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Innovation clusters and cluster policies in traditional industries

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Abstract

The purpose of dissertation is the understanding of the traditional industry innovation clusters' formation and further strengthening processes. Chapter 2 provides a literature review of cluster – related issues trying to understand the concept of clustering, its functions, and the factors that are considered to facilitate its emergence and strengthening processes. Cluster formation is a process that can be provoked either by political intervention or emerge as part of the development process. However the term cluster policies does not refer only in government actions, since according to the Triple Helix Model, the industry and the Science and Technology System have also crucial roles to play. A contextual analysis of the factors of clusters success is attempted taking in mind the fact that there is no "better policy", as the conditions and characteristics of regions and industries are significant aspects that need to be considered. Chapter 3 provides an attempt of learning from international experience of traditional cluster case studies, trying to analyze how effective practices come to offer positive outcomes. Finally, in Chapter 4, a comparative analysis of the findings will be attempted, in a close linking with the conclusions that derive from the literature review of Chapter 2.

Περίληψη

Ο σκοπός της παρούσας εργασίας είναι η κατανόηση της διαδικασίας της συγκρότησης και ενδυνάμωσης υπαρχόντων καινοτομικών cluster επιχειρήσεων σε παραδοσιακές βιομηχανίες. Το κεφάλαιο 2 παρέχει μια βιβλιογραφική ανασκόπηση θεμάτων σχετικών με τα cluster, προσπαθώντας να αναλυθεί η έννοια του cluster, οι λειτουργίες του, και οι παράγοντες που επηρεάζουν την ανάδυση τους, και την περαιτέρω ενδυνάμωση τους. Η διαδικασία της συγκρότησης μπορεί να προκληθεί είτε από πολιτικές παρεμβάσεις, είτε αυθόρμητα. Ο όρος cluster policies, δεν αναφέρεται μόνο στις κυβερνητικές δράσεις, αφού σύμφωνα με τη θεωρία του Τριπλού Έλικα, ο ρόλος της βιομηχανίας και της ακαδημίας είναι επίσης κρίσιμος. Παράλληλα επιχειρείται η ανάλυση των παραγόντων που χαρακτηρίζουν ένα cluster σαν επιτυχημένο ή όχι έχοντας υπόψη πως δεν υπάρχει «καλύτερη πολιτική», αφού οι συνθήκες και τα χαρακτηριστικά των περιοχών και των βιομηχανιών πρέπει να ληφθούν υπόψη. Το κεφάλαιο 3 είναι μια προσπάθεια ανάλυσης διεθνών παραδειγμάτων καινοτομικών cluster των παραδοσιακών βιομηχανιών, προσπαθώντας να παρουσιαστούν επιτυχημένες πολιτικές. Τέλος στο κεφάλαιο 4, επιχειρείται η συγκριτική ανάλυση των αποτελεσμάτων, σε συνάρτηση με τη βιβλιογραφική ανασκόπηση του κεφαλαίου 1.

Keywords: *innovation cluster, traditional industries, cluster policies, cluster formation process, cluster strengthening process*

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Chapter 1: Introduction

1. Introduction

Over the last decades of the 20th century tremendous economic and social changes took place, while a shift of the economic structures towards an integrated global economy deeply influenced by the growing trend of globalization occurred. A serious debate in the international literature is related to the complex connection between globalization and the role of location in the economic sector. Some have argued that the outcomes of globalization such as the creation of an international market with high rates of capital mobility and the transition to an economy closely connected to information, have rendered the factor of location for the modern economy as of minor importance. On the other hand, the most prominent opinion claims that because of globalization, location tends to have increasing importance while regional economies are now the "salient foci of wealth creation and world trade (Martin and Sunley, 2001).

Firms more and more were imposed to adjust to the new conditions that were created in order to survive and eventually focused their strategies towards acquiring a sustainable competitive advantage in the new borderless market. The constant differentiation of the products and services offered and the innovation in the production chain and management of the firm are considered as significant dynamics for the boost of productive capacities as they can lead to the decrease of the production and operational costs (Popadiuk and Choo, 2006). The process of innovation is closely connected to the process of knowledge creation, although their relationship can be characterized as particularly complex. Innovation consists of new ideas that have been transformed to products, services or processes that generate added value for the firm. These ideas are formed by the interactions among people within environments that are favourable to knowledge creation (Popadiuk and Choo, 2006). Initiatives such as innovation and knowledge creation are now considered as driving forces of economic growth, social development, and job creation (Park, 2001). The term knowledge-based economy started to gain ground in the international related literature with researchers trying to understand and analyze the conditions and norms of this new type of economy. The technological revolution that occurred is reflected in the industrial structures as more and more technological achievements are used in the production chain. Firms that innovate more tend to be more competitive, offer

more workplaces and higher wages, grow more and have greater production capacities (Park, 2001).

It is a consensus that firms that are involved in cluster are more likely to innovate. A main reason behind this argument is relevant to the element of knowledge externalities or spillovers. A firm is more likely to innovate if located in a region where the presence of firms in its own industry is strong (Baptista and Swann, 1998). Cooperation networks are developed and firms spontaneously start to cluster for their further development. Despite the fact that clusters can emerge without any political intervention, the latest years governments consider the reinforcement of the cluster – formation process as a crucial agenda of their policies related to regional economic development, since their positive contribution to regional economies is more than obvious. So recently, a new term was introduced in the field of regional development policies, the cluster policies, and a lot of academic works are oriented towards its better understanding and further development.

The aim of this dissertation is to learn from international experiences on how cluster policies were implemented, and clusters were formed in traditional industries. The cluster formation process in traditional sectors is differentiated than the process in high technology industries, since the historical background and the levels of the existing social capital are crucial.

Chapter 2 is a literature review of the cluster related studies, trying to understand the functions of the clusters, as well as the cluster policies and the role of Governments, Industry and S&T System, following the Triple Helix Model. Chapter 3 is the analysis of six case studies, and the presentation of the implemented policy actions. Finally, Chapter 4 is a comparative analysis of the case studies, and an attempt to better understand the cluster formation process in any case.

Chapter 2: The Theoretical Approach

2.0 Introduction

The current chapter is an attempt of reviewing the cluster related literature, trying to understand the concept of clustering, its functions, and the factors that are considered to facilitate its spontaneous emergence. The main question that is expected to be answered within this chapter is why clustering over the last decades has turned into a hot issue of researchers and policy – makers. In order to understand the nubilous cluster concept the following issues will be analyzed under the scope of policy-making:

Firstly, focusing on the consisting actors of a cluster, a deeper see-through in the two dimensions of the clusters, the horizontal and the vertical, will be attempted, recognizing the interactions of the involved firms and institutions on each level. An issue of great controversy is related to the "cluster boundaries" as the cluster definitions fail to define precisely the geographical, industrial and institutional barriers. By demonstrating a mix of the most prominent researchers' views I attempt to deepen in this matter.

Then, following the growing trend of using clusters as an innovation tool, the factors that enhance innovative activities will be approached. Maybe the most prominent positive externality of clustering is the enhancement of knowledge creation that derives from the locational advantages in addition to the increased levels of interrelations and interactions between the actors. So it is crucial to analyze how this process is facilitated within the clustering framework and what are the processes that lead to the creation of a common knowledge base. It is inevitable that the involved social capital that is developed will affect the functions of the cluster, so its linkages with the notion will be reviewed. Finally, following the Triple Helix Model, the roles of academia, industry and governments in the cluster policy planning and implementation processes will be analyzed.

2.1 The cluster concept

Porter's studies represent a source of inspiration for a great number of researchers to further analyze this chaotic concept. Porter (1990) defines clusters as formations of *"firms and industries linked through vertical (buyer/ supplier) or horizontal (common customers, technology etc.) relationships and with the main players located in a single nation/state. Geographic concentration of rivals, customers and suppliers in a*

region will promote innovation and competitiveness in a cluster". Later, Porter reviewed this definition and defined clusters as (1998): *"Geographic concentrations of interconnected companies and institutions (formal organizations) in a particular field".*

Although clusters are a relatively new concept, cluster theories can be categorized as belonging in the space – related theories, that highlight the importance of location and its initial conditions for economic growth and development. These theories share some similar theoretical perspectives such as the *agglomeration externalities* that derive from the spatial concentration of the industrial and economic activities in places of high population density. The most obvious externalities are related to the creation of a highly qualified labor force pool that is combined by people with at least adequate working experience on specific sectors, and local firms are benefited by obtaining a comparative advantage over competitors which are located on regions with no agglomeration structures. Alfred Marshall, in *Principles of Economics* (1890) was the first to introduce and analyze the term agglomeration externalities, referring to concentrations of trade as a triad of external economies: specialized labor, specialized trades, and specialized firms on different levels of the production circle (Martin and Sunley, 2001; Kukalis, 2009).

2.2 The Cluster dimensions

The firms and institutions that consist a cluster, interact, compete and cooperate in two dimensions: the horizontal and the vertical.

The *horizontal dimension* of the cluster refers to competing firms which produce the same or similar products, have similar relationships with customers and which within the clusters' framework, also cooperate (Roberts et al, 2001). It can play a critical role in the processes of the emergence and strengthening of the cluster, since the competition and rivalry between firms is an obligatory element of the innovation process, acting as a facilitator of clustering (Porter, 1990; Maskell et al, 2004). Marshall was the first to introduce the advantages of variation that are caused by the simultaneous performing of similar tasks (Marshall, 1890). The fact that within an agglomeration the companies have the same production conditions and costs with their competitors, allows them to compare practices even when the linkages to each other are eliminated. As a consequence rivalry conditions are developed leading to

innovation and product differentiation (Maskell et al, 2004). The horizontal dimension of the cluster enables companies to observe the diversifications that derive by the different approaches of other firms on a specific matter - either organizational or production-related - leading to the prevalence of the optimum solutions. This process would be out of question for a single firm that acts independently and without collaborating with partners. By watching, discussing and comparing dissimilar approaches firms become engaged in the process of learning and continuous improvement, while "know-how" and "best practice" approaches derive (Maskell, 2001). Porter (1990) states that competition and cooperation can coexist, because "they are on different dimensions or because cooperation at some levels is part of winning the competition at other levels". As a matter of fact, firms across the horizontal dimension can move to another stage of the production circle, or differentiate their product, moving the cluster to niche specialization. Even when an innovation is protected by a patent, clustering enables competitors to "invent along" the protection and imitate the success product or process, adding some own ideas for further improvement (Maskell, 2001).

The *vertical dimension* of the cluster refers to firms that produce complementary products and are mainly connected through input-output, service and customer relations (Maskell et al, 2004). When a cluster is formed, specialized suppliers and critical customers are attracted, looking to take advantage of the externalities of the agglomeration, such as scale economies and reduction of transaction and transport costs (Maskell et al, 2004). Moreover the comparative advantage that a firm gains within the cluster because of its isolated innovation activities in terms of practices or product differentiation, especially when they are protected by a patent, may lead to the movement of competitors from the horizontal to the vertical dimension, by specializing in a particular process around the innovation. In this way the vertical dimension of the cluster develops, with high levels of specialization, while the extended division of labour force is often closely associated with the production of knowledge within the cluster (Maskell, 2001).

Firms within a cluster, in both of the dimensions, can achieve "greater specialization of skills, technology and services", "greater flexibility as businesses are taking steps to become more flexible in order to improve efficiency and respond more rapidly to market signals", and "greater diversification creating a diverse group of producer and

supplier businesses within a region that complement each other working on specialized aspects of a broad industry cluster" (Roberts et al, 2001).

2.3 Cluster boundaries

As it is already mentioned, maybe the more argued cluster issue is the boundaries. The fuzziness of this issue derives the fact that the notion of clustering needs to be defined both in geographical terms, as well as in terms of the participating actors. Some scholars tried to define precisely the geographic barriers, failing however to convince the related researchers. A clear example is May et al (2001) who defined clusters as agglomerations that extend in "a range of fifty miles" (Martin and Sunley, 2001).

The focus of related literature and policy – makers to the notion of clustering and its linkage to the knowledge production process is not confined only in the process that takes place within the cluster, as they maintain an exogenous character highly affected by technological evolutions, innovations and academic research that occur outside the cluster. Much in the same spirit, the firms of a cluster can be highly affected by circumstances, events and decisions that take place in distant parts of the world (Maskell, 2001).

The actors that combine a cluster is also an important issue. Besides the businesses that act in the horizontal and vertical dimensions as it was analyzed above, a complex system of institutions is also involved, influencing the activities of the firms in both dimensions. These institutions have well – developed linkages to the economic structures of the cluster, and take part in the process of knowledge production, defining how learning takes place, whereas the firms define the needs and where R&D activities should estimate (Maskell, 2001; Lundvall and Maskell, 2000). Maskell (2001) anticipates that institutions tend to specialize towards a specific type of activity, becoming simultaneously less helpful to other activities. As knowledge within an agglomeration grows and activities start to diverge, new clusters emerge developing their own institutional systems. He concludes that the boundaries of a cluster are defined in two dimensions: firstly by the set of business activities, and secondly by the institutional environment that is developed through time in order to support these activities.

Maybe the most prominent view is that clusters should not be pre-defined in a geographical size or scale, as according to Porter they vary in "size, breadth and stage of development" (Martin and Sunley, 2001). Some clusters consist of SMEs, others from SMEs and large companies, others are university centred whereas others have no connections to academia, while there are also emerging, well-established and potential clusters (Martin and Sunley, 2001). Moreover clusters should be considered as constantly changing entities with evolving boundaries, as new firms emerge or decline and local institutions develop. The technological evolutions can cause market developments, leading to the emergence of new or to the shrink of the established industries, the creation of new linkages, and the shift of the served markets (Porter, 2000).

We can conclude saying that clusters can be found with a variety of characteristics, differing in the space dimension, and can be classified taking into account the type of locational dynamics their constituent industries are subject to (Ketels, 2003). More specifically, Ketels distinguishes industries to *"local",* which have tight bonds with the customers, needing to have close geographic proximity, *"natural resource-depended",* which need to be located close to natural resources, and *"traded",* which can choose their location according to business environment, choosing from a variety of regions or even countries (Ketels, 2003). So clusters can be found in a wide range of geographical levels, from local networks to national or even international clustering of firms and institutions. Roelandt et al. (1997) suggest another typology based on a range of possible levels of analysis, recognizing clusters in three levels: national (macro), branch or industry (meso), and firm (micro). At the national level clusters are understood as broad industry groups linked within the overall macro economy. The analysis in the level of national or "mega-clusters" include the study of patterns of industrial specialization and the examination of general innovation processes as well as the adoption and use of more generic production and management technologies (Feser, 1998). In the meso level clustering refers to linkages in the whole chain of production of a single end product and the analysis involves best-practice benchmarking and studies of cluster-specific technology adoption and innovation processes (Feser, 1998). Finally in the micro level clusters are understood as a group of cooperating and competing firms along with their specialized suppliers. The analysis in the latter level focuses on strategic business development needs, value

chain analysis and need for collaborative innovation projects (Feser, 1998). As Porter points out "although the geographic scope of a cluster can range from a single city or state to a country, or even a network of neighboring states, its common resources and capabilities are generally highly constrained by geographic proximity" (Kukalis, 2009). Maskell (2001) however confronts that firms that are spread across a large city among many unrelated business have diminished abilities to learn from other's mistakes, which is one of the positive externalities of the horizontal dimension.

2.4 Innovation clusters

The cluster concept gained its recognition emphasizing on the increase of productivity and value added among firms and regions. Porter argues that innovative capacity is closely linked to productivity and competitiveness -which are synonyms- acting as a significant driver (Porter, 2003; Karlsson, 2008). The spatial proximity of the firms in addition to the networks and interrelations that are developed among the actors of a cluster makes significant contribution to innovation, as it is presented in the current chapter. The notion of innovation can be found in different forms, varying from science- or technology-based to new ways of organisation and "how things are done", being in some cases equated to "imitation". In continuation to this fact, the connection of clustering with innovative activities is associated with a broad sense of innovation, incorporating technical, commercial and organisational change. In order for a cluster to be characterized as "innovative", high levels of innovative activities should be found and measured. The most common indicator that is used for the measurement process is R&D activities, which is specified to input indicators, along with the number of the patents, whereas there are also the output indicators, such as the new products and the number of emerging and fast-growing firms (IKED, 2004).

Firms that cluster, become members of channels for exchange of information, such as networks of innovators, diminishing in this way the uncertainty that derive from the innovation process. By definition, innovation is uncertain and complex, since the process of "searching for something new" may result in different outcomes from what were expected. Being involved in networks or clusters, firms are enabled to exploit technology developments in shorter time, as well as to take advantage of the flows of information and experience-sharing to facilitate the problem-solving process, and "learning by doing" activities (Baptista and Swann, 1998). Baptista and Swann (1998)

also argue that industrial innovation relies on a great scale on sources of scientific knowledge from knowledge institutions, and government-funded R&D activities.

2.5 Knowledge creation and common knowledge base

The concentrated firms along the two dimensions of the cluster, the flows of information and communication, in addition to the specialized labor force pool that is located within the cluster, create a common knowledge base that is used by the involved actors. Firms continuously combine and recombine similar and non similar resources to produce new knowledge and innovations. Economic specialization within the cluster is stimulated while common localized capabilities are developed and used by the firms (Maskell et al, 2004).

2.6 Social capital

Over the latest decades, scholars have increasingly focused their attention to the notion of social capital not only by emphasizing on its link on the development of human capital, but also on its impact on economic performance (Nahapiet and Ghoshal, 1998). The main idea of the term social capital derives by the consensus that networks of communication and relationships constitute a valuable resource (Nahapiet and Ghoshal, 1998). Coleman (1988) understands social capital as a group of entities with "two elements in common: they all consist of some aspects of social structure, and they facilitate certain actions of actors within the structure". It is also critical that he sets clear that the actors that constitute social capital can be either persons or firms (corporate actors) (Coleman, 1988). This fact comes along with the statement of the OECD studies that the sources of development of the social capital are similar to the central elements of cluster formation and development, which on a great scale rely on the interrelationships within firms and labor force (OECD, 2002).

Although within a cluster the element of social capital in any case exists, it is difficult to measure its level. The limits of measuring can be attributed to three reasons: the lack of data and problems of definition, the lack of clear boundaries in the cluster concept, and the fuzziness of the factors that impact on cluster formation and development processes (OECD, 2002).

Related researches (see OECD, 2002), have shown that social capital is associated to high performance, innovation and knowledge intensity, especially within the clusters that are internationally – oriented, and take advantage of the global rather than the

local social capital. Woolcock and Narayan (2000) distinguish the linkages of social capital with economic development in four dimensions that have been the foundations for related research: the communitarian view, the networks view, the institutional view and the synergies view. The cluster concept is highly connected to the networks view, which can give communities a sense of identity and common purposes, which is a crucial implication for the cluster development process, having however simultaneously a negative aspect, that is the considerable non-economic members' sense of obligation and commitment that can act as a barrier (Woolcock and Narayan, 2000).

The interrelations that are developed between the actors of a cluster lead to a better understanding of how each firm is organized since they share the same views, language, and purposes (OECD, 2002). As a consequence isolated attempts to over – utilize asymmetric information, pass defective goods, or create hold – ups for own benefits at the expense of the other participating firms, will be easily detected. Such misbehaviors will lead to the isolation of the firm, setting it as a local outcast, banned from the knowledge flows including the tacit knowledge, which is very difficult to be substituted (Maskell, 2001). Moreover, by sharing trust, common beliefs and values, firms can more easily distinguish between successful and unsuccessful practice through the horizontal dimension (Maskell, 2001).

However social capital can also have a negative dimension within a cluster. People and firms that lack of the right connections fail to integrate in the market within a cluster. As Woolcock and Narayan (2000) state, the gaining of membership to an exclusive club (like a cluster) for an outsider, may need an existing acquaintance with the "right persons" of the group (Woolcock and Narayan, 2000). The exclusion of the outsiders can lead to limited mobility of labor force and limited adaptability to change, acting as a barrier in the further development of the cluster. The strong ties that are developing within the framework of the social capital can end in lock-in situations, blocked from development and change (OECD, 2002).

Buzz, noise or atmosphere of the cluster

A hot issue of the clustering related literature is what is labeled as "buzz" or "noise" following the Marshallian notion of "industrial atmosphere". The main idea of this notion is the "ecosystem" of information and communication that is developing

within an agglomeration or cluster, by the co-presence of firms and labor force of the same industry. The existing information are constantly updating through intended or unintended learning processes, organized or spontaneous meetings, and is closely related to the social capital and the shared vision that is developed, as the participating actors own mutual understanding of knowledge and technologies, as well as similar cultural traditions and habits (Maskell et al, 2004). The shared culture also results in the meaningful understanding of the buzz through the institutional structures and the "same spirit" under which the firms act. It is not only referred to the diffusion of tacit or codified knowledge in the business context, but also in the gossip and news that arise from the face – to – face contacts even in lunch breaks (Maskell et al, 2004). The participation in the buzz does not require an investment as the actors that constitute the cluster are enrolled more or less automatically by being surrounded by rumors, impressions and strategic information. However according to Bathelt and Glückler (2002) sometimes social relations within the actors of a cluster can act as barriers to the creation of the buzz, blocking the diffusion of critical information (Maskell et al, 2004).

2.7 Cluster Policies following the Triple Helix Model

As far as cluster policies are concerned, a safe conclusion that derives is that there is no "ideal model" of policy measures that can be applied for the facilitation of the emergence and strengthening processes of clusters. Trying to apply already successful practices that were used in other cases, skipping to take into account the initial conditions and competences of the region and the industry, may lead to failure. Todtling and Trippl (2005) recognize 3 different types of regions, each of which needs a specialized policy approach: central (or metropolitan) regions, peripheral regions and old industrial areas (see Table 2.1, page 10).

It is a consensus that the emphasis of industrial policy under the cluster approach should be oriented towards the intensification of the use of knowledge in existing clusters, and the creation of new cooperative structures for the emergence of potential clusters (Jacobs and De Man, 1996). It is crucial that policy makers that participate in the latter form of policy, recognize the need to built on already developed structures (even in a low intensity), rather than trying to create completely new activities (Jacobs and De Man, 1996).

Table 2.1 Types of Regions and Policy Approaches

Type of Region	Characteristics of the Region	Policy Approach
Central	High concentration rates which result in increased R&D activities as well as product innovations	Creation and development of clusters that are based on the element of knowledge. Policies should target on the better coordination between S&T system with the market
Peripheral	Isolated regions with lower rates of agglomeration economies, labor force of low quality and lack of institutions	Policies targeting to "catching-up" process with the more developed regions while the innovation capabilities of the SMEs should be improved. The educational system needs to be supported with the establishment of technical schools, where the interrelations of the region with more "advanced" regions is essential
Old industrial	Agglomeration areas which suffer from lock-in effects with significant consequences on the region's networks and further development processes	Policies targeting to diversification of the industries, the formation of new firms and the turn of the clusters in innovative for the region fields. Since the levels of clustering are usually already dense, the proper policies regarding this type of regions are concerned with the mobilization of the clusters, the strengthening of their innovative processes and the enforcement of their research and development activities. In order to face the problem of lock-in in the knowledge generation and diffusion sector, the S&T system need to be modernized and linked to the market.

Source: Todtling and Trippl (2005)

Following the different types of analysis of industrial clusters that are presented in the section 1.2, differentiated policy interventions - ranging from the establishment of framework conditions and general technology policies at the macro level, to initiatives for the enhancement of networking and business development at the micro level – are imposed (Feser, 1998). Policy makers need to opt for the most effective combination of policy measures, having to successfully choose from five types of actions: brokering, framework policies, demand side policies, training policies, and international cooperation policies (IKED, 2004).

In the current research work it was made clear that governmental authorities and knowledge institutions along with the companies, constitute the actors of a cluster. Each of these actors -the interrelations of which constitute the so called Triple Helix Model- has a role to play in the process of cluster formation and further strengthening. A triple helix regime typically begins as university, industry, and government enter into a reciprocal relationship with each other in which each attempts to enhance the performance of the other. The majority of relevant initiatives take place at the regional level, where specific contexts of industrial clusters, academic development, and presence or lack or governing authority influence the development of the triple helix (Etzkowitz, 2008). In the following sections, the role of each helix to the cluster formation process is analyzed.

2.7.1 Role of Governments

Clusters can emerge either with political intervention or spontaneously. Policy makers need to estimate and analyze what are the needs and expectations that provoke their spontaneous emergence and adjust the designed policies to take advantage of them. The benefits of clustering that result in the increase of productivity and in the growth of innovation capacities can be assumed to be the primary expectation, for their spontaneous emergence. Over the latest years, cluster facilitation policies tend to become a central issue within the agendas of the governmental agencies. Although the optimum general business environment is a crucial factor for competitiveness, clustering externalities and spillovers that involve public entities, allow an economic system to move to terms beyond factor cost competition (Porter, 1990). Besides modifying its own practices and policies, a government can act as a facilitator, by motivating and providing incentives for joint actions in the private sector (Porter, 1990). Jacobs and De Man (1996) anticipate that the governmental policy actions need to be directed at increasing knowledge intensity. Programmes of vocational training as well as supporting and maintaining centres of excellence for the attraction of firms are two well-accepted policy measures (Jacobs and De Man, 1996).

As clusters are entities with an exogenous character, Porter (1990) states that not only they contribute to regional and national productivity, but also they affect other clusters. So it is important that traditional industry clusters should be facilitated and motivated for upgrading and further development rather than being abandoned. It is also important, that the policy – makers will focus on the reinforcement of established

clusters and emerging business networks, and not attempt to create entirely new ones. The process of cluster formation is more likely to take place in environments and industries that already provide locational externalities (Porter, 1990; Jacobs and De Man, 1996).

The first step of the governmental actions is the recognition of the factors that prove the existence of the cluster, and subsequently "removing obstacles, relaxing constraints, and eliminating inefficiencies that impede productivity and innovation in the cluster" (Porter, 1990). Traditional governmental policies that focus on the enhancement of competitiveness of individual firms such as subsidies and technology grants don't keep up with modern economic environment.

The policies that are planned and implemented by the governments should target on ameliorating the functioning of the markets by creating favorable framework conditions and by removing market and system imperfections, rather than "picking winners". That means that market forces - and not governments - will determine which clusters will survive and which will fail (Porter, 1990; OECD, 1999).

2.7.2 Role of Industry

Similar to one of the roles of governments, firm strategies need to be focused at increasing cluster's knowledge intensity (Jacobs and De Man, 1996). The involvement of firms in the process of adoption of new knowledge presumes their involvement in the process of interactive and social learning in close coordination with universities and knowledge institutions (Bramwell and Wolfe, 2008). The density of the linkages of firms with suppliers, customers and knowledge institutions is critical for the capacities of firms to adopt new knowledge through the constant learning process (Bramwell and Wolfe, 2008).

For the capture of the role of cluster facilitator, firms need to adopt a cooperating attitude, by behaving positively in the regional networks and strike a balance between cooperation and competition. The establishment of new mechanisms of coordination (such as the exchanging of labor force), as well as the support of sector initiatives (such as education, environmental and quality policies, internationalization and market development), are also crucial strategies towards the strengthening of the cluster's structures. Besides the intensification of its linkages to knowledge institutions for the facilitation of new knowledge production process, firms should

also enhance the international orientation of the cluster, by taking part in EU's and international relevant initiatives (Jacobs and De Man, 1996).

2.7.3 Role of Science and Technology System

It is a consensus that Universities and knowledge institutions play a substantial role in the process of regional economic development, including clusters, since their involvement in the knowledge creation process is crucial (Bramwell and Wolfe, 2008; Lambooy, 2004; Chen and Kenney, 2007). Over the latest decades universities have turned their focus in more applied research in relevance with the industry, as well as in the diffusion of technical knowledge and support (Bramwell and Wolfe, 2008). The modern structures of the new knowledge-based economy imply the evolution of the role of universities from a peripheral supporting institution that provides the industry with human capital and research resources, to a more active role in economic and social development, which is labeled by the related scholars as "entrepreneurial university" (Etzkowitz and Klofsten, 2005). The most traditional function of universities is that of educational institutions, upgrading and specializing the human capital, making it however more mobile at the same time. This means that highly qualified labor force is more likely to move in more developed regions or countries for work-related reasons. In order for the region - and in continuation clusters - to be able to maximize the human capital benefits, a high quality economic and social environment is required (Paytas et al, 2004). Universities have a role to play towards this direction, looking to foster economic development. It is required to set their own strategic priorities focusing in economic and social development as an academic goal, and make sure that the produced knowledge is put to use in the business level (Etzkowitz and Klofsten, 2005). This process takes place in the form of "spillovers", "spin-offs" and participation in initiatives. The former term refers to the formal and informal transmission of concepts, ideas and technical procedures from the knowledge institutions to firms, presuming spatial proximity as well as high levels of existing social capital between the actors. The term "spin-offs" refers to the establishment of new firms by former students and researchers of the universities (Lambooy, 2004). Finally the latter term refers to the participation in joint programs with the industry and other knowledge institutions, looking to facilitate the use of the applied research in practice, as well as the taking up of R&D activities in relevance with the needs of the industry.

However, although Jacobs and De Man (1996) acknowledge the fact that a specialized knowledge infrastructure of high quality can contribute to a country's or a region's competitiveness, they anticipate that the role of the S&T system in the process of knowledge intensification should not be overestimated. The larger part of the knowledge that is used within the production chain is not produced by the knowledge institutions, but tends to derive by the market forces, through suppliers, clients, competitors and sector specific organizations, trade fairs and journals (Jacobs and De Man, 1996).

2.8 Conclusions

In conclusion, clusters are networks of cooperating firms and institutions which interact in two dimensions: the horizontal and the vertical. They can be found in a variety of levels, differing in geographic terms as well as in terms of the participating members. The innovation activities that take place within a cluster are oriented both towards product and organizational diversification, and can be a consequence either of the production process or of the R&D activities.

In the process of cluster formation, the involved social capital can play a crucial role. When a communicative culture exists firms and institutions build trusted-relationships sharing common views, facilitating the diffusion of information, experiences and ideas. When firms and institutions lack of this element, policy interventions are needed for the boost of the networking linkages.

Following the Triple Helix Model, Governments, Industry and S&T system are directly involved in the cluster formation process. Governmental policies should not be oriented towards the creation of a cluster from the beginning, but they need to focus on the identification of existing clustering nodes, and the implementation of policies for their strengthening and further development. The role of industry in the formation process is mainly the adoption of a communicative culture, and their involvement to joint projects along with other firms and knowledge institutions. The S&T system, besides the educational role, need to adopt the role of facilitators, through enabling the diffusion of information, and the creation of new knowledge.

Chapter 3: Innovation clusters- theory and policy

3.1 Dutch Construction Cluster

3.1.0 Introduction

Just like in the vast majority of countries, the construction sector of the Netherlands plays a vital role in the structures of the national economy, in terms of employment and value added. Moreover the fact that the industries of the construction sector are responsible of building the country's infrastructure, which is a key aspect of the economic activities of any firm, household or government as it is closely connected to the transportation costs, sets the importance of the effectiveness and innovativeness of the cluster as particularly significant. In 1999 the construction cluster represented the 5% of the GNP, whereas the employees in the industry reached the 485000 individuals. (OECD, 1999; OECD, 2001)

3.1.1 National Policy Actions

The Dutch Government over the latest decades focused its industrial policies towards the new trend of the regional development theories that is the creation of favourable economic, social and regional environment for innovative processes for the boost of the regional and national economies. Facilitation of technological cooperation was put in the centre of the national rationales for policy – making by increasing the annual budget, for the strengthening of the competitiveness and innovativeness of Dutch firms. The strong link between innovative processes and knowledge could not but be a key aspect of the public research sector, with emphasis of the policy – makers on the cooperation between research organizations and firms.

The identification of the clusters

Although there are a lot of methods to analyze the regional and sectoral competences for the cluster identification, in Netherlands the two more prominent methods used are the *monographic case studies*, which is based on Porter's diamond, and the *input – output analysis,* which aims at the identification of clusters through the recording of the market and knowledge interrelations that exist within an industrial sector and region. The former method can reveal detailed information about the cluster's "players" as well as the social capital involved, whereas the latter reveals the trade linkages and interdependencies within the cluster. It is obvious that these two approaches are complementary and crucial conclusions regarding the form, the main

economic activities and the market orientation of the clusters can be derived (OECD, 1999).

After the above mentioned analyses the economic structure of the country was found to be consisted of 12 clusters: Construction, Chemical industries, Commercial Services, Non-Commercial Services, Energy, Health, Agro-food, Media, Manufacturing (paper), Manufacturing (metal, electro), Manufacturing (other), Port – transport and communication (OECD, 1999).

The imperfections

The imperfections that were detected by the Dutch government became the foundations for the rationales of policy making. Firstly, market informational and organizational failures that can derive from the lack of strategic information and fragmentation in cooperation within various actors result in the blockade of cluster production of new knowledge, many times the unawareness of possible positive externalities form the interrelations with other firms and institutions and the fear of fierce competition, disincline the emergence of innovative clusters. Secondly, some sectors such as the energy, infrastructures and the environment, can be characterized as special cases, since the social benefits of R&D investments outweigh the private returns. As a consequence, R&D private investments are decreased and governmental action is required. Finally, the government takes up the role of matching private needs with investments of public research, aiming at the increase of the rate of return on investments on R&D. It acts as an intermediate for the closer cooperation of the public institutions with the private sector (OECD, 1999; Ministry of Economic Affairs, 1999).

The policy roles

After recognizing the imperfections, Dutch policy – makers designed the governmental actions, focusing on the above mentioned rationales by taking up 3 roles: *framework policy*, *broker policies* and acting as a *demanding customer* when providing public services. The instruments of policy – making and implementation in Netherlands were horizontal, focusing on the whole innovation structures and all of the recognized clusters, or vertical, which are policies targeting on specific clusters OECD, 1999; Ministry of Economic Affairs, 1999).

- The framework policy

The first role of the government couldn't but be the creation of a favourable market environment for the emergence of chains of value added economic activities and innovation. Framework – related interventions are an integrated approach, with horizontal practices having generic scopes. *Competition – related policies* is an instrument towards this direction that concentrates on the facilitation of dynamic market functioning. Healthy competition will impose firms to innovate either on production or on the organization level, in order to attract their potential customers. (Ministry of Economic Affairs, 1999)

Renewal of structural forms and deregulation has also key roles to play on the dynamics for clustering. Traditional governmental practices, such as the procurement practice, can act as barrier to the economic development through clustering, and it is a primary goal to catch up with development of modern economic structures. (OECD, 1999; Ministry of Economic Affairs, 1999).

General Technology policies for the encouragement of firms to set up innovation alliances and invest in R&D were provided in the 'Knowledge in Action' paper, whereas *macroeconomic regulations* such as lowering the tax and labour cost burden were also implemented for the creation of a favourable economic environment (OECD, 1999; Ministry of Economic Affairs, 1999).

- Broker policies

The Dutch Government in its role as a broker, *undertakes initiatives for the limitation of the existing market imperfections in the informational and organisational levels*. The existing informational gaps, can lead to the misunderstanding of innovation possibilities and the setting of a common dialogue platform between the stakeholders, who are policy – makers, knowledge producers and market actors, is essential.

The *Technology Radar* is a technology foresight study carried out by the Foresight Steering Committee, the results of which were mentioned to offer an overview of the technology developments that would be crucial within the economic environment of Netherlands in the forthcoming years. (OECD, 1999)

As an *organizer of platforms*, the government plays the role of the independent external guider of partnership projects that are taken up by market players that want to cooperate.

The Government of the Netherlands was also involved in a total number of 24 specific cluster programs which led to the exchange of strategic knowledge and long – term partnership agreements. A positive externality of the accomplishment of such programs is the diffusion of information within the participating actors of knowledge and awareness of each other's value added (Ministry of Economic Affairs, 1999)).

In the construction cluster the programs that were released are *"subsoil building"* which aims at the innovation of the cluster's activities (OECD, 1999), and *"underground construction of infrastructure"*.

- The government as a demanding customer

In the construction cluster, a lot of the sectoral activities are mainly addressed to the government establishing it as a large and significant customer, that should set high demands of quality products, technology and production process, in order to stimulate innovation processes (OECD, 1999). Besides the procurement practices, government can also stimulate innovative clustering via the role of regulator, setting specific targets through specific programs which are described in OECD as initiatives for "high-level provision of public needs by renewal of government procurement policy". (OECD, 2001).

"Innovation in construction" is one of these projects which aim at the enhancement of innovation in the construction cluster by stimulating the market-induced incentives to the creation of innovative clusters and consortia. The ministry does not intend to have a strong orientation towards subsidizing clusters or limiting rivalry in the market. It intends to focus on the facilitation of synergies in the market. Primarily, this means correcting imperfections in the Dutch innovation system through stimulation of dialogue and interaction between researchers, corporate managers, policy makers and scientists. The program also includes substantial attention to local procurement policies, such that innovation and high quality are promoted (OECD, 1999; OECD, 2001).

Innovative procurements for large complex projects in the construction sector go beyond the above – mentioned program. In the *road construction* sector, projects with conditions set in ways that lead to innovation in the design or construction methods were included in the agenda. Moreover the *construction of new Hospitals* has been

approved, where procurement methods gave the opportunity to suppliers to collaborate by exchanging know-how techniques and skills.

3.1.2 Regional Policy Actions

In the regional level, the Ministry of Economic Affairs released two cluster-based programmes with a focus on supporting regional specialization, "Peaks in Delta" and "Key Innovation Areas". Although the Dutch regional policy was oriented towards the support of the lagging Northern regions, is has recently shifted towards the support of the economic strengths of the regions, that would lead in the national economic growth (OECD, 2007).

Peaks in the Delta is focused towards the targeting of the national strengths through a regional – based approach. The measures that were implemented have a geographic strategy, rather than a specific set of instruments or sectoral approach. The advantages of regions are acknowledged, and a spatial economic development strategy is implemented, including priority clusters for support, and national level funds that are provided to the regions. The approach of this policy measure emphasizes to the integration of the economic development need of regions with the national goals (OECD, 2007).

Key Innovation Areas is a policy measure under the umbrella of the national innovation strategy, with a strong regional impact. Innovation activities, commitment stakeholders and internationally strong performance are the characteristics of the regions that are acknowledged as competences important for the economic growth and development. Formal cluster governance mechanisms are developed, sharing a common vision and strategic planning (OECD, 2007).

Table 3.1.1 The Dutch National Policy Actions

Action	**Who**	**Scope**	**Rationale**
Competition – related policies	Ministry of Economic Affairs	Generic scope looking to promote healthy competition	Facilitation of dynamic market functioning
Renewal of structural forms and deregulation	Ministry of Economic Affairs	Generic scope looking to modernize traditional governmental practices, such as the procurement practice	Facilitation of cluster development process
General Technology policies	Ministry of Culture, Science and Education and the Ministry of Agriculture	Generic scope looking to encourage firms to set up innovation alliances and invest in R&D	Enhancement of technological innovation
macroeconomic regulations	Ministry of Economic Affairs	Generic scope	Looking to create favorable environment
Technology Radar	Foresight Steering Committee	*Study aiming to offer an overview of the technology developments*	Catching up of technological evolutions
subsoil building	Ministry of Economic Affairs	Cluster specific program	Innovation in subsoil building
underground construction of infrastructure	Ministry of Economic Affairs	Cluster specific program	Innovation in underground construction
Innovation in construction	Ministry of Economic Affairs	Stimulation of dialogue and interaction between researchers, corporate managers, policy makers and scientists	Enhancement of innovation in the construction cluster

3.1.3 The Construction Cluster

The Dutch Construction cluster can be characterized as a mature cluster, using a combination of traditional skills, industrial technologies, a well-established culture within the actors and a shared view of organizational and processes of the production chain. Its main economic activities impose the strong interrelations with other clusters (OECD, 2001). The industry groups that are comprised in the mega-cluster are: house building and maintenance; industrial buildings; installation of cables/pipes; construction of roads and bridges; dredging and "wet infrastructure" construction; and environmental construction works. The cluster is also surrounded by specialized suppliers such as installation services, construction materials producers and wholesalers, architectural and technical engineering services (OECD, 1999).

3.1.4 The S&T System

A system of institutions facilitates innovation development and innovation adoption across the cluster.

Table 3.1.2 The Dutch S&T System

Institution	Role	Type
Stimulation Funds	Provide financial support for investment in innovation and R&D	
SBR	Develop spread and promote know-how on buildings and building processes	Institute for Research and knowledge transfer
ISSO	Satisfy the need for technical development and innovation in building installations	Institute for Research and knowledge transfer
CUR	Develop spread and promote know-how on civil engineering technology	Knowledge Network Centre
CROW	Facilitate and transfer Knowledge and innovation in the GWW sector	Centre for research and legislation in traffic, transport and infrastructure
Intrabouw	Distribute news, knowledge and management services	Platform for information, communication and interaction
NOVEM	Execute, transfer and support research on energy and the environment	Energy & environmental research and subsidy coordination
Syntens	Advises SMEs on product-, process-, organisational and ICT innovation	Brokering Organization
Dubo-Centrum	Inform Companies organisations, institutions and government about sustainable development	National centre for sustainable construction

Source: Meijaard, 2001

3.1.5 International programme

The European Construction Technology Platform is a consortium composed of a variety of European organizations, including contractors, designers, owners, cities, cluster organizations, etc, looking to enhance the networking for the enhancement of the competitiveness and the performance of the construction sector (C. Kim et al, 2009; www.ectp.org/). The Strategic Research Agenda of the consortium was planned to show the vision for the European construction industry until year 2030, emphasizing on client satisfaction, sustainability and technology development (C. Kim et al, 2009). The main focus areas of the agenda are: Underground Construction, Cities and Building, Quality of Life, Materials, Networks, Cultural Heritage and Processes & ICT, while the tasks that are initiated are:

- Arrange discussion forums, workshops, etc.
- Formulate visions and strategies in coordination with HLG and SG
- Report to the Support Group
- Disseminate all deliverables
- Encourage and support proposals for projects and Joint European Technology Initiatives.

(www.ectp.org/)

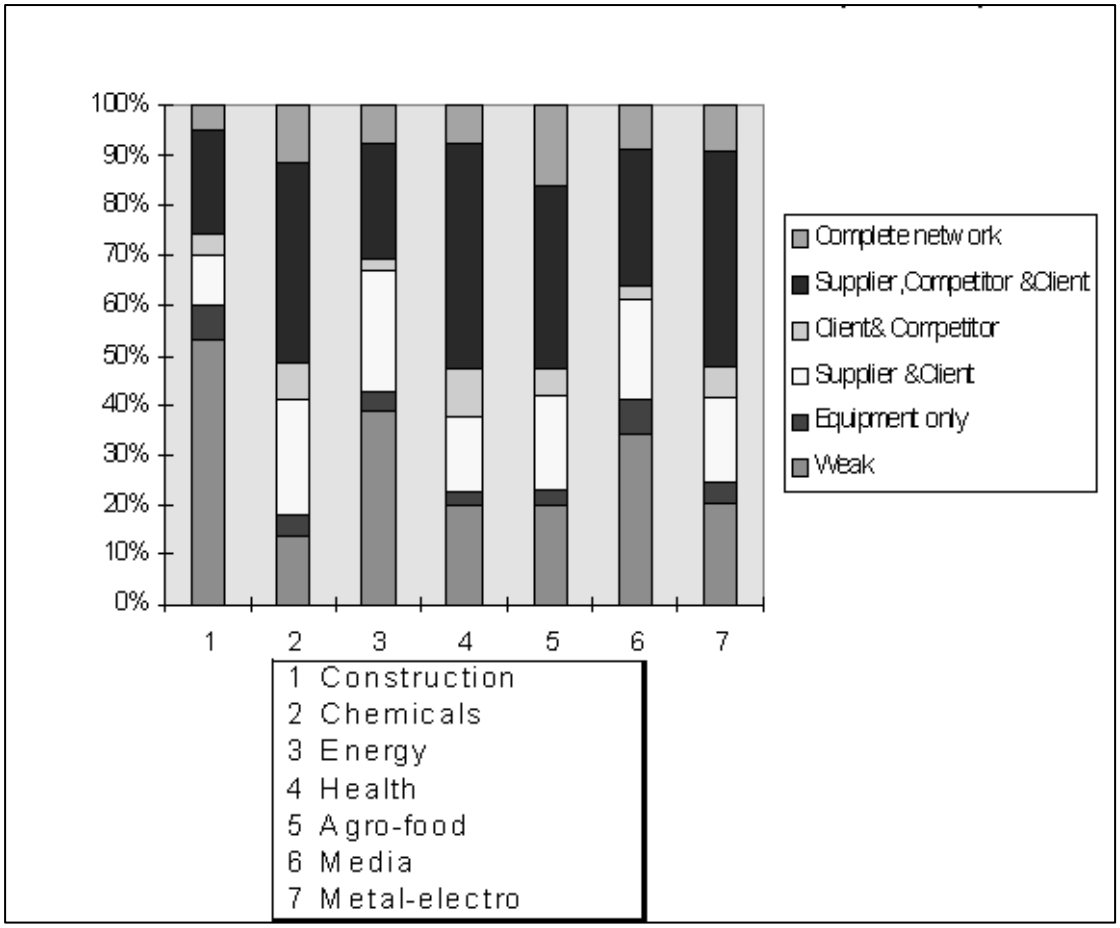
Under the umbrella of the ECTP, the Dutch government established a National Technology Platform, the DeltaNeth which is led by the industry in coordination with the government. Its purpose is to include the stakeholders of the industry into a communication platform for the identification of technological, regulatory and financial challenges in order to improve the performance of the industry in terms of productivity and environmental impact. A working group gathering representatives of all the National Technology Platforms meets 2-3 a year for the enhancement of the links within the continental industry (www.ectp.org/)

3.1.6 Innovation Patterns and cooperation within the cluster

As we can see from figure 1, the construction cluster holds a weak network of innovation and the need for product differentiation is fulfilled by specialized suppliers. Innovative firms, regardless of their industrial activities and sector, depend on a great scale on the collaboration with suppliers, competitors and customers for innovative processes. The Dutch Construction firms are mainly receptors of technological innovation and they seem to maintain high absorptive capacity for

innovative practices and technologies, originated mostly from firms of the manufacturing and commercial service clusters (OECD, 2001; Meijaard, 2001). The technologies used in this cluster are related to construction technologies and civil engineering. The absorptive attitude of the cluster is a consequence of the well – established organizational patterns within the cluster, which impose "how things should be done". The R&D investments are relatively low in relation to other national clusters, and although few firms are enrolled in the R&D processes for some materials, such as the cement research, other materials, such as the construction of roads and buildings, are left behind and the related expertise and technologies are purchased from specialized suppliers outside the cluster. Therefore, the construction cluster in terms of patterns of innovation is characterized as a knowledge absorptive cluster.

Figure 1: The Dutch Innovation Network



Source: OECD, 1999

3.2 The Slovenian Construction Cluster

3.2.0 Introduction

Slovenia is a newly established country that was formed after the collapse of Yugoslavia, with a population of 2,055,496 people in 2012. Undoubtedly, the institutional and economic changes that the country experienced after the break – down of the formal socialist system of Yugoslavia, affected the structures of the academia, industry and government that constitute the Triple Helix model, setting the country as a case of transition economy. However it is worth mentioning that Slovenia managed to maintain a high quality research capability, higher than any other transition economy of the continent, by keeping the public investment rate on R&D close to the EU's average, that is 2% of the GDP.

3.2.1 National Policy Actions

The first phase

The first phase of the cluster development policies in Slovenia was applied in 1999 with the introduction of measures for the promotion of networking and innovation in the agenda of governmental actions. The key aspects of the implemented policies in the first scale concerned the identification of the existing clusters and of the industries and regions with high levels of linkages that act as favorable conditions for the development of clusters (OECD, 2005). The used methodology included comparative analyses between the regions, while a potential cluster map was classified, containing the industrial concentrations with well – developed linkages (OECD, 2005). Innovation factors such as patents, qualification structures, employment in R&D departments and export orientation were studied for identifying the innovation – oriented clusters, leading to the assessment of the innovative potential clusters (see appendix).

The conclusions that derived by the analysis revealed the strengths and the weaknesses of the economic structures, and were used as the foundations of the upcoming policy measures. More specifically, the levels of cooperation and networking among businesses, and their linkages to knowledge suppliers were found to be particularly weak, while the needed infrastructure for the process of clustering is in the beginning of its emergence (OECD, 2005).

In continuation to the above – mentioned analysis the Ministry of Economy designed and implemented in 1999 the *Cluster Development Program* with three main objectives. First of all, the enhancement of networking and co-operation among firms and knowledge institutions, by the funding of joint projects and partnerships of at least 3 firms and 1 R&D supplier, in the areas of technological improvements, product development, specialisation, supply chains, joint production and marketing. Secondly, the increase of direct investments in cluster – supporting infrastructure entailed the strengthening of know-how, skills and expertise for cluster development. Finally, the third objective targeted in the initiation of clusters in practice (OECD, 2005; Tea et al, 2002).

The second phase

The cluster pilot program

The absence of clustering-development related experiences and expertise in the country, leaded to the initiation of a pilot program in 2000 by the Ministry of Economy. It was planned and implemented in a three year duration plan, form 2000-2003, emphasizing on the development of concrete knowledge with the promotion of the cluster concept and "way of thinking" for the eventual strengthening of the cluster policies in the future. An open call for businesses and institutions was initiated with a scope of developing a shared vision for the future, and enhance networking of the Ministry with the participating players. The groups that were formed for the participation in the program, were specialized in one of the potential clusters that were identified, while the Ministry selected 3 of the innovative potential clusters for participating: the machine tools, the automotive and the transport and logistics. The selection criteria included geographical concentration of companies, access to international markets in high value-added market segments, existing co-operation and networking relations among companies and research and development institutions, the existence of support organisations and the reputation of key companies in the respective groups. Subsequently a cluster development strategy and an action plan were designed and implemented (OECD, 2005). These strategies were re-defined in 2001 and started to be implemented in 2002. The key characteristics of the participating "clusters" were different, and as a result the orientation of the plans was differentiated and adapted in the initial conditions (OECD, 2005).

The financial support

The Ministry of Economy took up actions for the financial support of cluster initiatives. As a matter of fact, companies and organizations participating in a cluster project could benefit by the amount of 70000 Euros per project, used in activities related to the cluster's internal communication process. Joint activities and innovation platforms were funded, targeted to groups of at least 10 businesses and 3 knowledge institutions (OECD, 2005).

Program for local networks

In 2002 the Slovenian Ministry of Economy, initiated a cluster program with a focus on SME's and companies with a limited market in geographical terms. This program intended to create favorable environment for the further strengthening of the national and regional clusters with a bottom-up approach. After the identification of the potential local networks and clusters, the cluster managers promoted the investments in specific knowledge, skills and expertise that were needed for the strengthening of the networks. Brokers and coordinators played a key role, consulting and stimulating the SME's activities for the creation of a shared view, and for the facilitation of their access to funding resources (OECD, 2005).

The third phase

In the third phase of the cluster policy in Slovenia that entailed the implementation of the cluster development program, the Ministry of Economy and in extend the Slovenian Government, acted as a catalyst, promoting the transfer of knowledge and expertise to the business environment (OECD, 2005). The direct financial support to cluster organizations and projects started to cease, while clusters are not seen as a strategically important policy tool, but are considered as one of the forms of innovative groups (Wise and Johansson 2012).

During the period 2003-2006 the cluster development program is implemented by the Ministry of Economy, following a bottom-up, strategic and dynamic approach. Strategic because it promotes the concentration of know how to companies, and dynamic because the cluster development program is firm – oriented.

Entrepreneurship and Competitiveness Policy

The program "Entrepreneurship and Competitiveness Policy 2002-2006" that was launched by the Ministry of the Economy had a clear objective to stimulate

innovation and investments in the process of knowledge and technology production (Bartlett and Čučković, 2006). The enhancement of the adaptation capacities of the business sector to any kind of innovation, either managerial or technological was also a goal of the measure (Wise and Johansson 2012). Brokering services and support was provided for the creation of incubators at universities, as well as for the creation of technology parks and joint research programs (Bartlett and Čučković, 2006).

A clear attempt of increasing the linkages between academia and business was the sub-program "Knowledge for Development", which included 3 specific measures. The first one intended to foster the absorptive rate of young researchers in the business sector, whereas the second emphasized on the creation of incubators within universities. In order to increase joint research activities between knowledge institutions and companies, the third measure aimed at the co-financing to enterprises for the costs of equipment that was provided to the institutions for the needs of the enrolled projects (Bartlett and Čučković, 2006).

The sub-program "Improving Enterprises' Competitive Capacity" supported the creation of clusters and technology centres trying to involve knowledge institutions and companies in the process of the development of new technologies and innovations (Bartlett and Čučković, 2006).

Finally the third sub-program "Promoting Entrepreneurship" was specified towards the SMEs looking to promote knowledge diffusion, by providing financial incentives for SMEs in technology parks and incubators, and through subsidized loans, investment guarantees and direct credits to innovative companies (Bartlett and Čučković, 2006).

Centres of Excellence and Competence Centres

In the period 2009-2013 the Slovenian Ministry of Higher Education, Science and Technology, following the international trend of policy measures that focus on the scientific and policy issues, launched and implemented the Centres of Excellence and, looking to foster the development of new knowledge that would lead to the production of new technologies, and the horizontal linking in the entire knowledge production chain. Strategic partnerships among knowledge institutions and the private sector that were taken up after the open call that was initiated, ended at the formation of 8 Centres of Excellence (see appendix).

In continuation to the above – mentioned measure, the Ministry of Higher Education, Science and Technology launched the complementary program Competence Centres that was applied during the period 2010-2013. After the public invitation 7 Competence Centres were formed, owing an industry – oriented character, as they are managed by the private sector focusing on manufacturing new competitive products, services and processes at priority areas of technological development (see appendix).

The institutional Environment and Actors of Cluster Development

In order for the cluster development program to be implemented effectively, the institutional environment of the country needed to be restructured in order to support and promote adequately the policy measures as well as private – public partnerships and initiatives. The complex system of the actors that influence a cluster and its development process was mapped for the convenient restructuring of the institutional environment.

Table 3.2.1 The Slovenian institutional Environment and Actors of Cluster Development

Area	Actors
Business environment	Companies, particularly from potential cluster companies in the pilot projects. Representatives of Chambers of Commerce.
Knowledge infrastructure	Three universities (Ljubljana, Maribor and Primorska); GEA College, International Conference on Data Engineering Bled. 360 developmental organisations, including 66 public institutions (including faculties), 204 companies, 19 private researchers, approximately 8,000 registered researchers. Technological centres.
Governmental bodies	Ministry of Economy; Ministry of Labour, Family and Social Affairs; Ministry of Education, Science and Sport; Ministry of the Information Society; Ministry of Agriculture, Forestry and Food; Ministry of Defence; Ministry of Transport.
Analysis and study	Faculty of Economics, Ljubljana, Central & Eastern Europe Privatization Network (CEEPN), Faculty of Economics and Business, Maribor, Faculty of Social Sciences, Institute of Economic Research, Ljubljana, Economics Institute at the Faculty of Law, Ljubljana.
Intermediaries with potential for active involvement	Technology Agency (new establishment), Small Business Development Centre, National/ Regional Development Agency, Chambers of Commerce and Industry, Slovenian Trade and Investment Promotion Agency (TIPO), 48 local development centres, 12 regional development centres, technology Parks financial institutions / banks.
Promotion and advisory capacity	Technology and Innovation Agency (new establishment), Small Business Development Centre (SBDC), National Regional Development Agency (and 12 centres), advisory organisations, promoters, agents of development
Implementation of incentives	Technology and Innovation Agency (new establishment), institutionalized clusters, SBDC.

Source: OECD 2005

Table 3.2.2 The Dutch National Policy Actions

Year	Action	Who	Scope	Rationale
1999	*Identification*	Ministry of Economy	The identification of the existing clusters and of the industries and regions with high levels of linkages	The emergence of clusters
1999	*The Cluster Development Program*	Ministry of Economy	The increase of networking, the attraction of FDI and the initiation of clusters in practice	The emergence of clusters
2000	*The Cluster Pilot Program*	Ministry of Economy	The promotion of the cluster concept and "way of thinking"	The creation of clustering-development related experiences and expertise in the national policy makers
2002	*Program for Local Networks*	Ministry of Economy	Brokering and consulting SMEs for the creation of local networks of cooperation	The strengthening of the national and regional clusters with a bottom-up approach
2002	*Entrepreneurship and Competitiveness*	Ministry of Economy	Brokering services and support was provided for the creation of incubators at universities, as well as for the creation of technology parks and joint research programs	To stimulate innovation and investments in the process of knowledge and technology production
2009	*Centres of Excellence*	Ministry of Higher Education, Science and Technology	To foster the development of new knowledge through the linking of academia and industries	The production of new technologies, and the horizontal linking in the entire knowledge production chain
2010	*Competence Centres*	Ministry of Higher Education, Science and Technology	Industry – oriented complementary program to the Centres of Excellence	

3.2.2 The Construction Cluster

The Slovenian Construction Cluster (CCS) is a private sector initiative that was founded in 2004, looking to become a network of construction companies with a vision of offering complete solutions for domestic and EU construction market. Technological and organizational innovation processes are in the centre of attention for the further growth of the sectoral competitiveness and market position within the European and universal build environment. The CCS occupies about 3000 employees while the total turnovers of the cluster reaches the amount of 600.000 EUR on RTD projects and the revenues of the members are approximately 2.000.000 EUR. The Key Technologies and activities of the members are: structural and architectural design, consulting and engineering, construction contracting, prefabricated products for construction, prefabricated products for apartments, hotels, hospitals and similar, construction products and materials, building shuttering system, stone pavings and facades, stonecutting, building restoration, stone restoration, sustainable construction, academic research and higher education, IT, construction R&D, documents archiving and technologies for skating (www.sgg.si).

Table 3.2.3 The members of the Slovenian Construction Cluster

Manufacturing/service Companies	**Core Specialization**
VEGRAD d.d., Velenje	Expansion and renovation, refitting, demolition work, carpentry, metal works, concrete construction, engineering, and lime production; processing building materials and non-metals for the chemical industry; and production and installation of sanitary cabins
KRAŠKI ZIDAR d.d., Sežana	Building construction and construction engineering; engineering, production of building materials and different products in the field of construction
MARMOR HOTAVLJE d.d., Gorenja vas	Housing products of marble, quartzite, granite, sandstone, limestone, porphyry, slate etc
VARIS LENDAVA d.d., Lendava	Concrete prefabricated bathrooms, light prefabricated bathrooms, designer radiators, concrete skateboard elements
VEGRAD Projektivni biro d.o.o., Velenje	Expansion and renovation, refitting, demolition work, carpentry, metal works, concrete construction, engineering, and lime production; processing building materials and non-metals for the chemical industry; and production and installation of sanitary cabins
GRAS d.o.o., Ljubljana,	Remedial works and building construction engineering
GRAMOZ, Lendava	Building materials
MINS No1 d.o.o., Velenje	
EPIC d.o.o., Postojna	Formwork Systems, Panelling Systems, Fiberglass Formwork Systems, Plastic System, Construction System and related aspects services

GRADIS Biro za projektiranje Maribor d.o.o., Maribor	Engineering Services
GRADIS, GP Ljubljana d.d., Ljubljana	Engineering Services
KPL d.d., Ljubljana	Road maintenance, and maintenance of green areas and playgrounds
KEMA PUCONCI d.d., Puconci	Building materials
NEOSYS d.o.o., Ljubljana	ICT Solutions
EOCEN d.o.o.	Digital and microfilm archiving, document management editing and sale of technology for archiving
ROBOTINA inženiring d.o.o.	Production, distribution, support and service for automation components and electronic drives

Source: www.sgg.si

3.2.3 The S&T System

The Slovenian public science research sector is constituted by 56 state-owned research institutions, occupying more than 3000 employees. The two most prominent institutes are located in the capital and are the Chemical Institute and the Jozef Stefan Institute (covering natural and technical sciences, technology and engineering). The Universities of Ljubliana and Maribor, also host smaller research institutes and laboratories (Bartlett and Čučković, 2006).

Table 3.2.4 The S&T System

Research and Development	**Core Specialization**
Faculty of Civil and Geodetic Engineering, Ljubljana University	Educational and scientific research
Faculty of Civil and Geodetic Engineering, Maribor University	Educational and scientific research
Gradbeni inštitut ZRMK	Research and development , acquisition and dissemination of knowledge and new findings in the field of construction
IRMA Inštitutza raziskavo materialov in aplikacije	Research and development in the field of concrete, testing, certification of factory production control of concrete and aggregates productions, design of repair works and special technical solutions, quality supervision and advising
LIVEO d.o.o.	

Source: www.sgg.si

3.2.4 International Programmes

The Construction Cluster of Slovenia looking to acquire an international character has widened its horizons to external international partners, with memberships on networks

of construction related companies, where joint projects are taken up looking to boost innovativeness, competitiveness and market position of the participating companies.

Under the umbrella of the European Technology Platform (ECTP) that was already presented (see 2.1.5), it serves as the secretariat of the Construction Technology Platform of Slovenia, which is a member of the ECTP (www.sgg.si).

CCS is also a member of Tecnalia Corporation, which is a Spanish technology corporation that was set up in 2001 with a principal aim of contributing towards the development of the economic and social environment by means of the use and promotion of Technological Innovation through the cooperation of stakeholders in the areas of development and dissemination of research in an international context (http://www.sgg.si; http://www.tecnalia.com/en).

3.2.5 Innovation Patterns and cooperation within the cluster

CCS looking to become a network of construction companies offering complete solutions for domestic and EU construction market, builds its long term competitiveness on technological and organizational innovations and development. Some of the projects that were initiated looking to provide its members with infrastructure, services and cooperation conditions, are presented in Table 2.2.6.

Table 3.2.5 The Collaborating Projects in the Slovenian Cluster

Projects
Market research of the markets of the EU, eastern Europe and Russia, and south-eastern Europe
Professional training
Construction Technology Platform of Slovenia
Implementation of European standards in construction practices
Establishment of a national system for construction classification
e-construction site
Research of the behaviour of thin-walled constructions made from light concrete
Development of technologies for the construction of sandwich panels
Electronic archiving of documents
Analysis of loan policies
Development of joint venture good practice
Supervising and maintaining buildings on motorways and high-speed roads
Rehabilitation of buildings on motorways
Computer-assisted management of business processes
Development of innovative construction companies
Promotion of civil engineering and construction professions
Sustainable construction
Intelligent buildings

3.3 Central Denmark's Agro-Food Cluster

3.3.0 Introduction

In the 2012 aggreement that was initiated by the Regional Growth Forum, the food sector was characterized as the most important export industry in the region, as it stands for the 15% of Central Denmark's exports. Meanwhile Central Denmark's food products represent the 55% of the country's sectoral exports. Over the last 15 years the sector has experienced an increased diminution in terms of employment, whereas an increase was observed in terms of exports and turnover (OECD, 2012). The strong global competition accentuates the need for higher degree of innovation within the food industry. The regional iniatives that were released focused on the support of innovation through further colaboration between firms, knowledge institutions and customers, and the improvement of the skill levels of employees of the industry. In collaboration with national level, the agreement focused on getting a "Food KIC", stregthening the regional food culture, and marketing Danish high – quality food products and gastronomy abroad (Central Denmark Region, 2012).

3.3.1 National Policy Actions

The cluster concept is not a new notion of the Danish policy making, since the tradition in Denmark during the 1990's has been to undertake broad analyses of bussiness sectors using a cluster – based approach (OECD, 2001: p. 66). Although cluster – related studies and policies can be found in Denmark and earlier, under the inspiration of industrial complexes and micro-founded studies of clusters, the most direct influence derived from Porter's studies (Drejer, Kristensen and Laursen, 1999). After the analysis of the clustering structures of Denmark during 1987-1991 using the Porter methodology, five clusters with a high competitive ability were identified: the agro-food cluster; the shipping cluster; the technical cluster; the pharmaceutical/biotech and medico cluster; and the mink cluster (Drejer, Kristensen and Laursen, 1999).

In 1989 the Ministry of Trade and Industry initiated a three-year program for the development of inter-firm co-operation and linkages. Looking to improve cooperation and networking among bussinesses, brokers were trained to stimulate the development of networks and companies were funded to take up joint projects (OECD, 2007).

In 1994 the Ministry of Trade and Industry initiated the so called Resource Areas (mega clusters) (OECD, 2007). Following the Porter studies, Danish policy – makers analyzed clusters as ”resource areas”, which can be defined as clusters with a ”wider scope”, since they are made up of sectors that are mutually interdependent or are in a common relation due to the requirements to produce the final product or service in co-operation. Six resource areas were finaly acknowledged: food, Consumer goods and leisure, construction/housing, communication, transport and supplying industries, medico/health and general supplier business (Drejer, Kristensen and Laursen, 1999).

In 1999 it was decided that cluster approach was used in a two broad sense. The Ministry of Industry and Trade initiated a narrower concept of cluster activities, the Clusters of Competence. After the mapping and analysis that took place, 29 clusters of competence were identified. However the government was blamed for picking winners, and as a result the current policy measure was abandoned after the change of government in 2001, moving national cluster policy approach to stimulating framework conditions and strengthening innovative co-operation between business and knowledge institutions on a regional level (see Table 3.3.1) (OECD, 2007).

Table 3.3.1 The Danish Policy Actions (2001-2007)

Year	Policy Action	Who	Scope	Rationale
2001	*Regional Growth Centres*	Ministry of Science and Technology	17 Regional Growth Centres were established	To strengthen and develop the framework for regional cooperation and knowledge sharing among stakeholders
2004	*Action Plan for Public-Private-Partnerships on Innovation*	Government	Co-operation on research and innovation	To further strengthen cooperation between various players in research, trade and business and facilitate access to knowledge for SMEs
2005	*Establishment of Reg.Lab*	Government	Benchmarking activities, knowledge sharing, and discussions among the members within the Reg.Lab network	Focuses on regional business development
2006	*Regional Growth Fora*	Government	To carry out strategic planning, monitor regional growth conditions, develop projects and prioritize EU’s Structural Funds	To gather the most important partners within the field of regional development to decide on the strategic development of each region
2007	*Reformation of the sub-national administrative system*	Government	A more suitable governance structure and better public service	

Source: OECD, 2007

The Innovation Network Denmark:

In 2008 the national approach of cluster policy changed, with the Danish Council for Technology and Innovation (DASTI) initiating the "Innovation Network Denmark", aiming to strengthen innovation and research, public-private interaction and knowledge sharing between knowledge institutions and companies in defined industries or clusters. The main focus of the program is the enhancement of the innovativeness of SME's, through their participation in specific networks. The governmental role in this instrument is broker as the network takes up an informal character. Platforms are organized for the co-operation and contact of stakeholders, which are the firms and knowledge institutions, leading at the provision of value added in the production chain of the participating firms. (DASTI, 2011) Each network employees an average number of 4-5 specialized professionals who consult and support businesses and researchers in developing joint innovation projects. The Ministry of STI funds the networks with approximately DKK 75 million, while a similar amount of co-funding is required by businesses, knowledge institutions and regions (OECD, 2012). At this moment 22 specific sector-oriented programs are initiated, with the FoodNetwork directed towards the food industry (see appendix).

The Food Network:

FoodNetwork is an extensive network which includes a large number of Danish universities, research institutions, Approved Technological Service Institutions (GTS), innovation and development parks as well as technical and vocational schools. The aim of the network is to create growth within the food industry through networks, projects and activities. It is also to be the link that ensures visibility of the relevant partners within the food industry and to support and facilitate existing and new clusters (DASTI, 2011).

INSPIRE

InSPIRe started in 2011 as a strategic public-private platform between five universities, ATSIs and 23 businesses. InSPIRe's focus is to initiate and coordinate innovation projects, research, education and dissemination of results to the food industry with particular emphasis on productivity optimisation. In Central Denmark Region, inSPIRe works in partnership with Arla Foods, DuPont Nutrition Biosciences, AarhusKarlshamn, AgroTech, Danish Technological Institute and Aarhus University (Napier and Bjerregaard, 2013).

Table 3.3.2 The Danish National Policy Actions

Year	Action	Who	Scope	Rationale
1987	*Identification of clustering structures*			
1989	*Three-year cluster program*	Ministry of Trade and Industry	Looking to improve cooperation and networking among bussinesses, brokers were trained to stimulate the development of networks and companies were funded to take up joint projects	The development of inter-firm co-operation and linkages
1994	*Resource Areas*	Ministry of Trade and Industry	Analyzed clusters as ”resource areas”, which can be defined as clusters with a ”wider scope”	Inspired by Porter’s cluster studies
1999	*Clusters Of Competence*	Ministry of Industry and Trade	29 Clusters of competence were identified	A narrower approach of the cluster concept
2001-2007	*Framework conditions and moving to regional level*	Government	*See Table 3.3.1*	
2008	*The Innovation Network Denmark*	Danish Council for Technology and Innovation (DASTI)	The enhancement of the innovativeness of SME’s, through their participation in specific networks (Food Network in the case of Agro-food)	To strengthen innovation and research, public-private interaction and knowledge sharing between knowledge institutions and companies in defined industries or clusters
2011	*InSPIRe*	Research Council of Norway	A strategic public-private platform between five universities, ATSIs and 23 businesses	To initiate and coordinate innovation projects, research, education and dissemination of results to the food industry with particular emphasis on productivity optimisation

The Institutions

The Danish Council for Technology and Innovation (DASTI) was established by the Danish Ministry of Science, Technology and Innovation, and is responsible of Public research and innovation funding, Research and innovation policy, Researcher mobility, Dialogue on priorities in research and technology initiatives, Commercialization of public and private research, Interaction between research and business, Research and knowledge dissemination, Legislation on funding bodies for research, technology and innovation, EU research policy and international co-operation on research and innovation (www.taftie.org/).

3.3.2 Regional Policy Actions

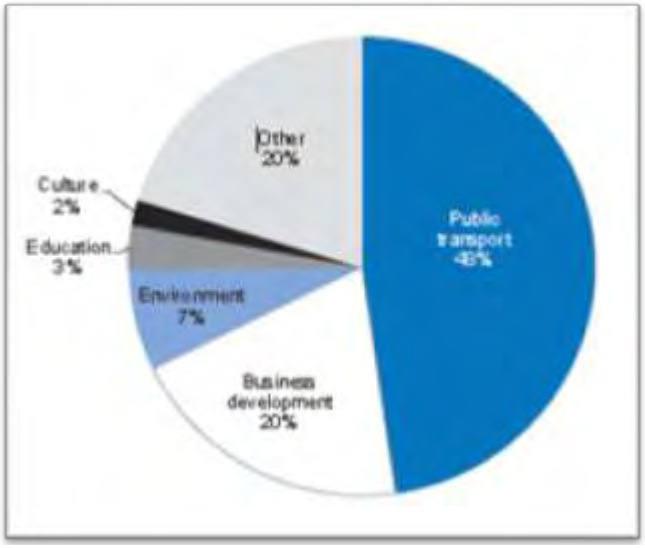
Regional Policy Mechanism

In the year 2007 the Danish Government moved in the reformation of the sub-national administrative system, by restructuring the former system of the 14 counties and 271 municipalities to 5 regions and 98 municipalities. Regional development is now operated by elected officials and private-public partnerships, which are monitored and implemented by the Regional Growth forums, established in 2007 (OECD,2012). The Regional Growth Forums are responsible of carring out strategic planning, monitoring regional growth conditions, developing projects and stimulating EU's Structural Funds in accordance with the regional competencies. The Regional Growth Forums act as brokers, taking the role of platform organizers for the co-operation of the region's stakeholders for the improvement of the framework conditions and the enhancement of innovation and business development. The participating actors are: municipalities, companies, organisations and research institutions, and the Regional Growth Forum is considered as the most important regional body lauching policy measures for innovation and business development. Annual partnership agreements between the regional growth forum and the national government play an important role as setting the frame for collaboration with specific ministries (ec.europa.eu/enterprise/policies/innovation/policy/regiona-innovation/monitor/index.cfm?q=p.support&n=13325). Furthermore, the regions also have their own analysis units, some specific regional data, and a number of regionally funded reports (such as on clusters) (OECD, 2012).

The 5 regions of Denmark have restricted "own" funds for financing initiatives regarding their major scope, that is innovation and business development. The fact

that there is no regional tax-raising authorities, sets a high level of dependecy of regional policies on the national policy administration. The national strategy of Denmark imposes the regional budgets to be spent on a great scale towards sthe sectors of health care, education and social service delivery. As a matter of fact in 2008 only the 2.6% (approximetely 303 million Euros) of the funds were used for regional development, excluding the EU funds. In the figure 1.0 the sectorial use of the funds in Central Denmark is demonstrated. As we can see the percentage of business development is relatively low, and regions are obligated to pool together funds from EU, state, municipalities and private sources along with their budgets, towards the selected regional strategy (OECD,2012).

Figure 2: Sectorial use of funds in Central Denmark



Source: OECD,2012

The Central Denmark Growth Forum, after the analysis of the regional competences prioritizes development within 4 industries or clusters: : IT, energy, food and health sector. (www.foresightplanning.eu/default.asp?id=980). Finally, the region of Central Jutland creates three mega-initiatives in energy and environment (wind-energy), healthcare and the food industry.

Regional policies

The primary regional policy – making authority, Regional Growth Forum, in 2009 initiated a policy measure regarding the food sector, trying to stimulate innovative process and creation of new jobs. Specifically, the Food Council was established, authorized to monitor, implement and co-ordinate policy initiatives (Napier and Bjerregaard, 2013).

The Smart Food Initiative including the Future Food Innovation are mechanisms trying to promote knowledge diffusion and innovation, by implementing actions such as seminars and workshops, supporting industrial PhDs as well as providing networking and matchmaking. In collaboration with the Ministry of Food, Agriculture and Fisheries, other regions and governmental institutions, the region's authorities supports the creation of synergies in the sector among the agricultural suppliers with suppliers of the energy sector (OECD, 2012).

Central Region Food is a business development programme that aims to create more innovation within the food businesses. By providing targeted advice, Central Region Food assists businesses with clarification of goals, action plans, subsidy schemes and making contact with external partners and consultants (Napier and Bjerregaard, 2013).

There are also a number of industry associations located in the region such as Danish Aquaculture, National Organic Association, and the Danish Dairy Board/Danish Agriculture and Food Council. This demonstrates that the food industry has strong support in Central Denmark Region. But it also underlines the need to bring together the different networks and organisations to support their coordination and collaboration. (Napier and Bjerregaard, 2013)

The Agro-Food Park in Aarhus

The Agro-Food Park is a cluster initiative that comes to connect specialized companies and knowledge institutions in the agricultural and food industries. (www.agrofoodpark.dk) The linkages that are developed within the cluster, under the guidance of the Agro-Food Park are expected to have positive externalities on the sector and the participating companies, leading to the production of expert knowledge, a consensus of know-how, consultancy as well as state of the art technology. The Agro-Food Park was initiated by Knowledge Centre for Agriculture, AgroTech, Institute for Agri Technology and Food Innovation, and Aarhus Municipality, and was officially opened in 2009. It is described as "an international centre for innovation and distribution of knowledge within the agriculture and food sector as well as the associated technology sector." (www.agrofoodpark.dk)

The role of the Agro-Food Park is to enhance cooperation between industry, universities, institutions and investors, by creating a favorable environment for the

generation and distribution of new knowledge. It should be mentioned that Agro Food Park is 100 % privately financed.

Søren Madsen, a clusterpreuner, is the key person to the development of the initiative, being the head of the establishment stage from 2009 to 2011 with a budget of DKK 6.5 million (www.regx.dk/en/facilitatorportraetter/soeren-madsen-agro-food-park.html). Today, he is in charge of the roles of Strategic development, cluster mapping and project management within the Agro-Food Park.

26 companies participate in the initiative, with a total number of 800 employees. The offices are located 5 km from the centre of Aarhus, and 40 km away from the international airport. All of the participating companies that are located in the facilities are knowledge companies within agriculture and the food industry and there is no production within the Park. Joint events for the sharing of knowledge are held in the facilities, as well as for the demonstration of inputs from external companies (www.regx.dk/en/facilitatorportraetter/soeren-madsen-agro-food-park.html)

An innovative initiative of the Agro-Food Park is the establishment of the Food Observatory, which is the first of its kind in Denmark, and gives the opportunity to external producers to demonstrate and test their products, before they launch them in the market. The test field is a canteen located within the facilities, where the 800 employees participate in the testing process (www.agrofoodpark.dk).

The long – term vision of this cluster initiative is to become one of the main centres of distribution of knowledge and innovation in the international level, with 3000 employees in 2020 (www.regx.dk/en/facilitatorportraetter/soeren-madsen-agro-food-park.html).

Table 3.3.3 The Danish Regional Policy Actions

Year	Action	Who	Scope	Rationale
2009	*Establishment of the Food Council*	Regional Growth Forum	Authorized to monitor, implement and co-ordinate policy initiatives	To stimulate innovative process and creation of new jobs
2009	*Smart Food Initiative*	Central Denmark region, in collaboration with Ministry of Food, Agriculture and Fisheries, other regions and governmental institutions	The creation of synergies in the sector among the agricultural suppliers with suppliers of the energy sector	To promote knowledge diffusion and innovation
2009	*Central Region Food*		Providing targeted advice	To enhance innovation within the food busi-nesses
2009	*Agro Food Park*	AgroTech, Institute for Agri Technology and Food Innovation, and Aarhus Municipality	Creating a favorable environment for the generation and distribution of new knowledge	Enhance cooperation between industry, universities, institutions and investors

3.3.3 The Historical background and Agro-Food Cluster

The broader area of eastern Jutland can be characterized as a crossroad of agricultural and food related knowledge, as for many years it was established as the natural center of related industries. In the city of Aarhus, the obseved concentration of international companies such as Danisco A/S, Arla Foods, AarhusKarlshamn, Dansk Supermarked and Danish Crown/Tulip Foods, sets high levels of proximity within the industry, creating an agglomeration of knowledge in the broader area (OECD, 2012). Moreover, world – class knowledge institutions are located in the region, such as Aarhus University, IT Byen Katrinebjerg and the University Hospital in Skejby.

After the set of the food industry as a priority sector for Central Denmark Region, by the Regional Growth Forum, Agro-Food Park, Central Denmark Region, Future Food Innovation and REG X, joined their forces for taking up initiatives for the establishment of a national food cluster with international character in the region. A

sectoral analysis was initiated (published in May 2013) using qualitative and quantitative data, examining the companies that are connected to the industry directly or indirectly. The companies that are included in the analysis are occupied in the whole value chain of food, from production of intermediate products, up to processed products ready for consumption (Napier and Bjerregaard, 2013).

It has been revealed that Central Demark region has the highest location quotient for the food sector than the other regions, and as a consequence the highest percentage of sectoral employment. However, employment on the primary industry is higher in other regions, in contrast to employment on the food manufacturing process, in which Central Denmark holds the first position, creating in this way a specialization norm towards the latter. More specifically, the analysis showed that the strongest specializations within the region are: food analysis and consultancy, processing of dairy products, processing of meat, and production of ingredients (Napier and Bjerregaard, 2013).

The qualitative analysis aimed at the mapping of the cluster's ecosystem, by recognizing the stakeholders (or potential actors of the cluster), based on the triple helix theory. Today the Danish Food Cluster is consisted of 117 members: companies, governmental and knowledge institutions. The core specialization of the participating companies can be found in various sectors of the food industry, that is: Agents and Wholesalers, Food Processing Technology, Food Analysis and Consultancy, Agricultural Supplies, Farming, Farm Technology, Processing of Dairy Products and Ingredients, Other Food Production, Production of Ingredients, Fish Farming, Fishing and Processing, Processing of Meat, Production of Bread, Cakes and Cereals, Beverage Manufacture, Fruit and Vegetable Producers, as well as ICT services. The participating members are not located only in Central Denmark Region, since companies, institutions, and the Region of Southern Denmark also participate in the cluster (danishfoodcluster.dk/).

3.3.4 The S&T System

The existence of internationally oriented businesses in addition to the knowledge institutions that are located in the region have created a knowledge base related to the agro – food industry. The knowledge institutions that participate in the Food Cluster can be found on Table 3.3.4.

Table 3.3.4 The S&T System

Knowledge institutions	
Aarhus University	Runs an international research centre for organic farming and food systems, the ICROFS, and a research center focused on product innovation, marketing and distribution of food, the MAPP Centre
Aalborg University	
Agro business park	Research park with a strong focus on entrepreneurship and innovation within agriculture, food, bioenergy and environmental technology
Agro food park	Cluster initiative that runs as a park looking to connect specialized companies and knowledge institutions in the agricultural and food industries
Agrotech	Approved Technological Services Institute (ATSI) dedicated to research-based consulting and technology services in the agriculture and food industry
Danish Aquaculture	Trade association for the Danish fish producing industry
Knowledge Centre for Food Development (VIFU)	A centre of excellence in the food sector with a focus on food, food development and food innovation
Danish Technological Institute	Independent ATSI established to address the industry's need for access to new knowledge and technology. DTIs food department is located in Aarhus
Danish Agricultural Advisory Service (DLBR)	DLBR is a network 32 independent companies organised into a trade association with headquarters in Agro Food Park
Knowledge Centre for Agriculture	Part of the DLBR and works to process and disseminate researchers' knowledge to Danish Agricultural Advisory consultants
Eurofins Steins Laboratory	Authorised and accredited to carry out analysis within agriculture, dairy and food products
Institute for Food Studies & Agro-industrial Development	Specializes in the collection, analysis and dissemination of information on international agro food trends
VIA University College	Educational institution that educates employees for the region's businesses and public sector at the health/food interface.

The Universities that participate in the network offer study programs related to the food industry, creating in this way a specialized labor force that can be absorbed in the cluster. The research of the Universities is also related to the agro-food industry, taking under consideration the competences of the region.

3.3.5 International Programme

The Central Denmark region has joined the international cooperation project "foresight planning", that is initiated under the umbrella of the Interreg IVB North Sea region programme. The region is collaborating with partner-regions from the North Sea area looking to enhance regional development through the exchanging of experiences, and developing new ideas through an innovative way of planning and decision making that is the "foresight planning". The term "foresight" stands from the convergence of three trends, Futures Studies, Strategic Planning and Policy Analysis. The vision of the project is to develop competitive businesses by strengthening the innovative foresight planning in the private and public sector. "Foresight planning" project acts as a platform organizer for the increase of the transnational cooperation levels between business and regions and the clustering in 4 industries: Food, Energy, Advanced technologies, and Financial services. The primary approach for the measures towards this direction is the organization of conferences, workshops, and cooperation with other similar projects, while web communication is given a great focus. In each of these 4 clusters the tools that were used included, establishment of working groups, collection of relevant studies, carrying out and comparing SWOT analyses, as well as recommending innovative activities and practices were made. Finally SMEs could be benefited by the programme through funds for innovative projects (Interreg, 2008).

3.3.6 Innovation Patterns and cooperation within the cluster

The Food Cluster initiated the project "New food", which aims in the promotion and advertisement of innovative products. In collaboration with the member "Dansk Supermarked" an area within the stores was created for the demonstration of the innovative products of the firms-members. Moreover, the Danish Food Cluster initiates conferences and workshops looking to promote the networking among stakeholders, and to increase the diffusion of information that could boost product innovation (danishfoodcluster.dk/).

Projects elaborated in 2013 by the Food Network

A number of projects are initiated and financed by the Food Network, aiming at 4 different activities: networking, courses and seminars, internationalization, and development (see Tables 3.3.5).

Tables 3.3.5 Projects elaborated in 2013 by the Food Network

Networking:	**Scope**
Knowledge resources (Vidensberedskabet)	Consulting on new ideas
Project accelerator (ProjektAcceleratoren)	Networking of SME's with University students
Food Network (Fødevaresikkerhedsnetværk)	Inform members of regulations on quality
PAKNET	Networking regarding food packing
A Taste of Denmark (Smagen af Danmark)	Platform for exchange of experiences
Value Chain Forum (Værdikædeforum)	Meet of production and industry players
Nordjysk fisheries component cluster	Regional strategy for cooperation
Food Experience (FoodErfa)	Knowledge exchange between small producers and salesmen
Network of marine ingredients	
Nordjysk aquaculture platform	Regional strategy

Source: www.foodnetwork.dk

Courses and Seminars:	**Scope**
Sensorikkursus	Courses on sensory methods on food quality for SME's
Courses in Food (Efteruddannelse I fødevaresektoren)	Courses for mechanics

Source: www.foodnetwork.dk

Internationalization:	**Scope**
Erhvervsdelegation til international messe	Educational Trips
Individual assistance	Counseling for international matchmakings
Cooperation with international clusters - Innovation Express	International co-operations with clusters for knowledge exchange
International Process Equipment Group - EHEDG	Creation of contacts with international firms and knowledge institutions

Source: www.foodnetwork.dk

Development	**Scope**
Forretningsgørelse af innovationsprocessen	Ensuring of innovation process
Innovation i øjenhøjde	Development of SME's
Utilization of crop residues for human consumption	"Plant wastes"
Innovation in process equipment - evaluation team	Evaluation team for safety of food
Survey of training skills	Needs on labor force as guiders to educational system
Innovative use of materials and surface technologies	Matchmaking between industry and Universities for exchange of research results
Optimization of 'Go to market' test environment	Testing of products

Source: www.foodnetwork.dk

3.4 The Icelandic Ocean Cluster

3.4.0 Introduction

Iceland is a Nordic island country with a population of 321,857 inhabitants. The capital city is Reykjavík and the population of the country is mostly occupied in traditional sectors. Taking into account the small size of the Icelandic economy and the weak innovation system, Iceland was obligated to base its capacities of economic growth on international cooperation (OECD, 2010).

A clear example of this attitude is the participation of the Icelandic Ocean cluster to the North Atlantic Ocean Cluster Alliance. The scope of the alliance is to support the national Ocean Clusters of the countries Norway, Iceland, Greenland, the Faroe Islands, Denmark and Newfoundland Canada, through the provision of a platform for cooperation, knowledge diffusion and new opportunities on the sector. This program is sponsored and supported by the Nordic Marine Innovation Programme, which is planned and implemented by the Nordic Innovation, an institution looking to promote cross-border trade and innovation within the Nordic Countries (nordicinnovation.org/news/north-atlantic-ocean-cluster-alliance-founded/).

3.4.1 National Policy Actions

In Iceland, the directions and priorities that are set in the policy – making process are defined by the Science and Technology Policy Council which meets twice a year. After the prioritization of the goals, the Ministry of Industry and Innovation, which is responsible of the cluster policy, takes up the required actions for the translation of the designed strategies into specific activities and programs.

Although the Ministry of Industry and Innovation plays an important role in the drawing of the directions of the cluster policy as well as in the planning of specific policy actions, the implementation of the measures is a matter of the regional policy – making agencies and actors, whereas the Central Government takes up the role of financer.

The Ministry of Industry and Innovation collaborates closely with the Ministry of Education, Science and Culture and the Ministry of Finance for the innovation policy – making process.

The innovation Policy

The Icelandic "innovation policy mix" was concentrated towards research and new knowledge generation, rather than on innovation and knowledge diffusion. The applied measures for years were horizontally oriented instead of having specific thematic prioritization (Verbeek and Consult, 2011; OECD, 2010). However this imperfection of the policy – making process was observed and policy actions started to be influenced by the intention to strengthen the national knowledge base, and hasten the transition of Iceland to a knowledge – based economy. Traditional industries and especially the fisheries industry was set in the centre of the attention, trying to boost its economic growth through new technologies that were mend to derive by applied research from related knowledge institutions (OECD, 2010). As a matter of fact, the initiation of three focused policy actions towards this direction took place: the Nanosciences and genomic biomedicine programme, the Added Value in Fisheries programme, as well as the new Centres of Excellence which include the Icelandic Institute for Intelligent Machines, the Geothermal Research Group, and the Centre of Excellence in Gender, Equality and Diversity Research (Verbeek and Consult, 2011).

AVS-Added Value for Seafood

The AVS program was initiated in 2003 by the Ministry of Fisheries in collaboration with the Icelandic Fisheries laboratories and sectoral private partners. The goal of the program was to increase the export value of the Icelandic seafood sector, through the enhancement of innovation. It aimed at the support of the applied research and development in the fishing, fish farming and fish processing industries. Joint projects in the areas of aquaculture, production, biotechnology and marketing, were proposed by private companies and research institutions and financed by the programme after the initiation of annual calls by the Ministry. The selection criteria of the projects are based on the expected impact on terms of value added in the industry as well as on the width of diffusion of the results. Although the collaboration of firms and institutions on the projects is a positive element, it is not considered as an obligatory qualification for the selection. Foreign participating actors from the EU and from third countries are allowed to take part and be funded under the auspice of the AVS programme if they can add value to the specific project

(erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/is/supportmeasure/support_mig_0004**)**.

Establishment of the Technology Development Fund

The Technology Development Fund plays an important role in the Icelandic innovation process, since the 75% of the beneficiaries claim that the projects that they were involved would not be accomplished without the Fund's contribution. The knowledge and experience that are acquired through the accomplished projects, lead to the increased success of future projects, contributing this way in the creation of value added knowledge in the national level (Verbeek and Consult, 2011).

The establishment of Icelandic Living Lab

The Innovation Center Iceland (ICI), in an attempt to enhance collaboration between users and producers in the development and use of goods and services for the strengthening of the linkages between research institutions and private sector, established the Icelandic Living Lab (LL). Being connected to the strong international network of Living Lab technology initiatives, LL can provide access to international networks, to any interested actor, besides the test facilities that are provided to users and developers (Verbeek and Consult, 2011).

Table 3.4.1 The Icelandic National Policy Actions

Year	Action	Who	Scope	Rationale
2003	*AVS-Added Value for Seafood*	Ministry of Fisheries in collaboration with the Icelandic Fisheries laboratories and sectoral private partners	Support of the applied research and development in the fishing, fish farming and fish processing industries	To increase the export value of the Icelandic seafood sector, through the enhancement of innovation
2003	*Establishment of the Technology Development Fund*	Ministry of Industry and Commerce	Financial support of technological development and research to the benefit of innovation in the economy of Iceland.	To enhance the effectiveness of public money for the development of scientific knowledge and technical development
2009	*Establishment of Icelandic Living Lab*	Innovation Center Iceland (ICI)	To enhance collaboration between users and producers in innovation, and the development and use of goods and services	The boost in innovation activities and value creation

The Institutions

Science and Technology Policy Council is looking to promote scientific research and research training in the sciences and encourage technological progress for the enhancement of the economic capacities of the Icelandic economy. It operates under the umbrella of Prime Minister's office, and is composed by ministers, scientists and business representatives, formulating public policy on scientific research and technological development (Prime Minister's Office, 2004).

Innovation Center Iceland (ICI) is a R&D and business support institute that was established in 2007 by the Technical Institute of Iceland (IceTec) in collaboration with the Icelandic Building Research Institute (IBRI), looking to foster the innovation, productivity and competitiveness capacities of the Icelandic business sector. Innovative technology research, diffusion of knowledge and support to start-ups consist the core activities of the institute (www.nmi.is/).

The *Technological Institute of Iceland (IceTec)* is a technological and educational institute aiming to boost economic growth through transferring expertise to industry that will lead to the increase of innovation activities and productivity. Its main activities are related to consultation, testing of new products, education, applied research and product development, where it operates a technology park, the Biotechnology House (OECD, 2010; www.randburg.com/is/iti/).

Rannís (The Icelandic Centre for Research) is an institution which cooperates closely with the Icelandic Science and Technology Policy Council, providing assistance and guidance in the preparation and implementation of the innovation and technology policy – making process (www.rannis.is/rannisenglish/).

IMPRA, the Service Centre for Entrepreneurship and SMEs, was established in 2002 with a scope of increasing the interactions and linkages of institutions, enterprises and administrative system, running several support programmes looking to stimulate innovation (erawatch.jrc.ec.europa.eu/).

3.4.2 Regional Policy Actions

As it is already mentioned, clusters in Iceland are understood as a part of the regional innovation policy, and related policies were implemented through regional growth agreements that were initiated in 2003, in six out of the eight administrative regions (INNOVA, 2007). The Regional Development Institute, an organization that runs under the umbrella of the Ministry of Industry and Innovation, is responsible of

stimulating economic growth. It supports eight regional agencies, one in each region, which participate in the regional growth agreements, overseeing the implementation of the agreement, and cooperating with municipalities, enterprises, trade unions and knowledge institutions (OECD, 2010; INNOVA, 2007). IMPRA also runs a centre in each region, through which it participates in the agreements, offering brokering services, to the clusters, as well as participating in a working group together with the Ministry and the Regional Development Institute, helping in the emergence of new policy recommendations (OECD, 2010; INNOVA, 2007). Both these two institutions co-fund the agreements, with the participation of municipalities, private companies, and any other participating institution (OECD, 2010; INNOVA, 2007).

The scope of the regional growth agreements program was to recognize the strengths of each region, identify the potential clusters, and finally support the emergence of the clusters. After the identification of the potential clusters by a top-down approach based on employment rates, the local governmental tools led by a general manager and supported by cluster facilitators, drafted the agreement encompassing activities towards the further specialization of the cluster. The areas that were prioritized are food and fisheries, education and research, tourism and the health sector. The fact that in Iceland there is a lack of international companies, and its business sector is composed mostly by SMEs, imposed the targeting of the program towards SMEs. The program was first implemented on two pilot regions, Northern Iceland and the Western Peninsula, and after the maturation of the concept, the rest of the regions started to be interested themselves in initiating growth agreements (INNOVA, 2007). IceTec, the Technological Institute of Iceland, played also a central role in the implementation of the program offering consulting services.

Table 3.4.2 The Icelandic Regional Policy Action

Year	Action	Who	Scope	Rationale
2003	*Regional growth agreements*	Regional Development Institute	Identify the strengths of each region along with the potential clusters, and support the emergence of the clusters	Strengthening and supporting clustering

The Institution

The Icelandic Regional Development Institute is an independent institution owned by the Ministry of Industry, looking to monitor regional development in Iceland. Its main function is to contribute to regional development through the implementation of government policy via the introduction of regional strategies (www.byggdastofnun.is/en).

3.4.3 The historical background and Ocean cluster

Despite the fact that the Icelandic fishing industry represents only the 7%-10% of the national GDP and is currently occupying the 5% of the national labour force, it is still considered as one of the locomotives of the Icelandic economy, because of the value creation that is developed in the whole production chain and in complementary industries (Sigfusson, Arnason and Morrissey, 2012). In terms of annual turnovers, the fishing industry is Iceland's fifth largest industry, following wholesale, retail trade, food processing and construction (OECD, 2006).

The Icelandic Ocean Cluster can be described as a 3 dimension cluster, with the core industry, referred as the fishing industry, to be consisted of fisheries, fish processing and fish marketing activities, surrounded by a group of industries that provides the cluster with resources and services, such as the packaging industry, fishing gear manufacture, shipping, mechanical manufacture, metal industry and public sector. The prosperity of these sectors in Iceland is closely connected to the vertical linkages that are developed with the fishing industry. Other complementary industries that are included in the cluster, recognizing however their peripheral and sparse role are the following industries: rubber and plastic manufacturing, machine leasing, energy production and utilities, R&D operations, chemical industries, commission trading and various specialised services which range from technical consultancy services to auditing, management consultancy services and financial services of various types (Sigfusson, Arnason and Morrissey, 2012).

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Image 1: The Icelandic Ocean Cluster

Source: Sigfusson, Arnason, Morrissey, 2012

Table 3.4.3 The members of the Ocean Cluster

Companies		
3X Technology ehf.	Optimal á Íslandi	Pólar togbúnaður
Akraborg	Iceland Seafood International ehf.	PwC
Akureyrarhöfn	Isavia ohf.	Promens Tempra
Auðbjörg	Íslandsbanki hf.	Reykjaneshöfn
Alasund Shipbrokers	Jakob Valgeir ehf.	Samey
Bláa lónið ehf.	Kadeco	Samhentir – Kassagerð ehf.
Borgarplast	KPMG ehf.	Samherji hf.
Deloitte ehf.	Kælismiðjan Frost	Síminn hf.
DIS	Landsbankinn hf.	Skinney-Þinganes hf.
Egill vélaverkstæði ehf.	LEX ehf.	Stálsmiðjan ehf.
Eimskip Ísland ehf.	Lýsi hf.	Stórkaup
Ekran	Mannvit hf.	ThorIce ehf.
Faxaflóahafnir sf.	Marel á Íslandi	Trackwell hf.
Grindavíkurbær	Marport	Trackwell hf.
Hafnafjarðarhöfn	Mjólkursamsalan	Tryggingamiðstöðin hf.
HB Grandi hf.	N1 hf.	Vélsmiðja Steindórs
Hraðfrystihúsið – Gunnvör hf.	Naust Marine	Vísir hf.
Ice-Group	Navis	Wise lausnir ehf.
Icelandair Cargo ehf.	Nortek	Þorbjörn hf.
Icelandic group		

Source: www.sjavarklasinn.is/en

3.4.4 The S&T System

University of Iceland runs a *Research Liaison Office (RLO)* with a scope of providing a platform for cooperation between academia and industry, by promoting the University to the business sector, assisting on contract negotiations between the University and firms, running national offices that are focused on the European collaboration in research programmes and vocational training (OECD, 2010). The higher education system of Iceland is combined also by the University of Akureyri, the University of Reykjiavik and the Agricultural University of Iceland.

The *Institute of Freshwater Fisheries* that was founded on 1946, today runs as an independent organization with a focus on the application of research and management in freshwater fisheries. Its functions are related to the R&D procedures, as well as to the role of consulter (www.veidimal.is/default.asp?sid_id=22731&tre_rod=002|002|&tId=1).

One prominent clustering – facilitating institution is the *Fisheries Technology Forum*, that was established in 1992, taking up the mission of involving stakeholders in partnerships within the fishery sector, in order to innovate and boost the value creation in the production chain (OECD, 2010).

The *Icelandic Food Research (Matis OHF)* is an independent governmental research company that was formed in 2007 after the merger of three former existing research institutions, the Icelandic Fisheries Laboratories, Matra, and the Research division of the Environmental and Food Agency. Its primary goal is to increase the value added of the food production and processing industry, as well as to maintain high levels of quality to the supplied products (www.fisheries.is/management/institutes/the-icelandic-food-research/).

Marine Research Institute is a governmental institute that was established in 1965 looking to provide to the Ministry of Fisheries with scientific advice, based on applied research on marine resources and environment (www.hafro.is/undir_eng.php?ID=1&REF=1).

3.4.5 International Programme

The Nordic Marine Innovation Programme as it is already mentioned is planned and implemented by the Nordic Innovation institute, with a focus on the increase of competitiveness and revenues of the Nordic Marine Industries, through the

enhancement of their innovative activities. The projects that were released under the umbrella of the programme can be found in the appendix.

3.4.6 Innovation Patterns and cooperation within the cluster

Ocean cluster runs an Incubator Centre, named as Ocean Cluster house, that was formally opened on September 26th 2012 and is located by the harbour of Reykjavik. 40 firms of the cluster are located within the O.C. House. Furthermore, it runs an Innovation Centre within the house, with a scope of providing entrepreneurs with facilities, a creative environment and professional advice in order to work on innovation, as well as the potential of developing a strong and powerful network of contacts with important parties in business and with other entrepreneurs who are going through the same process (www.sjavarklasinn.is/).

The major innovation projects that are currently running within the cluster are summarized on Table 3.4.4.

Table 3.4.4 The major innovation projects of the Ocean Cluster

Name	Scope	How
Green Marine Technology	Focused in durable goods, efficiency, good use of energy, oil savings, water savings and hygiene	
Marine Service Iceland	The aim of the project is to increase services and amount of foreign ships that come to Iceland, as well as the purchases among foreign shipping companies and fish operators in Icelandic products	Discussions among port directors, ship brokers , suppliers, interest groups, fish, government and other who could supply information about businesses between operators and shipping companies operate.
Utilization of North Atlantic Fish Catches	An international action research program with the objective of increasing utilization of fish in the North Atlantic Ocean. A key to this topic are by-products, parts of the fish not typically considered for production purposes	Will conduct research on fish utilization in the North Atlantic and develop cooperation between parties in the countries fishing in the area
School presentations	Aims to increase awareness and interest in marine related activities for students in high school	Students are informed of the high technology industry that follows fisheries, and the various career options associated with it in different ways
Menntavitinn	Aims to increase awareness and knowledge on ocean-related activities	Establishment of more partnerships between schools and businesses in, introduction of people to the technology and work that is taking place
Codland	Aims to increase the value and awareness of rest raw materials from fish.	Owing a factory to fully utilize fish by-products.
Verkefnamiðlun	Aims to connect students and companies in ocean related businesses	A website (www.verkefnamidlun.is) containing projects for the meeting of companies and students
Icelandic Logistics Cluster 2030 strategy	Aims to increase Iceland's competitiveness in logistics and was formed by airlines, shipping companies, ports and related businesses	It promotes R&D and education in logistics and transportation
The Economic Importance of the Ocean Cluster	Aims to evaluate the total contribution of the ocean cluster in Iceland to GDP	Research and publication of the paper "The Importance of the Ocean Cluster for the Icelandic Economy" by Ragnar Arnason and Thor Sigfusson (2010)
The Icelandic solution for fresh-fish trawlers	Innovation on fresh-fish trawlers	10 tech-firms within the Iceland Ocean Cluster have started developing a comprehensive design of an ice-trawler

Source: www.sjavarklasinn.is/e

3.5 Raufoss aluminium and light weight material cluster

3.5.0 Introduction

Raufoss is a small city of approximately 6000 inhabitants 113 km northern than the capital of Norway, Oslo. The economic activities of the area were greatly affected by the military production company, Raufoss Ammunition (RA), which was the main supplier of ammunition of the Norwegian Army and one of NATO's suppliers for more than a century (Johnstad, 2007). After the WW2, the diminishing demand of ammunition imposed the company to re-arrange its production, shifting to the manufacturing of primary aluminum and other light weight materials for the automotive and defence markets (Johnstad, 2007; Onsager et al, 2007; Isaksen and Karlsen, 2011; www.raufossindustripark.no; www.nce.no). Up to the beginning of the 1990's, the region of Raufoss was an one – company town, which since then evolved to a dynamic cluster with the establishment of 6 large companies and about 30 smaller scale firms.

3.5.1 National Policy Actions

Norway today is in its third generation of cluster policy programs. The first program, named as REGINN, ended in 2001 and aimed at the increase of regional network-based innovation. The program's foundation can be found in the triple-helix model, implied on collaborative R&D projects, while regional R&D institutions acted as facilitators (OECD, 2007). Today, two cluster policy programs are initiated, the Arena program, and the Norwegian Centres of Expertise (NCE). In addition, the programs Centres of Excellence (SFF) and Centres for Research-based Innovation (SFI) aim at the strengthening of the R&D institutions that cooperate on research related projects and initiatives with companies (Isaksen and Karlsen, 2011). Finally, the Value Creation 2010 research program emphasizes on the boost of economic growth and value creation in companies through the enhancement of collaboration between enterprises and knowledge institutions on organizational development and product innovation (Fosse, 2010).

Both the Arena Program and the Norway Centres of Expertise are aimed in reinforcing innovation and value creation through synergies and coordination of the cluster's actors. The two ministries that are responsible of financing the programs are the Ministry of Trade and Industry and the Ministry of Local Government and

Regional Development, while in the year 2012 approximately 100 million NOK were granted to the cluster programs. Furthermore, both programs are owned by the three innovation agencies: Innovation Norway, the Industrial Development Corporation of Norway (SIVA) and the Research Council of Norway, with the first one taking up the primary role.

The SFF and SFI programs refer to the initiation of joint R&D projects between knowledge institutions and companies, targeting any thematic area that can be of importance for value creation through innovation (www.forskningsradet.no/). The participating company must finance the centre with a minimum of 25% of the needed budget, whereas the SFI consortium with at least 50% (www.forskningsradet.no/).

The institutions

In the current paragraph the state-owned institutions that played a role in the development of the cluster are presented.

The state-owned institution *Innovation Norway* was established in 2004 with the replacement of four existing organizations: the Norwegian Tourist Board, the Norwegian Trade Council, the Norwegian Industrial and Regional Development Fund (SND) and the Government Consultative Office for Inventors (SVO) (en.wikipedia.org/wiki/Innovation_Norway). It is considered one of the most important governmental instruments for innovation and development of firms and industry, as its mission is to support the business environment through enhancement of innovation and development of their competitive advantages. The services that are provided are related to consulting, financing, networking and promotional (innovasjonnorge.no/).

The *Industrial Development Corporation of Norway (SIVA)* is a state-owned corporation, established in 1968 and responsible for stimulating governmental investments in incubators, science and industrial parks and real estate for the boost of economic growth through the enhancement of innovation capacities (en.wikipedia.org/wiki/Industrial_Development_Corporation_of_Norway). The mission of SIVA is to develop strong clusters through ownerships in infrastructure, investment and knowledge centres (www.siva.no/english/).

Table 3.5.1 The Norwegian National Policy Actions

Year	Action	Who	Scope	Rationale
1997	*REGGIN*	Research Council of Norway, Ministry of Local Government and Regional Development and the Ministry of Trade and Industry	Focus on building relationships between selected industries or industry clusters, regional R&D institutions and public authorities. The program helped to set network-based innovation in regional context	It functioned as a experiment program to promote network-based innovation through functional regional innovation systems
1998	*The TotAl group*	Chamber of Commerce, Toten Savings Bank and several companies	Business network of 35 companies. It functioned more as an informal network until 2005 when it became a formalised business association	Functions as a development arena and is involved in coordinating training programs such as 'the study stairs' initiative.
2003	*The Value Creation 2010 research program*	Research Council of Norway, Norwegian Confederation of Trade Unions, Confederation of Norwegian Enterprise and Innovation Norway	Acted as a broker and counselor. In collaboration with TotAl network it organized six seminars which resulted in the establishment of a formal network, as well as an annual conference	The boost of economic growth and value creation in companies through the enhancement of collaboration between enterprises and knowledge institutions on organizational development and product innovation
2003	*The Centres of Excellence (SFF)*	Research Council of Norway	A "host institution", university or knowledge institution, is selected as the management authority of the centre, and is funded by the Research Council to perform the selected R&D	Focus on the development of high quality research
2004	*Arena light metal*	Innovation Norway, Industrial Development Corporation of Norway (SIVA) and the Research Council of Norway	Played the role of facilitator. TotAl network played a central role and the business incubator has attracted several promising start-ups	The rebuild of the interactions and the networks after the reformation that took place in the 1990's. It is focused focused towards clusters that are in an early stage of development or have weak structures
2006	*NCE Raufoss*	Innovation Norway, Industrial Development Corporation of Norway (SIVA) and the Research Council of Norway	Initiated projects towards 5 directions: the development of the cluster itself and the existing networks, the establishment of new businesses, the development of technology and infrastructure, the creation of links between the educational system and practice, and the commercialization of R&D findings	The establishment of Raufoss as a national resource center for manufacturing with international orientation
2006	*The Centres for Research-based Innovation (SFI)*	Research Council of Norway	Companies are encouraged to take up long – term partnerships with research institutions	The promotion of the development of industry-oriented research clusters for the enhancment of the innovative activities of firms

The *Research Council of Norway* is the governmental official body, responsible for the development and implementation of national research strategy through grants and financing. It also acts as an advisor body for the government on subjects related to the research policy (en.wikipedia.org/wiki/The_Research_Council_of_Norway). Furthermore it serves as a networking platform, bringing into contact any party related to research, such as researchers, funders, and users of research findings. It comprises 5 thematic research divisions: division for science, division for energy, resources and the environment, division for society and health, division for innovation and division for administrative affairs (www.forskningsradet.no/).

3.5.2 Raufoss Cluster and the historical background

In the 1990's significant transformations of the industrial structures of Raufoss occurred, leading to the devolution of RA Raufoss into an industrial park with spin-offs and attraction of foreign companies that looked to take advantage of the agglomeration. In 1995 two business areas were established as fully owned subsidiaries, the automotive and the defence. The 40% of the former company, was initially buyed by the Norwegian Hydro company. In 1997 Norwegian Hydro proceeded to the buyout of the company. The latter was organized as a separate company together with partners from Sweden and Finland, under the name Nammo in 1998 (Johnstad, 2007; Onsager et al, 2007; www.raufossindustripark.no). Nammo is today considered as the leading company of the area and the most important technology-driver force of the cluster (Isaksen and Karlsen, 2011). In the 1990's two more important companies were formed, Plastal which produces exterior details in plastics, and Steertec specialized in aluminum steering components. Lastly, the group of the leading companies of the cluster is completed by Raufoss Technology, with a core production of suspensions systems, and Kongsberg Automotive, specialized in couplings (Isaksen and Karlsen, 2011; Johnstad, 2007). While most of the R&D activities of these companies are performed in the region, some parts of the production takes place in other countries for cost-reducing reasons (Isaksen and Karlsen, 2011).

Table 3.5.2 The evolution to the Raufoss cluster

Year	Action
1947	The status of the company changed, from being under direct public administration to establishing the company as a separate legal unit
1953	The company became an independent state – owned company, with civil leadership replacing the old military leadership
1955	Establishment of a Committee for proposing potential strategic investments in civil production
1957	First small contract with Volvo
1965	Contract with Volvo for 500,000 bumpers over 5 years
1990	Partly privatized and introduced on the stock exchange
1995	2 spin – offs as fully owned subsidiaries: Automotive and Defence
1997	Buyout of the automotive subsidiary by the Hydro Company
1998	Establishment of Nammo
1998-2004	Spin – offs of smaller scale companies

Until 2004 after many years of spin-offs from the former leading company RA Raufoss, the area was transformed to an industrial park, the Raufoss Industripark, which is an agglomeration of merely 35 companies (Johnstad, 2007). Besides the companies that were presented above, the Raufoss cluster consists of smaller highly specialized firms, producers of machinery, engineers and suppliers (Isaksen and Karlsen, 2011). More specifically, there are 15 manufacturing firms and 18 service firms mainly occupied with the production of light materials and automotive components; partly related firms produce building and construction materials, demilitarization technology, rocket engines and ammunition (see Table 3.5.2) (Onsager et al, 2007; Johnstad, 2007).

Tables 3.5.3 The members of the Raufoss Cluster

Production Companies	Core Specialization
Hydro Aluminium Profiler	Aluminium balcony railings and balcony glazing
Benteler	Aluminium components
Hydro Building Systems	Aluminium building components
Kongsberg Automotive	Automotive products
Nammo AS	Ammunition
Plastal AS	Plastic products
Steertec	Aluminium steering components
Ragasco AS	Steel products
Raufoss Fuel Systems	Complete storage systems for alternative fuels
Raufoss Industrial Tools	Complex details and system deliveries
Raufoss Metall	Metall products
Raufoss Technology	Suspension components
Raufoss Water & Gas	Couplings and related products
TotAl-gruppen	Processing of aluminium and other metals
VP Metall AS	Products of aluminum materials, steel and brass

Service Companies	Core Specialization
Adecco	HR solutions
Eidsvia Nett	
ErgoGroup	Business consulting company
SINTEF Raufoss Manufacturing	Transmission of expertise and competences
Forsvarets Logistikkorg	Ammunition logistics
Multisped	Transportation company
Raufoss Beredskap	Transportation company
Opplæringskontoret OIR	Training Office for Industrial Subjects
Raufoss Eiendomsforvaltning	Real Estate services
Raufoss Fotball Service	Office support
RISC	Innovation & Science Centre
Raufoss Næringspark	Holding company of Raufoss Industrial Park
Raufossnett AS	Electric Utilities
Sameiet Profilanlegg	
Sillongen Catering AS	Catering
Tess	Supplier of hoses and hose fittings
Mediaa Service AS	Railway products
Grobi AS	Grinding technology

Source: www.raufossindustripark.no

The fact that Raufoss acquired high levels of fragmentation imposed the development of new forms of cooperation between the industry and knowledge institutions, for the enhancement of innovation through the production of new knowledge and technologies. Because of fragmentation, local companies developed interdependent relations, leading to the development of a network for the sharing and development of "how things should be done".

3.5.3 The S&T System

Close links of cooperation between regional firms with knowledge institutions and especially with the Norwegian University of Science and Technology (NTNU) and the SINTEF research institution in Trondheim, are observed (Johnstad, 2007). SINTEF owns the majority of SINTEF Raufoss Manufacturing (SRM), whereas the rest of it is owned by local companies. SRM's scope and orientation is towards delivering expertise and competences, specialized in manufacturing, material technology and technology management, while it is the organizer of various laboratories that offer workshop services (Isaksen and Karlsen, 2011).

Moreover, the Norwegian Defence Research Establishment (FFI) which is the main institution responsible for defence-related research in Norway, collaborates closely with knowledge institutions and industry for the enhancement of new knowledge production through joint R&D projects (www.ffi.no/).

After the selection of the cluster under the NCE program NCE, SRM is responsible of managing the program's initiatives. Over the years, the Raufoss cluster developed a knowledge base through a combination of the production system and industrial research (Isaksen and Karlsen, 2011).

Table 3.5.4 The actions of the NTNU

Project Name	Scope
SINTEF Operations Management	Research program in the areas of Logistics and business development
SFI Norman	Eight year research program with the vision to develop new and multi-disciplinary research on next-generation manufacturing, and create theories, methods, models, and management tools that enable Norwegian manufacturers to thrive in global competition
SMARTLOG	An interest group for supply chain management in Norway. The SMARTLOG Network includes at present 25 Norwegian production companies and is organised by SINTEF Operation Management. SMARTLOG arranges two seminars annually on various topics related to supply chain management.
Green Value Creation (GVC)	Research program aiming to facilitate internal and external collaboration, increase visibility and knowledge dissemination, and to develop applications for external funding.

Source: www.ntnu.edu/

3.5.4 Innovation Patterns and cooperation within the cluster

According to the analysis of the innovation patterns of the cluster that was made the core companies were characterized as particularly innovative both in terms of process and production, while they all have established R&D departments. On the contrary, most of the smaller-scale companies of the cluster base their learning processes on experience-based knowledge, while few of them are collaborating with national and local knowledge institutions (Isaksen and Karlsen, 2011). Furthermore, the core companies have established closer links to the knowledge institutions and Universities than the smaller firms, while the labor force that is occupied by them is highly qualified in terms of education (Isaksen and Karlsen, 2011).

The innovation processes of the core companies can be categorized in three types that are analyzed in the following table:

Table 3.5.5 The innovation processes of the Raufoss companies

Type of Program	**Comments**
Technology programs	Long-term programs that aim at the creation of firms' technological base and core competence. They are initiated in collaboration with SRM, SINTEF, NTNU and FFI(Defense Institute)
Development projects for customers	Financed by the customers and have shorter time perspective
Self-financed product development	There is no customer and firms see larger potential for commercialization

3.6 Styrian Auto-motive Cluster (AC Styria)

3.6.0 Introduction

Styria is situated in the south-east of Austria, with a population of 1,210,700 inhabitants and an unemployment rate of 4,4%. The capital of Styria is the city of Graz, with a population of 301,368 inhabitants, characterized as the economical, cultural and social center of south-eastern Austria. In the region there are 4 universities, the 3 of which are located in Graz, where merely 40,000 students can be found.

In the decade of the 1990's, after the integration of Austria in the European Union, Styria was established in the heart of the EU, attracting increased levels of foreign direct investments. The economic structures of the region were based on mature industries, left behind of the globalized new economy. As a result, national and regional policy-makers and firms faced a great challenge, which was the need for transformation of the regional economic environment, the enhancement of cooperation, as well as the amelioration of the innovative dynamics of firms, in order to remain competitive (Hartmann, 2008).

3.6.1 National Policy Actions

National cluster policy in Austria was in the past specified towards the identification of the clusters and clustering potentials, while policy making and implementation was a matter of the regional governmental level. Although the results of the cluster studies offered useful conclusions to the policy makers, the need for more specified analyses for the elimination of the risk of developing policies under the wrong notion "one size fits all" was prominent. Eventually, it was decided that cluster policies should occur in a bottom-up approach, coming from the region, and competing with other regions (Tödtling, 2001).

In 2008 the Federal Ministry of Economy, Family and Youth acted as a broker, establishing the Cluster Platform Austria with a scope of facilitating communication and information disposal to national and federal cluster – related stakeholders. An annual conference is held, while several workshops were initiated trying to increase networking and information transfer in order for regional clusters to strengthen and become the "locomotives" of the economic growth of Austria. Joined activities and

partnerships are also initiated while particular importance is given in the relevant cluster policies of the European Union.

The program Centres of Competence (Kplus) that was launched in 1998 by the Ministry for Science and Transport focused on the increase of collaboration within industry and academia in order to foster both the economic growth through innovation and the R&D system. The 60% of the used funds were financed by the public sector, whereas the 40% by the participating private companies while the created centres had a predefined duration. In 2005 18 K centres were established, funded by the FFG (research promotion agency) that was formed in 2003 in order to run the program (Biegelbauer, 2006).

The Ministry for Economic Affairs in continuation to the efforts of the Ministry for Science and Transport for what was later called as K-plus program, initiated two policy measures, for the establishment of its own centres of competence. The K-ind and K-net Programs also focused on the technology clustering of firms and knowledge institutions.

In 2006, the Austrian Research Promotion Agency (FFG) was appointed by the newly established Ministry of Transport, Innovation and Technology in coordination with the Ministry of Economy, Familiy and Youth, to manage and run the COMET program (Competence Centres for Excellent Technologies). This program is a fusion of the existing programs, with a principle aim of enhancing the new culture of cooperation between science and industry, with the establishment of research institutions named as centres of expertise for the development of new knowledge through jointly defined top level research programmes (Biegelbauer, 2006; www.ffg.at).

After the fusion of the programs and the creation of COMET, the projects that were initiated and funded were categorized in 3 groups: K2- large centres of competence with international vision, K1- including smaller-scope centres, and K- including cooperative projects without the need of institutionalization (erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/at/supportmeasure/support_mig_0038). In the case of Styria, currently there are 8 centres of competence located in the region.

Tables 3.6.1 The Centres of Competence (COMET)

K2	Full Name	Scope
K2-Mobility	K2 Mobility – Sustainable Vehicle Technology	Mobility, Vehicle, Engines, System Optimisation
MPPE	Integrated Research in Materials, Processing and Product Engineering	Materials, Materials Characterisation and Development, Materials Processing, Manufacturing Processes, Mechanical Engineering, Product Engineering, Integrated Research
ACIB	Austrian Centre of Industrial Biotechnology	Industrial Biotechnology, Biocatalysis, Biopharmaceuticals, Systems Biotechnology, Biochemical Engineering

Source: www.ffg.at/

K1	Full Name	Scope
Bioenergy 2020+	Bioenergy 2020+	Biomass combustion, biomass gasification, biomass combined heat and power, fermentation, biofuels, modelling and simulation
RCPE	Competence Center for Pharmaceutical Engineering	Drug development, pharmaceutical manufacturing, diagnostics, engineering, drug products, simulation, process analytical technology
evolaris	evolaris next level	Mobile communication in the management of the customer relationships
KNOW	Know-Center Graz	Knowledge Services, Knowledge Technology, Knowledge Discovery, Knowledge Management
PCCL-K1	Competence Center in Polymer Engineering and Science	Polymer engineering, Polymer processing and technology, Polymer chemistry

Source: www.ffg.at/

Table 3.6.2 The Austrian National Policy Actions

Year	Action	Who	Scope	Rationale
1990's	*Identification*	Institute for Industry Studies (IWI) and Austrian Centre for Economic Research (WIFO)	In cooperation with the Austrian Technology, Information, Policy consulting program (TIP program) and OECD activities, identified existing cluster structures in the Austrian economy, through performing specialized analyses using differentiated methodologies	Inspired by Porter's studies and the positive externalities of clustering
1998	*Centres of Competence Kplus)*	Ministry for Science and Transport	Focused on the increase of collaboration within industry and academia. The 60% of the used funds were financed by the public sector, whereas the 40% by the participating private companies. The created centres had a predefined duration	Looking to foster both the economic growth through innovation, emphasizing to the R&D system
2001	*Kind and Knet Programmes*	Ministry for Economic Affairs	Centres of competence focused on the technology clustering of firms and knowledge institutions	Emphasize on the industry and on technology transfer
2006	*COMET program (Competence Centres for Excellent Technologies)*	Austrian Research Promotion Agency (FFG)	Establishment of research institutions named as centres of expertise for the development of new knowledge through jointly defined top level research programmes	Enhancement of the culture of cooperation between science and industry. Fusion of the existing programs
2008	*Cluster Platform Austria*	Ministry of Economy, Family and Youth	An annual conference and several workshops are initiated aiming to increase networking and information transfer	Facilitation of communication and information disposal to national and federal cluster – related stakeholders

The Institutions

The Austrian Research Promotion Agency (FFG) is a state-owned institution that was founded in 2004, and is owned by the Federal Ministry for Transport, Innovation and Technology and the Federal Ministry of Science, Research and Economy. It functions as the national funding agency for industrial research and development, offering to businesses a diversified and targeted programme portfolio, and simultaneously working for other national and international institutions (www.ffg.at/).

The Institute for Industry Studies (IWI) is a non-profit organization that was established in 1986. Being supported by leading university researchers, interest groups and companies, IWI performs analyses and research projects. Its expertise is concentrated in the areas of: Research & Innovation, Energy & Environment, Taxes & duties, Production costs, networks and patterns of cooperation, Education & Human Capital, Health and Demography, and Trade & International Economics, Infrastructure and corporate finance & capital markets (www.iwi.ac.at/).

Austrian Centre for Economic Research (WIFO) that was founded in 1927 is Austria's leading institute for application-focused empirical economic research. The findings of its research activities are designed for use as underpinnings for economic policy and entrepreneurial decision-making and to contribute to a rationale economic policy discourse (www.wifo.ac.at/en).

3.6.2 Regional Policy Actions

The industrial, educational and networking structures of the Styria region became the foundations for the establishment of the region as a "pioneer" in the cluster policy making and formation processes. Styrian firms were found to be particularly innovative with well- established networks, not only within the region but also in the national and international levels (Tödtling, 2001). In this research work it was made clear that the decade of 1990's and Porter's studies were crucial for the development of the cluster approaches. In Styria, two studies were undertaken, the first one by the Joanneum Research institution, and the second one by the IWI. As a result, a categorization of the firms' activities and networking was achieved, leading to the drawing of the regional cluster map. The clusters or "potential" clusters that were found in the region are within the industrial cores of materials-metals, wood-paper, construction-housing, food and vehicles-transportation (Tödtling, 2001).

The Styria Bussiness Promotion Agency (SFG) was founded in 1991 and is the main regional institution for the support of firms (MacNeill and Steiner, 2010). AC Styria was the first cluster organization that was established by the SFG, the undoubtful success of which leaded to the establishment of six other cluster organizations in the region, in the core industries of 'Wood', 'Human Technology', 'Materials', 'Eco-cluster', 'Tech for Taste' (food technology) and 'Creative Industries'. Companies were involved in informal meetings organized by the management unit, while stakeholders were informed regarding technological and market developments in scientific conferences and workshops (Tödtling and Trippl, 2004). The projects that were developed and managed by the authority were also financed by the SFG (Sölvell et al, 2003). Simultaneously to the initiation of the cluster, a steering committee (Clusterbeirat) was formed with the participation of representatives from the industry, governmental authorities, scientific and educational systems. The main reports of their meetings were related to the identification of bottlenecks and working on policies for their overcome (Tödtling and Trippl, 2004; IKED, 2004). Although these organizations are public-owned and funded in their initiation, as the related cluster develops, the level of public ownership eliminates. The cluster organizations are composed by the SFG, private sector representatives, and knowledge institutions (MacNeill and Steiner, 2010).

Table 3.6.3 The development process of the cluster organizations

Stage	SFG ownership	Actions	Timescale
Set-up	100%	Measurement/mapping Feasibility study Strategy development	Approximately 3 months per step
Start/implement	51% (approximately)	Projects Market information Networks	1 year
Consolidation	Reduces progressively	Projects market Information networks	Ongoing

Source: MacNeill and Steiner, 2010

After the identification of the need for increase of the interactions and communication within the industry, investigations were carried out in order to analyze the clusters' competences and bottlenecks. SFG initiated the opinion - gathering project "Vehicle-Cluster", while the reports technology/policy plan and the Steiermark Economic model were released by the knowledge-related institutions (Sölvell et al, 2003). The priorities of the policy agenda was not the financing of the cluster, but the improvement of the

Table 3.6.4 The Austrian Regional Policy Actions

Year	Action	Who	Scope	Rationale
1990's	*Identification*	Joanneum Research institution and IWI	The drawing of the regional cluster map	
1991	*Establishment of the Styrian Business Promotion Agency (SFG)*	Austrian Government	Service provider, that focuses on monetary support with financing programs, as well as tasks like raising and steering clusters and networks, technology parks, technology transfer, and the consulting of foreign investors	The main regional institution for the support of firms. Looking to contribute to the consolidation and growth of the Styrian economy
1995	*Establishment of AC Styria*	SFG in cooperation with the Association of Industrialists	Informal meetings with companies, workshops and conferences for the enhancement of networking and information diffusion	Linking up business, industry, research and public institutions in addition to identifying areas of strength and synergies.
1995	*Establishment of a steering committee (Clusterbeirat)*	SFG	Meetings with the participation of representatives from the industry, governmental authorities, scientific and educational systems	Identification of bottlenecks and working on policies for their overcome
1995	*"Vehicle-Cluster"*	SFG	Opinion gathering project	Analyze the clusters' competences and bottlenecks

business, institutional and educational environments in order to improve communication, information disposal and partnerships among the players (Sölvell et al, 2003). After the dialogue with the leading companies, SMEs, and research institutions, lists of proposals related to the needs for clustering were prioritized, and actions for the development of the cluster were applied. The SMEs and research institutions proposed solutions on imperfections regarding the interrelations, the generation of new ideas, the funding and the formation of R&D communities, whereas the leading companies emphasized towards the creation of a common vision, the interdependencies of the suppliers, the assistance to potential new suppliers, the reduction of gaps in the training of technical employees, and the attraction of foreign labor force (Sölvell et al, 2003).

The Institutions

The *Styrian Business Promotion Agency (SFG)* was established in 1991 and is considered as the main regional institution for the support of firms looking to contribute to the consolidation and growth of the Styrian economy. It operates as a service provider that focuses on monetary support with financing programs, as well as tasks like raising and steering clusters and networks, technology parks, technology transfer, and the consulting of foreign investors. The industrial and commercial environments are supported through services like: investment project support and consulting, information support, analysis of potential sites, advice about support, fact finding missions, and technology, business and research partner search (www.sfg.at/).

3.6.3 The Historical background and AC Styria

Although the automotive industry was particularly developed and represented an important sector for Austria and Styria, the occurred transferring of the production process to less developed countries for cost reducing reasons, was a great threat for the industry (SFG, 2010). A reconstruction of the value chain of the industry was required in order for local firms to meet the new pretentious conditions that derived from the "new economy", and improve their quality and innovation capacities (IKED, 2004; Tödtling, 2001; Tödtling and Trippl, 2004). There was a need for development of a culture of communication and social capital, and the adoption of horizontal relations among firms, rather than having only vertical, as a lack of input-output and non-market relations was observed (IKED, 2004; Tödtling and Trippl, 2004). As a

response to this threat that derived after the globalization of the markets and the intensification of the fragmentation of demand, the Styria Bussiness Promotion Agency (SFG) in coordination with the Association of Industrialists, took up the initiative for the establishment of a regional industrial cluster, the AC Styria, that was launched in 1995 (SFG, 2010; Tödtling and Trippl, 2004). It took up the role of stimulator, by bringing into contact regional with international firms, and financier, funding the initiatives that were taken up (SFG, 2010; Tödtling, 2001). International firms act as flagships, by providing "know-how" related knowledge to local firms for their upgrade to high quality suppliers, and by taking up marketing activities in order to make the cluster known to the international level (Tödtling, 2001).

Leading automotive related firms were already located in the region before the initiation of the AC Styria. Some of the most prominent are: AVL, an automotive consulting firm as well as an independent research institute, Voestalpine AG, a steel company specialized in steel, automotive, railway systems and tool steel industries, Böhler Edelstahl, a manufacturer of high speed steels, tool steels and special materials with key customers in the automotive industry, and Magna Steyr, an automobile manufacture company, and the automotive related firm of Chrysler (Tödtling and Trippl, 2004; www.voestalpine.com/; www.magnasteyr.com/; www.bohler-edelstahl.com/ http://www.clusterlink.com/acenet/new/).

Although the production system of the cluster consists of the complete value chain, it is particularly focused on the core sectors of metalworking and material processing, plastics, electronics and engineering. Its main strength can be found in the production of vehicle with all-wheel drive technology, while the expertise in the sectors of power transmission and combustion engines is also particularly developed (Sölvell et al, 2003). The cluster is consisted of 186 companies that are categorized in six groups in relation to their core specialization: service companies, logistics, machines and plant engineering, basic/raw materials and preliminary products, R&D, and commercial vehicles (www.acstyria.com/).

Table 3.6.5 The members of AC Styria

Company Group	Number of Firms
Service	66
Logistics	15
Machines and plant engineering	31
Basic/raw materials and preliminary products	28
R&D	41
Commercial vehicles	5

In 1999 the AC Styria changed its status, becoming a privately-owned cluster, and simultaneously stops receiving financing by governmental funds (Tödtling, 2001).

3.6.4 The S&T System

Styria owns a well developed automotive-related knowledge base that derives both from the industry and from the regional-based knowledge institutions. In the following table, the main research institutions that are located in the region are presented.

Table 3.6.6 The S&T System

Institution	Research Areas
The Technical University of Graz	Telematics, physics, chemistry, architecture and production engineering
Joanneum Research	Materials, Health, Digital technologies, resources, policies
The University of Leoben/Technology Transfer Center Leoben	Mining, materials and metallurgy.
AVL List	research and development of combustion engines
Steyr Fahrzeugtechnik	four-wheel-drive technology
Christian Doppler Research Association	Research laboratories are created with partnerships
Styrian Technology Park	Common Infrastructure and consulting to start-ups
College (Fachhochschule) for Automotive Engineering	Production of highly skilled technical personnel for the automobile industry

Sources: Tödtling and Trippl, 2004; www.clusterlink.com/acenet/new/; en.wikipedia.org/;

The Joanneum Research Institution is owned by the province of Styria and provides services of consulting on different thematic categories to enterprises and policy makers.

The University of Leoben established the Technology Transfer Center Leoben to enhance technology flow from the University to industry.

Christian Doppler Research Association is a research organization established in 1988 with a goal of launching thematic research units for the performance of high-level scientific R&D. The units are established after the meet of the need of a company for new knowledge and "know-how" in a specific subject, with the willingness of the research institutions to collaborate on a related project (www.cdg.ac.at/en/). When this prerequisite is accomplished jointly projects lasting for specific years are launched.

3.6.5 International Cooperation

The attraction of FDI was in the centre of attention and marketing activities to promote the cluster's brand name in the international market were initiated (Tödtling and Trippl, 2004; Tödtling, 2001; IKED, 2004). Institutional networking activities with European automotive clusters were taken up. More specifically, the region of Styria joined the Acenet network, an interregional network of cluster regions and facilitators with a scope of fostering relationships and jointly development (www.clusterlink.com/acenet/). The AC Styria today has cooperation agreements with Slovenia and Hungary, as well as with leading automotive production regions such as Stuttgart, Turin, Birmingham, Cardiff and Munich (Sölvell et al, 2003).

3.6.6 Innovation Patterns and cooperation within the cluster

Although the regional interactions within the firms are limited, according to Tödtling and Trippl, the analysis that was made by Adametz *et al.* (2000) indicated that automotive firms were collaborating with the regional knowledge institutions in a regular base. A number of partnerships were initiated between firms and knowledge institutions, creating thematic centers of competences, Christian Doppler Laboratories and other R&D projects (Tödtling and Trippl, 2004).

The Competence Centres are supported by the state and aim at the cooperation of several firms with Universities while the Christian Doppler laboratories aim at the collaboration of one firm with one institution. In the case of the competence centres, the observed involvement of two of the cluster's leading companies is a result of the developing culture of networking and trust within the cluster, that some years ago was unimaginable (Tödtling and Trippl, 2004).

Table 3.6.7 The Collaborating Innovation projects

Competence centres	**Regional knowledge suppliers**	**Cluster firms**
Automotive Acoustics	Institute of Internal Combustion Engines and Thermodynamics (TU Graz)	AVL List Magna Steyr Fahrzeugtechnik
The Virtual Vehicle	Several institutes of the TU Graz and the University of Leoben Technikum Joanneum One university institute from outside the region	AVL List Magna Steyr Fahrzeugtechnik Pankl Racing Systems Several other firms

Christian Doppler Laboratories	**Regional knowledge suppliers**	**Cluster firms**
Engine- and Vehicle Acoustics	Institute of Internal Combustion Engines and Thermodynamics (TU Graz)	AVL List
Thermodynamics of the Internal Combustion Engine	Institute of Internal Combustion Engines and Thermodynamics (TUGraz)	AVL List
Fuell Cell Systems with Liquid Electrolytes	Institute of Chemical Technology of Inorganic Materials (TU Graz)	AVL List
Automotive Measurement Research	Department of Electrical Measurement and Measurement Signal Processing (TU Graz)	AVL List

R&D projects	**Regional knowledge suppliers**	**Cluster firms**
Digital image processing	Joanneum Research	Several companies
Development of laser-welded gearpox parts	Laser Centre (Joanneum Research)	Magna Steyr
Development and production of a new oil pump		AVL List Several local SMEs

Source: Tödtling and Trippl, 2004

Chapter 4: Comparative Analysis

4.1 Introduction

Chapter 4 provides the comparative analysis of the six cases studies presented in the previous section, targeting on the identification of the common policy and business elements that were adopted for the processes of the clusters' formation and further strengthening. The comparison is made in two dimensions: horizontal, following the core industries of the clusters, and vertical, following their formation process.

4.2 The Dutch and the Slovenian Clusters

4.2.1 Netherlands

In the case of the Dutch construction cluster, the government performed sectoral analyses in order to identify the existing clusters, as it is presented in section 3.1.2. As far as the construction industry is concerned, a well developed cluster was identified, the linkages of which can be found across the national level. Besides the horizontally interconnected firms that can be identified within the core specializations as it is analyzed in section 3.1.3, the vertical dimension is composed by specialized suppliers, clients, as well as governmental and knowledge institutions. The wide range of the participating firms' core specializations which extend in the whole construction sector, in addition to the geographical boundaries of the cluster that is spread in the entire country, characterize the cluster as a "mega – cluster" (see section 2.3). The geographical conditions of Netherlands, with a big part of the country being underwater, have imposed the construction sector to grow and innovate. The Dutch construction "mega – cluster" developed spontaneously, with a bottom – up approach while the Dutch government took up the role of facilitator of its further development. The demanding requirements of the high quality projects that were initiated led to the increase of the sectoral R&D activities by the knowledge institutions and to innovative activities by the companies. Horizontal linkages for the diffusion of knowledge within the industry were developed, while at the same time the cooperation levels between firms and knowledge institutions were increased for the production of new knowledge (section 2.2). The construction companies failed to reach innovation through the production process and as a consequence they became receptors of product and technological innovation from specialized suppliers, knowledge institutions and firms of other industries, giving the characterization "absorptive" to the cluster which owns weak endogenous knowledge creation rates (OECD, 1999). Despite the fact that the members of the cluster lack of geographic

proximity, which according to Maskel (2001) can act as a barrier in the development of social capital, the cluster owns a well-established informal culture of the "way things are done" and share a common co-operational culture (OECD, 2001). As a result we can assume that the levels of social capital are particularly developed within the cluster (section 2.7).

Cluster Policies

Netherlands' initial conditions acted as a catalyst to the genre of the policy – making approach, looking to create the further ameliorate the environment for the emergence of new cluster and strengthening of the existing ones with more horizontal policies with generic scopes. The role of the Dutch government is not creating new clusters, but facilitating the market processes, by removing system and market imperfections in order to set up the environment for the creation of strategic alliances and combination of various skills in production chains. Subsequently, favorable conditions will be created for the "spontaneous" emergence of new clusters, and the strengthening of the existing ones. However, direct policies for boosting innovation and networking were also initiated, while brokering services was maybe the main policy instrument.

The 2002 evaluation of the cluster policy in Netherlands showed that the term cluster policy was used in a wide set of policy instruments, without clear definition. As a result any kind of policy was labelled as cluster policy. The Dutch policy makers shifted their focus to supporting dynamic innovation systems, abandoning the term cluster policy (EC, 2003).

4.2.2 Slovenia

Slovenia in the 1990's faced the transition impacts after the collapse of the Socialist Federal Republic of Yugoslavia. With a population of approximately 2 million, and weak economic structures, the position of the Slovenian companies in the international market is restricted. Owing diminished networking levels between academia and industry, and with an academic system emphasizing more towards education rather than on R&D activities, vertical measures were essential for the shift of the facing situation.

CCS is a cluster that exists in the meso level (see section 2.3), with its members been located mainly in the two larger cities of Slovenia, Ljubljana and Maribor. The members of the cluster are categorized by the management authority into two groups,

manufacturing/services and knowledge institutions. In the former group horizontal and vertical relations can be found among the manufacturing and service companies, while the firms interact in the vertical dimension with the group of knowledge institutions (section 2.2). In comparison to the Dutch construction cluster, CCS is narrower, both in geographic terms and participating members, owning less technology diversification, while its innovation patterns are less radical and systemic. The links between the academia and industry are particularly weak, and the initiation of policy measures towards their strengthening is essential (Cuckovic, 2006). The Universities are primary teaching units rather than research institutions, whereas the academic research is centralized towards the publications on scientific journals, rather than in the needs of the industry (Cuckovic, 2006). The formation of the Slovenian Construction cluster is a private sector initiative, with a bottom – up approach, after the decision of firms to cooperate under the guidance of a management unit. This unit set priorities for cooperation in innovative activities, and took up initiatives such as the "Construction Technology Platform of Slovenia", for the increase of the networking among the participating actors, that will lead to the increase of the level of social capital.

Cluster Policies

Slovenia faced a lack of cluster – related experiences in the governmental, industrial and academic environments, and tried to adopt a learning-by-doing concept with the cluster pilot programme. Funding was the most prominent policy – measure, while after the first phase of the cluster policy – making process, the attention of the government shifted towards R&D and knowledge diffusion measures, such as the Centres of Excellence and Competence Centres programmes.

According to Mr. Vladimir Gumilar, the director of the Slovenian Construction Cluster, after 2005 the governmental actions for facilitating and strengthening clustering were diminished, with clusters being "almost a bad think". The survival of the CSS can be attributed to the willingness of local SME's to collaborate and cluster, in addition to EU collaboration projects.

4.2.3 Similarities and differences

The main difference of the cluster approach of the current cases is that Dutch policy – makers plan their policy agenda under more generic actions and scopes, whereas the

Slovenian policy – makers attempted to facilitate the development of cluster – related experiences through more direct policy actions. In the case of Netherlands, the lack of a cluster's management authority, may acted as barrier to the further development of the cluster. On the contrary, the Slovenian Construction Cluster has an established organization responsible of stimulating activities, whereas the Dutch Construction Cluster is based on the spontaneous linkages that are developed within the industry.

The fact that innovation is linked to cooperation and networking as it is analyzed in Chapter 2 imposes the development of cooperating linkages and networks for the enhancement of innovative activities through the diffusion of cooperation. A clear aftereffect of these implications is the plan and implementation of brokering programs aiming to enhance the links between knowledge institutions and industry. Netherlands initiated the "platforms of cooperation", the cluster specific programs "Subsoil building and "Underground construction of infrastructure", the "Innovation in construction" as well as the annual "Technology radar studies". Slovenia initiated the Program for local networks, the Knowledge for Development, the "Improving Enterprises' Competitive Capacity" and the "Promoting Entrepreneurship". Under the same scope the programs "Centres of Excellence and Competence Centres" were implemented.

As it is mentioned in Chapter 2, the horizontal dimension of a cluster is closely connected with the process of watching, discussing and comparing dissimilar approaches among firms, leading to the selection of the optimum solutions in organizational as well as production issues. In order for this process to occur, spatial proximity and shared facilities are needed. A well – accepted policy measure towards this direction, the establishment of a cluster-thematic science park, was not implemented either in Netherlands or in Slovenia.

In both cases, the above mentioned brokering policies affect the development process of the social capital. The notion of buzz, that is analyzed in Chapter 2, refers to the informal relations that are establishing among the actors of the cluster, including the labor force, and can act as a reinforcement of the building of trust and common culture, through the development of social capital. The lack of measures to support spatial proximity and common facilities that are observed in both cases, is blocking the development of the buzz.

4.3 The Danish and Icelandic Clusters

4.3.1 Denmark

Denmark's national government performed analyses in the national level for the identification of "mega-clusters" that were named as "resource areas". However after the reformation of the regional policy mechanisms (see section 3.3.2) the Central Denmark's Region Forum performed its own analysis in collaboration with the institutions Future Food Innovation, Agro Food Park and REG X. As it is already mentioned, the food – sector holds a considerably high percentage of Denmark's exports, setting the sector as significant in terms of growth capacities. The findings revealed that in the broader area the stakeholders that are expected to take part to the formation process and interact in the two dimensions are: large established companies that act as flagships, entrepreneurs and small innovative companies, relevant knowledge stakeholders, advisors who can support companies in their development and innovation cooperation, venture investors and network facilitators (section 2.2). The cluster that is in the phase of emergence, is understood and analysed in the meso level (section 2.3). Although the main economic activities and the existence of the cluster are based in the region of Central Denmark, its geographic barrier are not limited within the region, as considerable linkages exist with firms and institutions located in the Southern Denmark region. The establishment of the cluster is mainly a regional government's initiative, with a top – down approach. However, a private initiative, the establishment of the Agro Food Park, facilitated the governmental actions in the formation process. The existence of international oriented firms and institutions in the area enhances the innovation activities that derive both by the production process and R&D activities. Eventually, a management unit was established and located within the Agro Food Park, for the further strengthening of the networking and innovation capacities through diffusion of information, joint projects and setting of priorities. Taking into account the early development stage of the cluster, we can assume that the social capital is also in the phase of developing (section 2.6).

Cluster Policies

Denmark's national policy was mainly oriented towards offering brokering services, as well as providing the regional governmental institutions with adequate funds for

the initiation of direct measures. As it is analyzed in section 3.3.1, governmental policies in Denmark were highly affected by the different approaches of the elected governments. The political hostility of the parties leaded to a competing approach of policy – making. A clear example of this attitude is the measure of Clusters of Competence, which was abandoned after the change of governments in 2001.

In the regional level policy actions were sector oriented, and since the agro-food industry was prioritized by the Growth Forum, the implemented measures had a direct impact on the process of cluster formation. In close collaboration with the South Denmark region, which also owns a highly specialized agro-food sector, steps towards the establishment of a national cluster based on Central Denmark region were made (see section 3.3).

4.3.2 Iceland

In the case of Iceland, the sector of fisheries is widely believed to be the country's single most important industry even if this fact is not immediately supported by the national economic statistics, as fisheries have contributed only between 7%-10% in nation GDP over the latest years. Iceland generates approximately 2% of the global marine catch on average and operates one of the world's most efficient fishing industries (Sigfusson, Arnason, and Morrissey, 2012). Although the core competence of the fisheries cluster is referred to fisheries, fish processing and fish marketing, the cluster is a collection of industries that provides the sector with resources and services, interacting in the vertical dimension (section 2.2). The close vertical connections of the fishing industry with the manufacturing, wholesale, retail trade and food processing industries reveal the significance of the fishing industry for the Icelandic economy, despite the diminished direct contribution to the GDP and employment rates. Following the theoretical approach, the cluster can be categorized as existing in the meso level (see section 2.3). The Ocean cluster started as a project at the University of Iceland but is now a company which facilitates networking opportunities for ocean related industries. In the geographical level although the main economic activities are concentrated in the capital city, members of the cluster can be found in the whole island of Iceland. The innovation priorities within the cluster are set by the management unit and are demonstrated in the Table 3.4.4. Moreover, innovative projects are offered by the "Nordic Marine Innovation Programme", as it is presented in the appendix. The social capital of the cluster is reinforced by the

initiative of the management unit, "OC House". Common facilities are offered to 40 companies, as well as formal meetings that are held, which in addition to the informal meetings that occur within the OC House can lead to the increase of the communication linkages and to the building of mutual trust-relationships (section 2.6).

Cluster Policies

The governmental cluster-related policy actions in the national level were mainly oriented to the prioritization of goals, and the funding of regional mechanisms for the implementation of the related measures. As it is presented in section 3.4.3, the regional growth agreements is the main policy action, under which potential and existing clusters were indentified, and actors were matched, for the emergence and further development of clusters. The Ocean cluster bases its main economic activities in Reykjavik, acting however as a national cluster with members spread across the Icelandic territory.

Besides the above mentioned actions, section 3.4 sets clear the fact that the Icelandic government have done very little to facilitate the development of the cluster. As a matter of fact, even in a cluster – related policy action such as the Centres of Excellence program, the fishery sector was left outside the planning. Sigfusson, Arnason, and Morrissey (2012) argue that the Ocean cluster has developed in a hostile environment, since a lack of public support awareness of the existence of the cluster was observed, and the governmental framework policy making was acting as a barrier to the development process, as "special heavy taxation of the fishing industry and substantial erosion of the fishing rights on which the industry is based can only diminish the economic growth potential of the fisheries cluster".

4.3.3 Similarities and differences

It was made clear that while the Danish cluster had a well developed supporting governmental policy agenda with brokering services offered both in the national and regional levels, in the case of Iceland a lack of supporting measures was observed. This lack of policy actions leaded the actors of the Ocean cluster to turn to international cooperation programs for the enhancement of the innovative capacities and economic growth and development of the cluster. The geographic position of Iceland, and its cooperating culture that was developed within the Nordic countries

acted as favourable conditions towards the participation of Ocean cluster in the Nordic Marine Innovation Programme.

In both clusters the existence of common facilities that are used by the members of the clusters, create agglomerations enhancing the cooperating levels, the diffusion of information, the building of trusting relationships, social capital and buzz. Although both clusters are operating under management units, in the case of Denmark the innovation activities are defined by the production process, and the unit takes up the role of coordinator, while in the case of Iceland priorities and joint projects are offered by the management unit.

4.4 The Raufoss and Styrian Clusters

4.4.1 Raufoss

Raufoss is a city in the Nordic country of Norway, the production structures of which were always closely connected and affected by a single company, RA Raufoss which subsequently evolved to an industrial park with numerous spin-offs. Foreign investments were attracted to the area, and eventually the cluster was formed with a bottom – up approach (see section 3.5). The Raufoss cluster is a regional cluster that can be categorized as identified and existing in the micro level (section 2.3). The formation process was highly affected by the private sector, which in addition to the favorable policy interventions that were offered by the Norwegian Government, leaded to the further strengthening of the cluster. Although a lack of specific international cooperating programs is observed, firms are integrated in global production and knowledge networks, mainly through external ownerships. Many firms that are located within the geographic barriers of the cluster, are owned by foreign corporations, maintaining independent positions within them, with regard to strategy, innovation activity and production. In this way, firms often own a competence that is not found in the rest of the corporation. This competence is linked to historically developed experience and knowledge that is embedded in the labor force, as well as in routines and established ways of doing things, creating the social capital (section 2.6) (Isaksen and Karlsen, 2013). A crucial conclusion that derives regarding the Regional Innovation System of Raufoss is that universities, customers and SINTEF Raufoss Manufacturing (SRM) are the main sources of technologic and research-based knowledge. The group of the core companies of the cluster acts as

stimulators for technology development and innovation processes. Besides the SRM, it is clear that SINTEF, NTNU and FFI cooperate with local companies on innovation projects. Projects that are initiated by the SRM are not always carried out by a single company, as in many cases they are performed through the collaboration of more than one company, strengthening in this way the local collaboration and knowledge exchanging network. Eventually, a common culture has developed within the RIS and the cluster, which is backed up by the national cluster-policy initiatives, the Arena Program, NCE and Centre for research-based Innovation in production technology (section 2.6) (Isaksen et al, 2012).

Cluster Policies

The formation of the Raufoss cluster was backed – up by a well developed policy system that was planned and implemented in the national level. After the initiation of an experimental program in 1997, the national policy makers acquired the needed experience, to move to more specific cluster facilitation programs, under the Arena Program and the Norway Centres of Expertise. Their main difference is that the former is focused towards clusters that are in an early stage of development or have weak structures, whereas the latter on well-established clusters with international orientation. Taking a look into the theoretical approach of the current research work, it is clear that the policy – making approach of the Norwegian Government comes along with the consensus that policy interventions should be focused in both emerging or potential clusters, as well as to already existing ones (Section 2.6). The SFI and SFF programs pattern on the "Centres of Expertise" programs that are initiated in numerous European countries. The thematic sectors that are targeted include any area that can be of importance for value creation through innovation. The main difference of SFI with SFF is that the former is industry oriented with an emphasis on research for the boost of business innovation whereas the latter is focused on the academia and the further development of the R&D activities.

4.4.2 Styria

In the case of AC Styria, the existing economic structures attributed to the region the characterization "old industrial area", mainly specialized towards the low technology traditional sectors (Hartmann, 2008). Following this acknowledgment and taking into account Table 2.1, the evaluation of the policy approach will be attempted.

The participating members of the cluster are categorized in 6 groups: service companies, logistic companies, companies specialized in machines and plant engineering, companies producing basic/raw materials and preliminary products, R&D companies, and companies specialized in commercial vehicles (see Table 3.6.5). The horizontal dimension is composed by the interactions of firms within each group, whereas the vertical dimension by the interaction among the differentiated categories, along with the external knowledge institutions (see Table 3.6.6) and governmental bodies (section 2.2). A Styria is a regional cluster the structures of which come along with the theoretical approach of the meso level clustering (section 2.3). However, besides the fact that the majority of the cluster's economic activities are concentrated within the Styria region, there are also members located in other parts of Austria. The clusters' external interrelations are constituted by the cooperation agreements that are mentioned in section 3.6.5. It was formed with a top – down approach as an initiative of the Styria Business Promotion Agency (SFG) in coordination with the Association of Industrialists.

The strengthening of the cluster's innovative processes and the enforcement of their research and development activities (see Table 2.1), was in the case of AC Styria mainly achieved through the mobilization of the S&T system, under the guidance of primarly the policy interventions in the national level. In addition, under the guidance of the cluster's organization, innovative priorities were set, in the fields of "Green Cars - Clean Mobility" with three main objectives: ECO-Powertrains, ECO-Materials and ECO-Design & Smart Production (www.acstyria.com/).

Cluster Policies

In the national level the policy approach was mainly oriented towards brokering services for the increase of the cooperation rates among firms, as well as the modernization of the S&T system. The former goal was achieved through the "Cluster Platform Austria", whereas the latter through the programs "Kplus" and "Kind and Knet" which were eventually fused under the "COMET program". According to Biegelbauer (2006) the reason that "Kplus" and "Kind and Knet" coexisted is the institutional fuzziness of the Austrian R&D structures, where several ministries are responsible of sectoral researches and technology driven policies. Their basic difference is that "K-ind and K-net" are less formalized and emphasize on the industry and technology transfer, whereas "Kplus" is mainly knowledge driven

looking for excellence in research (Biegelbauer, 2006). The imperfection of the institutional fuzziness was fixed with the establishment of the Austrian Research Promotion Agency (FFG), which took up the responsibility of implementing and funding R&D related policy measures, the most important of which is the "COMET program".

In the regional level the cluster was backed-up by sector specific interventions. The establishment of a cluster's organization for the facilitation of the development process was crucial, since it acted as a supervising committee, which mainly offered brokering services bringing the stakeholders into the participation of the cluster development process.

4.4.3 Similarities and differences

The basic difference of the two case studies derives by the initial economic conditions of the regions. On the case of Raufoss cluster the element of social capital was well-developed since the cluster is a direct consequence of the devolution of RA Raufoss into an industrial park. The spin-offs that occurred after 1998 (see Table 3.5.2) leaded to the reconstruction of the region's economic structures, under a shared culture that was diffused to the newly-established companies, while well-developed trusting relationships also existed. In addition, the fact that the cluster is facilitated by the Raufoss Industrial Park offers close geographic proximity to its members, helping to further develop the social capital through formal and informal meetings.

On the other hand, the Styrian automotive cluster managed to overcome its fragmented situation that was closely connected to the initial conditions of the region. This fact is reflected to the increasing level of linkages between industry and the S&T system. A stock of social capital was activated after the policy interventions that were implemented in the national level, as well as under the cluster's management unit, which focused its actions towards the encouragement of firms with limited interrelations to develop communicative links and to search actively for synergy potentials. After the formal and informal meetings that were held by the management unit, firms developed the element of trust, giving rise to the exchange of information, ideas and experiences (Tödtling and Trippl, 2004).

Both clusters were well supported by policy actions in the national and regional levels.

Table 4.1 Comparison

Case Study	How	Who	Government's Role	Innovation Processes
Netherlands	Bottom-up	Private sector	Facilitator of the market processes. Brokering.	Firms became receptors of product and technological innovation
Slovenia	Bottom-up	Private sector	Direct cluster policies that were abandoned. Brokering policies oriented to S&T system.	Less radical and systemic innovation patterns than the Dutch cluster
Denmark	Top-down	Central Denmark Region	Direct involvement in the formation process. Brokering policies.	Derive both by the production process and R&D activities
Iceland	Technology-push	University of Iceland	Weak levels of policy actions.	Innovation priorities are set by the management unit
Raufoss	Bottom-up	RA Raufoss	Direct facilitation of specific clusters with brokering policies. Strengthening of S&T System.	Derive mainly by the production process in cooperation with the S&T System
Styria	Top-down	Styria Business Promotion Agency	Strengthening of S&T System. Establishment of institutions for further involvement.	Derive By the S&T System, along with priorities that are set by the management unit

4.5 Vertical comparison in relation to the formation process

Following the comparative analyzes of the clusters, it is clear that the selected case studies vary in terms of dimensions (section 2.2), boundaries (section 2.3), innovation activities (section 2.4), social capital (section 2.5), and policy actions (section 2.7).

In the cases of Netherlands, Slovenia and Raufoss, the cluster formation process came from the private sector following a bottom – up approach. We can presume that the social capital of the actors along with their collaborative culture played significant role in the development process, as firms decided to cooperate for their survival and further strengthening. Of course the shift of the governmental actions towards the notion of cluster was also crucial, as mapping of cluster potentials and established clusters were performed. In the case of Slovenia direct cluster policies like the Pilot Program were implemented, without however including the construction cluster, although the identification process revealed its existence. The Raufoss cluster was well supported by a national level policy action agenda, with the initiation of the programs Arena light material cluster, and NCE Raufoss. The programs were planned and implemented taking under consideration the cluster's development stage. The former was focused on the newly established cluster of Raufoss, and in continuation the latter was based on the fact that the cluster has moved to the stage of well-established (see section 2.3).

In the cases of Denmark and Styria the clusters were formed with a top – down approach. In the first cluster, the cooperation culture and social capital were particularly developed, and before the governmental policy actions for the establishment, networking linkages already existed. The private-sector initiative Agro Food Park was catalytic for the development process. The Central Denmark Region in collaboration with institutions and the Southern Denmark Region, took advantage of the existing networking and tried to stimulate the formation process, backed-up by brokering policies in the national level. The region of Styria faced a lock-in situation, that in addition to the diminished levels of social capital acted as a barrier for the development of the cluster. By establishing the Styria Business Promotion Agency, which moved in the establishment of a management unit, they tried to involve firms in joint activities, an element that was absent. Following the role of the industry in the cluster formation process, as it is analyzed in section 2.7.2, the involvement of the

firms in networks needed to be enhanced. The effectiveness of the cluster and its further strengthening prove that the implemented policy actions were effective.

The Icelandic Ocean cluster was formed after a "technology-push" approach. In the lack of governmental policy actions, the University of Iceland implemented the Ocean cluster project, which proved particularly effective and continued its functioning as a private company (spinoff-see section 2.7.3).

4.6 Conclusions

In conclusion we can presume that some common strategy elements introduced by the actors that take part in the cluster formation process were detected, taking into account that policy interventions can acquire more generic roles, affecting in this way more than one elements of the process.

The basic elements of the process can be summarized as the inter-connectivity of firms, their collaboration in joint R&D activities along with the knowledge institutions, the intensification of the use of knowledge for the enhancement of innovation and their geographic and institutional proximity.

Brokering policies, the basic policy tool, were implemented in all of the cases. In the cases of Slovenia and Iceland, were the governmental policy actions were sparse, the industry and S&T system took up the role of facilitator of the process. As a result and following the Triple Helix Model, we can conclude that when the "governmental helix" is sluggish, the other two helixes mobilize towards the initiation of actions that can boost the formation process. In the cases of Denmark and Raufoss, the already well – mobilized helixes of industry and S&T system were supported by successful direct and indirect governmental measures, facilitating more the process.

In Iceland, the cluster continues to grow increasing its innovative activities, whereas in Slovenia the cluster declines, being highly affected by the economic crisis. As a result we cannot conclude in a safe presumption of whether the helixes of industry and S&T System can "cover the gap" that is created by a weak government helix, since the findings diverge.

Chapter 5: Conclusions

5. Conclusions

The aim of this work was to analyze six different cases of innovation clusters, and the policies that were implemented towards their formation and further strengthening processes. After the literature review, the clusters were analyzed under the following scopes: national policies, regional policies, historical background, S&T System, International programmes, and innovation patterns. The findings of the analysis were compared taking under consideration the conclusions that derived from the theoretical approach of the research work. The comparison took place in two dimensions, horizontal analysis in relation to the core industry of the clusters, and vertical analysis in relation to the formation process.

In the case of the Dutch construction cluster, the final conclusions are that although the cooperative culture is particularly developed, and the cluster was formed spontaneously, the cluster policies could be more direct, with the initiation of a management unit for the enhancement of cooperation and innovation prioritization. Furthermore, the initiation of a policy measure for the establishment of a science park, could increase further the levels of social capital.

In Slovenia, the construction cluster was not effectively supported by the central government. Firms turned to private-sector initiatives for the establishment of a management unit and international cooperation networks. The establishment of a science park for the relocation of the firms could be an effective policy for the further development of cooperation linkages, the formation of new firms, and the attraction of international oriented companies in the area.

In Denmark, the cooperation linkages were well developed, and the regional government took up direct role for the formation of the cluster. Both in the regional as well as in the national levels, the cluster is well supported by policy initiatives that cover the whole process of formation and further strengthening, as it is analyzed in chapter 2.

In Iceland, the cluster could be supported by brokering policies for the involvement of firms with the S&T system in joint projects that could enhance the process of knowledge creation. The weak governmental policy support level imposes the mobilization of the private sector, which after the establishment of the management

unit takes up activities for the involvement of firms and knowledge institutions in joint projects.

Raufoss acquired high levels of social capital and the cluster formation process was particularly spontaneous without the need of governmental policy actions. However, the central government well – supported the process, with direct and direct measures.

Finally, in the case of Styria one of the main problems was the lack of cooperation culture among firms. The element of competition was well developed and as a consequence the governmental institution SFG took up direct role for the formation of the cluster, with the establishment of a management unit. The governmental policies were mainly oriented towards the strengthening of the S&T system, and I believe that this is an effective tactic since a great part of the cluster's innovative activities derive from the knowledge institutions.

Concluding, it should be indicated that the main weakness of the current research work is the lack of direct communication with the actors that played crucial roles in the formation processes. The contact with the 'heroes' of each case study would offer a better understanding of which policy measures were crucial in the processes, and which were ineffective.

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Appendix

A1. Innovative potential clusters in Slovenia

Innovative Potential Cluster	Regions
Machine Tools	Koroška
Electrical/optical	Gorenjska, Goriška, Zasavska, Ljubljana
IT technologies (incorporating two sub-systems)	Ljubljana
Automotive (incorporating four sub-systems)	Dolenjska, Goriška, Obalno kraška. Koroška, Savinjska
Domestic appliances	Savinjska, Notranjsko Kraška, Gorenjska
Construction	Zasavska, Savinjska, Dolenjska, Gorenjska, Goriška
Transport - logistics	Obalno Kraška, Notranjsko Kraška

Source: OECD 2005

A2. Centres of Excellence in Slovenia

Centre of Excellence	Scope
Nanosciences and Nanotechnology	Goal of establishing technological infrastructure for the internationally competitive development of nano-sciences and nanotechnologies in Slovenia for the next decade and beyond
Biosensors, Instrumentation and Process Control	Compination of technologies in the fields of chemistry, biology, bioengineering, control systems and precision electrical instrumentation in innovative applications and products in medicine, biotechnology and chemical engineering
Integrated Approaches in Chemistry and Biology of Proteins	Research groups engaged in researching proteins, their characteristics and functions will be linked and technologies will be used in studies with a specific biological focus of high biomedical and environmental importance
Low-Carbon Technologies	Aims to convert solar energy into electrical energy and store it in batteries and super-capacitors (lithium technologies) or to convert it into hydrogen to be used in fuel cells
Advanced Non-Metal Materials with Technologies of the Future	Foster crucial technological progress in selected areas relating to inorganic non-metallic materials and their application in electronics, optoelectronics, photonics, and in medicine
Polymer Materials and Technologies	The centre's programme aims at developing polymer materials for advanced applications in line with sustainable development and low-carbon society policies in four areas: (1) technical products for advanced applications and energy, (2) coatings and adhesives, (3) renewable resources and (4) health
Science and Technology	Scientists and engineers from academic institutions, high-tech SMEs and large industrial and insurance companies, which are integrated in the network of strategic partners from the EU, has strong research and technological capabilities to develop MEMS-based micro-propulsion, satellite control, communication, data and image processing and to engage in virtual and experimental research of micro- and nano-satellite systems
Studies in Biotechnology, Pharmacy and Physics of Matter	Development of energy efficient products, and, accordingly, on the horizontal objectives of promoting an energy-efficient economy with an emphasis on sustainable development

Source:http://www.arhiv.mvzt.gov.si/en/areas_of_work/science_and_technology/centres_of_excellence_and_competence_centres/

A3. Competence Centres in Slovenia

Competence Centre	Scope
Advanced Control Technologies	Operates in the field of control technology, which connects automation, computerisation and cyberneticisation of processes and systems.
Advanced Systems for Efficient Use of Electrical Energy	An active network, which will be based on new technologies and will be tested within the Slovenian electricity transmission network.
Biomedical Engineering	Establishment of a large virtual research and development group joining companies and the academic sphere in the area of biomedical engineering, with a view to reaching a critical mass of knowledge, staff and material conditions enabling swift transfer of research findings into marketable products and revolutionary technological breakthroughs in the global market.
Sustainable and Innovative Construction	activities of researchers, investors, construction companies and industry, services and other factors aiming at achieving sustainable development while taking into account social, economic and cultural issues.
Biotechnological Development and Innovation	a strategic partnership between leading industrial partners and the most prestigious research organisations aiming to offer the required and sufficient critical mass of innovative industry and scientific excellence at a level comparable to international standards.
Cloud-Assisted Services	Developing competencies in the area of Cloud computing in order to enhance the competitiveness of the partners participating in the project, and – through access to the most advanced technologies and knowledge in this area – also the competitiveness of the Slovenian economy
Open Communications Platform for Integrated Services	Development of knowledge, technology and processes that will offer solutions to three key challenges: (1) slow expansion of internet and broadband access, (2) copious data, information, and content and the inability to use them effectively in comprehensive applications for individual areas of life, and (3) increase in the number of smart appliances, which are envisaged to be connected to the internet by the tens of billions by 2020

Source:http://www.arhiv.mvzt.gov.si/en/areas_of_work/science_and_technology/centres_of_excellence_and_competence_centres/

A4. The Actors of cluster formation process in Central Denmark

Stakeholder	**Role**	**Comment**
Large Companies	Act as flagships	Within business specialisation areas of ingredient production and dairy processing
SMEs	Innovative companies	There is a growing trend for new SMEs inspired to establish synergies and innovate in IT
Knowledge Institutions	Knowledge production and diffusion	Universities hold Departments specialized on food sector. Aarhus University is one of them
Advisors	Support companies	A number of Approved Technological Service Institutes (ATSI) are located in Central Denmark Region
Investors	Invest in innovation	
Network facilitators		

A5. The Innovation Network Denmark

Network	Website
AluCluster - Knowledge and technology centre for aluminium	www.alucluster.com
Animation Hub	www.animationhub.dk
Danish Sound Technology Network	www.lydteknologi.dk
FoodNetwork	www.foodnetwork.dk
Biopeople – Innovation Network for Biotech	www.biopeople.dk
Infinit – The Danish ICT Innovation network	www.infinit.dk
InnoBYG - Innovation Network for Energy efficient and Sustainable construction	www.innobyg.dk
The Innovation network for Environmental Technology	www.inno-mt.dk
InViO - Innovation network for knowledge-based experience economy	www.invio-net.dk
Innovation Network for Biomass	www.inbiom.dk
Danish Lighting Innovation Network	www.dansklys.dk
The Innovation network for Market, Communication and Consumption	www.imkf.dk
Service Platform – Service Cluster Denmark	www.serviceplatform.dk
The Innovation network for Environmental Technology	www.inno-mt.dk
InViO - Innovation network for knowledge-based experience economy	www.invio-net.dk
Innovation Network for Biomass	www.inbiom.dk
Danish Lighting Innovation Network	www.dansklys.dk
The Innovation network for Market, Communication and Consumption	www.imkf.dk
Service Platform – Service Cluster Denmark	www.serviceplatform.dk
Innonet Lifestyle Interior & Clothing	www.innonetlifestyle.com
Plastic and Polymer Network	www.plastnet.dk
No Age-innovative solutions for elderly people	www.lvvl.dk
Offshore Center Denmark	www.offshorecenter.dk
RoboCluster	www.robocluster.dk

Source: Danish Agency for Science Technology and Innovation, 2011

A6. The Nordic Marine Innovation Programme

Project Name	Objective
APRICOT (Automated Pinbone Removal In COd and WhiTefish)	Development and testing of equipment to automatically cut the pinbones out of whitefish fillets, such as cod.
Aquaponics NOMA (Nordic Marine) – New Innovations for Sustainable Aquaculture in the Nordic countries	Establishment of a network for cooperation between businesses, researchers and consumers in the Nordic region, in order to provide new innovations supporting a more competitive and sustainable aquaculture and food sector.
Enriched Convenience Seafood Products	Successful product development of enriched seafood dishes with bioactive compounds from the ocean, such as seaweed, fish proteins and fish oil and to increase the variety of seafood products with functional properties available to Consumers.
Completed project: Innovative fish counters	Creation of a better everyday life for all fishmongers in the Nordic countries, and hopefully also a better public understanding of seafood as a cornerstone in the Nordic cuisine – the way forward is more innovative fish counters
InTerAct - Industry-Academia Interaction in the Marine Sector	Establishment of interactions between the marine sector and universities, address the higher educational needs of the aquatic food value chain with the long term objective to enhance the innovation capacity of the marine sector.
Local fish feed ingredients for competitive and sustainable production of high-quality aquaculture feed	Utilization of microalgae, seaweed and mussel meal in fish feed.
Nordic Algae Network	Help the participants to a leading position in the field of utilizing algae for energy purposes and for commercial exploitation of high value compounds from algae. An additional aim is to increase the synergy and facilitating collaboration between the participants involved in the project and thereby increase their ability to compete in this new field.
Nordic Innovation Marine Marketing Program (NIMMP)	Improvement of the Nordic Marine Companies' international competitiveness by engaging students in consulting solution projects that could increase the Nordic Marine value proposition.
North Atlantic Marine Cluster project	Mapping of the marine clusters in the North Atlantic and strengthening relationships among them, building arenas to communicate their activities, benchmark and developing stronger networks in the ocean/marine sector.
Novel bioactive seaweed based ingredients and products	Development of technologies to process novel highly bioactive ingredients from bladderwrack and develop innovative products containing them with active collaboration of target consumers/users. The products include (a) food

	supplements, (b) cosmetics and (c) food antioxidants.
PIPE - Pelagic Industry Processing Effluents Innovative and Sustainable Solutions	The main goal for the PIPE project is to test cutting edge technologies, to separate water and organic material from pelagic industries effluents and to characterize as well as valorise the organic material collected.
Profitable Arctic charr farming in the Nordic countries	The main goal with this project is to enable economical and environmental ustainable growth in Arctic charr farming.
Tomorrow's fish counter	Building of increased insight through better understanding of future consumer preferences, translating consumer insight into concrete concepts for tomorrow's fish counter and contributing to increased market expertise in seafood. It also aims to improve skills and motivation for innovation processes across the value chain and different actors.
WhiteFishMaLL (North Atlantic Whitefish Marine Living Lab)	Building a branding platform for whitefish from the North Atlantic that facilitates market differentiation in terms of sustainable production and superior consumer benefits.

Source:http://www.nordicinnovation.org/projects/marine-innovation-projects/marine-innovation-projects/

A7. Norwegian Centres of Expertise (NCE)

NCE Maritime	This maritime cluster on the west coast of Norway is a world leader in designing, building, equipping and operating the world's most advanced vessels for the global oil industry
NCE Subsea	The Bergen area in Norway constitutes a word-leading cluster in subsea technology – focusing on the markets for maintenance, modification and operation, as well as innovative and cutting edge technical products
NCE Systems Engineering Kongsberg	The Kongsberg cluster comprises knowledge-based companies, several of which are world leading in demanding industries like subsea, maritime, automotive, aircraft, defence and aerospace industries
NCE Raufoss	The cluster's core area of activity is the manufacturing of products in lightweight materials by automated production. Today, the main markets are automotive and defence, and the goal is to develop a national resource centre for manufacturing
NCE Instrumentation	Situated in Trψndelag, NCE Instrumentation represents cutting edge expertise within the field of sensor technology and advanced control and communication solutions
NCE Micro – and Nanotechnology	The companies in the cluster comprise the most important commercial arena for micro- and nanotechnology in Norway, and play a leading role in the Norwegian electronics and ICT fields
NCE Oslo Cancer Cluster	This cluster focuses on developing new cancer treatments and diagnostics for the benefit of cancer patients all over the world
NCE Aquaculture	This aquaculture cluster focuses on value creation and innovation associated with commercial production of farmed fish and seafood for the global market
NCE Culinology	The food cluster in Rogaland's main objective is to strengthen the knowledge platform and capacity for innovation in the field of gastronomy and culinary differentiation for the benefit of Norwegian food production
NCE Tourism – Fjord Norway	The goal is to make the Fjord Norway region the world's leader in theme tourism, facilitating strength and the ongoing growth of tourism in Western Norway
NCE NODE	This oil and gas technology cluster at the southern coast of Norway operate within three niches – offshore drilling, offshore loading and offloading, mooring and anchoring, and active heave compensated cranes
NCE Energy and Emissions Trading Halden	The energy industry is facing radical changes to business conditions, market designs and policy instruments. NCE EET Halden is a cluster dedicated to tackling these changes that pose significant challenges for the energy industry

Source: www.nce.no