Regional Innovation Strategies for Bridging Academic Research and SMEs
About Medicon Valley Alliance
Medicon Valley Alliance (MVA) is a member financed network organization within the life science sector in the Medicon Valley region. MVA works to improve the conditions for science and knowledge production, technology transfer, innovation and for the preconditions for enterprises to exploit this knowledge. In addition, MVA works to visualize the potential of activities in both Sweden and Denmark as well as internationally.

MVA’s members include all the relevant university departments, healthcare organizations, and most of the biotech and medtech related companies and other organizations located in the Medicon Valley region. MVA is a not-for-profit organisation and managed by a Board of Directors and a staff located at offices in Ørestad City, Copenhagen, Denmark, and in the university town of Lund, Sweden.1

Disclaimer
The author has made efforts to ensure the reliability and validity of the data included in this report but the author does not assume any responsibility for the accuracy of the underlying data submitted by the participating BSR partners or information gathered from third party sources. The author does not assume any responsibility with regard to the use that could be made of the data contained in this report. The author further draws the readers’ attention to the information in the methodology section of this report.

1 For more information, see www.mva.org.
Table of Contents

About Medicon Valley Alliance ................................................................. 2
Disclaimer ................................................................................................. 2
Table of Contents ..................................................................................... 4
Summary ..................................................................................................... 5
1. Introduction ............................................................................................ 6
   Research Objective ................................................................................ 6
Method ......................................................................................................... 6
   Data Analysis ......................................................................................... 6
   Validity and Reliability ......................................................................... 6
2. Setting the Benchmark ........................................................................... 7
   Pan-European Private Equity & Venture Capital Activities .................. 7
   Pan-European R&D Activities ............................................................. 8
   Pan-European Mergers, Acquisitions, and Alliances ......................... 9
3. Review of Country Specific Data ........................................................... 10
   Latvia ....................................................................................................... 10
   Estonia ................................................................................................... 10
   Poland .................................................................................................... 11
   Northern Germany ............................................................................... 11
   Denmark & Sweden .............................................................................. 12
   Finland .................................................................................................. 13
   Lithuania ................................................................................................. 13
   North West Russia ................................................................................ 14
   Norway .................................................................................................. 14
   Iceland ................................................................................................... 15
4. Innovation Strategies .............................................................................. 16
   Academic Environment ......................................................................... 16
   Labour and Access to Talent ............................................................... 17
   Social and Economic Infrastructure .................................................... 18
   Supportive R&D Environment ............................................................. 19
   Access to Capital .................................................................................. 20
5. Findings .................................................................................................. 22
   Current conditions and innovation strategies ...................................... 22
   Future challenges and potential ........................................................... 23
6. Conclusion ............................................................................................... 24
   Recommendations ................................................................................ 24
Biography ................................................................................................... 25
Summary

Life science and biotech clusters have become an important factor in creating significant economic growth and employment of highly skilled people. This has occurred especially in the both the United States and Europe. In particular, the European Union (EU) sees the trans-national dimension of knowledge-transfer as a key to properly facing u to the implications of globalization of markets and industries. Compared to the US, however, European universities generate fewer inventions and patents due to a less systematic management of knowledge and a fragmented market for knowledge and technology. As a consequence, European markets lack a sufficient transference of academic research and interregional commercialization. The following draft report aims to identify the major challenges and opportunities for improving the bridging of academic research and small and medium-sized enterprises (SMEs) in the ScanBalt BioRegion.

The BSR region is challenged by a great level of diversity and the conditions for bridging academic research and SMEs differ widely resulting in different strategies. The anatomy of these regional strategies is analyzed and compared using a framework of the following five factors: academic performance; labour and access to talent; social and economic infrastructure; access to capital; and supportive research and development (R&D) environment.

Compared to the rest of Europe, the Baltic Sea Region has a very high commitment to R&D. Several of the Baltic Sea Region’s countries are investing heavily on R&D, however, despite the impressive capacity, the universities situated east of the Baltic Sea lack focus on life science specific research and only a few projects are subject to technology transferring and commercialisation. The opposite situation is in the countries west of the Baltic Sea – these countries are well prepared to finance the transferring of academic research to commercial development. An obvious rationalization is the fact that life science dedicated research and commercialization greatly depends on tradition as well as industry demand: the presence of an established life science industry is a vital element in bridging academic research and SMEs. Thus, the bridging of academic research is often – directly or indirectly – financed by the industry and the main challenge for the Baltic countries, also North West Russia and Poland is to find early stage financing.

Even though these countries have very few compounds in clinical development, the Baltic Sea Region as a whole takes a leading position in terms of clinical research and allocated venture capital.

The report further illustrates the great differences in salary, tax, and working hours across the Baltic Sea Region; being able to attract highly qualified professionals is an important factor when improving the bridging of academic research and SMEs. It is evident that the Nordic countries are benefiting from the combination of low working hours and very high salary levels (i.e. a research setting). In contrast, the Baltic countries, North West Russia, and Poland are being challenged by opposite conditions (i.e. an industrial setting).

Even though the Baltic countries, Poland, and Russia all are subject to very low GDP levels, these countries surpass Germany, Finland, and Denmark in terms of GDP growth. This trend clearly shows that these Baltic region countries are subject to an increasing economy which also is evident from the growing interest there from foreign venture capitalists. Due to the great level of diversity the Baltic Sea Countries complement each other very well and further exploitation of cross national synergies will result in additional strengthening of the region’s ability and capacity of bridging academic research and SMEs. In addition, it will obviously provide an excellent basis for the future positioning of the Baltic Sea Region.

The future success of the Baltic Sea Region greatly depends on the regions ability to overcome and turn the current challenges into new opportunities. Key stakeholders such as public research institutions, academia, private life science companies, cluster organizations, and investors should be encouraged to form partnerships to improve sharing of knowledge and resources, promote unexploited synergies across the Baltic Sea.

Summary of Conclusion

- The countries west of the Baltic Sea are very well prepared to finance the transferring of academic research to commercial development. The countries east of the Baltic Sea are not necessarily short of capital, but the region’s life science companies are. The universities east of the Baltic Sea have a notable capacity. In terms of life science, however, the academic environment appears to lacks focus.
- Life science dedicated research greatly depends on tradition as well as industry demand and academic research is often – directly or indirectly – financed by the industry. A major challenge for the Baltic countries, North West Russia and Poland is to find early stage financing.
- The Baltic Sea Region takes a leading position in terms of venture investments and compounds in clinical development. The private equity firms in the BSR have a regional investment focus – only a small share of the life science dedicated capital is invested outside the region.

Summary of Recommendation

- Improve sharing of knowledge and resources – certain outsourcing opportunities as well as cross-border research projects.
- Promote unexploited synergies across the Baltic Sea – cross border technology transfer and an improved coordination between the structural funds.
- Promote the Baltic Sea Region to international investors – opportunities for early stage collaborations with academic environment and opportunities to syndicate with national investors.
- Establish mentoring programs to follow-up interregional initiatives – identification and use of best practice and general support to interregional industry-academia collaboration.

2 BSR Project Annex.
1. Introduction
Cluster development is an integrated tool in the Baltic Sea Region (BSR) to increase the impact of policies and enhance cooperation between the public and private sectors. However, there is a broad gap in cross-border efforts to support SME-based innovation beyond the interests from the single regions. BRIDGE-BSR develops tools to overcome the gap within life sciences/biotechnology in BSR, named ScanBalt BioRegion. BRIDGE-BSR will identify regional bottlenecks in ScanBalt BioRegion for bringing the benefits of academic research to SMEs, develop a regional innovation agenda, promote mentoring, the use of best practises and bench marks plus initiate pilot activities. Partners represent triple helix clusters (public authorities, companies, universities), a tech-transfer specialist, a NCP and a cross-border cluster collaboration. Bridge-BSR builds on and number of Work Packages (WP) of which the final version of this report summarizes the work of WP1.

Research Objective
The analysis will be a fundamental tool to identify where clusters in ScanBalt BioRegion faces the major challenges in bridging academic research and SMEs and provides important information necessary to create the solutions.

Method
Quantitative data collection (project partners)
A set of publicly available regionally based input and output indicators have been selected in collaboration with the project partners. A data request was sent to the project partners using a reporting template as well as a data collection guide. The geographical areas being investigated are as follows: North West Russia, Lithuania, Latvia, Estonia (ABL/EBIO), Poland (IPPT PAN), Mecklenburg-Vorpommern, Berlin-Brandenburg, Schleswig-Holstein (SFZ and BCV), Denmark, Iceland, Norway, Sweden, and Finland (BFO). The project partners contributing are as follows: Steinbeis Forschungs- und Entwicklungszentren GmbH, BioConValley GmbH, Institute of Fundamental Technological Research, BioForum Oulu, Medicon Valley Alliance, Association of Biotechnology of Latvia, and the Estonian Biotech Association.

Use of other quantitative data
A number of national and international data sources have been applied to complete the data base. These data sources include the EUROSTAT, OECD, European Venture Capital Association (EVCA) statistics, financial market data, selected university statistics, regional statistics, as well as international reports such as “Beyond Borders” published annual by Ernst & Young.

Use of qualitative data
All data and findings have been validated and discussed with the project partners and industry experts on an informal basis. A number of regional publications have furthermore been taken into account when establishing an overview of the regional strategies.

Data Analysis
Triangulation has been applied to ensure an acceptable level of data validity. All data measures have been evaluated and grouped by means of availability and validity. Thus, emphasis has been placed on measures available for all of the geographical regions. Where relevant, other measures have been included for selected regions. The comparative analysis is therefore based on direct quantitative comparison of specific data as well as an indirect qualitative comparison of strategies and performance in general. Due to the fact that the different regions are of different sizes, it is not possible to make a like-for-like comparison of the data. Instead, the comparison is based on a primary analysis of each of the regions in questions.

Validity and Reliability
The quantitative data collection is subject to serious validity and reliability issues, primarily due to insufficient levels of data quality and unclear definitions. A number of measures have been used to improve the data quality. For example, all requested data measures have been reviewed by the project partners, the reporting templates have undergone a comprehensive classification to avoid mistyping and misunderstandings and all data measures have been explained and defined in a data collection guide. The data measures have further been discussed during a session at which all project partners were present.
2. Setting the Benchmark

This chapter aims to draw up the European tendencies in regards to private equity and venture capital activities as well as the latest trends in clinical R&D. The chapter is intended to act as an overall benchmark for the country specific chapters that follow on regional innovation strategies. The chapter is primarily based on data collected by the EVCA, data presented by Ernst & Young (2008), as well as data reported by the BSR partners.

Pan-European Private Equity & Venture Capital Activities

In 2007, the EU experienced a strong growth in real GDP and despite the global financial crisis the European private equity activity remains robust. The United Kingdom, France, and Germany were responsible for more than 70% of the total European deals in 2007. More than EUR 1 billion was raised by UK based funds – primarily for the European buyout market. 20% of the total buyout activities were represented by mega-deals in 23 European companies.

Fund-raising

Even though the private equity markets remain strong, fund-raising scaled back approximately 30% in 2007 to EUR 97 billion. This is still more than the 2005 figure and substantially higher than the fund-raising taking place during the late 1990s.

Even though the buyout market is the main driver of capital raised, a number of countries are still targeting more than 50% of the capital raised on the venture market. These countries include Norway, Portugal, Ireland, Denmark, Czech Republic, and Romania. The opposite tendency accounts for countries like the UK, Greece, Spain, and Sweden – the venture dedicated fund-raising in these countries is below the EU average. Most other EU countries have fund-raising higher than 50% targeted for buyouts.³

Investments

Even though the overall investments increased to a record high level of EUR 73.8 billion in 2007, the venture capital investments decreased more than 25% to EUR 15.4 billion.⁴ According to EVCA (2008), in 2007 the European investments increased value wise and decrease in terms of number of investments – this is explained by an increase in the deal sizes. This trend accounted for both the venture and the buyout segment. According to Ernst & Young (2008), in biotech, the average round size increased by 6% from EUR 7.8 million in 2006 to EUR 8.3 million in 2007.

Ernst & Young (2008) has further surveyed the investment round sizes across the different European countries; over the past five years countries like Switzerland and Denmark have had higher deal amounts (in average), while countries such as Germany, France, and the UK have had smaller amounts per investment round. This trend is most likely explained by the fact that the Swiss and Danish portfolio companies tend to be more matured, i.e. spun-off companies from the pharmaceutical industry with a more advanced pipeline.

Likewise the fund-raising statistics indicate the UK has the highest level of invested capital in 2007. In addition, the UK is the only European country with a substantially higher level of investments abroad than domestic. Sweden and France has a balanced investment distribution, but most other countries invested most capital in domestic companies and only a little abroad.

³ EVCA Yearbook, 2008.
⁴ This includes replacement capital (2007 (12+3.4) - 2006 (17.3+3.5) / 2006).
Despite the fact that the business and industrial sector are the primary investment sectors (in terms of value), the life science sector has the highest number of investments (971) in 2007. Most of these deals were venture capital and only 11.5% of the life science companies were, according to EVCA (2008), subject to buyout capital in 2007.

From the above figure it is evident that the life science industry is not largest in terms of invested capital when including buyout capital. However, when looking at the number of deals and number portfolio companies the life science sector takes first place. More than 1,600 investments in 971 different life science companies were executed in 2007. In fact in 2006, more than 2,000 investments were made in some 1,368 life science companies. This trend clearly illustrates the vital role of venture capital in the life science sector.

The average venture investments in Europe as percentage of GDP were close to 0.1%. As presented by EVCA (2008), the Baltic Sea Region is generally represented as high level investment countries; Denmark tops the list followed by Sweden and Finland while Poland is placed at the lower end with annual venture investments of GDP just above 0.04%.

Despite the fact that the general investment slow down in 2007, the European biotech industry manage to grow in terms of raised capital. According to Ernst & Young (2008), the industry raised approximately EUR 5.5 billion in 2007 – an 18% increase compared to 2006 (EUR 4.6 billion). Thus, over the last five years the biotech industry in Europe has increased the amount of capital raised at an average annual growth rate of approximately 36%. When looking only at venture capital raised the European biotech industry were subject to a decrease of 21% (EUR 1.52 billion) compared to 2006 (EUR 1.2 billion). Hence, the biotech industry is subject to the general trend in terms of raised capital and the buyout/venture distribution.

Initial Public Offerings in 2007 – Biotech
As with venture deals, there were fewer Initial Public Offerings (IPOs) in 2007, but the deals increased in size from EUR 737 million in 2007 to EUR 678 million in 2006. This is a clear indication that the IPO candidates are becoming more mature in terms of clinical development. Looking at the compounds in development by the companies subject to an IPO in 2007 only one-third were in pre-clinical. This distribution was close to 50% in 2006. Two BSR companies were subject to a major IPO in 2007: Danish Exiqon which raised EUR 54 million, and Norwegian Algeta which succeeded in raising EUR 31 million.

Pan-European R&D Activities
The European research based life science industry continued the strong growth in 2007 resulting in numerous pipeline achievements and product launch. This development was driven by a strong demand from international pharma who paid out considerable rewards to the European biotech companies.

The number of compounds in development and product approvals increased in 2007, and especially the late stage pipeline activities advanced. The overall number of compounds in development (including pre-clinical projects) reached 1,712 – higher than the figure for 2006 (1,576). The number of phase II compounds in the European pipelines increased by 18% from 439 in 2006 to 519 in 2007 which obviously is a very positive trend for the industry. Exactly how many of these will make the critical phase II is less certain, but given the current market environment several of these projects are becoming mature for exit.

According to Ernst & Young, the UK has the largest pipeline. Germany is second with 261 compounds in pipeline. Besides Germany, other BSR countries are represented among the leading countries: Denmark is third (188) despite its relatively small population and also Sweden is

---

5 Ernst & Young, 2008.
6 Ernst & Young, 2008.
7 Ernst & Young, 2008.
8 The data (as presented in the figures below), though, are subject to some validity questions: the data is based on self-reported data and most likely skewed towards larger biotech companies in more developed countries. Other BSR countries such as Iceland and the
France, Switzerland, and Italy are all represented with more than 100 compounds in pipeline. The Swiss pipeline of 132 has decreased more than 20% since 2006 (166) and thereby fell from third place in 2006 to being ranked fifth in 2007. Despite this, Switzerland still has the second highest number of phase III products in pipeline.

**Pan-European Mergers, Acquisitions, and Alliances**
Due to the fact the European biotech companies continue to advance product development and that the international pharma industry is seeking to strengthen pipelines, the prices and numbers of the European deals have boomed in 2007. According to Ernst & Young (2008), the total value of the European mergers and acquisition market has increased approximately 600% in 2007 (compared to the previous year), from EUR 2 billion to EUR 14.8 billion. It is important to note that much of this development is explained by the Merck-Serono deal (worth EUR 10.5 billion). Even when adjusting for the Merck-Serono deal, the market still increased more than 115% in 2007.

The European pharma companies were further a noticeable player in the 2007 European alliances. These alliances were primarily based on early-stage research. According to Ernst & Young (2008), the value of European alliances increased 77% in 2007 – from EUR 5.6 billion in 2006 to EUR 9.9 billion in 2007. The biotech-biotech and biotech-pharma deals increased 61% and 86% respectively.

Baltic countries do have several compounds in clinical development.

9 These countries may have compounds in clinical development which have not been reported to or identified by the report’s author.
3. Review of Country Specific Data

Latvia
National data has been reported for Latvia why this section primarily will investigate national figures and strategies. All data is USD per 2007 using current exchange rates.

Latvia's economy has experienced a GDP growth of more than 10% per year during 2006-07. The majority of companies, banks, and real estate have been privatized, although the state still holds sizable stakes in a few large enterprises. Latvia officially joined the World Trade Organization (WTO) in February 1999 and EU membership in May 2004. The current account deficit is more than 22% of GDP and inflation nearly 10% per year. The Latvian per Capita GDP (PPP) is currently 17,400 USD. The Latvian population is approximately 2.25 million and the labour force is approximately half of that figure of which 5.7% are unemployed.

The Latvian universities have a large capacity with more than 127,000 enrolled students and over 8,200 scientific employees. Adjusted for the Latvian population, the faculty/alumni ratio is high compared to other BSR countries. However, Latvian universities seem to have a rather low research performance. This is evident from the small number of published peer-reviewed articles (668) and the low number of graduated master and PhD students (1,982). The number of PhD students within the life science area is especially low (102). This tendency is also apparent from the low number of patented biotechnology technologies which according to EUROSTAT account for less than five of the 38 technologies patented in 2007. This tends to confirm that Latvian technology transfer efforts mainly focus on industries other than life science. The university sector also has a very low number of international students (1,425); they account for only 1% of all students. None of the Latvian universities are currently listed in the international ratings provided by the Shanghai Jiao Tong University Index.

An explanation for these data could be the low governmental commitment to R&D&RD which at preset is approximately 0.56% of the total governmental expenditure. Taking the overall biotechnology investments into account, Latvia’s contribution to total EU R&D investment is less than 0.3%. In terms of life science Latvia only counts one science park, four incubators, and a single cluster organisation counting eight members. Latvia has two listed life science companies with a total of 1,400 employees – taking non-listed companies into account, 3,100 people are employed in the industry. Latvia counts a total of 9 medtech companies, 10 pharma companies, and 25 biotech companies.

According to the EVCA the Latvian life science industry has not succeeded in attracting much foreign venture capital in 2007. This is despite the fact that the Baltic countries attracted a lot of interest in 2007 following the region’s rapidly growing economy. Currently, there is only a single life science dedicated venture fund located in Latvia and EVCA reports no or very little raised venture capital (including buyout capital) and capital under management.

Latvia scores low (6.008) on the EUROSTAT quality of life index and only 14% of the population has a higher educational degree. The Latvian average amount of annual working hours (1,860) is among the highest in the EU and besides the Polish annual working hours (1,994) the highest in the Baltic Sea Region.

The Latvian universities clearly have a large capacity and high level of attendance compared to the population. In terms of life science, however, the academic environment lacks focus in order to support research and commercialisation. The current situation is further challenged by the lack of venture capital and the national economic situation. The economic situation has a strong influence on the salary level and indirectly influences the quality of life rating. The latter is important in order to attract foreign talent and for instance, international students. The Latvian salary level is the lowest among the BSR countries as illustrated in the above Figure 1.

Estonia
National data has been reported for Estonia why this section primarily will investigate national figures and strategies. All data is USD per 2007 using current exchange rates.

Estonia is considered a modern market-based economy with a rapidly increasing per capita income level. However, the country is currently challenged by a large account deficit as well as rising inflation (6.6%), both of which are pressuring the national currency. The Estonian per Capita GDP (PPP) is currently 21.100 USD. The Latvian population is approximately 1.3 million and the labour force approximately 687,000 of which 4.7% are unemployed.

The Estonian Universities count approximately 68,000 students of which only 1,100 are foreign. The universities have a high number of scientific employees (nearly 8,800) and compared to the other BSR countries, Estonia has a high faculty/alumni ratio. In 2007, nearly 2,400 PhD students were enrolled in the Estonian Universities of which 590 were specialized in a life science related area.

Though the capacity is large the life science related research performance is low. In 2007, the Estonian universities only produced 1,005 peer-reviewed articles and according to EUROSTAT less than five of the 44 technologies patented in 2007 were related to biotechnology. None of the Estonian universities are currently listed in the international ratings provided by the Shanghai Jiao Tong University Index.

Even though the life science research activities are low the governmental commitment to general R&D is close to the average for the BSR region. In 2005, the reported Estonian GBOARD was approximately 1.51% of GDP. Taking the

---

10 CIA World Fact Book.
overall biotechnology investments into account, the Estonian contribution to total EU R&D investment is less than 0.3%.

Currently seven medtech, three pharma and 55 biotech companies are situated in Estonia. This is despite the fact that only limited venture capital is being raised – currently the Estonian venture capital organisations have approximately EUR 200 million under management and only few investments were placed in 2007. This is so even though the Baltic countries attracted a lot of interest in 2007 following the region’s rapidly growing economies. According to EVCA (2008), the Baltic countries attracted a total of EUR 363.6 million in 2007 from foreign investors – a significant amount considering the EUR 75.5 million invested by local private equity houses.

Among the BSR countries, Estonia takes last place on The Economist’s Quality of Life Index and only 22.5% of the population have a higher educational degree. The level of annual working hours is well above the OECD average and among the highest in the BSR region.

The Estonian research environment is very similar to the Latvian one, though the Estonian system appears more mobile in terms of commercializing and technological transferring. Life science, however, is not a focus area and capital is needed to drive future growth. The fact that Estonia already has an established life science industry could be a competitive advantage and serve as a platform for future start-ups.

**Poland**

National data has been reported for Poland why this section primarily will investigate national figures and strategies. All data is USD per 2007 using current exchange rates.

The Polish per Capita GDP (PPP) is currently 16,300 USD. The Polish population is approximately 38.5 million and the labour force just fewer than 17 million of which 12.8% are unemployed. The rate of unemployment has decreased in recent years but still sits above the EU average. In 2007, the GDP of Poland increased by 6.5%, which according to CIA is based on growing private consumption, additional corporate investment, and the inflow of EU funds. GDP per capita is still below the EU average, but similar to the other Baltic countries.

Nearly 2 million students are currently enrolled at the Polish universities which when adjusting for the total population (approximately 5%) is equivalent to the other BSR countries, as is the number of graduated master students (410,100). However, Poland has a relatively low number of enrolled PhD students (approximately 1.7% of all students) compared to the other BSR countries. Approximately 22% of the Polish PhD students are working within life science related areas. None of the Polish universities are currently listed in the international ratings provided by the Shanghai Jiao Tong University Index.

This life science focus, however, not evident from the number of biotech related technologies patented in 2007. Only six of the 613 patents filed related to biotechnology. The governmental commitment to general R&D in Poland (0.72%) is also very low compared to the other BSR countries, and taking the overall biotechnology investments into account the Polish contribution to total EU R&D investment is less than 0.3%. Poland has several life science based science parks and difference cluster organisations. There are 25 Medtech and 60 biotech companies which operate from Polish headquarters, which is few compared to the country’s size.

Only few life science dedicated venture funds are situated in Poland with little capital under management. The 2007 Polish private equity investments reflected the country’s economic development and ended at a record breaking level. Approximately EUR 3 billion was raised in 2007. Five life science companies received a total of EUR 102.7 million in 2007 equivalent to 13.8% of the total amount invested.

While Poland scores low on The Economist’s Quality of Life Index is higher than Estonia, Latvia, and Lithuania. Poland also has the highest annual working hours (1,994) among the BSR countries.

Poland has not succeeded in establishing a considerable life science industry, and this is despite the country’s enormous demographic and academic capacity. Very little focus is placed on life science related R&D.

**Northern Germany**

Regional data has been reported for the region of northern Germany why this chapter will take into account this area and investigate both regional and national performance and strategies. All data is USD per 2007 using current exchange rates.

Germany’s economy is the fifth largest in the world and currently has a per Capita GDP (PPP) of 34,200 USD. The German population is approximately 82 million and the labour force approximately 43.5 million of which 8.4% are unemployed. In 2007, the German GDP growth rate was 2.5% while the inflation rate (consumer prices) was 2.3%.

The German BSR partner has reported data referred to three life science clusters in northern Germany. They are: Hamburg/Schleswig-Holstein, Berlin/Brandenburg, and Mecklenburg-Vorpommern.

Approximately 285,000 students are enrolled in the region’s universities which adjusted for the region’s population (approximately 12.3 million) is considerably low compared to the other BSR countries. The number of graduated masters and PhD students is significantly lower than the Baltic countries and comparable to the Scandinavian countries. Compared to the other BSR countries, the region

---

14 The Economist Intelligence Unit’s Quality of Life Index is based on a unique methodology that links the results of subjective life-satisfaction surveys to the objective determinants of quality of life across countries. The index was calculated in 2005 and includes data from 111 countries and territories.
does have a record high number of foreign students (approximately 35,000).

Of the nearly 35,000 PhD students, approximately 4,000 are working in areas related to life science which indicates a considerable life science focus. This is also evident from the number of biotechnology patents issued in 2007 which according to EUROSTAT is well above the EU average. In northern Germany, a reported 35 biotechnology related patents were issued in 2007. One or several north German universities have been rated at 102-150 according to the international ratings provided by the Shanghai Jiao Tong University Index.

Several TTOs and science parks are operating in the region together with three major life science dedication cluster organizations with a total of 22 employees. More than 506 medtech companies, 93 pharma companies, and 409 biotech companies are situated in northern Germany, which by far has the highest concentration of life science companies in the BSR region.

In 2005, the reported German GBOARD was approximately 1.69% of the GDP (third highest among the BSR countries) and taking the overall biotechnology investments into account the German contribution to total EU R&D investment is more than 10%. This is also the case for northern Germany which has reported an even higher level of governmental investment focus.

This governmental contribution is backed by a substantial amount of private capital. The amount of German funds raised doubled in 2007 to more than EUR 5.5 billion and the accumulated amount invested by local private equity player amounted to approximately EUR 7.5 billion. In 2007, the regions life science companies received more than EUR 800 million which is equivalent to 7.7% of the total amount invested.

In addition, the region has an established life science industry with more than 13 listed major life science companies with a total of almost 9,000 employees. When taking major non-listed companies (31) into account, more than 27,000 people are employed in the region.

The level of annual German working hours (1,437) is the second lowest among the BSR countries. However, Germany still scores below the EU average on The Economist’s Quality of Life Index.

It is evident that the region of northern Germany has a high quality educational system, but it is operating at a very low capacity. The regional life science industry benefits from the high research performance and the life science industry is now attracting international capital. Access to talent will remain a major challenge.

**Denmark & Sweden**

Regional data has been reported for the Medicon Valley region why this chapter will take into account this area and investigate both regional and national performance and strategies. All data is USD per 2007 using current exchange rates.

According to the CIA (2008), the level of Danish unemployment is currently too low and capacity constraints are limiting future growth potential. Because of high GDP per capita, welfare benefits, a low Gini index, and political stability, the Danish living standards are among the highest in the world – though only ranked fourth among the BSR countries. A major long-term issue will be the sharp decline in the ratio of workers to retirees. The Danish per Capita GDP (PPP) is currently 37,400 USD. The Danish population is approximately 5.5 million and the labour force nearly 2.9 million, of which only 2.8% are unemployed. In 2007, the Danish GDP growth rate was 1.8% while the inflation rate (consumer prices) was 1.7%.

Sweden is in the middle of a positive economic development, boosted by increased national demand and rising exports. The Swedish per Capita GDP (PPP) is currently 36,500 USD. The Swedish population is approximately 9 million and the labour force around 4.8 million of which 6.1% are unemployed. In 2007, the Swedish GDP growth rate was 2.6% while the inflation rate (consumer prices) was 1.7%.

Medicon Valley has an especially high concentration of life science companies – backed by a well established collaboration between the academic environment and the private pharmaceutical industry. Approximately 150,000 students are currently enrolled in Medicon Valley universities. Compared to the other BSR countries, the universities have a relatively low number of scientific employees (6,316), though they do boast impressive research performance. Just about 10,000 master students and 1,000 PhD students graduated in 2007. Also, the region has a very high international student ratio – almost 9,000 international students in 2007.

In 2007, the Medicon Valley universities published 14,495 peer-reviewed articles and were responsible for 55 patent applications. According to EUROSTAT, Denmark has the highest level of biotech patent applications to the European Patent Office (EPO) per million inhabitants (2003). Several of the universities have been rated in the international Shanghai Jiao Tong University Index with the highest rating being given to Copenhagen University (currently ranked 8th in Europe).

The average governmental commitment to R&D of total governmental expenditure (adjusted for the Danish/Sweden population distribution) is currently 1.45% of GDP (GBOARD). Taking the overall biotechnology investments into account, the two countries contribution to total EU R&D investment is almost 29% (Denmark 17%, Sweden 11.9%).

The regions business environment is supported by several TTOs, science parks, and a major life science cluster organisation; Medicon Valley Alliance currently employs approximately 20 staff. Of the more than 500 life science companies situated in the region, 60 are in medtech, 24 are in pharma (headquarters based), and 214 are in biotech.

---

15 Major companies are defined as those companies employing more than 250 full-time employees.
Medicon Valley has a developed venture capital investment industry with more than 15 life science dedicated venture funds. 66% of all venture investments is receiving follow-up investments. The region’s Venture Capital funds have currently EUR 1.76 billion under management (EUR 3.37 billion when including buy-out capital) and have supported 13 biotech start-ups in 2007.

Nine of the major life science companies are listed as employing approximately 34,000 people (taking major non-listed companies (29) into account more than 47,000 employees). The region has a high level of international licensing deals and more than 150 compounds in clinical development. Corporate revenue for 2007 amounted to more than EUR 31 billion (listed companies only).

Denmark and Sweden are placed high on The Economist’s Quality of Life Index – 32% of the population has a higher educational degree and the annual working hours (1,551) is the third lowest among the BSR countries. Medicon Valley is benefitting from the strong industry/academic collaboration as well as the well established life science industry. The area is further backed by a substantial amount of regional and international capital. The region is currently challenged by the low workforce and access to talent which is limiting growth.

Finland
Regional data has been reported for the Oulu region why this chapter will take into account this area and investigate both regional and national performance and strategies. All data are USD per 2007 using current exchange rates.

Finland has a highly industrialized and largely free-market economy with per capita output roughly that of the UK, France, Germany, and Italy. Life Science is not a key economic sector but instead manufacturing – mainly the wood, metals, engineering, telecommunications, and electronics industries. According to the CIA yearbook, unemployment remains a persistent problem. The Finnish population is approximately 5.2 million and the labour force nearly 2.7 million of which 6.8% are unemployed. The Finnish per Capita GDP (PPP) is currently 35,300 USD. In 2007, the Finnish GDP growth rate was 4.4% while the inflation rate (consumer prices) was 1.6%.

Approximately 17,000 students are enrolled at universities in the Oulu region – this is a comparably high concentration of students when adjusting for the population (approximately 132,000). The region also has high faculty/alumni ratio with more than 2,500 scientific employees based in the Oulu region’s universities.

Compared to the other BSR countries, the Oulu region has a high level of peer-reviewed articles (2,254). However, there is a relatively low level of graduated masters (1,342) and PhD students (1,567) – especially the number of PhD students within life science (144). The high research performance level is also evident from the number of patents issued in Finland. Finnish universities submitted 46 patents in 2007 and according to EUROSTAT Finland has an average level of patented biotechnology patents. The Oulu region currently has one tech transfer office.

One or more universities in the Oulu region has been rated 172-207 according to the international ratings provided by the Shanghai Jiao Tong University Index. However, in 2007 only 334 international students chose to study in the Oulu region.

The Finnish governmental commitment to R&D of total governmental expenditure is 2.05% of GDP (GBOARD) – the highest of the BSR countries. Taking the overall biotechnology investments into account the Finnish contribution to total EU R&D investment is approximately 0.6%.

The Oulu region has one major life science cluster organisation (BioForum Oulu) and currently 5 medtech, 2 pharma, and 10 biotech companies are situated in the region. Finland succeeded in raising approximately EUR 1 billion in 2007 – an increase of 166% compared to 2006. The amount invested also increased and ended close to EUR 1 billion. Only 3.3% of this amount (EUR 36 million) was invested in life science. 35% of the Finnish population has a higher educational degree. Compared to the other BSR countries, Finland scores an average on The Economist’s Quality of Life Index and also the level of the annual working hours.

Finland has a very good starting base for developing a solid life science industry. The Oulu region’s university have a strong research performance and the national economic situation allows a high level of investment. The main challenge for Finland is access to talent as well as access to venture capital.

Lithuania
National data has been reported for Lithuania why this section primarily will investigate national figures and strategies. All data is USD per 2007 using current exchange rates.

The Lithuanian economy has grown rapidly over the past 10 years. Unemployment fell to 3.2% in 2007 while wages continued to grow at double digit rates, contributing to rising inflation. Exports and imports also grew strongly, and the current account deficit rose to nearly 15% of GDP in 2007. Trade has been increasingly oriented toward the West. The Lithuanian per Capita GDP (PPP) is currently 17,700 USD. The Lithuanian population is approximately 3.5 million and the labour force almost 1.6 million of which 5.8% are unemployed. In 2007, the Lithuanian GDP growth rate was 8.8% while the inflation rate (consumer prices) was 5.8%.

The Lithuanian universities have a relatively high concentration of university students (approximately 144,000) and low numbers of faculty staff (6,661). The number of graduated masters (8,883) and PhD students (147 life science PhD students) in Lithuania are also low. 920 peer-reviewed articles were published in 2007. Very few international students are attending the Lithuanian universities and none of the universities were included in the Shanghai Jiao Tong University Index for 2007.

16 Combined figures based on calculations adjusted for population.
The governmental commitment to R&D of total governmental expenditure was 0.76% of GDP (GBOARD) in 2007. Taking the overall biotechnology investments into account, the Lithuania contribution to total EU R&D investment is less than 0.3%. Lithuanian has two science parks but no life science dedicated cluster organisation. Of the life science companies currently operating from Lithuania, none are within medtech. However, 6 are within pharma and 10 are involved in biotechnology research. The country has no or very little capital available.

Only 22% of the population has a higher educational degree and according to The Economist’s Quality of Life Index Lithuania is placed below average. The level of annual working hours (1,803) is the highest in the EU.

The Lithuanian universities clearly have a large capacity compared to the population. In terms of life science, however, the academic environment lacks focus in order to support research and commercialisation. The current situation is further challenged by the lack of venture capital and the national economic situation. The economic situation has a strong influence on the salary level and indirectly an influence on the quality of life rating. The latter is important in order to attract foreign talent and for instance, international students.

**North West Russia**

National data has been reported for Russia why this section primarily will investigate national figures and strategies. All data is USD per 2007 using current exchange rates.

Russia ended 2007 with its ninth straight year of growth, averaging 7% annually since the financial crisis of 1998. Although high oil prices and a relatively cheap rouble initially drove this growth, since 2003 consumer demand and, more recently, investment, have played a significant role. Over the last six years, fixed capital investments have achieved real gains greater than 10% per year and personal incomes have achieved real gains more than 12% per year. During this time, poverty has declined steadily and the middle class has continued to expand.

Russia has also improved its international financial position over the past 10 years. The federal budget has run surpluses since 2001 and ended 2007 with a surplus of about 3% of GDP. The Russian per Capita GDP (PPP) is currently 14,700 USD. The Russian population is just under 141 million and the labour force approximately 74 million of which 6.2% are unemployed. In 2007, the Russian GDP growth rate was 8.1% while the inflation rate (consumer prices) was 11.9%.

Russia has been subject to an increasing level of interest in engaging in R&D of life science products for the domestic and international market, but the country is challenged by a poor innovation environment and lags far behind the other BSR countries. The Russian government has recognized the importance setting up an institutional framework to drive the development of a modern Russian biotechnology industry. This has resulted in ongoing efforts to strengthen innovation systems from basic molecular biology through to applied R&D, intellectual property and regulatory systems, scale-up and production capabilities, and commercial manufacturing, marketing and product distribution systems (The National Academies Press, 2008).

The Russian government is also committed to improve the venture market and access to talent and invested capital in several private-public funds. These investments have not been successful yet; however, several private institutions are taking up the responsibility to further strengthen the market. Many individual entrepreneurs have attempted to spin out technologies from research institution but failed because of lack of supporting technical and administrative infrastructure. Several health-related biotechnology investors are active in Russia, e.g. Medical Technology Holding, an affiliate company of the huge conglomerate Sistema.

Russia obviously has a very large capacity and the Russian universities have a profound tradition for life science research. The Russian government has recently initiated a 10-year plan to promote biotechnology across the country. More than 1,000 institutions and companies are participating to strengthen the country's unique research areas.

**Norway**

National data has been reported for Norway why this section primarily will investigate national figures and strategies. All data is USD per 2007 using current exchange rates.

After a growth rate of less than 1% in 2002-2003, GDP growth picked up to 3-5% in the period 2004-2007, partly due to higher oil prices. Domestic economic activity is the main driver of growth, supported by high consumer confidence and strong investment spending in the offshore oil and gas sector. Norway’s record high budget surplus and upswing in the labour market in 2007 highlights the strength of its economic position going into 2008. The Norwegian per Capita GDP (PPP) is currently 53,000 USD. The Norwegian population is approximately 4.6 million and the labour force is approximately 2.5 million of which 2.5% are unemployed. In 2007, the Norwegian GDP growth rate was 3.5% while the inflation rate (consumer prices) was 0.8%.

Norway has an established life science industry. Even though much of the Norwegian biotech industry is focussed on other areas than human life science, the country has fostered numerous successful biotech companies. Cancer is a major research area in the Norwegian biotech. The Oslo Cancer Cluster encompasses companies and institutions engaged in cancer research and innovation. The cluster currently has more than 40 members, including pharmaceutical companies, university hospitals, biotech companies, and for instance, well established venture capital firms.

The Norwegian R&D spending reached EUR 4.37 billion equivalent to 2% of the country’s GDP. The Norwegian government is committed to increase this to 3% before 2010. Most of the public R&D is controlled by a national research council which currently supports three major biotech programmes in the fields of genomics, bio-
processing, and marine biology. The Norwegian innovation environment has recognized that private-public research collaboration and innovation transferring could be improved.

The increased focus on fostering and commercializing biotechnology is evident from the new tax incentive programmes for innovative companies and construction of new public seed-funds. One example is the joint public/private seed fund Sarsia with USD 49.38 million under management. Norway recognizes the need to further develop the venture capital market which according to the OECD only accounts for 0.2% of the country’s GDP. Currently, Norway counts eight listed biotech companies.

Following the strong level of economic growth in 2007, Norway reached an all time high investment level of EUR 963 million. This is much higher than the recent years fund-raising which have varied from 400 to 500 million. Close to 11% of the amount invested in 2007 went to the life science industry (EUR 105 million).

**Iceland**

National data has been reported for Iceland why this section primarily will investigate national figures and strategies. All data is USD per 2007 using current exchange rates.

Iceland’s economy is similar to the Scandinavian economies with low unemployment and quite even distribution of income. The economy depends heavily on the fishing industry, which provides 70% of export earnings and employs 6% of the workforce. Substantial foreign investment in the aluminium and hydropower sectors has boosted economic growth which, nevertheless, has been volatile and characterized by recurrent imbalances. The Icelandic per Capita GDP (PPP) is currently 38,800 USD. The Icelandic population is approximately 300,000 and the labour force approximately 181,000 of which only 1% are unemployed. In 2007, the Icelandic GDP growth rate was 3.8% while the inflation rate (consumer prices) was 5%.

Despite the size Iceland is very dedicated to R&D. In 2005, total R&D expenditure in Iceland was close to 3% of GDP. The largest research area is life science – in 2005 more than EUR 111 million was spent in life science dedicated research. Approximately half of the Icelandic R&D expenditure R&D was spent by private organizations. Currently, 10 biotech companies are operating from Iceland, of which all are supported by a mix of local and international private equity.

Iceland makes out an ideal platform for certain biotechnology research fields. Iceland has a unique geographical position with access to high-temperature areas where thermophilic bacteria thrive. These bacteria can be utilized in various industries, especially pharmaceuticals. Another unique research base is the country’s access to an unspoiled and rather limited human gene pool which makes out an invaluable laboratory for the study of the role of genes in the transmission of diseases.
4. Innovation Strategies

In order to secure a thorough and valid investigation of the research question at hand, an exploratory study has been completed to further define and map the anatomy of regional innovation strategies. The data collection and the following comparative analysis are therefore based on the following five factors of innovation strategies: academic performance, labour and access to talent, social and economic infrastructure, access to capital, and supportive R&D environment. These factors make up the following chapter’s five subsections – each section will further define the factors by reviewing the relevant measurements applied in this study.

**Academic Environment**

Academic environments, of course, differ from one region to another and not all countries necessarily have the same tradition for life science research and commercialization. There are two central measurements to take into account when evaluating a regions’ academic environment: the research performance and the capacity. The latter is relevant in terms of current and potential capacity (i.e. the number of potential applicants and the number of students enrolled) while performance is an obvious necessity for a successful commercialization. In terms of research performance, a number of different measurements are available; number of peer-reviewed publications, number of invention disclosures; patent applications; and documented success in terms of technology transferring.

**Figure 6**

**Figure 7**

Even though the above patent application data (EUROSTAT, 2007) includes private research, it gives an indication of the BSR countries’ biotech research performance. The data is adjusted for population and therefore provides a fair basis for comparing the countries. As clearly illustrated, there is a difference between the BSR countries located east and west of the Baltic Sea. With an average of 21.25 patents per million inhabitants, Denmark and Sweden have the highest level of patent applications producing more than four times the EU-27 average, while the German (10.9) and the Finish (7.4) level are just above the average. The Baltic countries and Poland have less than 1 annual biotech patent application per million inhabitants and therefore are not included in the above data series.

This trend is comparable to the annual number of published peer-reviewed articles. When adjusting for population, the Baltic countries and Poland are all publishing less than 100 articles per 100,000 inhabitants, while the Medicon Valley and the Oulu region publish approximately 400 and 1,700 respectively per 100,000 inhabitants. Despite the low research performance, the Baltic countries and Poland have a relatively high capacity in terms of number of students enrolled and size of faculty. However, when reviewing the number of life science dedicated researchers (PhD student included) these countries fall behind the countries west of the Baltic Sea. This tendency explains the low number of peer-reviewed articles and patent applications.

The above described east/west tendency is also present when examining the number of graduated master students per year: the Nordic countries have approximately 280 graduations per 100,000 inhabitants while the Baltic Countries have 180 in average. In this case, however, Poland and Finland do deviate with a considerably high reported number of graduated master students per year (1065 and 1016 respectively). The Polish numbers correspond very well to the other measurements reported and are considered valid. This Finnish numbers are explained by the fact that the Oulu region has an especially high concentration of university students, which obviously is also very positive for the region’s access to talent. The Polish strategy is further evident from the OECD (2008) educational statistics: 51% of the Polish population holds a higher education. The Nordic countries (between 30% and 35%) scores below the Polish number, but is still much higher than the European average while the Baltic countries and Germany lag behind (between 14% and 22.5%).

EUROSTAT measure the human resources in science and technology as a share of the labour force (HRST) based on

---

17 This number is most likely much higher for Medicon Valley due to the fact that the region has a very high concentration of biotech research compared to the rest of Denmark and a substantial share of the Swedish biotech research.

18 This number is most likely much higher for the three life science clusters in northern Germany: Hamburg/Schleswig-Holstein, Berlin/Brandenburg, and Mecklenburg-Vorpommern. This is due to the fact that the regions most likely have a high concentration of biotech research compared to the rest of Germany.

19 This number is most likely much higher for the Oulu region due to the fact that the region has a higher concentration of biotech research compared to the rest of Finland.
the above reviewed numbers. In this perspective, Poland is actually placed last and this is symptomatic for the country’s current challenges in regards to R&D. Denmark, Norway, Finland, and Sweden are all placed well above the EU average which confirms the fact that these countries have a long tradition for education and employing people within research and technology.

When looking at life science only the numbers change is noteworthy; when adjusting for population, the Oulu region has the highest number of life science dedicated PhD students followed by Medicon Valley and northern Germany.

In terms of attracting international students, northern Germany leads the BSR region with more than 12% foreign students. Medicon Valley is second with just less than 6%, while the international students make up only between 1% and 2% in other BSR countries. Only universities in Medicon Valley, the Oulu Region, and northern Germany are listed in the international Shanghai Jiao Tong University Index.

**Labour and Access to Talent**

Access to talent is driven by two major factors: (i) the number of specialists being educated and retained regionally and (ii) the ability for the region to attract foreign specialists. The first is obviously connected to the academic environment (reviewed in the above section) while the ability to attract foreign talent is associated with a number of different factors – many of which will also be discussed in the sections to come.

Access to talent is a key element of innovation strategies, but different regions have different needs corresponding to their ongoing market situation. Before comparing the BSR countries’ capabilities in educating and attracting talent, it is important to investigate the countries’ current situation in terms of labour and unemployment.

The above data provide a useful comparison of the BSR countries’ labour forces and unemployment rates. The Norwegian, Swedish, and Danish unemployment rates are all much lower than the BSR average which primarily is explained by recent year’s economic growth and strong social economic environment. Obviously, the low unemployment is a challenge for the industry due to the fact that salaries increases and diminish competitiveness and make it more difficult to recruit the best candidates. The Russian, German, and Finnish unemployment rate is close to the BSR average, while Poland has an employment rate of more than 12%, which is the highest among the BSR countries. To what extent these countries are being challenged in the same way as the Scandinavian countries, of course, depends on several other aspects, such as the number of people being processed through the educational system. Germany, for instance, has percentage wise, a large unemployed workforce. However, compared to the other BSR countries it has a low number of graduated masters and PhDs. Germany might therefore be facing the exact same shortage of talent as is the case in the Scandinavian countries.

The Baltic countries are subject to a positive development with a well balanced unemployment rate and at the same time a relatively high number of graduated master students. The main challenge for the Baltic countries is the fact that they focus very little on life science research, technology transferring, and commercialization. As reviewed in the previous section, Poland is educating a considerable number of people and the main challenge will be to limit the unemployment rate and make use of these resources.

As argued above, another important factor is the regions ability to attract foreign talent. A number of different factors are of great influence in this regard. For instance, the regions living conditions such as general quality of life, tradition for working hours, wages and salary level, and the levels of taxation.

Similar to the case of life science dedicated research, the below quality of life comparison shows a significant difference between the countries west and east of the Baltic Sea. According to The Economist’s Quality of Life Index (2008), the five Nordic countries all have a quality of life rating close to the worldwide maximum whereas the Baltic
countries and Poland are rated significantly lower, but still well above the worldwide minimum. Germany is rated close to the BSR average.

Quality of Life Comparison

Another important factor for attracting foreign talent is, of course, the level of taxation. As is evident from the below BSR data, the tax levels differ considerably from one country to another. The figures provide an overview of the BSR regions’ tax levels and once again the region is separated by the Baltic Sea. The Nordic countries are all having tax levels above the EU-27 average and thereby among the highest globally. The countries east of the Baltic Sea all have lower tax levels. According to EUROSTAT (2008), all BSR countries have followed the recent years increase in tax burden – though, the general European tax burden is still lower than the historic maximum in 2000.

Social and Economic Infrastructure

The Baltic Sea Region’s innovation strategies and success in bridging academic research and SMEs greatly depends on each individual region’s social and economic settings. This section reviews the general social and economic indicators, while the R&D environment will be investigated in the following section.

Wages and salaries (excluding apprentices)

The annual average working hours and salary level also have an impact on the regions ability to attract and retain talent, and again there is a considerable difference between the countries east and west of the Baltic Sea (see the below figure). Norway has the lowest annual working hours followed by Germany, and the Nordic countries – all below the OECD average. On the other hand, the Baltic countries and Poland are listed with annual working hours above the OECD average.

The east/west tendency is further evident from the BSR salary level. The countries west of the Baltic Sea have a significantly higher salary level than the Baltic countries and Poland, which are challenged in terms of offering competitive salaries to local and foreign talents. Besides the high annual working hours, the Baltic countries are further challenged by a lower salary level. These numbers, of course, should be adjusted for prices and taxation levels but provide an overview of the basic factors influencing the ability to attract and retain local and foreign talent.
countries and Poland (i.e. an industrial setting). Germany deviates from the other BSR countries by having a combination of very low salary and low working hours, and in addition to this, the rate of German unemployment is among the highest in the BSR region.

The GDP is a key factor of influence to the innovative environment and captures the value of all goods and services produced by the country and the GDP per capita is therefore an adequate measure of the level of economic activity. When converted with purchasing power parities\textsuperscript{21} (PPP), GDP measures the size of the economies. Thus, PPP-based GDP data provide appropriate data for comparison of different countries economic activity.

\textbf{Figure 14}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure14.png}
\caption{Pr. Capita GDP (PPP) and GDP Growth}
\end{figure}

From the above figure on per capita GDP (PPP), it is evident that the Baltic Sea Region once again is split in an east and west side. The Nordic countries and Germany have a high level of GDP (PPP) compared to the countries east of the Baltic Sea. The Nordic GDP level is among the world’s highest – the Norwegian GDP level which currently is ranked third in the world. The Baltic countries, Poland, and Russia all have a GDP level below the EU average, but still within the world’s top 50.

However, when looking at the current growth rate in GDP, the picture changes. The countries east of the Baltic Sea all have higher growth rates than Germany, Finland, and Denmark. The Russian growth was, according to the CIA World Fact Book, more than 8% – the second highest in the Baltic Sea Region. This trend shows that the Baltic countries, Poland, and Russia are subject to an increase in economic activities and rapid development of the economic infrastructure.

\textbf{Supportive R&D Environment}

The structure and size of the domestic R&D environment is crucial for bridging academic research and SMEs. The R&D environment can be measured by a number of different factors of which we will only review a selection. The number and size of research based life science companies is important for the creation and exploitation of synergies – this section will compare the Baltic Sea Region’s product pipelines and further look into the most recent deals and alliances. The section will also look into the use of incubators, cluster organizations, and science parks.

One of the most important factors for the R&D environment is access to capital and the amount of money invested in research. This section will primarily investigate the governmental economic commitments to research while the chapter’s final section will deal with private investments and venture capital.

Medicon Valley and northern Germany have a very high concentration of life science companies compared to the rest of the Baltic Sea Region. Medicon Valley has approximately 200 biotech companies (all categories of biotech) while northern Germany has more than 400. The Oulu region has reported 10 biotech companies, Poland 60, Latvia, 25, Lithuania, 10, and Estonia 60. The Bridge BSR partners reported the following numbers on 2007 biotech company start-ups: Medicon Valley 13, northern Germany 25, Poland 0, Oulu Region 5, Latvia 1, and Estonia 3.

\textbf{Figure 15}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure15.png}
\caption{Product Pipeline - European Countries 2007}
\end{figure}

Another measurement to use for comparing the regions’ commercial research efforts is the number of products in pipeline. Compared to the rest of the Baltic Sea Region, Germany has the highest number of products in pipeline (262) and compared to the EU-27 only the UK (361) surpasses the German level. Despite the size of the country, Denmark takes third place with (188) products in development while Sweden has 93, Norway 40, and Finland only 13.

As set by the Lisbon summit strategy, the EU has a goal of achieving a R&D intensity of at least 3% by the year 2010.\textsuperscript{22} Currently, the EU average spending on R&D is stable at 1.84% of the total GDP, thus still below the 2010 goal. According to EUROSTAT (2008), in 2006 the total European expenditure on R&D amounted to more than EUR 210 billion. In 2006, Sweden reported the highest R&D intensity (3.82% of GDP) followed by Finland (3.45%) and Germany (2.51%) – all Baltic Sea Countries. The graph below provides a comprehensive overview and comparison.

\textsuperscript{21} Purchasing power parities is a currency conversion rate that take into account the differences in price levels between countries. To do so, prices of a basket of about 3,000 goods and services were compared across countries. OECD (2007).

\textsuperscript{22} R&D expenditures as a percentage of GDP.
of the EU commitment to R&D. It is clear that several of the Baltic Sea Region countries are investing heavily on R&D.

Figure 16

![R&D Intensity, Expenditures % of GDP](source:EUROSTAT (2008))

The governmental budget appropriations or outlays for R&D (GBOARD) data reflect national R&D policies and priorities when allocating the budgets. Hence, by comparing GBOARD data it is possible to study current and future national commitments to R&D.

As illustrated in the graph below, there is a significant difference in the level of governmental commitment to R&D. Once again the Baltic countries fall behind the Nordic countries. Finland, Iceland, and Sweden lead the level of GBOARD while Germany, Denmark, and Norway are placed near the EU average. This tendency is primarily explained by the fact that GBOARD is adjusted for GDP and the governmental commitment to R&D. The relatively low Danish and German GBOARD also indicated the fact that much of the investments originates from private industry. When comparing the GBOARD data to the above presented R&D intensity, it becomes clear that a significant amount of total Swedish expenditures is government funded. The Baltic countries all report GBOARD data below the EU average. This tendency is very much in line with the previous review measures and will become a major challenge if not improved. The three year data set reveals the fact that the Baltic countries and Poland have not increased their commitment to R&D over time.

Figure 17

![Governmental Budget Appropriations or Outlays for Research and Development, % of GDP (GBOARD 2004-2006)](source:EUROSTAT (2008))

Along with a growing life science industry usually come incubators, cluster organizations, and science parks. According to the Bridge BSR partners, the life science industry in Denmark, Sweden, Finland, and Germany is to a large extent supported by such organizations. At present, only a few organizations are operating in the Baltic countries and the majority of these only refer to a limited number of companies. Poland reports the presence of several science parks and incubators.

Access to Capital

Access to capital is an obvious necessity for the successful development and commercialization of life science innovation. Access to capital varies from country to country depending on certain focus areas. For example, France has a historic tradition for investing in industrial products while the Finnish investors primarily invest in consumer electronics. The following section will review a number of selected indicators such as number of life science dedicated private equity firms, total investment in life science, venture investment data, and buyout investments in life science. The section will further comment on national investment patterns in the Baltic Sea Region.

Figure 18

![2007 Life Science Investments Baltic Sea Region](source:EVCA (2008))

According to EVCA (2008), Sweden’s primary investment sector is life science. This is despite the fact that the amount invested in this area decreased more than 20% in 2007. The second largest investment sector is consumer goods and retail, followed by the communication industry. Sweden has the by far largest level of life science investments per year in the Baltic Sea Region; in 2007 more than EUR 1.7 billion was invested in Swedish life science. The Swedish private equity companies invested approximately EUR 1.25 billion in life science – in Sweden and internationally. According to the Swedish Riskkapitalföreningen, the majority of the Swedish investments were placed in domestic companies. Also the Swedish venture investments are very high – Sweden had the second highest level of venture investments in 2007 and the highest level of buyout investments in the Baltic Sea Region.

The Danish private equity firm’s investment in life science is almost equal to the amount invested in the domestic portfolio companies. According to the Danish Vækstfonden,
a considerable amount is invested internationally while the
remote portfolio companies are also supported by foreign
investors. Denmark takes third place in terms of annual
invested venture capital, though the amount invested in
2007 is less than half of the Swedish venture investments
and approximately one-third of the German investments.
This trend could turn out to be the largest challenged for
the Danish life science industry – according to the Danish
Vækstfonden, Denmark is short of risk willing capital in
order to finance the increasing numbers of biotech
companies. Thirteen new biotech companies were started in
2007.

Even though the annual German investments in life science
were considerably lower than in Sweden, Germany still has
the Baltic Seal Region’s second highest level of life science
investments. Almost half of the German investments came
from foreign investors and the level of investments made
by domestic private equity firms were equivalent to the
Danish level. Turning to the actual amount of venture
capital, Germany takes the lead of more than EUR 298,000
million a year (EVCA, 2008). This clearly shows a well
equipped German venture market which of cause is a
valuable advantage for the German entrepreneurs. Life
science is the largest venture investment sector in
Germany, followed by the computer and consumer
industry.

The Norwegian and Finnish investments almost make out
the remaining part of the Baltic Sea Region’s life science
investments. The Finnish private equity companies’
investments are much higher than the amount invested in
the Finnish portfolio companies and several of the Finnish
private equity firms are primarily focusing on foreign
investment opportunities. Only small levels of venture
capital was invested in Norway and Finland in 2007 – both
countries have only few life science based biotech
companies and the domestic investors are focusing
internationally. Even though these countries have success
in transferring research into commercial development, the
access to venture capital will remain a major challenge.

As is evident from the below chart, the Baltic countries are
investing very little in life science – according to EVCA
(2008), in 2007 approximately EUR 1 million was invested
as venture capital. This is despite the fact that the Baltic
countries have experienced a blooming interest from
international investors. In 2007, a total of EUR 363.6
million was invested by foreign private equity firms –
unfortunately not in life science.
5. Findings
The previous chapter compared innovation strategies and condition across the Baltic Sea Region. The analysis was based on the following five factors: academic performance; labour and access to talent; social and economic infrastructure; access to capital; and supportive R&D environment. The following chapter intends to recapitulate and map the current conditions and innovation strategies applied in the Baltic Sea Region, and further identify future challenges and potential for bridging academic research and SMEs – across the region and for the Baltic Sea Region as a whole.

Current conditions and innovation strategies
There is a very large difference in academic performance across the Baltic Sea Region – especially when measuring the life science specific research. The Baltic countries and Poland have a large capacity in terms of students and scientific personal, however, not within life science. From the above analysis it is evident that life science dedicated research greatly depends on tradition as well as industry demand. Medicon Valley, northern Germany, the Oulu Region, and Norway are all benefitting from the presence of an established life science industry and therefore a domestic demand for research. Medicon Valley and northern Germany further benefit from a direct corporation between academic institutions and pharmaceutical companies – a well established bridge and incubator for commercialization of new technologies. Thus, the transferring of academic research is often – directly or indirectly – financed by the industry. The main challenge for the Baltic countries, North West Russia and Poland is to find early stage financing.

As previously argued, access to talent is an essential necessity for commercialization and further development of academic research. Some of the regions have a low life science research performance and as an obvious consequence a low number of life science graduates, while other countries experience shortage of life science specialists due to low unemployment. It is also evident that there is a great difference in the level of salary, taxation, and working hours across the Baltic Sea Region. Even though several industries would prefer the combination of low salaries and high working hours, it is less important for the research based life science industry – instead attracting the right people is the most important factor for success. As previously described, the Nordic countries have a combination of low working hours and very high salary levels (i.e. a research setting) while the opposite combination applies for the Baltic countries and Poland (i.e. an industrial setting). Germany deviates from the other BSR countries by having the unfortunate combination of very low salary and low working hours, and in addition to this, the German level of unemployment is among the highest in the BSR region.

In terms of per capita GDP (PPP), the Baltic Sea Region is once again split according to the Baltic Sea. The Nordic GDP level is among the world’s highest – the Norwegian GDP level is currently ranked third highest in the world. The Baltic countries, Poland, and Russia all have a GDP level below the EU average, but still within the world’s top 50. However, when looking at the current growth rate in GDP, the picture changes. The countries east of the Baltic Sea all have higher growth rates than Germany, Finland, and Denmark. The Russian growth was, according to the CIA World Fact Book, more than 8% in 2007 – the second highest in the Baltic Sea Region. This trend shows that the Baltic countries, Poland, and Russia are subject to an increase in economic activities and rapid development of the economic infrastructure.

The Baltic Sea Region has a high concentration of life science companies. Medicon Valley has approximately 150 biotech companies (all categories of biotech) while northern Germany has more than 400. The Oulu region has reported 10 biotech companies, Poland 60, Latvia, 25, Lithuania, 10, and Estonia 60. As previously argued, an established life science industry is crucial for bridging academic research. There is an obvious relationship between the number of life science companies and the number of human life science products in pipeline. Compared to the rest of the Baltic Sea Region, Germany has the highest number of red biotech products in pipeline (262) and among the EU-27, only the UK (361) surpasses the German pipeline. Despite the size of the country, Denmark takes third place with (188) products in development while Sweden has 93 products in pipeline, Norway have 40, and Finland only 13. This key statistics demonstrate how important the Baltic Sea Region is for European biotech – a fact which also is evident from the amount invested on R&D. In 2006, Sweden reported the highest European R&D intensity (3.82% of GDP) followed by Finland (3.45%) and Germany (2.51%) – all Baltic Sea Countries.

The obvious link between research performance and the level of investments is evident from the above analysis. Not only are several of the Baltic Sea Region’s countries leading the European index of venture investments per GDP, they are also the most dedicated to life science. The countries west of the Baltic Sea therefore are very well prepared to finance the transferring of academic research to commercial development. The countries east of the Baltic Sea are not necessarily short of capital, but the region’s life science companies are. Most of the Baltic Sea Region receives more capital than invested by the domestic private equity firms which confirms an international interest.

There is a considerable potential for further development and growth of the Baltic Sea Region’s life sciences sector. This development, however, is delayed due to the adverse allocation of resources between the different countries and regions.

There is an unmet need for cross border knowledge sharing between not only research-based organisations but in particular between business developers, venture investors, and cluster organisations. The unexploited synergies primarily stems from the adverse allocation of venture capital and differences in competitive conditions for acquiring ventures – the price for innovation could very well be more favourable in the countries with non or very little existing venture capital. Another obvious synergy is found in the unexploited exchange of research and labour resources – a number of the countries’ economic growth is
stalling due to the low unemployment rate while the opposite is the case in other Baltic Sea Countries.

**Future challenges and potential**

Medicon Valley – in Sweden and Denmark – has established a well balanced life science industry based on a historic cooperation between industry and academia. The region benefits from a first class R&D environment which will foster many new companies and technologies in the years to come. One major challenge will be to control the balance of new projects and available capital. Medicon Valley is currently short of risk willing capital which most likely will become a major challenge in terms of driving all of the existing portfolio companies to exit. Thirteen new biotech companies were started in 2007.

The region of northern Germany covers a large area with more than 12 million inhabitants and currently more than 400 biotech companies are operating from there. This is also evident from the total number of products in the German pipeline. This success is an ideal basis for developing the German life science market further, especially when taking into account the high level of private equity allocated. One major challenge is the unfortunate combination of a very low salary level and low working hours. Currently, the high unemployment level is balancing the access to labour, but this could prove to become a future challenge. A number of projects have already been initiated by the Steinbeis Team Nordost\(^2\) working to exploit these synergies: The Steinbeis network collaborates with many scientist also from the new memberstates as they offer great applied science which can be utilised e.g. in contract research or collaborative RTD project driven by german experts. In many cases the advantage is that those expertise will be unlooked through a well known provider and does not have to struggle to get in contact with the business arena theerself. In the second step many of those partners will open up own business units or transfer centers as part of the network as they are then more maature and known in the technology transfer business\(^2\)\(^4\).

Norway and Finland have a relatively high level of academic research activities within life science. However, there are a surprisingly low number of commercial research projects and life science companies. As a consequence, the Finnish private equity is primarily seeking investment opportunities internationally. Both countries are subject to very high governmental investments to science and technology and a possible explanation could be lack of industry-academic cooperation. A future challenge will be for these countries to meet expectation and generate an acceptable return on investments.

Iceland is primarily challenged by the country’s size and thereby limited access to academic research and industry cooperation. Iceland has a very high level of governmental commitment and can benefit from a growing economy and excellent living conditions to attract foreign talents. Iceland has the potential to become a major contributor to the Baltic Sea Region by means of delivering key research and expertise.

The main challenge for the Baltic countries is the fact that they focus very little on life science research, technology transferring, and commercialization. The Baltic countries all report GBOARD data below the EU average. This tendency is very much in line with the previous review measures and will become a major challenge if not improved upon. The countries are also challenged in terms of attracting specialists – primarily because of the low salary level, the level of annual working hours, and the low quality of life. Despite these challenges, Latvia, Lithuania, and Estonia have the potential to become major contributors to the European life science industry. The recent years’ growth has sparked interest among international investors.

Poland has an established life science industry, but it is very small compared to the country size and economy. As with the Baltic countries, Poland lacks a focus on life science in terms of educated and employed scientists. Unlike the Baltic countries however, Poland has the opportunity to further develop the existing industry by initiating new partnerships between the academic environment and the private life science industry.

---

\(^2\) Steinbeis-Forschungszentrum Technologie-Management Nordost

\(^4\) Frank Graage, Steinbeis 2008
6. Conclusion

The BSR region is challenged by great diversity. Success in the future will depend on the region’s ability to turn this challenge into new opportunities.

- The countries west of the Baltic Sea are very well prepared to finance the transferring of academic research to commercial development. The countries east of the Baltic Sea are not necessarily short of capital, but the region’s life science companies are.
- The universities east of the Baltic Sea have a large capacity and high level of attendance compared to the population. In terms of life science, however, the academic environment lacks focus in order to support research and commercialisation.

Compared to the rest of Europe, the Baltic Sea Region has a very high commitment to R&D. Several of the Baltic Sea Region’s countries are investing heavily on R&D.

- The private equity firms in the BSR have a regional investment focus – only a small share of the capital is invested outside the region.
- The Baltic Sea Region has the highest level of venture investments in the EU.
- The Baltic Sea Region takes a leading position in terms of compounds in clinical development.

Life science dedicated research greatly depends on tradition as well as industry demand.

- The presence of a life science industry is a vital element in bridging academic research and SMEs
- Thus, academic research is often – directly or indirectly – financed by the industry and the main challenge for the Baltic countries, north west Russia and Poland is to find early stage financing.
- Companies spun-off from the pharmaceutical industry tend to mature faster and therefore attract higher deal amounts.

As is evident from the above analysis, there is a great difference in the level of salary, taxation, and working hours across the Baltic Sea Region.

- The level of salaries and working hours is less important for the research based life science industry – instead attracting the right people is the most important factor.
- The Nordic countries have a combination of low working hours and very high salary levels (i.e. a research setting) while the opposite combination applies for the Baltic countries and Poland (i.e. an industrial setting).

Recommendations

The Baltic Sea Region’s key stakeholders within life science R&D (i.e. governmental institutions, academia, private life science companies, cluster organizations, and investors) should be encouraged to form partnerships and coordinate their efforts on how to implement an action plan. To do so, the following action points should be borne in mind:

- Improve sharing of knowledge and resources – certain outsourcing opportunities as well as cross-border research projects.
- Promote unexploited synergies across the Baltic Sea – cross border technology transfer and an improved coordination between the structural funds.
- Promote the Baltic Sea Region to international investors – opportunities for early stage collaborations with academic environment and opportunities to syndicate with national investors.
- Establish mentoring programs to follow-up interregional initiatives – identification and use of best practice and general support to interregional industry-academia collaboration.
Biography

- The CIA World Factbook, CIA 2008
- The Economist Intelligence Unit’s Quality-of-Life Index, The Economist 2005
- Biotechnology in Europe, Patents and R&D Investments, EUROSTAT 2007
- Taxation Trends in the EU, EUROSTAT 2008
- Beyond Borders, Global Biotechnology Report 2008, Ernst&Young 2008-09-21
- EVCA Yearbook 2008, EVCA 2008
- The World Bank Group Online DDP Database, World Bank 2007
- Biotech and Medtech Start-up Companies. Medicon Valley Business. 2006
- Top of Europe in Life Science and Biotechnology, ScanBalt 2006
- Rapport om rammebetingelser for kommercialisering av bioteknologisk forskning I Danmark, Den Kgl Norske Ambassade, 2003
- "ScanBalt CompetenceRegion - a model case to enhance European competitiveness in life sciences, genomics and biotechnology for health on a global scale", ScanBalt 2006