

Universität Flensburg

## Distance Learning Project

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**Written Report of:**

### **Crossing- borders: International Clusters:**

**An analysis of Medicon Valley based on Value-Adding Web**

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Flensburg, 08 July 2007

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## Abbreviations

CRO	-	Clinical Research Organisations
DBF	-	Dedicated Biotech Firms
EMBO	-	European Molecular Biology Organization
GDP	-	gross domestic product
IDV	-	Individualism/Collectivism Index
IT	-	Information Technology
MAS	-	Masculinity/Feminity Index
OECD	-	Organization for Economic Co-operation and Development
PDI	-	Power Distance Index
PRO	-	Public Research Organisations
RIS	-	Regional Innovation System
R&D	-	Research and Development
UAI	-	Uncertainty Avoidance Index
UK	-	United Kingdom
UN	-	United Nations
US	-	United States of America
VAW	-	Value Adding Web

## **1. Introduction**

The creation of clusters has been increased in the last decades. This is not only a “fashion” or a “tendency” of many companies, but a new working strategy in a global and capitalistic market, where only the stronger and innovative firms can success. In this environment, cross-border clusters play an important role in small countries such as the European countries, where an alliance could be a key strategy, not only between firms, but between countries.

The following paper describes the terminology of a cluster; with a focus on the cross-border cluster. The successful Medicon Valley cluster, in the Øresund region between Denmark and Sweden, is analysed as an example of a cross-border cluster. The actors and activities of this cross-border cluster are described and analysed using the Value Adding Web. Socio-cultural factors such as culture and policy are also part of this analysis.

## 2. International Cluster-Definition & Theory

### 2.1. Cluster

The concept of “Cluster” has been used since 1920 with the work of Marshall on the English industrial regions of the 19th century<sup>1</sup>. However the first exponent of the “formal” definition of a cluster was from Michael Porter in 1990, who defines clusters as geographic concentrations of interconnected companies, provider, suppliers and institutions in a particular field that compete but also cooperate<sup>2</sup>.

In the last time many definitions of clusters have been created and the key common features that these definitions share are: (i) formal input–output relationships, (ii) buyer–seller linkages, (iii) geographic concentration of firms, and (iv) shared specialised infrastructures. A definition that covers all this characteristics is the cluster as “a Value Adding Web”, which says:

*“A cluster is a connection of horizontal, vertical and lateral value adding activities contributed by different actors in proximity to one another which all act in relation to a specific industry. Together the actors are building a value adding web which defines the boundaries of the cluster. Direct and indirect interactions take place between these actors which may be reflected in strong, medium or weak links.”<sup>3</sup>*

Clusters are generally built up spontaneously by the local business players, who want to take advantage from the synergy of several factors existing in the geographic area:

- the presence of customers and suppliers,
- the access to qualified labour force and know-how,
- the availability of specific natural resources and infrastructure,
- low transaction and communication costs due to geographical proximity,
- the vicinity of universities,

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<sup>1</sup> See Chiaroni, D./Chiesa, V. (2006), p. 2.

<sup>2</sup> See Porter, M.E. (1998), p. 197.

<sup>3</sup> Brown. . et al (2007), p. 18.

- training centres and research institutes,
- the presence of financial institutions and other private and public organisations.

The physical proximity of the factors above mentioned furthers the creation of formal and informal linkages and networks among firms, higher education and research institutions, financial establishments, public agents and other local organisations, where information can easily flow and propagate.<sup>4</sup>

## **2.2. Cross- border Cluster:**

The concept of a cluster covers a variety of different business structures which includes regional, national and cross-border clusters and is used for different purposes, for example, to increase the competitiveness, support collective research, rationalise a whole industry or implement environment management system<sup>5</sup>.

However, most of the definitions employ a very elastic understanding of what constitute the “geographical concentration”, which could be a single city or state to a country or even a group of neighboring countries. A better definition considering the geographical issue of a cluster can be found in Isaksen and Hauge.

*"Cluster is a concentration of 'interdependent' firms within the same or adjacent industrial sectors in a small geographic area which could be a city or a group of countries"<sup>6</sup>*

The following chapter will describe the conditions that provide the creation of a cross- border cluster using as example the successful cross-border cluster Medicon Valley.

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<sup>4</sup> See European Commission (ed.) (2002), p. 18.

<sup>5</sup> See Ibid, p.16.

<sup>6</sup> Coenen, L., Moodysson, J. and Asheim, B. T. (2004), p. 17.

### 2.3. Value Adding Web

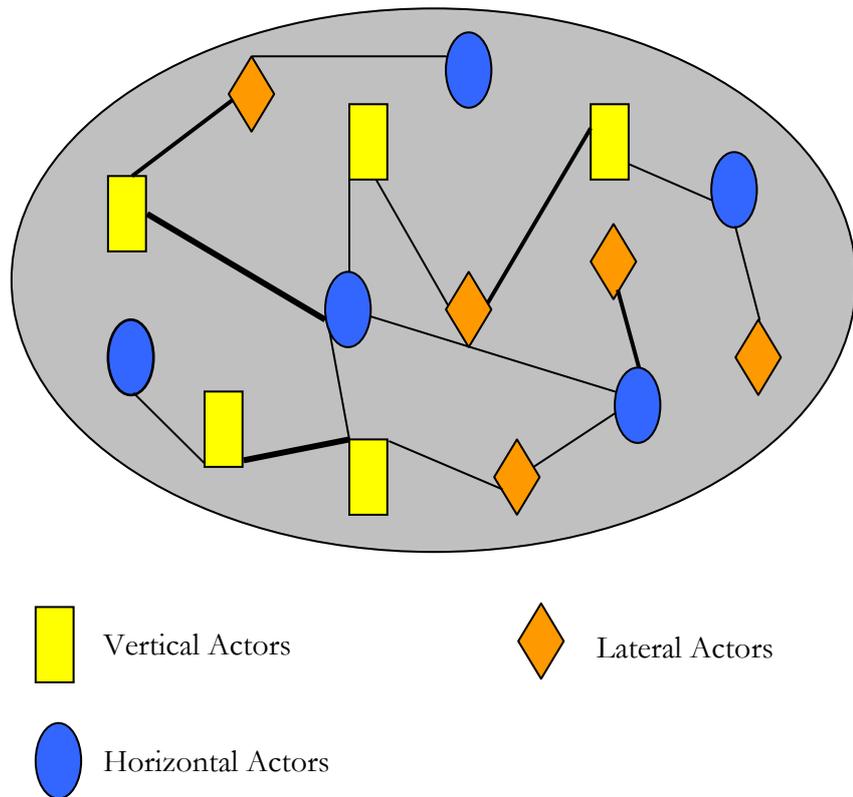


Fig. 1: Value Adding Web

Source: Brown, K. et al. (2007)

The actors of a cluster as a Value Adding Web are defined with the following characteristics.

- Vertical actors are firms which contribute to the production process of the horizontal actors; suppliers as well as buyers of the products delivered by horizontal actors.
- Horizontal actors are firms which produce the main products of the central cluster industry. They may have a different focus, but a common background.
- Lateral actors are for example universities or economic developers, helping firms in a cluster to perform better, usually not linked to the firms as strong as the other actors<sup>7</sup>.

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<sup>7</sup> Brown, K. et al (2007) p.18.

### 3. Biotechnology: industry and clusters

Biotechnology is defined as "any technological application that uses biological systems, living organisms, or derivatives thereof to make or modify products or processes for specific use"<sup>8</sup>. The biotechnological industry began to develop in the 1970s mainly with the discovering of the researchers Stanley Cohen and Herbert Boyer of a new recombinant DNA technique<sup>9</sup>. In 1976 Herbert Boyer co-founded Genentech which is now today biotechnology's largest company<sup>10</sup>. The research regarding insulin then was the first big milestone in the development of biotech industry. From the 1980s on, biotechnology continued to develop and biotechnology industry has become an increasingly important industry of the economic sectors in the industrialized countries<sup>11</sup>.

The applications of biotechnology can be found in various industrial sectors and biotech activities are widespread. One of the most used and popular categorization of these activities is to divide them into color type areas: red for health, medical and diagnostics activities, green for agricultural and environmental biotechnology, white for gene-based bioindustries, blue for aquaculture and marine biotech and so on<sup>12</sup>. Of these industries, the healthcare industry is the biggest one, in its share of investment, turnover and sales<sup>13</sup>.

The most important and biggest biotech industries can be found in the US and Europe. The US biotech industry is stronger<sup>14</sup> than the European one: In 2004, there existed 2163 biotechnology companies in Europe and 1991 biotech companies in the United States (US) which generated over 21.5 billion Euros and over 41.5 billion Euros respectively. The European companies spent about 7.6 billion Euros and the US companies 21 billion Euros on Research and Development (R&D). In Europe 119 new companies were formed in 2004 and in the US 78.<sup>15</sup>

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<sup>8</sup> United Nations (1993), p.146

<sup>9</sup> See Biotechnology Industry Organization (2006) and DuPont (2007)

<sup>10</sup> See Biotechnology Industry Organization (2006)

<sup>11</sup> See OECD (2007)

<sup>12</sup> See DaSilva, E.J. (2007)

<sup>13</sup> See Cooke, P. (2006), p. 1266

<sup>14</sup> See Coenen, L., Moodysson, J. and Asheim, B.T. (2004), p. 1007

<sup>15</sup> See The European Association for Bioindustries (2006), p. 5

Several biotechnology clusters can be found in these regions. An overview of these clusters is shown in illustration1.

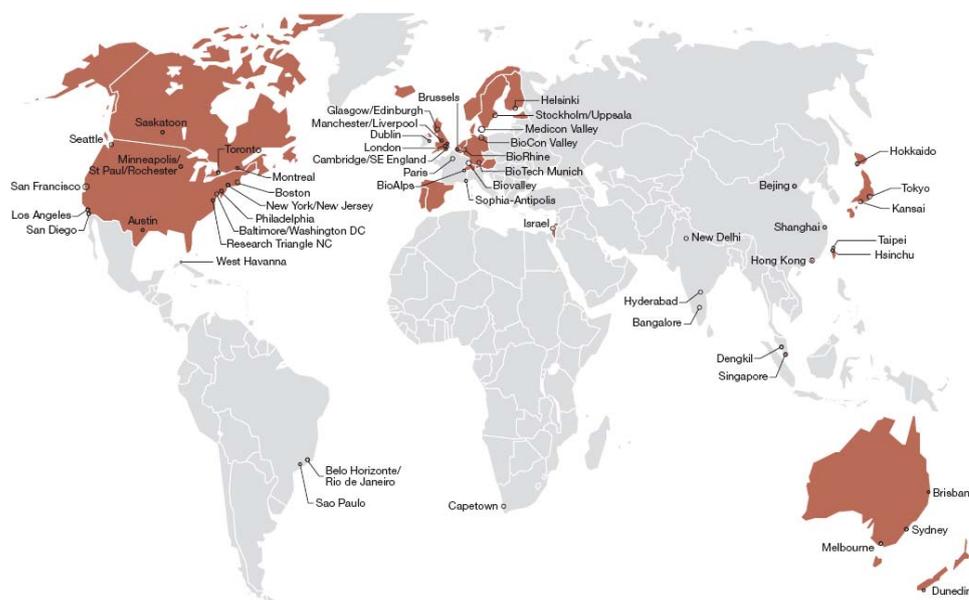


Fig. 2: Map of global biotechnology and bioscience clusters

Source: Rinaldi, A. (2006), p.130

Illustration 1 shows a world map with biotechnology and life science clusters. The circles indicate the existing clusters, their size according to the size of the cluster. The countries colored in brown rank highly in the Growth Competitiveness Index 2004 – 2005<sup>16</sup>. The biggest of these biotech clusters in the US can be found in San Diego, Boston, Raleigh-Durham-Chapel Hill, San Jose, Seattle-Bellevue-Everett, Washington, D.C., Philadelphia and San Francisco<sup>17</sup>. In Europe there are also several big biotech clusters, such as in Brussels (Belgium), Paris (France), Biotech Munich (Germany), BioCon Valley (Germany), Helsinki (Finland) and Stockholm/Uppsala (Sweden) as well as several cross-border biotech clusters as Medicon Valley in Denmark and Sweden, Biovalley in France, Germany and Switzerland and BioAlps in France and Switzerland.<sup>18</sup> As the strongest life science and biotech cluster in Europe, this report will give an analysis of the Medicon Valley cluster in the Øresund region covering the borders between Denmark and Sweden.

<sup>16</sup> See MBBNet (2007)

<sup>17</sup> See Dolan, Kerry A. (2004)

<sup>18</sup> See MBBNet (2007)

## 4. Medicon Valley

Medicon Valley is one of the strongest life science or biotech clusters<sup>19</sup> in Europe. It is located in the Øresund region, spanning the Greater Copenhagen area in eastern Denmark and the Skåne region in southern Sweden. It comprises hospitals, universities, research organizations and companies within the fields of biotechnology, life science, medical technology and also pharmaceutical companies. A brief introduction to the topics related with this cluster, its history and recent development will be given in the next sub-chapters.

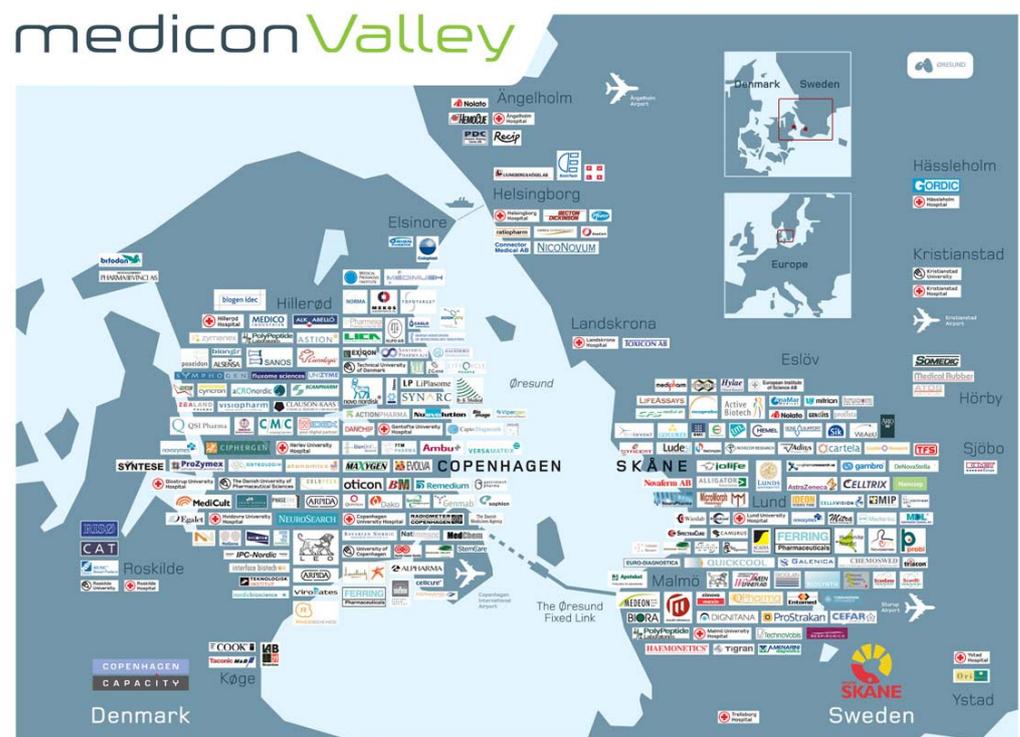


Fig. 3: Map of Medicon Valley

Source: Region Skåne, Copenhagen Capacity and Medicon Valley Academy (2007a)

<sup>19</sup> See Region Skåne, Copenhagen Capacity and Medicon Valley Academy (ed.) (2005)

#### **4.1. Brief history of Skåne region against the historical background of Denmark and Sweden (Piotr)**

Scandinavian region Øresund and its Skåne part in particular, have a long and very tumultuous history. Before it became part of Sweden, it had had a long period of independence but for more than 800 years it had been part of Denmark. In 1676 Skåne became part of Sweden through the Peace Treaty of Roskild<sup>20</sup>. The Roskilde Treaty contains a clause guaranteeing Skåne selfrule with the right to its own legislature. This was unilaterally nullified by Sweden in 1720 and the parliamentary functions moved to Stockholm. Skåne as a region has a long time intense trade relations with other countries located on the Baltic coast (e.g. Poland, Germany, Finland, Denmark) as well as with countries from Scandinavia.

For many years now Sweden as well as Denmark have participated in Nordic co-operation treaties which have to support each other and develop regional trade. The first unions concerned only military agreements and mutual back up (The Calmar Union), but with time more and more agreements started to focus on the economical problems. The most significant economical agreements are:

- Currency Union
- Nordic Council
- Nordic Council of Ministers
- European Union

##### **Currency Union<sup>21</sup>:**

Between Denmark, Sweden and Norway was implemented in 1873 for 40 years. Towards the end of the 19th century trade increased as a result of the developments in the railway traffic and shipping. With a view to facilitating trade, it was decided to introduce a Nordic currency in Denmark, Sweden and Norway. The governments decided to use a common unit of currency - the krone - applying the decimal system.

A common currency made life easier for people because they no longer had to bother about currency exchange procedures as the krone was valid in all the

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<sup>20</sup> <http://www.scania.org/facts/pages/summary.htm>

<sup>21</sup> <http://www.norden.org>

Nordic countries. Finland, however, did not join the currency union. Finland, which had introduced gold as the basis for the mark in 1878, now introduced the silver mark which was divided into 100 pennies. This made it easier to trade with countries in Eastern Europe and with the rest of the Nordic region<sup>22</sup>.

### **Nordic Council<sup>23</sup>:**

Formed in 1952 between Denmark Sweden and Norway is a co-operative body for the Nordic parliaments. In 1956 Finland joined the Nordic Council. The formation of the council made it possible for Nordic parliamentarians to play a larger role in the process of developing co-operation on legislation. Today the council has 87 members, elected among the members of the national parliaments. The composition of the council reflects the relative representation of the political parties in the national parliaments.

The Nordic Council holds its main session in autumn, while the so-called theme session is arranged in spring. Each of the national delegations has its own secretariat in the national parliament. The autonomous territories - Greenland, the Faroe Islands and Åland - also have Nordic secretariats.

### **Nordic Council of Ministers<sup>24</sup>:**

In 1971 was formed following the adoption of amendments to the Helsinki Treaty which stipulated that the Council of Ministers was to serve as the official joint co-operation body for the Nordic governments. In the summer of 1971 work was commenced on establishing a permanent secretariat. This was achieved when a secretariat was set up in Oslo on the 1st of July 1973. The secretariat of the Council of Ministers in Oslo was to work with all policy areas, with the exception of cultural issues. These were already being processed by a cultural affairs secretariat in Copenhagen established in 1972. As a result in 1986 the two secretariats were merged sharing the same premises in Copenhagen.

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<sup>22</sup> <http://www.norden.org>

<sup>23</sup> <http://www.norden.org>

<sup>24</sup> <http://www.norden.org>

The prime ministers assume overarching responsibility for Nordic co-operation within the framework of the Nordic Council of Ministers. The Council of Ministers is based on mutual understanding between peoples. It applies the consensus principle and is not a supra-state body. Each country appoints its own minister for co-operation who assumes responsibility for overall co-ordination of co-operation measures.

The Nordic Council of Ministers is not one council, but many councils. Ministers for policy areas, as well as the ministers for co-operation, hold a number of meetings each year. The ministers have appointed Executive Committees (senior civil servants) to cover specific policy areas. One of these is the Nordic Committee for Co-operation which is responsible for governance of the Council of Ministers' secretariat in Copenhagen.

### **1973 and 1995 - European Union**

Denmark joined EU in 1973 and Sweden in 1995. It was a very significant period for these two countries. At the beginning opening of their own markets to foreign competitors caused passing problems for domestic producer. In the long period, though, it caused improvement of their national economy and border market for their products.

Previous Nordic co-operation agreements were very important for these countries and helped to trade their domestic products on Scandinavia market. European Union opened almost all European markets to them and gave them new opportunities of development. The EU standardized the trade regulations and helped to achieve new potential markets.

## 4.2. The Øresund Bridge and infrastructure (Piotr)

Sweden and Denmark have particularly strong relationships especially in the Skåne region. Nowadays many Swedish families living near Danish border have relatives in Sweden or Denmark and work in the other country and vice versa. This results in frequent journeys between these two countries by numerous people every day. To help them travel as well as to solve many problems related with communication and movement of goods the Øresund bridge was opened in 2000.

The whole 16 km construction consists of a 4 km immersed tunnel, the artificial island, Peberholm, which is 4 km long, and an 8 km cable-stayed bridge with a main span of 490 m. The high bridge two pylons are 204 m high. The bridge has two levels – the railway runs along the lower deck while the motorway along the upper deck<sup>25</sup>

The new link attracted significant numbers of travellers in short time who had previously used air or ferry routes. Traffic across the Øresund resund Bridge increased by 16% from 2005 to 2006. In 2006, 15,800 vehicles crossed the Øresund Bridge every day, i.e. 2,200 vehicles more than in 2005. Rail traffic across the bridge went up by 17% in 2006. As a result, almost 60,000 travelers now cross the bridge by car, bus or train on a daily basis.<sup>26</sup>

Today traffic volumes are higher than envisaged before the bridge opening and traffic growth is expected to exceed the original forecasts prior the opening by a wide margin. For people who likes being near large cities, but not in them, the Skåne region was the ideal place for settle down. The Danish biotechnology industry is just 30 to 45 minutes away by frequent, comfortable, clean trains, and their Swedish counterparts are close by, in the vicinity of Malmö or Lund.

Dynamical development of Skåne region is caused by excellent infrastructure solution which encourages foreign investors to open there their business. The Skåne region is one of strong and diverse economies and the dynamic Øresund

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<sup>25</sup> Øresundsbro Konsortiet (ed.) (2007), p.5

<sup>26</sup> Øresundsbro Konsortiet (ed.) (2007), p.3

region is one of Europe most innovative cross-border regions and Medicon Valley is third the biggest biomedical region in Europe.

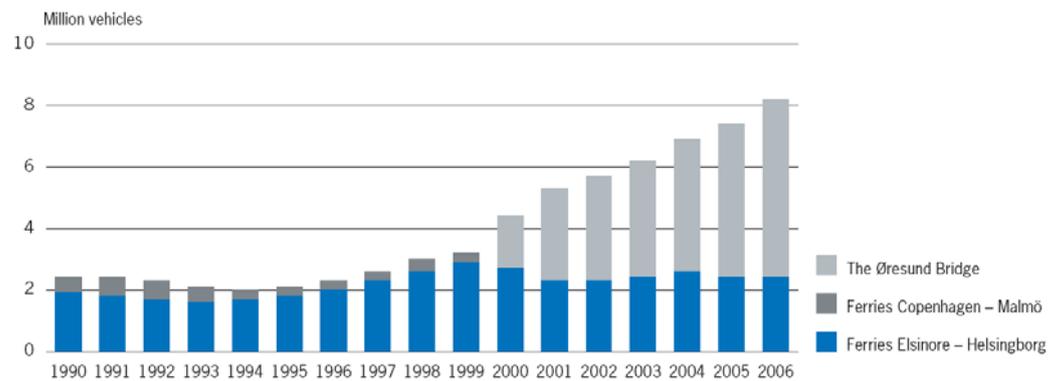


Fig. 4: Increasing Traffic across Øresund bridge vs. Ferry transportation

Source: Øresundsbro Konsortiet (ed.) (2007), p.9

The majority of passenger car traffic across the Øresund Bridge consists of regional traffic. 30% of traffic on the bridge is accounted for by commuters. Business traffic and regional leisure traffic each account for 20-25%. The remaining 20% is holiday traffic some of which is transit traffic.

Table 5: Daily Traffic across the Øresund Bridge

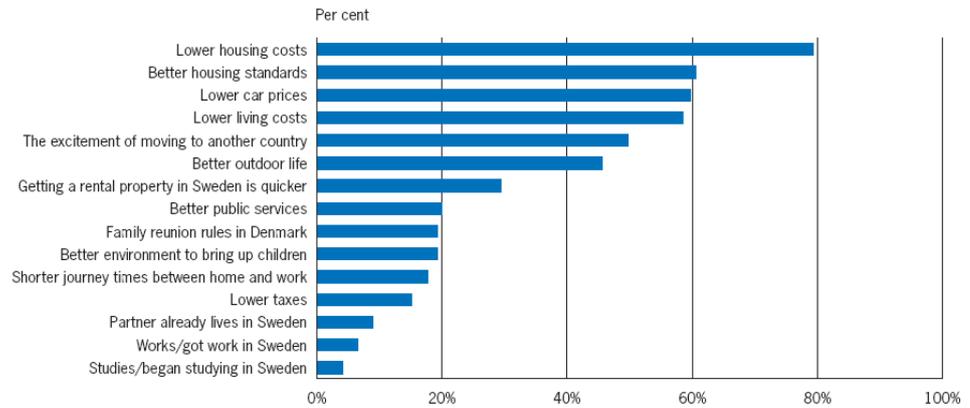
Daily traffic across the Øresund Bridge	2005	2006	Growth
Passenger cars	12,328	14,325	16.2%
Motorcycles	82	89	8.7%
Vans and camper vans	300	393	30.7%
Lorries	737	840	13.9%
Coaches	155	156	0.7%
<b>In total</b>	<b>13,602</b>	<b>15,802</b>	<b>16.2%</b>
<b>Passenger journeys</b>			
Cars	32,000	36,300	13.4%
Train	18,100	21,300	17.4%
<b>In total</b>	<b>50,100</b>	<b>57,600</b>	<b>14.9%</b>

Source: Øresundsbro Konsortiet (ed.) (2007), p.5

Approximately half the commuters are Danes who have chosen to move to Southern Sweden with its lower housing costs and car prices. Even if residential property prices have also increased in the Malmö area, the price

differential has widened over the past couple of years. The area also has a better access to the countryside and cheaper child-minding.<sup>27</sup> The chart number 2 shows the main reasons why Danes migrate to Sweden.

Fig. 6: Reasons why Danes move to Skåne



Source: Øresundsbro Konsortiet (ed.) (2007), p.33

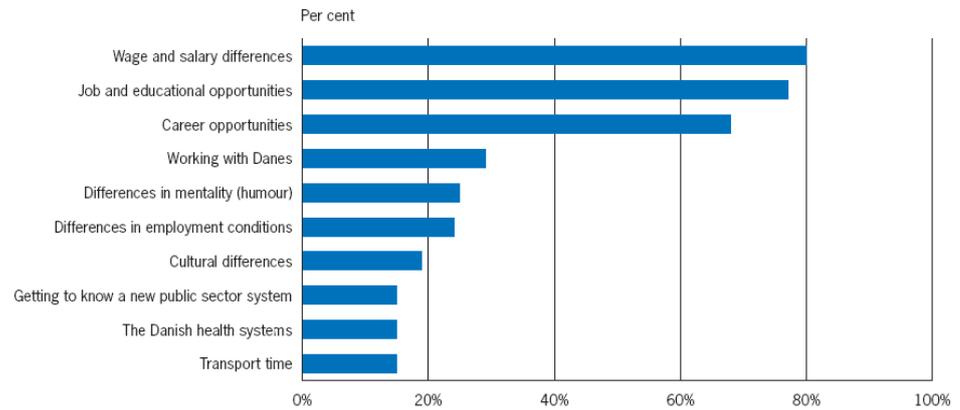
Also the foreign key personnel – executives, experts, researchers, and others qualify for a special tax relief when working in Sweden. The legislation provides an additional advantage to companies who need foreign expertise for their Swedish operations.

The phenomenon of migration occurs on the other side too. Also Swedes go to work to Denmark or just they move there. The foremost reason why they decide to work in Denmark are higher salaries and better job opportunities (chart 3). However, there are also some disadvantages such as:

- costs of transportation,
- time-consuming travel,
- unfavorable social security system,
- different tax system,
- language and cultural differences.

<sup>27</sup>Øresundsbro Konsortiet (ed.) (2007), p.3

Fig. 7: What are the advantages of commuting across Øresund for Swedes



Source: Øresundsbro Konsortiet (ed.) (2007), p.30

### 4.3. Development of Medicon Valley cluster (Piotr)

There exist numerous industrial clusters crossing the borders of the European countries. For several years, thanks to considerable funds being invested in new areas of biomedical research and development by world leading biotech companies, European biomedical clusters have been increasing their importance and share of new medicine discoveries and technologies also on the international arena. The dynamics in development and innovations in biotech areas and the growing investments in regions connected with biomedical research made biomedical clusters one of the most fascinating and successful clusters in European territory. The biomedical research is thus expected to remain at high level for a long time to come.

A good example of biotech cluster in Europe is Medicon Valley. This leading biotech cluster is situated in **Øresund Region**. This is an international region consisting of the most of the eastern part of Denmark, including Greater Copenhagen, and the Skåne region in southern Sweden. The location is not accidental in this case. The Great Copenhagen region in Denmark and the Skåne region in southern Sweden have a strong heritage in biomedical research and long history related with medicine. The hospitals and research centers have the support and cooperation of the oldest and the world leading medical and pharmaceutical companies. The institutions from this region such as Lund and Copenhagen Universities as well the Danish Pharmaceutical Academy and the

Royal Veterinary Academy had great impact on the world-wide medicine and have produced several Nobel Prize winners.

In the mid of 1990 the regional government and Biotech industry as well as the scientists decided to joint these two regions and commence the official international cooperation to strive for a common goal. They affirmed that mutual cooperation could be more fruitful than compete between each other. The better results could be achieved in scientific area as well as it could help to overcome many problems connected with infrastructure. The combination of these two region also ensured better international recognition as the main industrial biomedical strength.

Despite the long and rich history, it was only in 1997 that the official name was given to Medicon Valley. Within the space of years many companies have settled in this region. Currently there are 140 biotech companies, 70 pharmaceutical firms and approximately 130 medico-tech enterprises. These firms represent a wide range of activities related to drug fabrication from research, inventions and production to developing medical technologies and devices as well as supporting processes and services. Biogen, Genambed, Novo Nordisk, H. Lundbeck, AstraZeneca and LEO Pharma are just the few of the most famous companies which have chosen Medicon Valley as a place to locate its manufacturing factors. In the recent years the number of home-grown biotech companies has also increased significantly and includes, among others: BioImage, Symphogen, Exiqon, Zealand Pharmaceuticals, Combio, 7TM Pharma, Nat-Immune, Cureon, Odin Medical, Alligator Bioscience and Lundonia Biotech.

Each company situated in Medicon Valley found there some unique factors which induced them to establish their business in this region. Medicon Valley as a crossing border cluster is able to offer wide array of advantages and opportunities for firms, investors and well-educated and talented people. These capabilities make it the only one of its kind.

The Medicon Valley is an exquisite example of the place where education and business operate in harmony. Interaction between them ensures Øresund Region continuous development and their inhabitants' affluent lifestyle. The favorable business conditions have been formed by the public authorities to

attract new external investors. Øresund Region is characterized as place with one of the lowest corporate taxes. The rates for foreign staff are also very attractive and lucrative for up to 3 years to encourage people to settle in the region. Therefore Medicon Valley is perceived as a highly business friendly region focused on enhancing administrative procedures for the companies to be able to concentrate their activities on innovations and development. The bureaucracy has been reduced to the minimum and the activities such as bribery or corruption are almost non-existent. The pace of R&D activities is not restrained by law enforcement and the local authorities cooperate with companies, not against them.

Immense emphasis is placed on education and further development of research institutions and Universities in **Øresund Region** create the situation in which companies do not have any problems with finding qualified personnel. Over 100 000 students study in the local 14 Universities (Copenhagen Business School, Danish University of Education, IT University of Copenhagen, Kristianstad University, Lund University, Malmö University, Roskilde University, Royal School of Library and Information Science Swedish University of Agricultural Sciences/Alnarp, Technical University of Denmark, The Danish University of Pharmaceutical Sciences, The Royal Academy of Fine Arts, School of Architecture, The Royal Veterinary and Agricultural University, University of Copenhagen)<sup>28</sup>, which are deployed on both sides of the Sound (Øresund) in the Swedish province of Skåne (Scania) and the Danish province of Zealand (Sjælland)<sup>29</sup>. This group of universities is based on the geographical proximity and a long common history and culture. Aiming at becoming a significant science region, the consortium increases quality and efficiency among the participating institutions by opening up all courses, libraries and other facilities to all students, teachers and researchers.

The most popular faculties in the region are these one which are related to medicine and biotech researches. These Universities which contributes to Medicon Valley being regarded as an educational center of Scandinavia and a plentiful pool of well-educated labor force with extensive foreign language

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<sup>28</sup><http://www.uni.oresund.org/graphics/Oeresundsuniversitet/presentationer/PresentationOresundUniversityEnglish.ppt>

<sup>29</sup> <http://www.uni.oresund.org>

skills. In this highly developed region the high concentration of wide array of specialists and scientists has allowed for many world famous biotech researches to be undertaken in the space time.

Medicon Valley offers a number of scientific areas where research is conducted at the world-class level:

- Diabetes
- Cancer
- Inflammation & Immunology
- Neuroscience
- Biotechnology & IT
- Enzymes & Food Science

Medicon Valley is one of the leading research centers in the world as far as diabetes studies are concerned. Novo Nordisk, a world-leading diabetes pharmaceuticals company, spends almost 208 millions euro on diabetes corporate R&D a year. The tremendous research budget of Novo Nordisk makes the world class diabetes research possible and attracts world famous scientists from all over the world to Medicon Valley. Extremely successful diabetes research within this area and a mature company structure with small biotech companies as well as large and fully integrated pharmaceutical companies make Medicon Valley the diabetes leader against the other world leading bioregions.

For a few years cancer research has also become one of the key scientific areas in Medicon Valley. The interest in Cancer problem emerged from the Universities and hospitals which encourage some companies to focus on basic cancer researches. In Europe no other cluster can compete with Medicon Valley in this area. Øresund Region is probably the strongest region focused on cancer when it comes to the quality publications, research and the support of biotech companies. The presence of a big number of hospitals, public research organizations and network organizations ensure an intense and dynamic cancer research in Medicon Valley both now and in future.

Each cluster is known to need a very efficient infrastructure system. It is the case with Medicon Valle case. The airports, railways systems, harbors and very well-developed roads ensure various possibilities of access to the Øresund

Region. Also the transport system inside the cluster is very good and ensures easy and fast means of public transport for the 3,5 million inhabitants. The links between Denmark and Sweden ensure easy travel between these two countries.

Combination of foregoing features make MV unique as a regional organization and one of the most efficient and dynamic border crossing cluster in Europe. Biotech and medtech companies, pharma firms, universities and hospitals as well as public organization support each others in order to secure the conditions for creating, transferring and exploiting the knowledge in Medicon Valley, also promoting the region as one of the strongest and most technically advanced in Europe. The activities are:

- interdisciplinary and specific networks,
- conferences,
- seminars,
- regional and international marketing of Medicon Valley,
- knowledge gathering and databases,
- collaborations with other bioregions.

These allow to maintain high standards and research on the world-class level. This unique environment has led companies from this region to excel in research of the most commercially attractive illness areas as well as to contribute to the new discovers in most advanced scientific disciplines.

## 5. Analysis Medicon Valley: Value Adding Web

Medicon Valley is considered to be “one of Europe’s strongest life science clusters”<sup>30</sup>, located in the Øresund region, spanning the Greater Copenhagen area in eastern Denmark and the Skåne region in southern Sweden. It “comprises a dense cluster of universities, hospitals and companies within life science, biotech, medtech and pharma, many of which are R&D based.” The following chapter of the paper will analyze the actors and activities of the cross- border cluster Medicon Valley from the perspective of a Value Adding Web.

### 5.1. Main actors and activities

As described in chapter 3, biotechnology industry is one of the most research- and knowledge-intensive industries<sup>31</sup> and can be “referred to as a ‘prime example’ of an industry based on scientific knowledge”<sup>32</sup>. One of the most striking features of biotech industry is its development around nodes of excellence<sup>33</sup>. “Indeed, in the biotech industry geographical proximity plays a pivotal role in facilitating the use and transfer of technologies and tacit knowledge that are the key to successful development”<sup>34</sup>. Thus, looking at the knowledge value chain for biotechnology and bioscience, various key players in such a cluster can be identified:

- (DBFs) dedicated biotech firms,
- (Big pharma) large pharmaceutical companies’,
- (PROs) universities and other public research organizations,
- (CROs) and clinical research organizations<sup>35</sup>.

Within the healthcare based value chain of such a cluster the exploration knowledge is created by universities and other PROs, as medical research organizations and hospitals. From those findings of R&D CROs and DBFs are

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<sup>30</sup> Region Skåne, Copenhagen Capacity and Medicon Valley Academy (ed.) (2005)

<sup>31</sup> See Coenen, L., Moodysson, J. and Asheim, B.T. (2004), p. 1006

<sup>32</sup> *ibid*, p. 1006

<sup>33</sup> See Chiaroni, D./Chiesa, V. (2006), p. 1065 and Coenen, L., Moodysson, J. and Asheim, B.T. (2004), p. 1006

<sup>34</sup> See Chiaroni, D./Chiesa, V. (2006), p. 1065

<sup>35</sup> See Coenen, L., Moodysson, J. and Asheim, B.T. (2004), p. 1006

able to create examination knowledge and invent e.g. new drug candidates. This new knowledge from DBFs then is transferred to pharmaceutical companies for the development of drug treatments deriving from biotechnology. To retain power and control over DBFs, big pharmaceutical firms finance “R&D contracts with milestone payments and licensing agreements, managing due diligence, and marketing and distributing final treatments or drugs”<sup>36</sup>. The last element in this value chain is then the distribution of newly invented and created drugs and treatments to the healthcare system, through the channels of marketing and distribution.

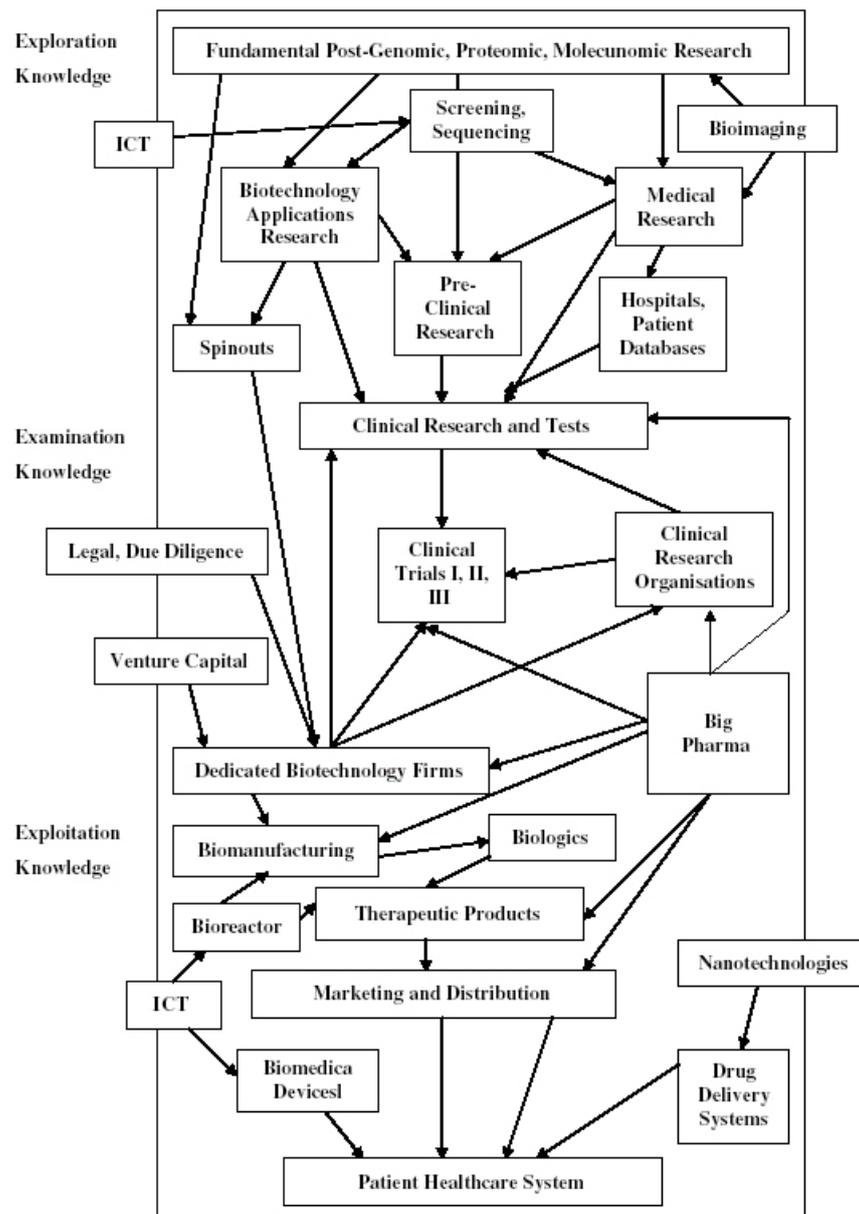


Fig. 8: Model of the bioscientific and biotechnological value chain

Source: Cooke, P. (2005), p.328

<sup>36</sup> Cooke, P. (2004), p. 625

Hence, big pharmaceutical companies are dependent of the R&D done by DBFs. But DBFs also heavily depend on the financing of R&D by big pharmas, as the invention of new drugs is time and cost consuming. This mutual dependence explains the tendency of DBFs to locate nearby big pharmas<sup>37</sup>. The creation of new drug candidates by DBFs very much depends on the first element in the value chain, the examination knowledge created by universities and other PROs. Hence, there is also an observable tendency for DBFs to locate near to leading universities in bioscience. There is need for stable relations between DBFs and universities and other research institutes for the creation of new knowledge, hence innovations. All the before mentioned dependencies claim a geographically nearby location of the involved actors, thus also in a biotech cluster as Medicon Valley.

These strong local concentrations are nodes of excellence, of which some can be classified as 'megacentres'. In these “megacentres” all elements of the “biotech based healthcare value chain” have to be present, including:

- Key universities and other leading Public Research Organisations (PRO)
  - Dedicated biotech Firms (DBF)
  - Clinical Research Organisations (CRO)
- and
- Large pharmaceutical firms.<sup>38</sup>

Medicon Valley is considered as a Megacentre. The relationship between their actors is following described:

- Biotechnology sector has been led and dominated by large pharmaceuticals firms.
- Large pharmaceuticals firms are getting increasingly dependent on new knowledge created by DBFs, and DBFs are heavily dependent on the financial resources of big pharma.
- DBFs to locate near leading universities.
- In order for DBFs to stay competitive they have to create and exploit new knowledge on a continuous basis. Therefore they need systemic relations with basic research institutes and leading

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<sup>37</sup> See Coenen, L., Moodysson, J. and Asheim, B.T. (2004), p. 1007

<sup>38</sup> See Coenen, L., Moodysson, J. and Asheim, B.T. (2004), pp. 1006-1007

universities, (PRO) not only for the recruitment of qualified labor but also for direct knowledge input.

- PROs research (and discover new things) and subsequently that is acquired by DBFs. Then the DBFs explore them further.

Looking at the above mentioned actors and their activities, these can be divided into four major categories as following:

### **Research and Development:**

- **14 Universities**

Sweden: Lund University, Malmö University, Kristianstad University and Swedish University of Agricultural Sciences/Alnarp

Denmark: University of Copenhagen, Copenhagen Business School, Roskilde University, Technical University of Denmark, Danish University of Education, The Royal Veterinary and Agricultural University, IT University of Copenhagen, The Royal Academy of Fine Arts, School of Architecture, The Danish University of Pharmaceutical Sciences and Royal School of Library and Information Science, Denmark

- **Public Research Organizations:** Danish Centre for Stem Cell Research, Biomedical Centre (BMC) in Lund, Sweden and Biotech Research and Innovation Centre (BRIC) in Copenhagen

- **140 Dedicated Biotech Firms (DBFs):** Pharmexa, NeuroSearch, Active Biotech, Biora, HemeBiotech, Exiqon and Pantheoco<sup>39</sup>

### **Clinical Research:**

- 15 Clinical research Organizations<sup>40</sup>
- 26 hospitals (11 of them university hospitals)

### **Production:**

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<sup>39</sup> Tödting, F., Trippel, M. and von Gabain, J. (2006), p. 52 and Copenhagen Capacity and nne (2003), p.10

<sup>40</sup> Copenhagen Capacity and Position Skåne (ed.) (2006), p.18

- 70 Pharmaceutical companies: four major big pharmas: Novo Nordisk (Denmark), AstraZeneca Lund Sweden, LEO Pharma Denmark, and H. Lundbeck Copenhagen DK – constitute the heaviest regional concentration of pharma power in Europe and probably in the world.<sup>41</sup>
- 30 Contract Manufacturing Organisations (CMOs): more than ten companies producing both sterile and non-sterile products, small chemicals such as monoclonal antibodies and large molecules such as enzymes and proteins (medical device manufacturers)<sup>42</sup>

### **Service and Distribution**<sup>43</sup>

- 250 service provider and consultants
- 60 venture capitalists
- Medtech suppliers: 130 medical technology companies
- Medicon Valley Academy

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<sup>41</sup> Tödting, F., Tripl, M. and von Gabain, J. (2006), p. 52 and Copenhagen Capacity and Position Skåne (ed.) (2006), p.14

<sup>42</sup> Ibid, p. 20

<sup>43</sup> Tödting, F., Tripl, M. and von Gabain, J. (2006), p. 52

## 5.2. Classification of the actors according to VAW

Table. 9: Actors according to the Value Adding Web in Medicon Valley

<b>Vertical actors</b>	<b>Horizontal actors</b>	<b>Lateral actors</b>
Clinical Research Organisations (CRO) and Hospitals	pharmaceutical companies	Venture capital firms
Leading Public Research Organisations (PRO)	Contract Manufacturing Organizations (CMO)	Service provider/ consultant firms (property rights, etc)
Key universities* with focus on Science, Research and Development.		Medical technology companies
Dedicated biotech Firms (DBF)		Medicon Valley Academy
Pharmacies		Universities* with focus on Business, Administration and Information.

Universities are special case in the division of actors, because they play an important role in the biotechnology sector, not only for the recruitment of qualified labor but also for direct knowledge input. In this classification Universities are in two categories; Vertical and Lateral actors.

The Universities that are classified as vertical actors are those that give the “direct knowledge input”. These are focus on science, research and development on the biotechnology sector. Lund University and Malmö University work for example on diabetes and cancer research, the University of Copenhagen work on cancer research. . Danish University of Pharmaceutical Sciences works on neuroscience and on nanobiotechnology<sup>44</sup>.

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<sup>44</sup> See Region Skåne, Copenhagen Capacity and Medicon Valley Academy (2007b)

Universities which are classified as lateral actors are those who help the cluster to perform better and do not have a very close relationship with the firms. Copenhagen Business School, The Royal Academy of Fine Arts, School of Architecture and the Danish University of Education, are examples of this categorization. An example of one of the activities of the lateral actors is the Copenhagen Business School with a total of 15,000 students, who study a specialization on management programs. “This guarantees a steady stream of highly qualified management personnel.”<sup>45</sup>.

### 5.3. Linkages between actors

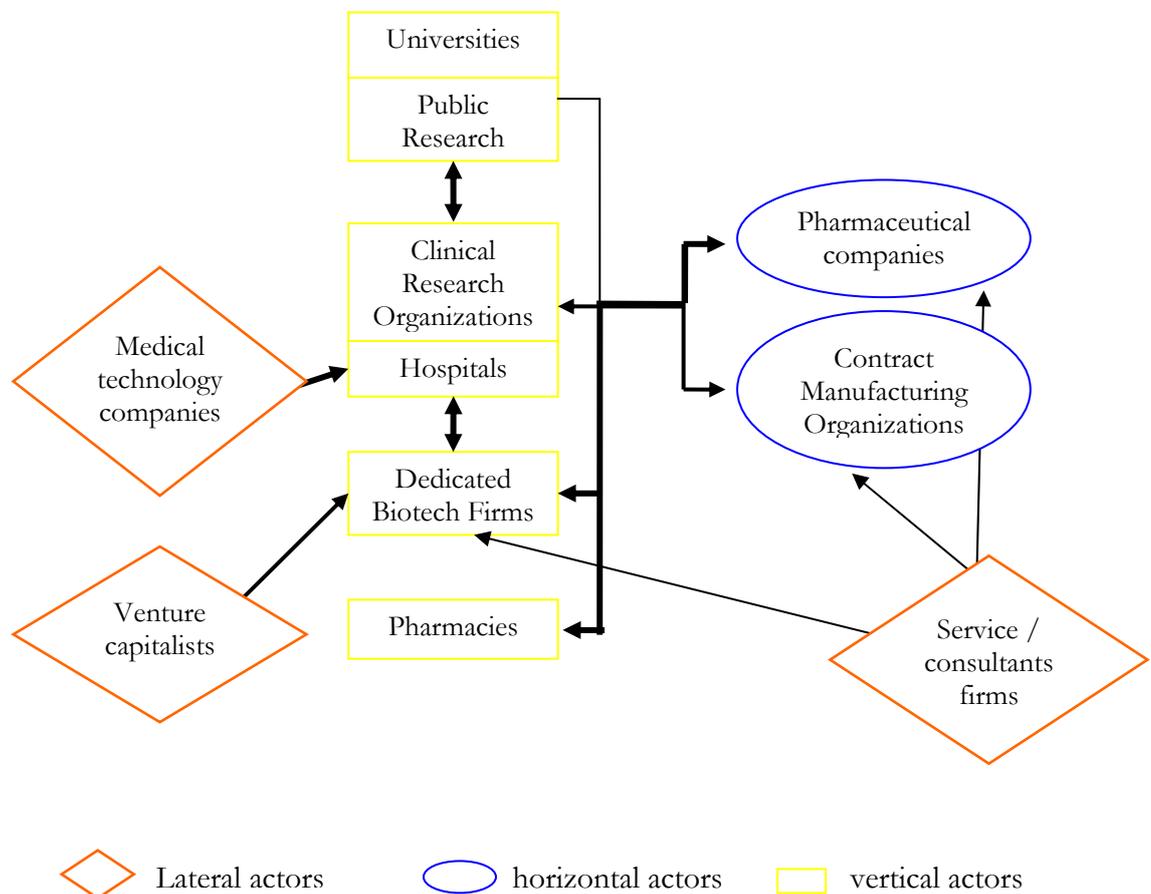


Fig. 10: Model of the Value Adding Web of Medicon Valley

The actors and their activities of the Medicon Valley cluster have been analyzed in the anterior sub-chapter. The horizontal, vertical and lateral actors

<sup>45</sup>See Region Skåne, Copenhagen Capacity and Medicon Valley Academy (2007c)

as well as their relation to each other are illustrated in figure 10. The relations between the actors can be categorized into strong, medium and weak links. Strong links exist between firms that interact on a regular basis and thus are dependent on each other, firms interacting on a regular basis but that are not dependent on each other to a high extent have medium links and finally weak links describe the relation between firms that interact directly, but not on a regular basis and that are not dependent on each other<sup>46</sup>. One actor that is not shown in the figure is the Medicon Valley Alliance (MVA), formerly named Medicon Valley Academy, which has medium links to a lot of actors in the Medicon Valley. As the MVA is an organization consisting of members of Medicon Valley cluster firms and organizations<sup>47</sup> and thus functions as the cluster management institution, it therefore interacting on a regular basis with its members but they are not highly dependent on each other, hence have medium links. As described earlier, the links between the vertical actors are strong, all interacting regularly with each other and to a certain degree being dependent on each other. The links between the vertical and horizontal actors are of different types. As described in 5.1, the DBFs and pharmaceutical companies are highly dependent on each other and thus interact on a regular basis. The link between them therefore must be described as a strong link, their relation to CMOs as medium links. The other vertical actors, such as public and clinical research organizations, have medium links to the pharmaceutical firms and CMOs. Hospitals and pharmacies in their buyer function of pharmaceutical products have strong links to pharmaceutical firms and CMOs, as they purchase on a regular basis their products. As biotech firms need capital to start up and to handle the high investment costs, they have a relation to venture capital firms (lateral actors) which are medium links, as they do interact with each other but not on a frequent level and are dependent on each other. The lateral actors of medical technology companies have only medium links to hospitals and other research organisations. The last lateral actors, the service and consultant firms, have only weak links to actors such as pharma firms, CMOs and biotech companies, as they do advice them but not on a very regular basis and they are not that dependent on each other.

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<sup>46</sup> See Royer, S./Steffen, C. (2007)

<sup>47</sup> See Medicon Valley Alliance (2007)

## 5.4. Cultural framework

The formal institutional context of a cluster, consider as the knowledge generation subsystem, consists of public and private research laboratories, universities and colleges, technology transfer agencies, vocational training organizations, etc. These circulated rapidly due to the informal institutional context which includes socio-cultural factors such as trust, customs, social ties, and other institutional characteristics of ‘industrial districts’.<sup>48</sup> The interaction of the formal and informal institutional context provokes an interactive learning, which is a very important part of the success of a cross- border cluster.

The power of “proximity” is not determined by its quality of being physically close together; this only provides accessibility which allows the possibility of shared understandings. This also implies that learning processes cannot take place anyplace or anywhere.

The following chapter contents an analysis of the “informal institutional context” of Sweden and Denmark, which includes the socio- cultural factors including trust, customs, social ties, manners, etc. and how that affect or influence the operation of Medicon Valley.

Two points of view are use. One is the Hofstedes Dimension, from Geert Hofstede, who is well- known for his studies of business culture. The other one is from Richard Lewis and his successful book “When Cultures Collide”.

### 5.4.1. Sweden

Swedes are universally popular for their profile as honest, caring, well-informed, efficient plodders, producing quality and goods delivered on time. However they are unpopular often ridiculed and occasionally despised inside the Nordic area (Denmark, Norway and Finland). This seems to derive from various historical factors<sup>49</sup>:

- Sweden has been a major player in the area for a long period.

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<sup>48</sup>See Cooke, P. (2004), p.2.

<sup>49</sup> See Lewis, R.D. (1999), p. 281.

- Swedes often laid siege to Copenhagen.
- Swedes ruled Finland for 600 years.
- Sweden and Norway shared an uncomfortable union until 1905.
- Norway, Denmark and Finland were battered in the Second World War. Sweden was not.

Swedes also differ in the “self’s consumption” from the Danes and Finns, who are extremely interested in cultural relativism and worry about what others think of them. Swedes, on the opposite, worry about their own conception.

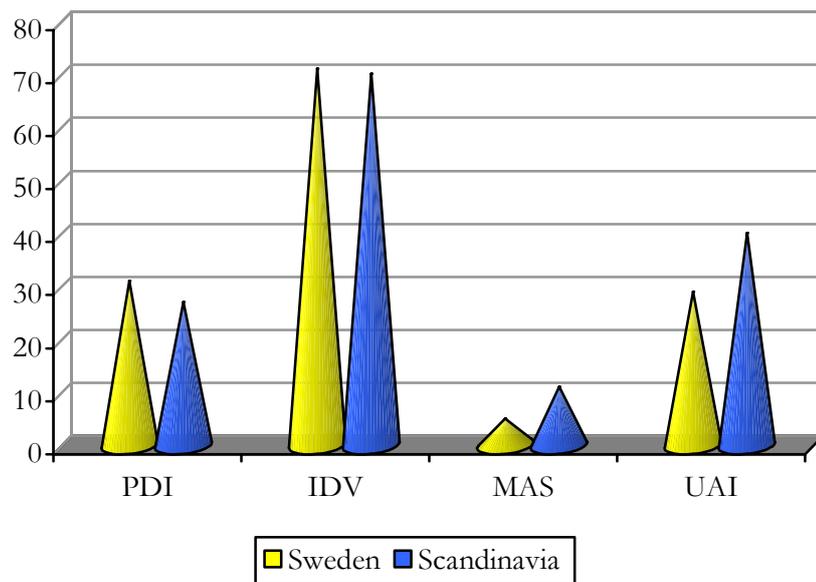


Fig. 11: Cultural Dimensions of Sweden

Source: Hofstede, G. (2003a), *ibid* (2003b) and Taylor, S.J. (2003)

According to the Hofstede Dimensions, Sweden has a moderately low Power Distance Index (PDI), thus indicating that inequality between people in a society is seen as non-desirable and has to be avoided as much as possible. Still ranging higher than its neighbouring Scandinavian countries, thus meaning that inequality is tolerated to a bigger extent than e.g. in Denmark.

Sweden is also considered to be an individualistic country. The individualism index (IDV) for Sweden scores nearby the average of Scandinavian countries, at 71 –but still a step away from high individualism as in the United Kingdom at 89. The moderately high individualism score correlates with the major protestant religion of the Swedish and Scandinavian population<sup>50</sup>. The ties

<sup>50</sup> See Taylor, S.J. (2003)

between individuals in an individualistic society are looser and everybody is seen to look after him/herself and his or her immediate family<sup>51</sup>.

The third index is the most exceptional: the lowest Masculinity Index (MAS) in the world. Sweden is considered the most feminine country in the world with a MAS scoring at 5, even at half of the average index of Scandinavian countries. Thus, in Sweden the roles of women and men are seen as equal, men and women sharing the same “feminine” values. Sweden is the most “tender”<sup>52</sup> or caring society in the world.

The Uncertainty Avoidance Index (UAI) indicates the degree of tolerance in a society towards the unknown, towards uncertainty and ambiguity<sup>53</sup>. The UAI for Sweden is low, scoring at 29 – still lower than the average Scandinavian index at 40. Therefore Sweden is a “curios” society, similar to Denmark and members of the Swedish society are tolerant of different opinions from their own. They are phlegmatic and contemplative and “try to have as few rules as possible”<sup>54</sup>

### **Business:**

Swedish management is decentralized and democratic (horizontal organigram). There is actually a Swedish law (MBL) which stipulates that all important decisions must be discussed with all staff members before being implemented.(similar with the Japanese system)

However they have weaknesses in the implementation of business<sup>55</sup>:

- Avoidance of conflict or taking sides,
- Fear of confrontation,
- Reliance on the team for initiatives,
- Avoidance of competition with others in the company.

Also the duration of decision making is very long (constant consultation at all levels, endless meetings, ultra cautiousness and habitual postponement of decisions) which differs with the new European and American system.

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<sup>51</sup> See Hofstede, G. (2003b)

<sup>52</sup> See *ibid*, p. 92

<sup>53</sup> See Hofstede, G. (2003b) and *ibid* (2002), p. 93

<sup>54</sup> Hofstede, G. (2003a)

<sup>55</sup> See Lewis, R.D. (1999), p. 183.

### 5.4.2. Denmark

Being the oldest monarchy in Europe and a very small land (40,000 sq km) Denmark is ranking of 25<sup>th</sup> in the worlds economies. Trading success mean that the Danes enjoy a high standard of living. The GDP per capita is one of the highest in the EU.

Danish flexibility, tolerance and business acumen are three of their characteristics. Danes are mainly Lutheran and shared their Protestant values with their Nordic neighbours. They are often referred as the “Nordic Latin’s” because they are more communicative, easy going, uninhibited and smoothly international than Swedes, Norwegians or Finns<sup>56</sup>.

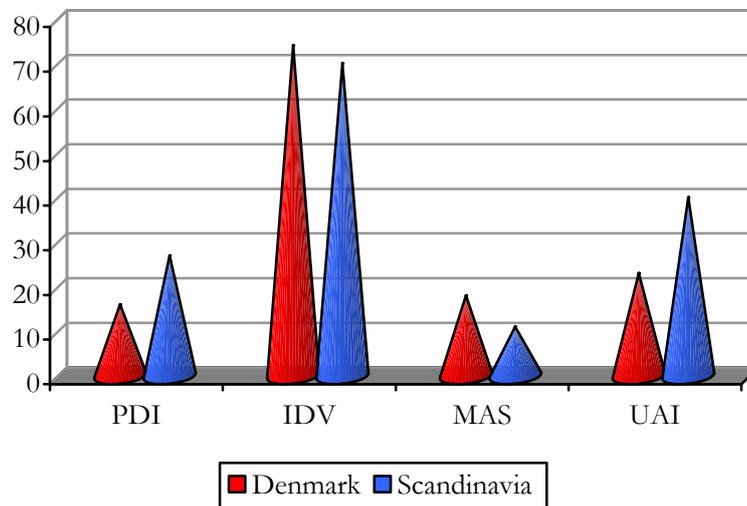


Fig. 12: Cultural Dimensions of Denmark

Source: Hofstede, G. (2003a), *ibid* (2003b) and Taylor, S.J. (2003)

According to the Hofstede Dimensions, Denmark has a low Power Distance Index (PDI). A low Power PDI indicates that the inequality between people in a society is seen as non-desirable and has to be avoided as much as possible. Denmark is ranging at the lowest PDI in the world, even with a smaller index than its neighbouring Scandinavian countries.

Denmark is considered to be an individualistic country. The individualism index (IDV) indicates the relationships between people in a society. The IDV for Denmark scores nearby the average of Scandinavian countries, at 75. But it is still not highly individualistic like its European neighbour the United

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<sup>56</sup> See Lewis, R.D. (1999), p. 293.

Kingdom at 89 or the world highest individualistic country, the US –scoring at 90. The moderately high individualism score correlates with the major protestant religion of the Danish population<sup>57</sup>. Relationships in an individualistic society are seen as “everybody for him or herself”<sup>58</sup> and the ties between individuals are looser.

Denmark is also considered as a “feminine” country, with an index of 18, still over the low masculine average index of Scandinavian countries. As a feminine country, in Denmark the social roles according to the gender should be maximally overlapping and “feminine” values are ingrained in society’s life, hence Denmark is described as a more “tender”<sup>59</sup> or caring society. The last index is the Uncertainty Avoidance Index (UAI), indicating the degree of anxiety in a society when confronted with a new unknown situation<sup>60</sup>. Denmark’s UAI score is very low, scoring at 23 –nearly half of the average Scandinavian index at 40. Therefore, Denmark is a “curios” society, its members are tolerant of different opinions from their own, phlegmatic and contemplative and they “try to have as few rules as possible”<sup>61</sup>

### **Business:**

Consultation before making decisions is mandatory as in Sweden, but Danes get through faster and act quickly. Danes are also ironic and sarcastic.

Status is based on qualifications, competence and results, yet materialism is downplayed. There is a focus on welfare<sup>62</sup>.

Danes show flexibility in obstacles and do not lack patience in seeking solutions. They show concerns regarding equalitarian procedures and processes; this is the only area where they refuse to compromise.

Danes are good negotiators (without making enemies) and all members of a delegation will voice their opinion. Being a nation of preponderantly small and middle size enterprises, they are less impressed by their own big companies than are the Swedes.

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<sup>57</sup> See Taylor, S.J. (2003)

<sup>58</sup> Hofstede, G. (2002), p. 92

<sup>59</sup> See *ibid*, p. 92

<sup>60</sup> See *ibid*, p. 93

<sup>61</sup> Hofstede, G. (2003a)

<sup>62</sup> See Lewis, R.D., p. 294

### 5.4.3. Influence of two different cultures on Medicon Valley

As described before, Denmark and Sweden are culturally different. These differences are more remarkable in terms of institutional set-up (which includes norms, values, concrete organisation and specific policy plans) and in industrial structure.

Denmark as survival of small scale and artisan-like production has fostered a kind of corporatism, very different from Sweden. Small, independent entrepreneurs in Denmark will often be quite negative to central union power, however they will cooperate locally with their workers and their representatives. This small-scale corporatist model often involving a flexible use of reasonably advanced production equipment and a continuous development of incremental product innovations has its strength in flexible adaptation.

In contrast Sweden is more against the backdrop of a dominating position of large firms and heavy investments in R&D on a national level. Denmark tends to fit best with the institutional features of a 'coordinated industrial district' while Sweden would belong to the 'collaborative' national business system

Although the factors previously mentioned and the current tax rules, bureaucracy and high competition, Medicon Valley can be consider as one community with specific language, habits, norms etc based on a common scientific background. This process hat not being easy, and the main reasons, more important than the spatial proximity is the highly specific knowledge profile of the collaborators (from Sweden and Denmark), and the collaborative spirit involving government, industry, and academia<sup>63</sup>.

One example of this is the relation between the researchers at the firm and their former colleagues at the university. The relationship is based on educational and professional background rather than personal friendship and territorially contained trust and understanding.

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<sup>63</sup> See Jensen, D. (2003)

Geographical proximity remains a necessary condition for relational proximity, (which is the intangible closeness in terms of relations) to evolve and sustain, the cross-border cluster.

### **5.5. Politics/ Cluster Policies**

Looking at the environment for a cluster to evolve and develop, one also has to look at the political dimension. Policy issues embrace the local, regional, national and EU level and are of different roles for the cluster. In their final report about clusters and networks in Europe, the European Commission puts it: “Basically, a policy on clusters should provide a framework for dialogue and inter-firm co-operation, as well as for co-operation between small enterprises, higher education and research institutions, public and non-public organisations at local, national, European and international level. Public sectors should therefore limit themselves in playing a catalytic role.”<sup>64</sup>

In the case of Medicon Valley, the policy actions taken by the governments to create the cluster were very limited, as the initiative to establish the cluster was driven mainly by the local universities and pharmaceutical firms<sup>65</sup>.

Most of the venture capital provided in Medicon Valley is private. Since 1996 the number of private venture capitalists has increased from 8 to 60, both Swedish and Danish venture firms<sup>66</sup>. But there are also government funds provided. During the start-up period (approx. 1995) venture capital was provided through a Danish national government agency, the Growth Foundation (Vækstfonden). Loans at no risk were provided for new companies to create. Still this government seed fund is endowed at 300 billion Euros for R&D projects of Danish firms and their internationalization. In 2004 the Danish National Advanced Technology Foundation (Højteknologifonden) and a new Danish High Tech Fund endowed at 2.1 billion Euros was established, to encourage the new industry areas of biotechnology, nanotechnology and IT (Information Technology). In 2005 the Fond-Seed Capital Denmark was established for new investments of 40 billion Euros. In Sweden the most important innovation agency is VINNOVA with a budget of 110 billion Euros per year to finance R&D and regional development projects. Since 2003 there

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<sup>64</sup> European Commission (ed.) (2002), p. 60

<sup>65</sup> See Technopolis (ed.) (2006), p. 120

<sup>66</sup> See Technopolis (ed.) (2006), p. 125

exists a national incubator program with the aim to establish incubators and start up companies as well as to provide seed capital for new firms.<sup>67</sup>

In 1997 the local governments, Copenhagen Capacity on the Danish side and Position Skåne as its Swedish counterpart, created a common name for the cluster: Medicon Valley. Together they formulated a clear vision to be the best bio-region in Europe in five years. The name created should serve as “an umbrella that made the various actors feel they belong together, but also a name that could be used to promote the region abroad and help create a regional brand”<sup>68</sup>. In 2000, through the building of the Øresund Bridge, the local infrastructure conditions were improved and regional economic integration fostered.

Both the Swedish and the Danish government drive an investment promotion strategy which focuses on attracting foreign biotech firms to the region<sup>69</sup>. The framework conditions by both countries concerning the Øresund region have been harmonised: e.g. taxation and social insurance.<sup>70</sup>

Table 13: Comparison of tax regimes in European countries

	<b>Corporate income tax rate (per cent)*</b>	<b>Special tax regime for expatriates</b>
<b>Denmark</b>	<b>28</b>	<b>Yes</b>
<b>Sweden</b>	<b>28</b>	<b>Yes</b>
France	33.33	Yes
United Kingdom	30	No
Netherlands	29.60	Yes
Germany	38.34	No
Spain	35	No
Italy	33	No
Poland	19	No
Czech Republic	24	No
Belgium	33.99	Yes
Ireland	12.50	No

Source: Copenhagen Capacity (2007a)

Note: \*All rates are maximum rate

<sup>67</sup> See Technopolis (ed.) (2002), pp. 127-128, European Commission (ed.) (2002), p. 69 and Copenhagen Capacity (2007b), p. 2

<sup>68</sup> European Commission (ed.) (2002), p. 70

<sup>69</sup> See Technopolis (ed.) (2006), p. 120 and European Commission (ed.) (2002), p. 70

<sup>70</sup> See Technopolis (ed.) (2006), p. 120

On the European level, the European Union established the EU’s Seventh Framework Programme (FP7) for Research and Technological Development which is effective from January 1<sup>st</sup> 2007. It funds “collaborative research, technological development and demonstration activities designed to improve the competitiveness of European industry”<sup>71</sup>.

Furthermore, Medicon Valley Academy (MVA) was set up to “help contacts across the border and to diffuse information and knowledge more easily between the members of the cluster”<sup>72</sup>. The MVA as the cluster management institution has changed the name to Medicon Valley Alliance, as of 1<sup>st</sup> of July 2007<sup>73</sup>.

Another important policy point for the well-functioning of the cluster are the Research and Development (R&D) expenses by the Danish and Swedish governments. On average the European-12 countries spend 1.9 percent of their gross domestic product (GDP) on R&D expenses. The Nordic governments spend more on R&D than other Western European countries which increased since the 1990s. Sweden spends the highest GDP share of 3.7 percent and Denmark 2.6 percent of its GDP for R&D<sup>74</sup>.

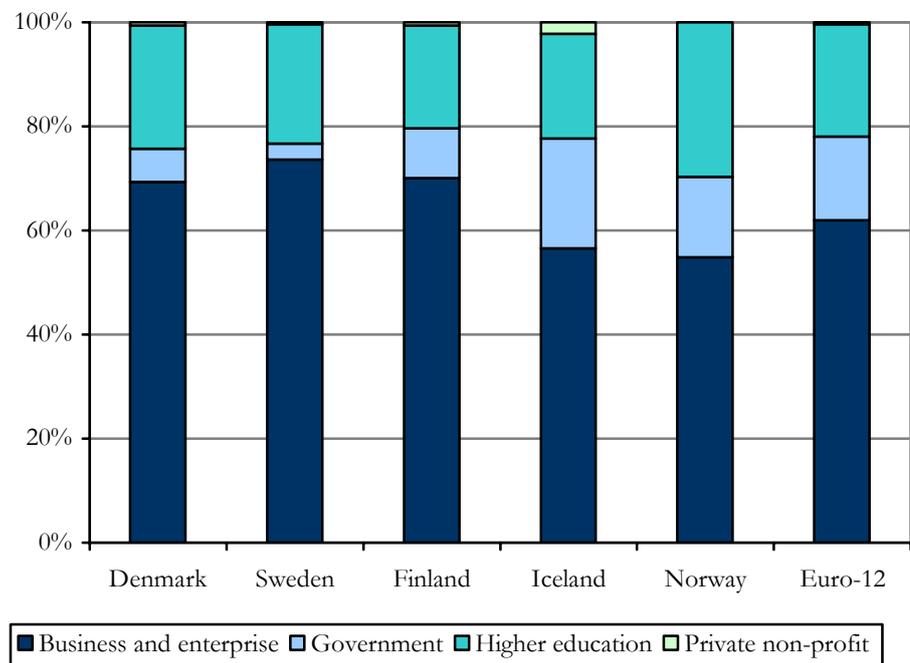


Fig. 14: R&D expenditure by sector, percent, 2004

<sup>71</sup> Copenhagen Capacity (2007b), p. 3

<sup>72</sup> European Commission (ed.) (2002), p. 70

<sup>73</sup> See Medicon Valley Alliance (2007)

<sup>74</sup> See Dahlgaard, F. (ed.) (2006), p. 225

Source: Dahlgaard, F. (ed.) (2006), p. 228

As shown in the figure, the major part of the R&D expenses is paid by private business, 74 per cent in Sweden and about 70 percent in Denmark. The second biggest part of the R&D expenses is paid by universities and other institutions of higher education, making up approx. 23 percent in Denmark as well as Sweden. A closer look at central government expenses for R&D reveals that most of the research takes place at universities, accounting for approx. 45 percent of the expenditures in Denmark as well as in Sweden.<sup>75</sup>

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<sup>75</sup> See Dahlgaard, F. (ed.) (2006), pp. 228 and 230

## 6. Conclusion

Biotechnology industry is one of the most innovative industries. As it was described before, biotech is a Research and Development intensive industry, including high investment costs. Characteristic of biotech industry is the development of megacentres around nodes of excellence. Geographical proximity thus plays an important role: biotech firms establish nearby universities and other public research organizations, doing research and hence delivering the newly created knowledge to the pharmaceutical companies. These geographical concentrations of companies and organizations related to the biotech value chain form biotech clusters. These clusters are also to be found crossing borders in Europe. One example is Medicon Valley that was analyzed in this paper. The formerly mentioned actors of a biotech cluster in the Øresund region are both from the Danish and the Swedish part of the region. The factors that could influence the formation and development of this cross-border cluster are e.g. cultural or political factors in the cluster framework.

The cultural and political framework of Medicon Valley was described in the previous chapters. As shown, the culture of both regions is quite similar and thus enhances an appropriate understanding and cultural framework for the actors in the cluster to work and function. The political framework of the Øresund region comprises regional as well as national policies. The policies taken by the governments in the region favour the development of the cross-border cluster as well as the similar cultural framework.

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Mir ist bekannt, dass alle Hilfsmittel mit korrekter Quellenangabe versehen sein müssen. Ich erkläre hiermit, dass ich die vorliegende Arbeit selbständig verfasst und jenseits der angegebenen Quellen keine weiteren Hilfsmittel benutzt habe, insbesondere keine anderen als die angegebenen Informationen aus dem Internet.

Ich habe die, etwaige Betrugsversuche betreffenden, Paragraphen der für mich gültigen Prüfungsordnung an der Universität Flensburg zur Kenntnis genommen. Ich stimme der Speicherung schriftlicher Arbeiten von mir zum Zweck der Kontrolle zu.

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