the metalworking technology industry (the estimated variance is 0.7: Wald p<0,1; LR p<,001). The intraclass correlation indicator (ICC) measures the percentaje of performance variation resides at region level is very low 0.7%.

Model 2 incorporate the level 1 explanatory variables. Only leverage (positive sign) and ROA (negative sign) are statistically significant (p>.001). Model 3 incorporate level 2 representatie indexes of the social capital and the mechanisms. Only the strategic planning (negative sign, p<.05) and social capital (positive sign, p<.1) are statistically significant. So, hypotheses 1 to 6 are rejected, and H7 is accepted. Again, Model 3b removes the influence of diversity integration due to its high VIF value. Now, the magnitude and statistical significance of the social capital index is increased.

Finally, in Model 4 interactions at level 2 are tested. The social capital is positive and statistically significant; so, H7 is accepted, and H9 and 10-13 are rejected.

Table 8.5: Results (Productivity Growth)

Vble. Dep.: Productivity Growth (CAGR)

	2008-2013 - 6,578 fims					
Model	**1**	**2**	**2b**	**3**	**3b**	**4**
Fixed Components						
Intercept	-2,571 ***	-2,537 ***	-2,468 ***	-2,358 ***	-2,357 ***	-2,346 ***
	0,25	*0,29*	*0,28*	*0,16*	*0,15*	*0,19*
Level 1						
Age		-0,004				
		0,04				
Age²		0,000				
		0,00				
Leverage		1,130 ***	1,079 ***	1,075 ***	1,076 ***	1,078 ***
		0,22	*0,21*	*0,21*	*0,21*	*0,21*
Assets		0,013				
		0,10				
ROA		-0,123 ***	-0,123 ***	-0,123 ***	-0,123 ***	-0,123 ***
		0,01	*0,01*	*0,01*	*0,01*	*0,01*
Exports (dummy)		0,466				
		0,88				
País Vasco (dummy)		0,859				
		1,07				
Level 2						
Diversity Integration				-1,256		
				1,48		
Strategic Planning				-0,394	-0,290	
				1,21	*1,16*	
Regulatory Framework				-3,468 **	-3,992 **	-3,945 **
				1,02	*0,76*	*0,88*
Informal Norms				-0,902	-0,583	-0,531
				0,73	*0,60*	*0,63*
Social Capital Index				3,576 *	4,639 **	4,334 **
				1,62	*1,05*	*1,16*
Strategic Planning*Social Capital Index						
Regulatory Framework*Social Capital Index						-1,564
						4,63
Informal Norms*Social Capital Index						2,890
						3,52
Population Density				0,274	0,152	0,199
				0,29	*0,25*	*0,19*
Variance of Random Components						
Deviance (-2LL)	48527	48293	48276	48248	48252	48244
ICC	0,7%	1,0%	0,1%		0,1%	0,2%
Wald Test	1,890 *	1,963 **	2,057 **		0,423	0,569
Likelihood Ratio (Chi-Square)	29 ***	234 ***	251 ***	28 ***	25 ***	8 *

*p<.1, **p<.05, ***p<.01

Source: Own Elaboration.

8.4.2.3. Results for survival. The results of the multilevel logistic regression model in relation to the proposed binary dependent survival variable are presented in Table 8.6. The results of the null model show that 1.7% (ICC) of the variance is explained by level 2 factors. Model 2 incorporates the first level variables, with age and export dummy being significant. In multilevel logistic regression, the level 1 parameters are interpreted as an increase in the probability of survival compared to the companies that are in the same region. The value of the

intercept of 0.676 indicates the log-odds of survival for an average firm (age and exports character) in a region. For example, an additional year implies a 6.52% increase in the probability of survival against firms in their region [exp (1,876) = 6.52%]. Which is logical in an industry where experience and reputation is important; However, this effect decreases in the long term (age squared negative sign, but low effect). In model 3, the variables of level 2 are incorporated, and the indicators of social capital (positive sign) and population density (negative sign) are statistically significant. The significant positive coefficient of social capital supports H7 and indicates that location with high social capital increses the probability of survival. Removing the diversity integration indicator (by multicollinearity) increases the effect of the social capital indicator. Then, in Model 4, the effect of level 2 interactions is evaluated, maintaining the significance and positive direction of the social capital index, and its interaction with the regulatory framework is significant and positive.

Table 8.6: Results (Survival)

Vble. Dep.: Survival (2008-2013) - 18,455 fims

Model	**1**	**2**	**2b**	**3**	**3b**	**4**
Fixed Components						
Intercept	0,111	0,378 ***	0,387 ***	0,390 ***	0,393 ***	0,344 ***
	0,07	*0,06*	*0,06*	*0,05*	*0,05*	*0,05*
Level 1						
Age		0,147 ***	0,147 ***	0,147 ***	0,147 ***	0,147 ***
		0,01	*0,01*	*0,01*	*0,01*	*0,01*
Age²		-0,002 ***	-0,002 ***	-0,002 ***	-0,002 ***	-0,002 ***
		0,00	*0,00*	*0,00*	*0,00*	*0,00*
Exports (dummy)		0,311 *	0,312 **	0,306 *	0,308 *	0,309 *
		0,16	*0,16*	*0,16*	*0,16*	*0,16*
País Vasco (dummy)		0,139				
		0,24				
Level 2						
Diversity Integration				-0,277		
				0,40		
Strategic Planning				-0,125	-0,065	0,013
				0,33	*0,32*	*0,37*
Regulatory Framework				-0,271	-0,365 *	-0,096
				0,27	*0,22*	*0,24*
Informal Norms				-0,228	-0,168	-0,112
				0,20	*0,18*	*0,17*
Social Capital Index				0,786 *	0,990 ***	1,033 ***
				0,43	*0,30*	*0,29*
Strategic Planning*Social Capital Index						1,202
						1,47
Regulatory Framework*Social Capital Index						2,465 **
						1,25
Informal Norms*Social Capital Index						0,637
						0,88
Population Density				-0,135 *	-0,158 **	-0,208 ***
				0,08	*0,07*	*0,07*
Variance of Random Components						
Variance Intercept	0,04	0,03	0,03	0,01	0,01	0,01
Deviance	78310	81313	81301	81292	81288	81298
ICC	1,7%	1,2%	1,2%	0,6%	0,6%	0,5%
Likelihood Ratio (Chi-Square)				10	13 **	

*p<.1, **p<.05, ***p<.01

Source: Own elaboration.

Finally, supplementary analyzes have been carried out dividing performance between 2008 and 2011 and between 2011 and 2013 (which coincide with two "phases" of the crisis in Spain) in order to evaluate whether there was more or less heterogeneity in firms' performance in these subperiods. The results are presented in Appendix 8.1 and 8.2 at the end of the chapter and will support the discussion below.

8.5. Discussion

As expected, the influence of the internal characteristics (level 1) has a dominant effect to differentiate among firms' performance. Meanwhile, the influence of the context seems to be least important, as has been observed in other studies such as Fazio & Piacentino (2010): 4%, Raspe (2009): 3%, Ruiz Fuensanta (2010): 2%. Though, the results obtained in relation to the effects of the variables related to local context (level 2) show interesting insights and should be taken into account. First, the statistical evidence validates the influence of social capital in firm performance since it is shown that social capital has a direct influence over the employment growth, the labour productivity, and the survival of metalworking firms. Second, the effects of second-level interactions between social capital and mechanisms have not been effectively validated, even when some evidence relating to social capital as the driver of knowledge diffusion and regulatory framework appears as statistically significant.

Table 8.7: Summary of results and effects

		Performance Indicator		
Hyp.	Variable	Employment Growth	Productivity Growth	Survival
1	Risk culture	+	+	+
2	Diversity Integration			
3	Strategic planning			
4	Regulatory framework			
5	Informal norms			
6	Knowledge dissemination	+	+	+
7	Social Capital	+	+	+
8	Risk culture * Social Capital	+	+	+
9	Diversity Integration * Social Capital			
10	Strategic planning * Social Capital			
11	Regulatory framework * Social Capital			+
12	Informal norms * Social Capital			
13	Knowledge dissemination * Social Capital	+	+	+

Source: Own elaboration

Considering first the effects of social capital, it is remarkable that the indicator during the whole period has shown a positive impact to affect firm performance despite of measured indicator. This statistical

evidence corroborates the literature that values the importace of social capital in terms of the enhancement of coordination, entrepreneurship, and learning and innovation (e.g. Wolfe, 2002; Parrilli 2004, 2009; Malecki, 2012; Durston, 2000, among others), and reinforces the relevance of social capital as a conceptual asset to study cluster development.

At the same time, we should admit that regarding the effects of level 2 interactions (i.e. social capital as a driver of mechanisms that influence firms), the results obtained are not conclusive. For the purpose of our conceptual approach, the high correlations among explanatory variables the the level 2 are an expected consequence, but that brings with it the need to deal with the problem of multicollinearity. Thus, the interpretation of the statistical results shows regions with strong social capital (in this case represented by the social capital index) have increase and supported knowledge dissemination mechanisms having a further impact on firms' employment decisions. Therefore, this allows to partially validate the proposition made in the conceptual approach regarding the importance of the mechanisms of knowledge dissemination (providing both an atmosphere for knowledge diffusion along with the availability of knowledge infrastructures) in a transformation phase like the evidenced in the metalworking technology before the crisis. Meanwhile, the interaction with social capital with the other mechanisms does not present a clear pattern of influence in this test. All in all, it is appropiate to consider the prevention made by Cooke, Clifton & Oleaga (2005 pp. 1069) that "social capital theory, in combination with the many exogenous variables involved at firm and regional levels, means that it is simply not realistic to do this [to assume propositions of linear causality]. Rather a more complex interactive process is suggested in which certain firms (or regions) may possess higher levels of social capital, which in turn enables them to perform in ways in which they otherwise could not".

And last but not least, the performed study has its limitations which lead to a cautious interpretation of the results obtained. For example, the generalization of the results is not assured since the analysis has been restricted to a specific set of economic activities and geographical context. Also, the non-availability of sufficient data at such territorial level limited the creation of better level 2 indicators, especially those related to the construction of mechanisms (Chapter 7). In turn, a more precise validation about the variables selected to characterize the facets of social capital and the mechanisms, and their influence in the performance of the companies could be achieved through the execution of the combination of confirmatory factor analysis (CFA) and a multilevel model in a so called multilevel structural equation modeling (Kline, 2011).

8.6. Conclusions

The purpose of this chapter is to evaluate the effects of facets of a social capital notion, extracted from a set of the socioeconomic characteristics of the territorial context (provincial level), on the Spanish metalworking technology firms' performance during the recent economic crisis. Methodologically, a MLM scheme has been established in which there are firms at lower-level and higher level are composed by

variables at territorial level (region in this case) variables such as the facets of social capital and mechanisms. This approach is aligned with the recent guidelines that for the evaluation of "micro-macro" performance links, it is necessary to focus on the "proper level of analysys" i.e. firms (Beugelsdijk, 2007; also Raspe, 2009; Menzel & Fornahl, 2010).

This work is the first exploratory attempt, at least from the reach of our knowledge, to measure in the Spanish context the impact of social capital (i.e. regional perspective) on the performance of firms using the multilevel regression technique. Another contribution of this research is the use of the characterization of those regional variables through the application of synthetic indicators method to compose indexes of social capital and the mechanisms, extracted from a set of territorial socioeconomic indicators.

The research performed has the novelty that it is the first exploratory attempt, at least from the reach of our knowledge, to measure in the Spanish context the impact of social capital (i.e. regional perspective) on the performance of firms using the multilevel regression technique. Two major results have been evidenced in this quantitative research. First, la novedad del estudio es el intento por examinar y explorar la incidencia del capital social (medido a nivel regional) en el desempeño empresarial. Also, although there is a low incidence of territorial factors (observed also in other studies), the indicator of social capital has had a positive and significant impact to influence the performance of firms. In this sense, the high correlation of this indicator in relation to the characterization of risk culture and knowledge dissemination mechanisms suggests that there are path-dependency features (manifested through the pattern of specialization and the regional innovation system) that seem to play a critical role to shape cluster evolution (and thus into firms' performance) under external pressures. Second, the individual characteristics of the firms are the dominant drivers to explain the differences into the performance of firms in this very competitive and highly specialized set of economic activities.

Appendix 8.1: CAGR employment (2008-2011 & 2011-2013)

Vble. Dep.: Employment Growth (CAGR)

	2008-2011 - 6,486 fims						2011-2013 - 6,486 fims					
Model	**1**	**2**	**2b**	**3**	**3b**	**4**	**1**	**2**	**2b**	**3**	**3b**	**4**
Fixed Components												
Intercept	-10,014 ***	-10,409 ***	-10,410 ***	-10,519 ***	-10,592 ***	-10,578 ***	-7,394 ***	-7,773 ***	-7,754 ***	-6,814 ***	-7,008 ***	-6,612 ***
	0,51	*0,44*	*0,44*	*0,36*	*0,31*	*0,33*	*0,57*	*0,43*	*0,42*	*0,38*	*0,40*	*0,41*
Level 1												
Age		-0,425 ***	-0,434 ***	-0,438 ***	-0,438 ***	-0,437 ***		-0,071				
		0,07	*0,06*	*0,06*	*0,06*	*0,06*		*0,06*				
Age²		0,005 ***	0,005 ***	0,005 ***	0,005 ***	0,005 ***		0,001				
		0,00	*0,00*	*0,00*	*0,00*	*0,00*		*0,00*				
Leverage		0,233						-1,055 ***	-0,887 ***	-0,842 **	-0,842 **	-0,846 **
		0,40						*0,35*	*0,33*	*0,33*	*0,33*	*0,33*
Assets		0,429 **	0,427 **	0,431 **	0,434 **	0,437 **		0,653 ***	0,570 ***	0,536 ***	0,544 ***	0,548 ***
		0,19	*0,19*	*0,19*	*0,19*	*0,19*		*0,16*	*0,15*	*0,15*	*0,15*	*0,15*
ROA		0,069 ***	0,066 ***	0,065 ***	0,066 ***	0,065 ***		0,033 **	0,036 ***	0,036 ***	0,037 ***	0,036 ***
		0,02	*0,02*	*0,02*	*0,02*	*0,02*		*0,01*	*0,01*	*0,01*	*0,01*	*0,01*
Exports (dummy)		2,952 *	2,985 *	2,900 *	2,911 *	2,866 *		3,080 **	3,081 **	3,076 **	3,092 **	3,052 **
		1,59	*1,59*	*1,59*	*1,59*	*1,59*		*1,37*	*1,36*	*1,36*	*1,36*	*1,36*
País Vasco (dummy)		3,505 *	3,488 *	4,356 **	5,027 **	8,117		4,674 **	4,638 **	-0,864	1,173	-6,147
		1,56	*1,56*	*1,79*	*1,28*	*3,50*		*1,54*	*1,51*	*1,88*	*1,63*	*3,98*
Level 2												
Diversity Integration				-1,985						-5,502		
				3,46						*3,40*		
Strategic Planning				6,256 **	6,947 **	10,025 *				-5,803 *	-2,261	-9,668 *
				2,57	*2,24*	*4,14*				*2,63*	*1,72*	*4,63*
Regulatory Framework				1,091	0,342	-0,228				-0,282	-2,036	-2,369
				1,89	*1,36*	*1,41*				*1,93*	*1,67*	*1,67*
Informal Norms				-4,082 **	-3,897 **	-5,913 *				0,972	1,163	5,438 *
				1,36	*1,27*	*2,25*				*1,42*	*1,44*	*2,49*
Social Capital Index				3,050	4,015	2,023				5,791 *	7,943 **	12,064 **
				2,91	*2,20*	*2,68*				*2,98*	*2,53*	*3,12*
Strategic Planning*Social Capital Index						4,138						-21,457
						15,74						*17,13*
Regulatory Framework*Social Capital Index						-12,824						-3,301
						8,72						*9,88*
Informal Norms*Social Capital Index						-10,831						29,659 *
						12,47						*13,36*
Population Density				0,364	0,249	0,830				-0,099		-1,146
				0,53	*0,45*	*0,65*				*0,54*		*0,72*
Variance of Random Components												
Deviance (-2LL)	55987	55924	55924	55891	55896	55873	53382	53338	53323	53293	53301	53273
ICC	1,0%	0,6%	0,0%	0,1%	0,1%	0,1%	2,0%	0,9%	0,0%	0,3%	0,4%	0,3%
Wald Test	2,038 **	1,619	1,621	0,574	0,457	0,759 ***	2,291 **	1,728 *	1,711 *	0,837	1,135	0,407 ***
Likelihood Ratio (Chi-Square)	41 ***	63 ***	63 ***	33 ***	28 ***	18 ***	93 ***	43 ***	59 ***	30 ***	22 ***	28 ***

*p<.1, **p<.05, ***p<.01

Source: Own elaboration.

Appendix 8.2: CAGR productivity (2008-2011 & 2011-2013)

Vble. Dep.: Productivity Growth (CAGR)

	2008-2011 - 6,392 fims						2011-2013 - 6,352 fims					
Model	**1**	**2**	**2b**	**3**	**3b**	**4**	**1**	**2**	**2b**	**3**	**3b**	**4**
Fixed Components												
Intercept	-4,550 ***	-4,523 ***	-4,285 ***	-4,055 ***	-3,977 ***	-3,740 ***	-1,838 ***	-1,825 ***	-1,845 ***	-1,605 **	-1,657 **	-1,429 ***
	0,53	*0,54*	*0,54*	*0,50*	*0,56*	*0,40*	*0,44*	*0,50*	*0,45*	*0,47*	*0,48*	*0,27*
Level 1												
Age		-0,025						0,056				
		0,07						*0,08*				
Age²		0,000						0,000				
		0,00						*0,00*				
Leverage		1,961 ***	2,088 ***	2,096 ***	2,103 ***	2,086 ***		1,063 **	0,955 **	1,017 **	1,012 **	1,040 **
		0,44	*0,41*	*0,41*	*0,41*	*0,41*		*0,45*	*0,42*	*0,42*	*0,42*	*0,42*
Assets		-0,329						0,357 *	0,435 **	0,417 **	0,415 **	0,412 **
		0,21						*0,21*	*0,18*	*0,18*	*0,18*	*0,18*
ROA		-0,255 ***	-0,258 ***	-0,259 ***	-0,258 ***	-0,258 ***		-0,011				
		0,02	*0,02*	*0,02*	*0,02*	*0,02*		*0,02*				
Exports (dummy)		2,279						-0,021				
		1,73						*1,76*				
País Vasco (dummy)		2,677						0,089				
		1,97						*1,77*				
Level 2												
Diversity Integration				-7,761						4,922		
				4,22						*4,06*		
Strategic Planning				3,144	4,856	3,177				-3,684	-4,519	1,778
				3,53	*3,85*	*2,95*				*3,39*	*3,35*	*2,32*
Regulatory Framework				-1,370	-4,208	-6,102 **				-6,189 *	-4,242	-3,480 ***
				2,91	*2,67*	*1,80*				*2,80*	*2,30*	*1,26*
Informal Norms				-2,912	-1,120	-1,222				-0,001	-1,196	-0,414
				2,12	*2,09*	*1,34*				*2,04*	*1,80*	*1,06*
Social Capital Index				-1,171	4,510	2,758				9,873 *	6,089 *	9,415 ***
				4,57	*3,62*	*2,44*				*4,41*	*3,15*	*1,92*
Strategic Planning*Social Capital Index						-24,247 *						51,010 ***
						12,96						*10,98*
Regulatory Framework*Social Capital Index						-34,919 **						16,373 **
						10,19						*7,83*
Informal Norms*Social Capital Index						14,059						3,026
						7,30						*5,73*
Population Density				1,613 *	1,022	1,374 *				-0,963	-0,562	-0,441
				0,83	*0,85*	*0,59*				*0,80*	*0,73*	*0,45*
Variance of Random Components												
Deviance (-2LL)	55676	55400	55394	55364	55372	55340	55255	55262	55247	55218	55224	55189
ICC	0,9%	0,9%	0,0%	0,7%	0,9%	0,2%	0,5%	0,7%	0,0%	0,6%	0,6%	
Wald Test	1,848 *	1,775 *	1,937 *	1,176	1,381	0,510 ***	1,427	1,481	1,468	1,174	1,223	0,000 ***
Likelihood Ratio (Chi-Square)	26 ***	276 ***	283 ***	29 ***	21 ***	25 ***	11 ***	4	8 **	29 ***	23 ***	35 ***

*p<.1, **p<.05, ***p<.01

Source: Own elaboration.

Chapter 9: Conclusions, implications & limitations

9.1. Introduction

The aim of the thesis is to analyze the trajectories of clusters with special attention to the role exerted by the social capital in their different developmental stages. The critical argument of this thesis highlights the multifaceted nature of social capital that operates as a latent driver to boost joint actions to address internal and external challenges. Thus, the research raises two major questions of interest. On the one hand, it is pertinent to ask: How a notion of Social Capital operates within clusters' evolution? lead us to propose a conceptual approach after reviewing the literature trends in this topic. On the other hand, to corroborate the conceptual framework, the empirical evaluation is guided by the question: does social capital can exert a distinct influence on the performance of clusters in a changing environment?

Following a deductive direction, it has developed a conceptual approach (Chapter 3) that links a notion of social capital facets with some operating mechanisms of clusters (labeled from the extensive literature about the clusters functioning). This vision stands out that some underlying factors for the development and reproduction (i.e. a positive incidence) of an industrial district are the ethic of work, the attitude to change, and the reciprocity (Becattini, 1990). Then, to provide a suitable scheme to frame clusters' dynamics, the perspective of the cluster life cycle is adopted. Subsequently, propositions about a differentiated influence of social capital facets to affect key mechanisms depending on the stage of the life cycle of a cluster are set.

Empirical results have been developed in three modes. In Chapter 5, the validity of conceptual approach propositions, in six well-known clusters, is explored. Thus, the interaction between the facets of social capital and the mechanisms seems to be relevant in the evolution of clusters, albeit not completely homogeneously in all cases analyzed. With this, three evolutionary types are categorized: the clusters that keep their growth drivers operating effectively (growth-prolongued), the clusters that show a stagnation stance (mature), and the clusters that have confronted internal and external tensions, but have managed to renew their growth sources (transformers). In Chapter 6, the historical evolution of the machine tool in the Bajo Deba district in the Basque Country is developed. The study confirms the importance of social capital to boost local agents' actions for economic progress in critical periods. However, the analysis stress about current tensions that are eroding the evolution of the cluster (and maybe the region) competitive advantages. Chapters 7 and 8 are jointly developed. In Chapter 7, due to the lack of specific measures of social capital (and the impossibility of direct observation of them), a set of synthetic indicators have been developed to characterize the social capital facets and the mechanisms. Next, in Chapter 8, an examination of the determinants of the performance of firms in the metalworking technology cluster in Spain (which includes the machine tool manufacturing activities) is performed, considering firm-level characteristics (e.g. age, size, leverage, etc.) and region-level social capital and mechanisms indexes, as explanatory variables.

This chapter contains three fundamental sections. First, the link between the results obtained and the research questions is made. Secondly, the main implications of the thesis are evaluated. Finally, conceptual and methodological limitations are mentioned.

9.2. Results

The present thesis has two modest contributions regarding the call for academic need to expand conceptual and empirical research about clusters' evolutionary issues (e.g. Nadvi & Schmitz, 1994; Boschma & Fornahl, 2011; Lorenzen, 2005), and the incidence of social capital in such evolution (e.g. Staber, 2007; Parrili, 2012). On the one hand, the configuration of a conceptual approximation scheme that considers a proactive and differentiated evolutionary incidence of social capital depending on the stage of a cluster trajectory. On the other hand, the empirical contribution stands out for addressing evolutionary aspects from a combination of qualitative and quantitative methods. These attempts are aligned with the suggestion of the use of variegated empirical techniques to improve the understanding of clusters' trajectories (Boschma & Fornahl, 2011; Hassink et al. 2012).

To begin with, the **aim** of Chapter 3 was to develop a conceptual approach that connects the role of social capital during the stages of the cluster life cycle. The core argument lies in Becattini's view that the longstanding values of ethic of work, attitude to change and reciprocity provide crucial bases to interpret the development trajectories of clusters. An analytical framework was set up centered on a set of cultural, institutional and technical mechanisms that are activated by a given social capital, which is transformed - but always determined - at each stage of the cluster. In **relation with the literature of clusters**, a humble contribution of this chapter is the attempt to contribute to the open academic debate on cluster evolution (Boschma & Fornahl, 2011; Lorenzen, 2005; Fornahl, Hassink & Menzel, 2015; Belussi & Hervás-Oliver, 2017). Also, by paying special attention to the proactive role of social capital, the research modestly responds to critics made to the cluster life cycle model due to the lack of attention to important aspects such as context sensitivity, multi-scalar features, and human agency (Trippl et al. 2015). In addition, the research is involved in a problematic area of study which is the difficulty of defining social capital concepts (nature, dominance, and results) and the operational problems (e.g. Van Deth, 2003; Staber, 2007; Beugelsdijk & Van Schaik, 2005; Malecki, 2012 among others) that affect their theoretical and empirical efforts.

Next, the main findings of the empirical chapters and their relationship with literature are summarized in the following.

9.2.1. Results of the exploratory evaluation of social capital operation in six cases.

The **purpose** of the comparative study of Chapter 5 was to explore the validity of the conceptual framework, which establishes certain propositions regarding the proactive role of social capital for regional development by means of activating various critical mechanisms of growth through the different stages of the cluster life cycle.

In relation to the **research method**, the use of the comparative method helps to compose a preliminary setting for empirical research, and to "obtain information about the possibility of carrying out a more complete investigation on a particular context" (Hernandez Sampieri et al., 2010). This empirical exploration is focused on six clusters that represent different historical, cultural, economic, and industrial activity backgrounds.

A key **finding** is that it is possible to find evidence of the social capital incidence into the the historical trajectory of the clusters analyzed. Moreover, this incidence is not monotonous, but it is "activated" according to the needs of each evolutionary stage of the clusters. In **relation to literature**, the general assertion that clusters do not follow a single path, but complex trajectories, is validated. For this reason, as mentioned by Kilkenny (2008), “maybe a different social capital is needed for different phases. And because places specialice in different phases, different social capital maybe needed in different places”. This reinforces the view that social capital is a multifaceted and “situational and dynamic” factor (Piselli, 2003). This means that it should not be restricted or associated with a strict configuration, but as actors’ interactions, settings and their meanings, and the specific context (Staber, 2007).

Finally, the **conclusions** of the exploratory analysis found that it is possible to group the clusters and their trajectories according to common traits, their current state and the operation of certain characteristics. For the group of ‘prolonged growth’ clusters, their success has centered on their capacity to provide flexible adaptation to demand, competition, and technology changes. In these cases, social capital has been esssential to the identification of novel paths. The second group shows a ‘maturity’ stage that has been challenged by the changing competitive conditions. Social capital has served here to activate strategic and regulatory mechanisms that help to identify new ways forward and out of economic stagnation. Nevertheless, they have not yet found the capacity (and drivers) to reactivate growth along novel development trajectories. Finally, the third group of clusters has been able to pursue a ‘transformation’ path. In these cases, social capital has served to strengthen prior collective social and institutional capacities in order to integrate new knowledge and new heterogeneous agents in the cluster. Finally, there was also evidenced the need to adjust in the conceptual approach, and also the need to investigate in some cases in greater depth.

9.2.2. Results about the incidence of social capital into the evolution of the machine tool manufacturing in the Bajo Deba district (Basque Country)

The **objective** of the study was to investigate in greater depth the evolutionary proceedings of social capital into the evolution of the machine tool manufacturing in the Bajo Deba district (Basque Country). This district presents two characteristics that make it attractive. On the one hand, it is located in a region that has a reputation of strong identity (basque Country) combined with a rich history of industrial development. On the other hand, in the last 100 years, the machine tool cluster has experienced the various phases of the life cycle, and fundamentally, it has shown important transformation patterns.

The applied **methodological approach** is that of the case study method which has apropriate tools and procedure for in-depth analysis (Villareal & Landeta, 2013).

Among the study results are highlighted the identification of the effective role of social capital to enhance the generation of different adaptive options (and support the design of regional policies). Also, the focus on the historical process provides an opportunity to observe differentiated behavioral patterns (based on specific local idiosyncratic characteristics) in the cluster. Such features fit into the literature of the life cycle of clusters as the issue of contextualization (Staber, 2007) is in some way approached by the evaluation of the impact of social capital into the evolutionary development of the MT cluster by differentiating its functions, related actions through the historical stages. Also, it is confirmed the fact that clusters "do not follow homogeneous evolutionary paths" due to their different intrinsic characteristics and conditions as well as their "different responses to the same external factors (e.g. international demand, global competition, etc). Therefore, cluster policy must be designed and implemented attending to the specific circumstances of the cluster stage (Brenner & Schlump, 2011; Elola et al. 2017). In addition, the interpretation of social capital as a "meso" underlying factor (i.e. community view of social capital: Putnam, 1993; Malecki, 2012) that provide essential guides about what makes sense (Barandiaran & Korta, 2011) is observed in the case.

In brief, the evolution of the machine tool cluster in the Bajo Deba area is schematized by the analysis of successive developmental stages. In this way, the effective role of social capital to enable different developmental mechanisms of growth is analyzed. It is worth to say that, at different critical moments, social capital has been a major factor for ensuring a sustainable path. At the initial stage, Basque society's propensity to strong competition, hard work and a sound community-driven sense served to encourage pioneering manufacturers to channel their business risk attempts and to provide the necessary funding needs. The exploitation of previously existing skills and the deep sense of creativity in the field of metal processing were used to satisfy a strong demand for industrial goods in the Spanish market after the Civil War. In turn, an open attitude towards migratory flows was conditioned by modesty and dedication to work, as valuable guides in such process of integration. After that, a period of sustained Spanish industrial development (1960-1975) was accompanied by a significant expansion in the founding of MT companies. The imprint of social values facilitated the openness for the transfer of knowledge which was carried out in different ways such as enterprises set up by workers from the pioneer factories (spin-offs), the promotion of cooperative schemes and a positive link between companies and local schools. In addition, MT managers had prominent

involvement in adapting the training infrastructure to local idiosyncrasies. Complementarily, the existence of implicit codes and practices helped to frame a favorable scenario for discussion and community integration. By the mid-1970's, the previous process of expansion began to show signs of tension affected by structural changes in political, economic and technological spheres. Thus, against a background of stagnation in entrepreneurship and strong foreign competition, social capital contributed to find sufficient cohesion for strategic planning initiatives, action and regulation (institutional arrangements). The creation of the vocational training institutes, the technology centres, and the cluster association are examples of such collective commitment. Subsequently, grounded in the foundations of the previous step, the cluster has undergone a growth path (1994-2008) in which social capital has served to reinforce the exploitation of culture of risk mechanism and technology upgrades. The sustained strengthening of foreign sales and the generation of competitive technological development has been the core feature of transformation. Additionally, government intervention has been positive to complement the collaborative nature of the Basque society.

The crisis of 2008 highlighted the need for local manufacturers to adapt, based on the collaboration of the local productive system, to a global context that demands mandatory conditions of productivity, flexibility and environmental compliance. Thus, the need to reactivate the forces of growth is manifested; therefore, the role of social capital (supported on characteristic values of Basque society and Debabarrena) will be crucial to fostering joint action and local leadership. For instance, with the current challenges, the development of institutional mechanisms helps to create incentives for action based in the consolidated regional system of innovation and capacity of economic value generation. On the contrary, two factors of alarm, for the long-term sustainability of the cluster, are the decline in the rate of creation of enterprises and the smaller capacity of integration of immigrants which are clear evidences of the changes in local values.

9.2.3. Results of the quantitative examination of the incidence of social capital and its interactions with the mechanisms into the performance of the metalworking technology firms in Spain

The quantitative evaluation carried out has been developed using two analytical blocks. Thus, indicators have been developed that are representative of social capital and operational mechanisms, and then these indicators have been merged into a database of companies belonging to the cluster of metalworking technology in order to examine their incidence according to the underlying assumptions of the conceptual approach. The critical aspects and results of each quantitative analytical component to be highlighted are mentioned below.

9.2.3.1. Representation of indicators of facets of social capital and operational mechanisms for the regions of Spain.

The **goal** of Chapter 7 was to develop composite indexes (or synthetic indexes) to represent the social capital facets and the inducing mechanisms at the Spanish regional level following the “ten-steps” **methodology** of the OECD (2008).

In **relation to literature**, the chapter is related to one of the major operational challenges regarding the concept of social capital refers to its measurement due the diversity of methods and indicators used as it is not directly observable (Van Deth, 2003; Malecki, 2012; Beugelsdijk & Van Schaik, 2005; Staber, 2007). This is a consequence of the complex, dynamic, and multifaceted character of the concept (Woolcock & Narayan, 2000). So, the attempt to build composite indicators of social capital and the mechanisms is a modest answer to the significant operational challenge to study its role in clusters (Staber, 2007).

Two major **findings** appear in this attempt. First, in relation to the index of social capital and the facets, the outcomes reveal a rather logical order with higher values assigned to the northern regions and those with greater economic and demographic power. This could be attributed to the selection of indicators in the facets of work ethics and the attitude of change which have major economic connotations. However, a postive and significant relation between social capital and economic gowth is observed in Beugelsdijk & Van Schaik (2005) in their study covering 54 European regions (NUTS 1). So, these authors mention to the endogeneity between both constructs, and they refer to Putnam’s explanation that there is "a dialect process of reciprocation" (Putnam, 1993). Second, in relation to the relationship between the mechanisms and facets of social capital, it has been possible to establish important correlations which validates the proposed interactions in the conceptual approach, but also prevents the evaluation of causal patterns between them.

9.2.3.2. Social Capital and firms’ performance in the Spanish metalworking technology cluster

The **purpose** of Chapter 8 was to evaluate the effects of facets of a social capital notion, extracted from a set of the socioeconomic characteristics of the territorial context (provincial level), on the Spanish metalworking technology firms’ performance during the recent economic crisis. Methodologically, the MLM scheme (Hox, 2002; Goldstein, 1999; Kreft & De Leeuw, 1998; Heck, Thomas, & Tabata, 2014) has been established in which there are firms at lower-level and higher level are composed of variables at territorial level (i.e. region) variables such as the facets of social capital and mechanisms. This approach is aligned with the recent guidelines that for the evaluation of “micro-macro” performance links, it is necessary to focus on the “proper level of analysys” i.e. firms (Beugelsdijk, 2007; also Raspe, 2009; Menzel & Fornahl, 2010).

This work is the first exploratory attempt, at least from the reach of our knowledge, to measure in the Spanish context the impact of social capital (i.e. regional perspective) on the performance of firms using the multilevel regression technique. In relation to literature of clusters, this attempt fit with the need to examine causality relations based on a pluralistic way due to the combination of different indicators and using the

information contained in case studies, which is a specific empirical-related claim made in Boschma & Fornahl, (2011) and Hassink et al. (2012).

Two major **findings** have been evidenced in this quantitative research. Considering first the effects of social capital, it is remarkable that the social capital index during the whole period has shown a positive impact to affect firm performance despite of measured indicator. This statistical evidence corroborates the literature that values the importance of social capital in terms of the enhancement of coordination, entrepreneurship, and learning and innovation (e.g. Wolfe, 2002; Parrilli 2004, 2009; Malecki, 2012; Durston, 2000, among others), and reinforces the relevance of social capital as a conceptual asset to study cluster development. At the same time, the high correlation between social capital index with the mechanisms of knowledge dissemination and risk culture respectively are an expected consequence of our conceptual approach (in line with studies of other authors), and the hypoyhesis of the social capital positive influence is accepted. However, the interaction with social capital with the other mechanisms does not present a clear pattern of influence in this analysis; so, the findings invite to deepen the conceptual approach an to extend the empirical analysis. All in all, it is appropriate to consider the prevention made by Cooke, Clifton & Oleaga (2005 pp. 1069) that "social capital theory, in combination with the many exogenous variables involved at firm and regional levels, means that it is simply not realistic to do this [to assume propositions of linear causality]. Rather a more complex interactive process is suggested in which certain firms (or regions) may possess higher levels of social capital, which in turn enables them to perform in ways in which they otherwise could not". Second, even though, the individual characteristics of the firms are the dominant drivers to explain the differences into the performance of firms in this very competitive and highly specialized set of economic activities, it is notewhorty that social capital is statistically significant as an explanatory variable of firm growth.

9.3. Implications

As is common in the theses of this field of research, the implications will be conceptual and practical.

From an academic perspective, this thesis has two implications to mention: the development of a simple framework to depict the operation of the social capital in the life cycle of clusters, and the recognition of social capital as a latent driver to impulse the development of heterogeneous responses (i.e. institutional, cultural, or technical) to confront internal and external challenges. Thus, the proactive characterization of social capital intervention is portrayed through the integration of key conceptual units, and considering a distinctive role in the different stages of cluster development (contextualization). This perspective contrasts with a one-dimensional view of social capital as well as with a characterization of social capital as an aspect that has initially positive effects, but detrimental adaptive consequences for the long-term.

Among the implications of designing territorial policies, the idea that the framework for designing a cluster policy must respect and foster the participation of local actors, public-private coordination, and systemic cooperation (Aranguren 2010; Navarro 2003; Ybarra, 2006, Atherton & Johnston, 2008, and must also take into account the stage of economic development of the area (Parrilli 2004, 2006) as well as the stage of the cluster (Brenner & Schlump, 2011; Elola et al. 2017). At this matter, social capital has a mediating role to influence policies towards the integration of new resources, the collective learning, the establishment of shared goals, and the development of regional adaptive capacities (e.g. Aragón et al. 2012; Valdaliso et al. 2012; Parrilli, 2012.

9.4. Limitations and future aspects of research

Certain limitations have made difficult to draw more conclusive conclusions about the validity of conceptual propositions of the thesis. Thus, the following aspects can be highlighted:

Some limitations relate to the nature of the concepts studied in the thesis. First, since its inception , there is ambiguity about the the cluster concept and a terminological overlap. Second, there is a the lack of agreement in this field of study about the framework to study clusetrs' evolution. Third, there is still a lively debate about the dichotomous perspective of the idea of social capital. Throughout the thesis, decisions have been taken on considering these issues in order to demarcate the research field of action in the investigation. So, in this thesis, it is not made a depth inquire about different perspectives discussed in the literature in topics such as: clusters and industrial districts (or other LPS), the method of cluster evolution, or the social capital instrumental vs. community.

Another set of limitations are referred to two aspects of the empirical evaluation: the difficulties of operationalization, and the validity of the conclusions.

The first one is a direct consequence of the conceptual difficulties mentioned above, and it refers to the critics that the concepts adopted in this research have received for the ambiguity in their definitions. In the case of social capital, its use and operationalization has been wide and very heterogenous (Staber, 2007; Van Deth, 2003; Malecki, 2012).

The second one affects to both the qualitative and quantitative analysis. It refers to the problem of generalization. First, despite the advantages of the case study research method, Yin (2003) recognizes that there are some concerns regarding this research strategy, including lack of rigor -problems of systematization mentioned in Yin (2003) and in Villarreal and Landeta (2010)-, little basis for scientific generalizations, and that they are too long to be readable. The risks assumed with this methodological choice (i.e. single case study) are the possibility of "misrepresentation", failure in data collection, and limited external validity (Yin, 2003; Villarreal and Landeta, 2010). Then, some causal connections and propositions that we make in terms of direction of influence and time of effect could be criticized. For further development, nested case study

research might be developed as a means to inquire more directly (and also to provide quantitative evidence) about the effective power of social capital on the selected growth mechanisms to increase the validity and generalization of the conclusions obtained in other contexts, territories and sectors.

As a matter of the quantitive techniques applied, there are some constraints to mention. In relation to the synthetic indexes, they have been criticized due to the possibility of misinterpretation of the outcomes, and the possibility of bias in choices of the analyst during the process of construction. This a direct consequence of limitations in the data availability. Thus, in the future, data quality could be improved and triangular with other data sources such as the EVS or national surveys of social capital. Last but not least, the MLM study has its limitations which lead to a cautious interpretation of the results obtained. For example, the generalization of the results is not assured since the analysis has been restricted to a specific set of economic activities, which is a mature industry, and geographical context. Así, una línea de investigación futura es evaluar el comportamiento del capital social en el desempeño de industrias y en otros contextos geográficos. In turn, a more precise validation of the variables selected to characterize the facets of social capital and the mechanisms, and their influence in the performance of the companies could be achieved through the execution of the combination of confirmatory factor analysis (CFA) and a multilevel model in a so called multilevel structural equation modeling (Kline, 2011). Also, as social capital is considered a longstanding factor, the availability (or construction) of longitudinal databases will enrich the examination of a complete evolutionary frame.

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Annexes

Annex 1.1: The diversity of cluster definitions & key features

	Cluster definition	Reference
Spatial proximity elements	Groups of firms within one industry based in one geographical area	SWANN and PREVEZER (1996, p. 1139)
	Cluster and agglomeration will be judged to be synonymous since they both define geographical areas where an industry (or industries) is concentrated to produce localized economic advantages	OAKEY *et al.* (2001, p. 401)
	Spatial and sectoral concentration of firms	BRESNAHAN *et al.* (2001, p. 836)
	Referred to as 'locational economies' and embraces those economies that arise from geographical agglomeration of related economic activities. The territorial configuration most likely to enhance the learning process	MASKELL (2001, p. 922)
	Concentration of related activities in a particular area	VAN KLINK and DE LANGEN (2001, p. 450)
	Industrial districts as examples of advantage – generating 'super-firm' groups inside industries, within each member, and within each member firm simultaneously shares and differentiates sources of competitive advantage	TALLMAN *et al.* (2004, p. 259)
Knowledge and network elements	Inter-industry level, underlying networks of interrelated cooperating businesses	DEBRESSON (1996, p. 161)
	Strong collection of related companies located in a small geographical area, sometimes centred on a strong part of a country's science base	BAPTISTA and SWANN (1998, p. 525)
	Geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions in a particular field, linked by communities and complementarities	PORTER (1998, p. 199)
	Networks of production of strongly interdependent firms (including specialized suppliers), knowledge-producing agents (universities, research institutes), bridging institutions (brokers, consultants), and consumers related to each other in a value-adding production chain	HERTOG and MALTHA (1999, p. 193)
	Localized sectoral agglomerations of symbiotic organizations that can achieve superior business performance because of their club-like interaction	STEINLE and SCHIELE (2002, p. 850)
	Homogenous knowledge communities	DAHL and PEDERSEN (2003, p. 7)
	Specific spatial configuration of the economy suitable for the creation, transfer, and usage of knowledge	MASKELL and LORENZEN (2004, p. 991)
	Non-random geographical agglomerations of firms with similar or closely complementary capabilities	MASKELL and KEBIR (2005, p. 1)
	Group of firms, related economic actors, and institutions that are located near each other and have reached a sufficient scale to develop specialized expertise, services resources, suppliers and skills	COMMISSION OF THE EUROPEAN COMMUNITIES (2008, p. 5)

Source: Partially adapted from ALMODOVAR and TEIXEIRA (2009).

Source: Cruz & Teixeira, 2010

Annex 1.2: Major measures of social capital (inverse measures in italics)

		Structural aspects	Cultural aspects	
Location	Data collection method	Networks/social contacts	Trust/confidence	Civic norms and values
Individual feature	Surveys/polling	Membership in vol. associations Volunteerism (Ego-centred) networks and social contacts Time budgets Number of children in the household	Trust in other people Confidence in institutions Ethics and corruption	Norms of reciprocity Obligations Democratic attitudes Solidarity and identification Togetherness Subjective well-being
	Statistical indicators/ Official statistics	–	–	–
	Community studies/ observations	Voluntary associations Networks and social contacts	–	–
	Projects/experiments	–	–	–
Collective feature	Surveys/polling	Aggregate membership figures Aggregate voluntarism figure Network characteristics (density etc.) Aggregate time budget figures Social mobility	Aggregate figures on trust in other people Aggregate figures on confidence in institutions	Aggregate figures on norms of reciprocity Aggregate figures on democratic attitudes Aggregate figures on solidarity and identification
	Statistical indicators/ Official statistics	Organizational activity and resources Volunteerism Mass media and use of (new) technology	Balance sheets of co-ops	*Voting turnout* *Crime rates* *Legal protection*
	Community studies/ observations	Voluntary associations Networks and social contacts	–	–
	Projects/experiments	–	Lost wallets with money	–

Source: Van Deth (2003)

Annex 4.1: Semi-structured interview template

Información sobre la Entrevista y el Entrevistado

Fecha de la Entrevista:_____

Lugar de la Entrevista:_____

Duración de la Entrevista:_____

Entrevistador:_____

Identificador para el entrevistado:_____

Edad del Entrevistado:_____

Profesión del Entrevistado:_____

Trabaja en esta profesión desde:_____

Campo Profesional:_____

Peculiaridades de la entrevista:_____

Cuestionario Modelo

1. Introducción

1.1. Objetivo del estudio: Analizar y comprender el rol del capital social durante las diferentes etapas del ciclo de vida de un cluster.

1.2. Capital Social: Concepto relacionado a valores, normas y rutinas de larga duración que determinan y condicionan el comportamiento social y económico de los agentes en un cluster (Bordieu, Putnam, etc). Específicamente, siguiendo a Becattini, asociamos el sistema de valores a las facetas de ética del trabajo, actitud hacia el cambio, y reciprocidad como requerimientos esenciales para el desarrollo y reproducción de un cluster.

1.3. Facetas del Capital Social

-Ética del trabajo: Sentimiento de responsabilidad y disciplina comprometidos a la obtención de resultados comerciales y sociales.

-Actitud de Cambio: Sentido de predisposición para efectuar cambios y asumir riesgos individuales y colectivos.

-Reciprocidad: Actitud de correspondencia frente al accionar comunitario.

1.4. Mecanismos en el Ciclo de Vida

-Culturales

Cultura del Riesgo: creación y sostenimiento de un ambiente favorable para asumir riesgos económicos.

Integración Cultural: actitud abierta para favorecer la integración social y económica de personas con origen ajeno al territorio/cluster.

-Institucionales

Marco Regulatorio: formalización instituciones y prácticas para coordinación de actividades.

Planeamiento Estratégico: desarrollo e implementación de una visión y objetivos comunes.

Normas Informales: códigos de comportamiento implícitos en normas y sanciones.

Financiamiento del Riesgo: provisión de recursos financieros para actividades novedosas.

-Técnicos

Diseminación del Conocimiento: procesos de transferencia de información clave para mejorar la calidad de productos y procedimientos productivos.

Infraestructura de Aprendizaje: creación de estructura de entrenamiento y capacitación para soportar las necesidades de recursos humanos requeridos por el cluster.

2. Mecanismos de Aglomeración y Facetas del Capital Social

-¿Qué factores y/o mecanismos han sido vitales durante la evolución de este cluster?

-¿Las facetas del Capital Social antes mencionadas ha contribuido también a facilitar esta evolución?

-¿A través de qué mecanismos?

3. Fases del Ciclo de Vida

3.1. Definición Temporal Estructural y contexto Macroeconómico General

-¿Entre que fechas/décadas encuadraría Ud. los períodos evolutivos de este cluster (creación de valor añadido, firmas, empleo, etc.) y qué condiciones del contexto macroeconómico favorecieron este proceso?

3.2. Emergencia

-En los orígenes del cluster en este período, ¿cuáles fueron los factores más importantes que impulsaron el surgimiento?

-¿Cuáles son los grupos sociales y económicos más importantes? (ej. Identificados por industria, propósito, público, privado, etc.)

-¿El capital social ejerció un rol central en este proceso?

-¿A través de qué mecanismos y cómo se podría caracterizar esta influencia?

-¿Considera que la cultura del riesgo, la financiación del emprendizaje y la integración culturales son mecanismos importantes en el origen del cluster?

3.3. Crecimiento

-¿Cuáles fueron los factores más importantes que impulsaron el fuerte crecimiento del cluster? (ej. creación de spin-offs, start-ups de ex empleados, compartir conocimientos).

-¿Qué mecanismos dominantes en la etapa anterior sirven para sostener el desarrollo de los mecanismos dominantes antes mencionados?

-¿Qué rol ejerció el capital social en esta etapa?

-¿A través de qué mecanismos y cómo se podría caracterizar esta influencia?

-¿El capital social tiene alguna relación con la diseminación del conocimiento, el desarrollo de infraestructura de entrenamiento y capacitación, y el establecimiento de normas informales en este período?

-¿Con que relaciona usted a normas informales?

3.4. Madurez

-¿Cuáles fueron los factores más importantes en la etapa de madurez del cluster?

-¿Qué rol ejerció el capital social en esta etapa?

-¿Ejerció un rol central para mejorar la situación o por el contrario existieron otros aspectos los que movilizaron a los agentes económicos?

-¿A través de qué mecanismos y cómo se podría caracterizar esta influencia?

-Por ejemplo, ¿el capital social ha tenido un rol directo en la madurez del cluster para la exploración y determinación de opciones estratégicas colectivas?, ¿el desarrollo de un marco formal de regulaciones, instituciones y prácticas ha mejorado la coordinación de actividades en esta etapa del cluster?

3.5. Transformación

-¿Cómo se detecta y manifiesta la necesidad para transformarse y cambiar?

-¿Es parte de un proceso colectivo o dependió de las acciones individuales de los agentes involucrados?, ¿qué cambios se observan en comparación con etapas anteriores?

-¿Existió algún actor que asumió el liderazgo?

-¿Qué rol tuvo el capital social?

-¿A través de qué mecanismos?

-¿Con que relacionaría Ud. a la cultura del riesgo en la transformación del cluster?

-¿Que rol tiene el Capital Social para la introducción de nuevos conocimientos que favorecieron la transformación?

-¿Qué importancia tiene en la coyuntura reciente los aspectos financieros en la evolución de las empresas y cuál es la influencia del capital social en este sentido?

-¿Con que aspecto de la transformación del cluster estaría relacionada la cuestión de cambios en la estructura social (migraciones)?

4. Consideraciones Finales

-¿Considera que los valores de ética del trabajo, actitud de cambio y reciprocidad han sido fundamentales para facilitar el proceso evolutivo del cluster?

-¿Son representativos del Capital Social?

-¿Estos valores se han mantenido inmutables a través del tiempo?

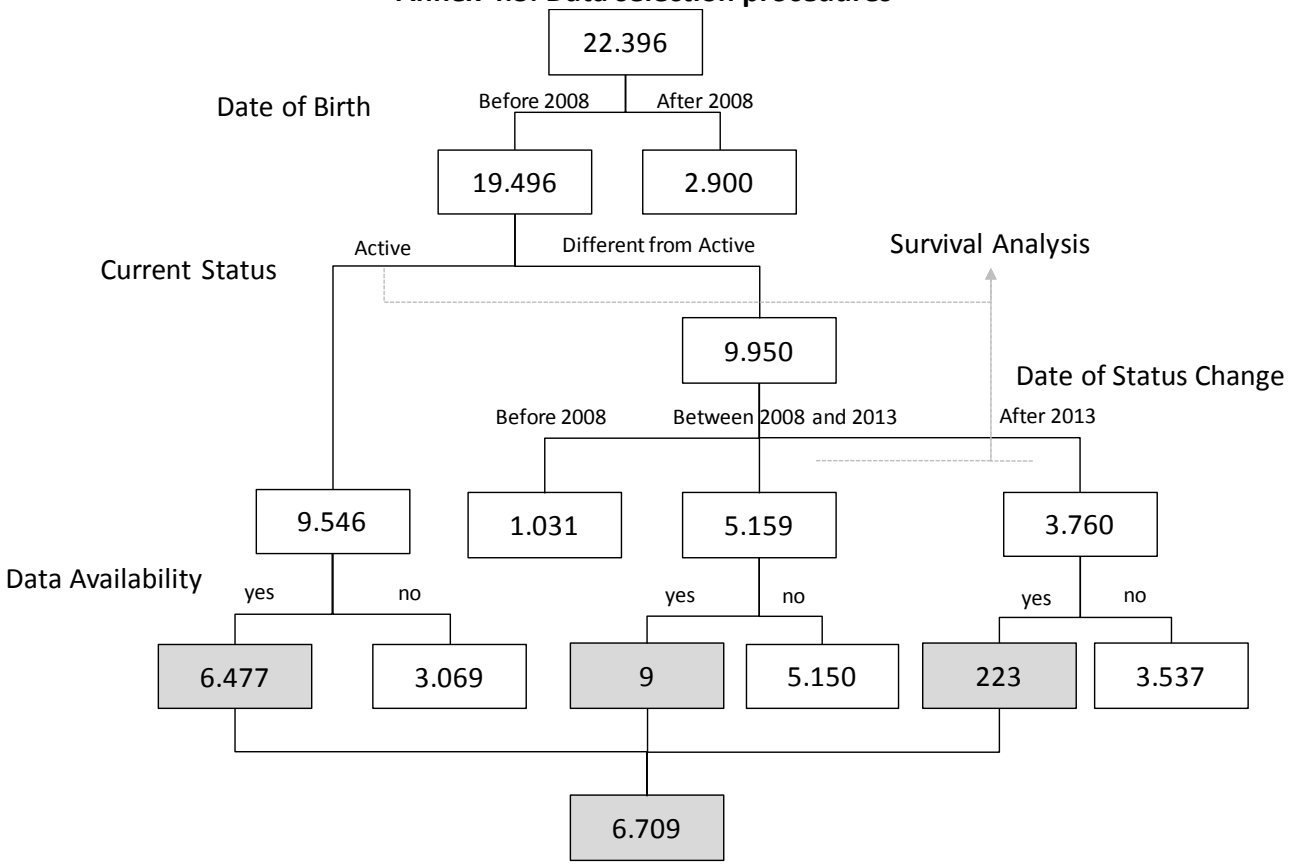
-¿Por qué y cómo se manifiesta el cambio?¿Podría mencionar algunos ejemplos?

Annex 4.2: Phases of thematic analysis

Phase	Description of the process
1. Familiarising yourself with your data:	Transcribing data (if necessary), reading and rereadingthe data, noting down initial ideas.
2. Generating initial codes:	Coding interesting features of the data in asystematic fashion across the entire data set, collating data relevant to each code.
3. Searching for themes:	Collating codes into potential themes, gathering alldata relevant to each potential theme.
4. Reviewing themes:	Checking in the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic "map‟ of the analysis.
5. Defining and naming themes:	Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells; generating clear definitions and names for each theme.
6. Producing the report:	The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis ofselected extracts, relating back of the analysis to the research question and literature, producing ascholarly report of the analysis.

Source: Braun & Clarke (2006)

Annex 4.3: Data selection procedures



Sample extraction was performed on 01/05/2016
Source: Own elaboration

Annex 6.1: Main MT Industry Variables Evolution

	1970	1975	1980	1985	1990	1995	1999	2008	2012
Firms (Bajo Deba)	34	28	24	26	26	24	26		
Firms (Guipúzcoa)	87	67	66	60	61	48	51	47	41
Firms (Spain)	250	137	139	114	114	84	96	92	80
Bajo Deba/Spain	*14%*	*20%*	*17%*	*23%*	*23%*	*29%*	*27%*		
Employment (Bajo Deba)		2.820	2.578	2.268	2.168	1.538	1.787		
Employment (Guipúzcoa)	5.366	5.811	5.054	4.177	4.123	2.799	3.322	3.751	3.014
Employment (Spain)	12.432	10.192	9.454	7.405	7.284	4.435	5.614	5.652	4.761
Bajo Deba/Spain		*28%*	*27%*	*31%*	*30%*	*35%*	*32%*		
Production (Bill.Ptas.)	8	17	25	43	104	79	152	176	142
Production Index (Ind. Prices Machinery 2005=100)		1146	777	794	1467	983	1838	1605	1246
Exports (Bill.Ptas,)	2	5	16	26	46	48	79	122	130
Exports Index (Ind. Prices Machinery 2005=100)		345	503	475	653	592	957	1118	1144
% Exports/Production	*25%*	*30%*	*65%*	*60%*	*45%*	*60%*	*52%*	*70%*	*92%*
Spain: % of World MT Exports				*1,5%*		*2,3%*			*2,1%*
IT-FR-SUI-UK: % of World MT Exports				*21,1%*		*22,9%*			*15,0%*
Productivity (Production/Employment)	*1*	*2*	*3*	*6*	*14*	*18*	*27*	*31*	*30*
Productivity (Constant Production/Employment)		*11*	*8*	*11*	*20*	*22*	*33*	*28*	*26*

Sources: AFM, AIIMH (1971), CLP, INE (Industrial Price Index: Machinery and Equipment 2005=100).

Annex 7.1: List of indicators complied

#	Variable Code	Variable Description	Initial date	End date	Unit	Source
1	Work Stability	Indefinite Registered Contracts / Total Registered Contracts	1992	2012	%	Fundación Encuentro (MEySS: Anuario de Estadísticas)
2	Unemployment	Unemployment Rate	1990	2011	%	INE - Encuesta Población Activa
3	Labor Agreements	% of Workers Covered in Collective Agreements	1991	2010	%	INE
4	Agreed work hors	Hours legally established by verbal agreement, individual contract or collective agreement between the worker and the company. (Hs.	2000	2014	Index	Encuesta Trimestral de Coste Laboral (ETCL) - INE
5	Efective work hours	Hours actually worked both in normal working hours and in extraordinary working hours. (Hs. per worker per month)	2000	2014	Index	Encuesta Trimestral de Coste Laboral (ETCL) - INE
6	Non-worked hours	Hours not worked during the working day for any reason (holidays, temporary incapacity, maternity, personal reasons, labor conflict,	2000	2014	Index	Encuesta Trimestral de Coste Laboral (ETCL) - INE
7	Work Productivity	GDP at market prices / Occupied Population (1991-2010)	1995	2010	%	INE / Fund.Encuentro
8	Strikes	Participation / Workers affiliates to Social Security (SSN)	1991	2010	%	INE (Social Indicators 2011); Min. Empleo y Seg.Soc.
9	Employment Rotation Index	Number of registered new placements per registered unemployed	2000	2007	Index	Fundación Encuentro a partir de Ministerio de Trabajo y Asuntos Sociales, Boletín de estadísticas
10	Exports Sophistication (Total)	Exports sophistication value	1996	2005		Minondo (2008)
11	Exports Sophistication (Manufactures)	Exports sophistication value (manufactured products)	1996	2005		Minondo (2008)
12	High Tech Patents	High tech sectors patents applications to the EPO (Every million of inhabs.)	2000	2012	Index	Eurostat
13	Innovation 1	Patents per million inhabitants (Spanish census 2011)	2011	2011	Index	Bergua-Amores et al. (2016)
14	Innovation 2	Expenditure in Tech Innovation (Euros per inhabitant)	2005	2010		Indicadores del Sistema Español de Ciencia y Tecnología 2012 - ICONO Observatorio Español de
15	Internationalization	Exports (1995-2014) / Total Firms (1999-2013)	1999	2013	%	MEyC - DataComex / Fundación Encuentro (INE - Contabilidad Regional de España)
16	Cooperatives	Cooperatives / Total Firms	1999	2013	%	Fundación Encuentro (INE - DIRCE)
17	Associations	Associations / Total Firms	1999	2013	%	Fundación Encuentro (INE - DIRCE)
18	Coops+Associations 1	(Cooperatives + Associations) / Total Firms	1999	2013	%	Fundación Encuentro (INE - DIRCE)
19	Coops+Associations 2	(Cooperatives + Associations) / Surface area (Sq-km)	1999	2013	Index	Fundación Encuentro (INE - DIRCE)
20	Blood donations	Absolute Index	2011	2011	Index	Casado-Neira (2013)
21	Employment Regulation	Reduced + Suspention / Occupied Population	2002	2013	%	MEySS - Anuario Estadístico
22	Electoral participation	Participation in Autonomic Elections	1995	2008	%	Observatorio Social de España
23	Crime Rates (Condenados)	Condemned persons every 1000 inhabitants	1991	2010	Index	INE - Indicadores Sociales 2011
24	Crime Rates (Detenidos)	Detained persons every 1000 inhabitants (By Civil Guard & National Police)	1993	2010	Index	INE - Indicadores Sociales 2011

#	Variable Code	Variable Description	Initial date	End date	Unit	Source
25	Industrial Business Dimension 1	Number of Industrial Firms (1995-2008) / Active Population (1990-2011)	1995	2008	%	Fundación Encuentro (INE - DIRCE)
26	Industrial Business Dimension 2	Number of Industrial Firms (1995-2008) / Surface area (Sq-km) (1990-2013)	1995	2008	%	Fundación Encuentro (INE - DIRCE)
27	New Firms (Capital)	New firms capital / New Firms	2000	2013	%	Fundación Encuentro (Bank of Spain Data)
28	Net balance of firms Stock	(New Firms - Death Firms) / Total Firms (1999-2013)	2000	2013	%	INE - Estadística Sociedades Mercantiles
29	Investment	Net Worth Capital Increases (2000-2013) / Total Firms (1999-2013)	2000	2013	%	INE - Estadística Sociedades Mercantiles
30	Inmigration	Foriegn Population / Active Population	1998	2010	%	INE - Ppales. Series de Población
31	Foreign People Unemployment	Unemployment Rate of Foreign People	2002	2014	%	INE - Encuesta Población Activa
32	Unemployment Gap	Spanish people unemployment rate - Foreign people unemployment rate	2002	2014	Index	INE - Encuesta Población Activa
33	Tolerance	Tolerance to Inmigrants	2011	2011	Index	Bergua-Amores et al. (2016)
34	Foreign People in Industry	Work Permits to Foreigners (Industry) / Active Population (1990-2012)	1999	2012	Index	MEySS - Anuario Estadístico
35	Total Interregional Migration	Total Internal Residential Changes (Origin - Destination / Total Movements)	1998	2013	%	INE - Encuesta de Variaciones Residenciales
36	Spanish people Interregional Migration	Spainsh Internal Residential Changes (Origin - Destination / Total Movements)	1998	2013	%	INE - Encuesta de Variaciones Residenciales
37	Foreign People Interregional Migration	Foreign persons Internal Residential Changes (Origin - Destination / Total Movements)	1998	2013	%	INE - Encuesta de Variaciones Residenciales
38	Financial Support for Local Development	Funds to support employment & R&D (2003-2013) / Active Population (1990-2012)	2003	2012	Index	MEySS - Anuario Estadístico / Ayudas para el fomento de desarrollo local
39	Financial Support for Local Development	Funds to support employment studies (2003-2013) / Active Population (1990-2012)	2003	2012	Index	MEySS - Anuario Estadístico / Ayudas para el fomento de desarrollo local
40	Financial Support for Local Development	Funds to support agents of employment promotion (2003-2013) / Active Population (1990-2012)	2003	2012	Index	MEySS - Anuario Estadístico / Ayudas para el fomento de desarrollo local
41	Financial Support for Local Development	Funds to support R&D projects (2003-2013) / Active Population (1990-2012)	2003	2012	Index	MEySS - Anuario Estadístico / Ayudas para el fomento de desarrollo local
42	Gross Investment per capita	Gross Investment / Active Population	1990	2012	Index	IVIE
43	Capital Stock per capita	Capital Stock / Active Population	1990	2012	Index	IVIE
44	Public Expenditure for R&D	R&D Expenditure (Public)	2000	2010	%	Funcas
45	Quality Certifications	Firms with quality certifications (every 1000 firms)	2007	2007	%	Fundación BBVA
46	Work Accidents	Incidence Index (every 100 th. workers at risk)	1991	2010	Index	INE – Indicadores Sociales 2011
47	Conflict Resolution	Labor conflict resolution by extrajudicial way / Active Population	2003	2013	%	MEySS - Anuario Estadístico
48	Industry Employment	(FP I + FP II + Superiores) / Ocuppied population	1977	2013	%	IVIE
49	People in R&D	Employment R&D / Occupied Population	1990	2006	%	Fundación Encuentro - INE / Estadística sobre actividades de I+D
50	R&D Expenditure (Firms)	R&D Expenditure (euros) / Total Firms	1990	2011	%	Fundación Encuentro - INE / Estadística sobre actividades de I+D
51	Education Index	Average (2000-2006) every 1000 firms	2000	2006	%	Fundación BBVA - IVIE

Sources: Own elaboration.

Annex 7.2: Transformation of the social capital indicators

CCAA	z1	z2	z3	z4	z5	z6	z7	z8	z9	z10	z11
Andalucía	4,42	-19,39	4300059	3,16	0,16	3,49	134,80	0,06	1,89	73,45	-7,21
Aragón	10,39	-7,79	5039905	2,00	-0,63	6,62	483,82	0,02	13,99	68,45	-5,71
Asturias	8,81	-11,02	4788537	3,64	1,47	5,27	239,65	0,03	16,17	64,53	-5,47
Baleares	11,39	-10,50	4871803	0,27	0,19	1,99	97,90	0,04	1,32	61,00	-8,88
Canarias	10,74	-15,23	4409148	0,31	2,04	1,41	94,54	0,08	1,76	63,18	-9,34
Cantabria	8,81	-10,01	4743597	2,79	0,71	3,46	177,52	0,02	13,80	71,95	-6,11
Castilla-La Mancha	8,51	-12,05	3091139	0,43	0,88	1,66	143,62	0,02	3,03	75,93	-5,49
Castilla y León	9,57	-10,84	6419800	2,01	-0,72	3,31	268,37	0,01	9,65	71,70	-3,96
Cataluña	14,05	-10,35	5261097	3,04	1,28	14,82	509,92	0,15	7,52	60,33	-5,42
C. Valenciana	10,56	-12,55	4399577	0,84	1,23	6,21	190,08	0,11	6,87	71,35	-8,59
Extremadura	4,44	-17,94	3893824	1,19	1,15	2,14	74,68	0,02	1,80	76,18	-4,35
Galicia	9,25	-11,45	4156110	7,55	0,84	3,37	293,71	0,03	5,08	62,78	-4,24
Madrid	15,40	-9,05	5733984	2,04	1,25	25,96	963,71	0,22	2,74	65,28	-6,84
Murcia	8,38	-12,93	4131916	0,22	2,44	4,05	167,93	0,12	1,85	70,43	-7,47
Navarra	9,64	-6,53	5639388	8,17	0,12	13,02	593,17	0,03	20,73	69,78	-3,66
País Vasco	7,88	-9,07	5855556	13,16	1,71	9,09	758,51	0,15	19,07	71,25	-3,59
La Rioja	9,88	-7,89	5067941	1,14	0,88	6,63	294,07	0,04	6,73	73,33	-5,93

CCAA	z_r_1	z_r_2	z_r_3	z_r_4	z_r_5	z_r_6	z_r_7	z_r_8	z_r_9	z_r_10	z_r_11
Andalucía	1	1	5	13	4	8	4	11	5	15	5
Aragón	12	16	11	8	2	12	13	4	14	7	9
Asturias	7	8	9	14	14	10	9	6	15	5	11
Baleares	15	10	10	2	5	3	3	10	1	2	2
Canarias	14	3	7	3	16	1	2	12	2	4	1
Cantabria	6	12	8	11	6	7	7	5	13	13	7
Castilla-La Mancha	5	6	1	4	8	2	5	2	7	16	10
Castilla y León	9	9	17	9	1	5	10	1	12	12	15
Cataluña	16	11	13	12	13	16	14	15	11	1	12
C. Valenciana	13	5	6	5	11	11	8	13	10	11	3
Extremadura	2	2	2	7	10	4	1	3	3	17	13
Galicia	8	7	4	15	7	6	11	8	8	3	14
Madrid	17	14	15	10	12	17	17	17	6	6	6
Murcia	4	4	3	1	17	9	6	14	4	9	4
Navarra	10	17	14	16	3	15	15	7	17	8	16
País Vasco	3	13	16	17	15	14	16	16	16	10	17
La Rioja	11	15	12	6	8	13	12	9	9	14	8

CCAA	z_n_1	z_n_2	z_n_3	z_n_4	z_n_5	z_n_6	z_n_7	z_n_8	z_n_9	z_n_10	z_n_11
Andalucía	0,059	0,059	0,294	0,765	0,235	0,471	0,235	0,647	0,294	0,882	0,294
Aragón	0,706	0,941	0,647	0,471	0,118	0,706	0,765	0,235	0,824	0,412	0,529
Asturias	0,412	0,471	0,529	0,824	0,824	0,588	0,529	0,353	0,882	0,294	0,647
Baleares	0,882	0,588	0,588	0,118	0,294	0,176	0,176	0,588	0,059	0,118	0,118
Canarias	0,824	0,176	0,412	0,176	0,941	0,059	0,118	0,706	0,118	0,235	0,059
Cantabria	0,353	0,706	0,471	0,647	0,353	0,412	0,412	0,294	0,765	0,765	0,412
Castilla-La Mancha	0,294	0,353	0,059	0,235	0,471	0,118	0,294	0,118	0,412	0,941	0,588
Castilla y León	0,529	0,529	1,000	0,529	0,059	0,294	0,588	0,059	0,706	0,706	0,882
Cataluña	0,941	0,647	0,765	0,706	0,765	0,941	0,824	0,882	0,647	0,059	0,706
C. Valenciana	0,765	0,294	0,353	0,294	0,647	0,647	0,471	0,765	0,588	0,647	0,176
Extremadura	0,118	0,118	0,118	0,412	0,588	0,235	0,059	0,176	0,176	1,000	0,765
Galicia	0,471	0,412	0,235	0,882	0,412	0,353	0,647	0,471	0,471	0,176	0,824
Madrid	1,000	0,824	0,882	0,588	0,706	1,000	1,000	1,000	0,353	0,353	0,353
Murcia	0,235	0,235	0,176	0,059	1,000	0,529	0,353	0,824	0,235	0,529	0,235
Navarra	0,588	1,000	0,824	0,941	0,176	0,882	0,882	0,412	1,000	0,471	0,941
País Vasco	0,176	0,765	0,941	1,000	0,882	0,824	0,941	0,941	0,941	0,588	1,000
La Rioja	0,647	0,882	0,706	0,353	0,471	0,765	0,706	0,529	0,529	0,824	0,471

Sources: Own elaboration.

z1	Work Stability
z2	Unemployment
z3	Labour Productivity
z4	Strikes
z5	Exports Sophistication
z6	High Tech Patents App.
z7	Innovation Index
z8	Coops. + Assoc.
z9	Blood Donations
z10	Electoral Participation
z11	Crime

Ethic of work
Attitude to change
Reciprocity

Annex 7.3: Transformation of the mechanisms indicators

CCAA	z13	z14	z16	z17	z19	z20	z22	z23	z24	z25	z26
Andalucía	48,16	3,86	-2,62	38,95	8371,91	1778,93	10,27	-5131,62	0,27	28,92	0,61
Aragón	85,98	2,62	-8,81	60,72	3601,94	3016,41	10,79	-4742,82	0,22	85,92	0,84
Asturias	82,60	2,03	-10,86	21,99	3170,96	2971,69	11,28	-5963,35	0,35	64,74	0,69
Baleares	54,71	3,65	-9,27	100,00	542,65	1893,12	8,36	-6614,10	0,12	19,60	0,21
Canarias	41,74	3,78	-2,80	65,78	4330,32	1820,87	7,71	-5615,66	0,25	18,06	0,49
Cantabria	79,74	2,38	-7,29	31,32	4156,06	2627,71	8,22	-4977,05	0,54	77,10	0,44
Castilla-La Mancha	59,07	3,36	-9,32	50,68	5499,02	2543,84	7,93	-6370,38	0,22	36,85	0,28
Castilla y León	61,11	2,27	-8,89	31,84	5415,74	3105,81	9,82	-5243,95	0,27	65,61	0,77
Cataluña	70,33	3,68	-10,20	74,35	4250,43	1831,10	5,89	-4942,63	0,22	82,82	1,05
C. Valenciana	60,20	3,86	-7,97	74,84	3441,73	1546,18	8,81	-4671,12	0,18	54,26	0,68
Extremadura	44,65	2,27	-6,84	17,36	9020,12	2718,28	9,54	-4658,81	0,18	21,73	0,41
Galicia	68,70	2,57	-5,60	18,53	4897,89	2348,18	7,48	-5613,30	0,06	54,26	0,66
Madrid	182,11	4,61	-3,55	72,93	2882,68	2203,16	11,43	-4443,70	0,20	49,17	1,47
Murcia	64,93	4,17	-6,89	76,70	1715,62	1674,57	9,31	-4676,19	0,15	41,70	0,58
Navarra	90,87	3,31	-8,23	50,56	3008,15	2208,00	8,34	-5096,27	0,12	123,75	1,36
País Vasco	163,97	2,33	-13,91	32,18	2329,50	2024,29	14,24	-5448,72	0,38	138,83	1,21
La Rioja	63,87	2,43	-8,29	68,06	1129,25	2420,54	14,36	-5129,11	0,12	94,44	0,61

CCAA	z_r_13	z_r_14	z_r_16	z_r_17	z_r_19	z_r_20	z_r_22	z_r_23	z_r_24	z_r_25	z_r_26
Andalucía	3	14	17	7	16	3	12	8	14	4	7
Aragón	14	8	7	10	9	16	13	13	9	14	13
Asturias	13	1	2	3	7	15	14	3	15	10	11
Baleares	4	11	5	17	1	6	7	1	4	2	1
Canarias	1	13	16	11	12	4	3	4	12	1	5
Cantabria	12	5	11	4	10	13	5	11	17	12	4
Castilla-La Mancha	5	10	4	9	15	12	4	2	11	5	2
Castilla y León	7	2	6	5	14	17	11	7	13	11	12
Cataluña	11	12	3	14	11	5	1	12	10	13	14
C. Valenciana	6	15	10	15	8	1	8	15	7	8	10
Extremadura	2	3	13	1	17	14	10	16	6	3	3
Galicia	10	7	14	2	13	10	2	5	1	9	9
Madrid	17	17	15	13	5	8	15	17	8	7	17
Murcia	9	16	12	16	3	2	9	14	5	6	6
Navarra	15	9	9	8	6	9	6	10	3	16	16
País Vasco	16	4	1	6	4	7	16	6	16	17	15
La Rioja	8	6	8	12	2	11	17	9	2	15	8

CCAA	z_n_13	z_n_14	z_n_16	z_n_17	z_n_19	z_n_20	z_n_22	z_n_23	z_n_24	z_n_25	z_n_26
Andalucía	0,17647	0,82353	1	0,41176	0,94118	0,17647	0,70588	0,47059	0,82353	0,23529	0,41176
Aragón	0,82353	0,47059	0,41176	0,58824	0,52941	0,94118	0,76471	0,76471	0,52941	0,82353	0,76471
Asturias	0,76471	0,05882	0,11765	0,17647	0,41176	0,88235	0,82353	0,17647	0,88235	0,58824	0,64706
Baleares	0,23529	0,64706	0,29412	1	0,05882	0,35294	0,41176	0,05882	0,23529	0,11765	0,05882
Canarias	0,05882	0,76471	0,94118	0,64706	0,70588	0,23529	0,17647	0,23529	0,70588	0,05882	0,29412
Cantabria	0,70588	0,29412	0,64706	0,23529	0,58824	0,76471	0,29412	0,64706	1	0,70588	0,23529
Castilla-La Mancha	0,29412	0,58824	0,23529	0,52941	0,88235	0,70588	0,23529	0,11765	0,64706	0,29412	0,11765
Castilla y León	0,41176	0,11765	0,35294	0,29412	0,82353	1	0,64706	0,41176	0,76471	0,64706	0,70588
Cataluña	0,64706	0,70588	0,17647	0,82353	0,64706	0,29412	0,05882	0,70588	0,58824	0,76471	0,82353
C. Valenciana	0,35294	0,88235	0,58824	0,88235	0,47059	0,05882	0,47059	0,88235	0,41176	0,47059	0,58824
Extremadura	0,11765	0,17647	0,76471	0,05882	1	0,82353	0,58824	0,94118	0,35294	0,17647	0,17647
Galicia	0,58824	0,41176	0,82353	0,11765	0,76471	0,58824	0,11765	0,29412	0,05882	0,52941	0,52941
Madrid	1	1	0,88235	0,76471	0,29412	0,47059	0,88235	1	0,47059	0,41176	1
Murcia	0,52941	0,94118	0,70588	0,94118	0,17647	0,11765	0,52941	0,82353	0,29412	0,35294	0,35294
Navarra	0,88235	0,52941	0,52941	0,47059	0,35294	0,52941	0,35294	0,58824	0,17647	0,94118	0,94118
País Vasco	0,94118	0,23529	0,05882	0,35294	0,23529	0,41176	0,94118	0,35294	0,94118	1	0,88235
La Rioja	0,47059	0,35294	0,47059	0,70588	0,11765	0,64706	1	0,52941	0,11765	0,88235	0,47059

z13	New Firms' Investment
z14	Net Stock of Firms
z16	Unemployment Gap
z17	Tolerance to Inmigrants
z19	Financial Support R&D / employment
z20	Gross Investment pc
z22	Quality Certif.
z23	Work Accidents Index
z24	Conflict E xtrajud.
z25	Industry Employment (qualifications)
z26	People in R&D

	Risk Culture
	Diversity Integration
	Strategic Planning
	Regulatory Framework
	Informal Norms
	Knowledge dissemination

Sources: Own elaboration.