



STATE OF MEDICON VALLEY 2016

An Analysis of Life Science
in Greater Copenhagen

medicon valley **alliance**

Creating Opportunities

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An Analysis of Life Science in Greater Copenhagen

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Updated version.

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Creating Opportunities

PREFACE

Life science in Denmark and Sweden has developed in different directions over the past decade. Danish life science exports doubled in seven years, and last year they were nearly 50% greater than Swedish. The number of employees has risen, and thanks to a well-developed system with industrial foundations, the large companies' headquarters and major shareholders are still in Denmark. At the same time in Sweden, more large companies are now foreign-owned, the largest headquarters have left the country and more important operations have either shrunken in scale or closed down, and the number of employees in the sector has diminished. But there are signs of a change for the better in the university city Lund as well as in Södertälje, Stockholm and Uppsala, visible with for example new biotechnology companies, new research facilities and new investments in the R&D of biological medicines. It is part of a new phase in the life science sector's global transition, and it is also perceptible in Denmark as the simultaneous reports of cutbacks and the hiring of new competence.

Medicon Valley Alliance is also in a transitional phase, with a new strategy that focuses more on our role as a networking organisation for the life science cluster on both sides of the Öresund. Part of our upgraded ambition is to increase knowledge about the companies and research in Medicon Valley. This is the first edition of our new annual analytic report State of Medicon Valley, which offers a unique presentation of life science developments in our region, on a macro- as well as a micro-scale. Measuring developments in a sector like life science is a challenge; there are no clearly defined statistical definitions for the sector, and there are also overlaps, which further increases the complexity. That makes this analysis more important than ever.

The analysis reveals that Greater Copenhagen has developed into the leading Nordic region for life science in the past ten years. The majority of the Danish life science companies are located in the Region, and Medicon Valley overshadows the other Nordic countries when it comes to the number of international patent applications for life science. On the other side of the Strait in the Skåne region, a new beacon is being erected with the new materials research facilities ESS and MAX IV, which will become an important resource for the Region's life science companies. There is also fertile ground for new companies in the Region's many established and emerging science parks such as COBIS, Scion DTU, Symbion, Medeon, Medicon Village and Ideon.

State of Medicon Valley 2016 is the first of a long-term analysis collaboration between Medicon Valley Alliance and ØresundsInstitutet. The analysis will be released every year, and each year will bring an in-depth investigation of a new topic. Special reports are planned for release throughout the year. The analysis is part of an open process, where you – the sector's players – are welcome to contribute with your points of view and reflections.

Copenhagen and Malmö
7 November 2016

Petter Hartman

CEO Medicon Valley Alliance



PHOTO: BAVARIAN NORDIC

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PHOTO: BAVARIAN NORDIC

35 700

was the number of employees at life science companies in Medicon Valley in 2014. That is equal to 53% of the total number of employees in the life science industry in Denmark and Sweden. The number of employees has increased by 4% since 2008.

124 500 employees in the health care sector

The health care sector in the Greater Copenhagen Region employs 124 500 people, some 85 000 of whom are in Eastern Denmark. That means that close to 160 000 people in the region work within life science and health care. In addition to those are researchers at the region's universities.



PHOTO: NEWS ØRESUND

22 billion Swedish crowns are being invested in ESS and MAX IV

Medicon Valley is getting a new beacon – the two facilities for materials research MAX IV and ESS in Lund, with ESS' data management centre in Copenhagen. The facilities will improve the balance within Medicon Valley; Zealand dominates industrially, but Lund is growing into a centre for the natural sciences.



PHOTO: NEWS ØRESUND

Novo Nordisk was Medicon Valley's tallest beacon with its almost 40 000 employees in December of 2015. In the same year, plans were made for several billion-crown investments in new facilities. Recently however, the company announced that it was no longer hiring, later cutting 1 000 jobs, 500 of which were in Denmark.

50%

Danish life science exports are nearly 50% greater than Swedish. Danish pharmaceutical exports and health technology will surpass agricultural exports in a few years.

– The conditions, with high tax rates and overhead costs are miserable. No-one would start a pharmaceutical company in Denmark today, says Kåre Schultz, CEO of Lundbeck and chairman of the Danish government's life science growth team. See interview on page 78.

2x

Medicon Valley is on top in Denmark and Sweden, submitting the greatest number of patent applications to EPO and with more than two times as many patent applications than Stockholm-Uppsala region.

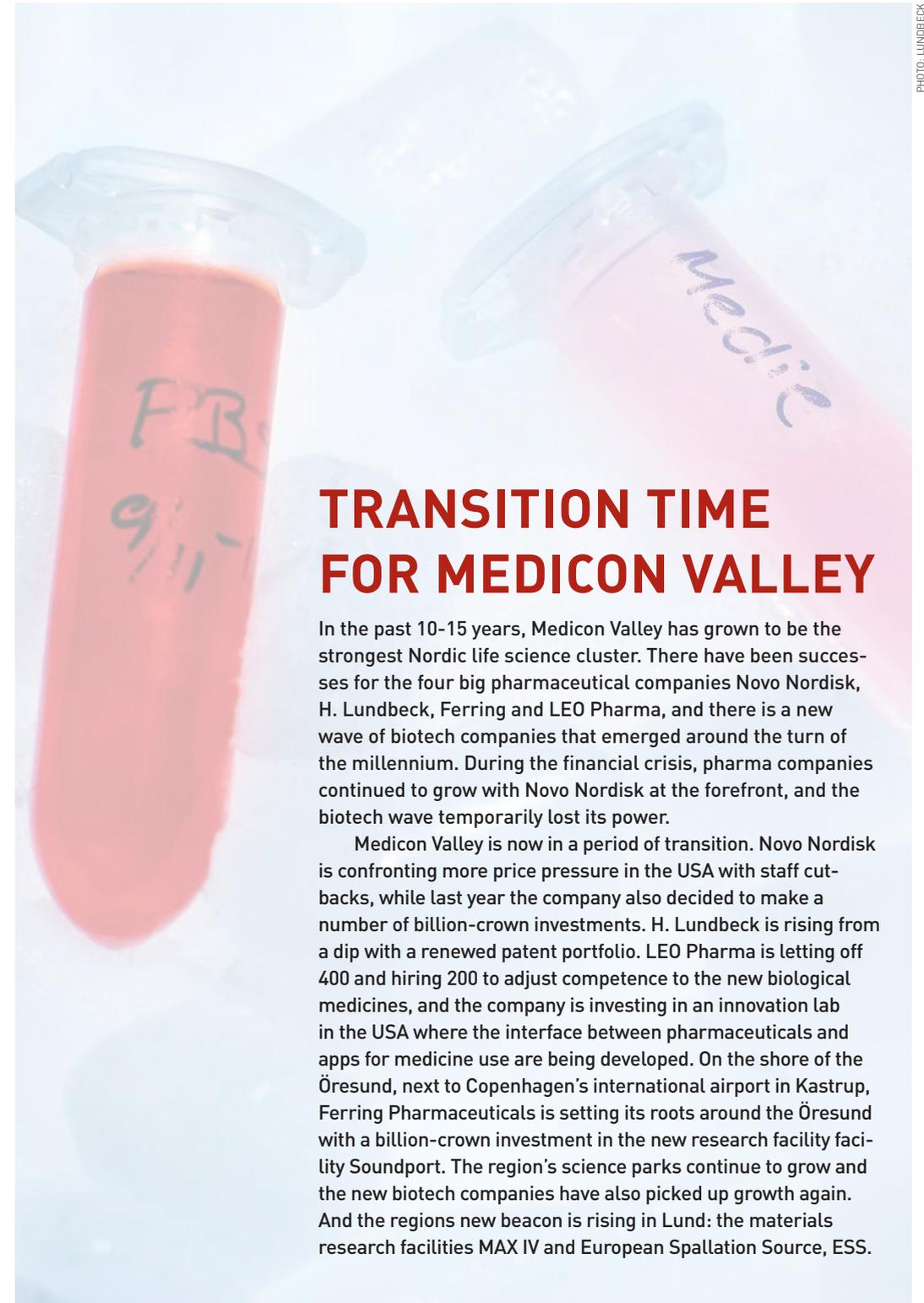


PHOTO: LUNDBECK

TRANSITION TIME FOR MEDICON VALLEY

In the past 10-15 years, Medicon Valley has grown to be the strongest Nordic life science cluster. There have been successes for the four big pharmaceutical companies Novo Nordisk, H. Lundbeck, Ferring and LEO Pharma, and there is a new wave of biotech companies that emerged around the turn of the millennium. During the financial crisis, pharma companies continued to grow with Novo Nordisk at the forefront, and the biotech wave temporarily lost its power.

Medicon Valley is now in a period of transition. Novo Nordisk is confronting more price pressure in the USA with staff cut-backs, while last year the company also decided to make a number of billion-crown investments. H. Lundbeck is rising from a dip with a renewed patent portfolio. LEO Pharma is letting off 400 and hiring 200 to adjust competence to the new biological medicines, and the company is investing in an innovation lab in the USA where the interface between pharmaceuticals and apps for medicine use are being developed. On the shore of the Øresund, next to Copenhagen's international airport in Kastrup, Ferring Pharmaceuticals is setting its roots around the Øresund with a billion-crown investment in the new research facility facility Soundport. The region's science parks continue to grow and the new biotech companies have also picked up growth again. And the regions new beacon is rising in Lund: the materials research facilities MAX IV and European Spallation Source, ESS.

Things are going well for Danish life science. Not so for Swedish life science. That has been the general picture of life science in the two countries for the past ten years. Novo Nordisk's enormous successes during the last decade and the shortcomings of AstraZeneca and Pharmacia in Sweden offer an explanation for many of the differences in the developments in the two countries. Danish life science exports have doubled in seven years, and they are now almost 50% greater than Swedish exports. But now Swedish exports are also on the rise.

This is one of the first indications that Swedish life science is on the verge of a transitional period with positive overtones. Among these are new and substantial investments in the manufacturing of biological medicines. Not everything is positive, however. If we look at the research aspect, we notice that the number of patents from Swedish life science companies has dropped by half between 2005-2012. The number of Danish life science patents is also decreasing after an all-time high in 2005.

There is another change with negative overtones: the Danish engine for progress, Novo Nordisk, has been forced to reduce its workforce by 1 000 people, 500 of them in Denmark. As a result of the pressure on prices in the USA, Novo Nordisk also has had to lower the bar for its long-term financial goals and heighten cost consciousness. Last year's announcement that a number of new billion-crown investments in new and expanded facilities demonstrates continued confidence in the future, but the company's role as an engine for progress as regards personnel is not as much of a given in the future. This in turn has an effect on Medicon Valley.

At the same time, some Danish companies are continuing their expansion; Ferring is putting billions into the new research facility Soundport by Kastrup, which will accommodate 50% more employees than the current facility in Ørestad. Coloplast's new strategy Lead20 talks of global growth and 3 000 new employees by 2020. H. Lundbeck carried out a generational shift in its patent portfolio and is on its way out of a dip. Of course, there are also companies

making cutbacks. Cost-consciousness has definitely reached the life science sector.

One area that is often unduly neglected is health technology – an area in which there are a number of successful beacon companies on both sides of the Öresund Strait. In the Copenhagen area there are three large and successful hearing aid manufacturers, and together they hold a dominating position in the global market. In Region Skåne and around Gothenburg, there are a number of health technology companies that have created a strong position for themselves with a combination of Swedish industrial know-how and life science research at the universities.

"The small, innovative companies of our time are gathering more and more in Medicon Valley's six large science parks, which one could call modern-day big businesses."

Another indication that we are in a period of transition is to be found in the large as well as the small. The small, innovative companies of our time are gathering more and more in Medicon Valley's six large science parks, which one could call modern-day big businesses. Since 2009, the region has gained two new science parks that focus on life science: COBIS in Copenhagen and Medicon

Village in Lund. Altogether there are about 4000 people working in life science at the various companies that rent space at the region's six science parks. These geographical clusters of many small businesses cannot replace big businesses, however; this is one lesson learned from the differences between Denmark and Sweden's development. Sweden's life science industry is hampered by the lack of large businesses. Small businesses are responsible for many of the innovations of our time, but with few products and the early research necessary, the stakes are often high, and smaller companies often lack the brawn to enter the world's largest market in the USA.

It is apparent that a transitional period is upon us in the field of natural science research. When it comes to research in the natural sciences, Medicon Valley is the Scandinavian centre with 49% of the research capacity in pure research companies external to the hospitals and universities. The balance between the Danish and Swedish sides of Medicon Valley is more equal here, where Lund is the largest municipality with 4 300 employees in companies with

research in the natural sciences as main purpose. Zealand is significantly larger than Skåne if the municipalities around Copenhagen are included. However, a powerful rebalancing lies ahead with the investment of 22 billion crowns in the new materials research facilities MAX IV and ESS in Lund,

with ESS' data management centre in Copenhagen. Interestingly, there are Danish investments in both research facilities that are clearly linked to the possibility of performing advanced life science research and thereby develop Medicon Valley's spearheading products for the future.

LIFE SCIENCE DEFINITION

Life science can be defined as the study of living organisms (including microorganisms, plants, animals and human beings), but when describing

a life science cluster, life science is perceived in a broader context. It includes the pharmaceutical, biotechnological and medical technology

industries, as well as the academic institutions conducting research within life science and hospitals treating patients in the clinic.



The new materials research facilities MAX IV and ESS in Lund.

LIFE SCIENCE IN SWEDEN AND DENMARK: Key figures and trends

PHOTO: GENMAB

Power relations in Danish and Swedish life science have changed over the past 10 years; Danish life science exports and employment have surpassed their Swedish counterparts. In 2014, 52% of all employees in the life science industry in the two Nordic countries were employed in Denmark.

- Danish life science exports are almost 50% greater than Swedish life science exports.
- Danish pharmaceutical exports and health technology will exceed agricultural exports in a few years.
- Denmark is the fourth largest exporter of life science products per capita, while Sweden is the tenth largest.
- Medicon Valley has reinforced its position as the Scandinavian life science centre in the period from 2008-2014, employing a total of 53% of those in the life science sector in Denmark and Sweden.
- An ever-increasing number of employees in the life science sector are highly trained. In 2014, people with higher education made up 29% of those employed in life science in Denmark and 40% in Sweden.
- The companies with research in natural sciences as main purpose reduced their number of employees by 33% in the period from 2008-2014 in Sweden, whilst in Denmark, 6% more were employed in the same period.
- Medicon Valley is also the Scandinavian centre for commercial research in the natural sciences. A total of 49% of all the Danish-Swedish natural science research capacity – outside of hospitals, universities and life science production companies – can be found in Medicon Valley.

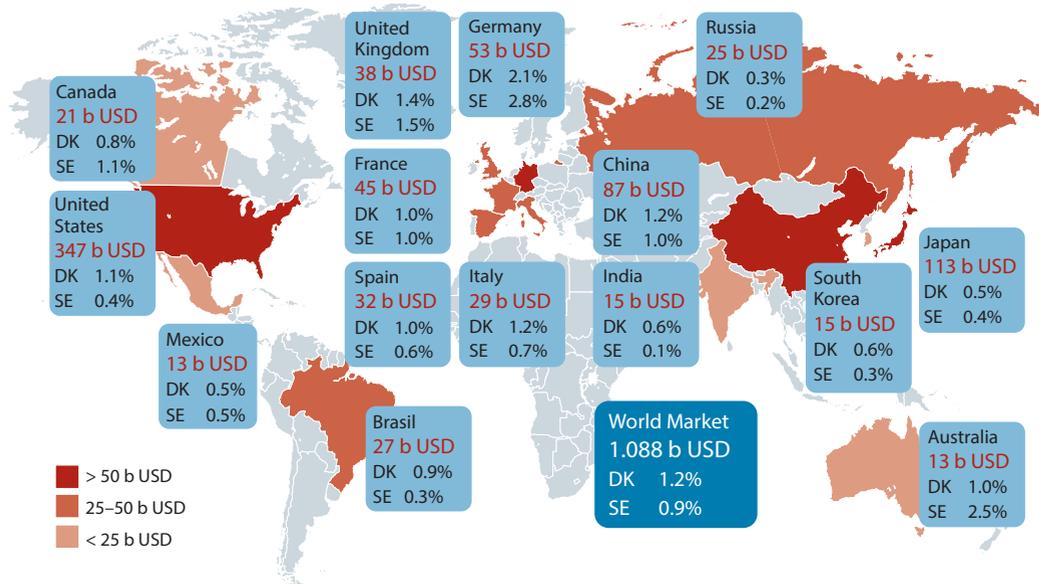
USA EXPORTS BOOST DANISH LIFE SCIENCE

The American market is the dividing-line between Danish and Swedish product exports within the life science industry. Advancements in the US have been an important factor in the doubling of Danish life science exports in only seven years. Last year, Danish life science exports to the USA went up to 26 billion Danish crowns; this can be compared to the Swedish exports, which were the equivalent of 10 billion Danish crowns. Denmark is the world's fourth largest exporter of life science products per capita.

The global pharmaceuticals (medicines) market is a 1.1 trillion USD industry in 2015 and is expected to reach 1.4 trillion USD in 2020 – that is an almost 30% increase from 2015. The United States is unquestionably the largest pharmaceuticals market, accounting for 40% of global sales. Per capita spending on medicine rose by 27% from 2006 to 2015 if calculated according to the prices paid to distributors, but only 9.5% if calculated according to the net amount, including discounts; i.e. the amount that goes to the manufacturers. Since

its adoption in 2010, the Patient Protection and Affordable Care Act, better known as Obamacare, has reformed the American health care sector, and has been a contributing factor in increasing medicine sales in the US. Formerly, the American market was distinctive in that prices were not negotiated between distributors and manufacturers, as they are in Europe. The developments in the USA have affected companies differently. The three largest PBMs cover 75% of insured Americans. In Novo Nordisk's semi-annual report for the

SALES AND MARKET SHARES



Source: IMS Institute for Healthcare Informatics and UN Comtrade database

ABOUT THE FIGURES

The figures for the global pharmaceuticals market are the amounts invoiced to pharmacies and hospitals by distributors. Those amounts are not equivalent to the amounts that manufacturers of pharmaceuticals receive for their products; discounts and other price agreements are not included.

The source for this information is the IMS Institute for Healthcare Informatics. The source for the global market export is the UN Comtrade database. The Danish figures however have been retrieved from Statistics Denmark, since figures available on the UN Comtrade database were incorrect, presu-

mably because secrecy protects the figures for a large portion of Danish exports.

The Danish and Swedish life science sectors' exports are calculated as the export of Medicinal and pharmaceutical products (SITC 54), as well as Instruments and appliances, n.e.s., for medical, surgical, dental or veterinary purposes (SITC 87.2). The SITC classification is the UN's classification system for goods (Standard International Trade Classification). The sources are the foreign trade statistics from Statistics Denmark and Statistics Sweden, respectively.

first half of 2016, there is talk of intensified price competition, whilst the CEO of H. Lundbeck Kåre Schultz reports that they have not noticed anything but perfectly normal price discussions. From a global perspective, the USA, China, Japan and Germany are the four largest markets for the sale of pharmaceuticals and health technology. Of these countries, the USA, Germany and China top the list – in that order – of the largest markets of Danish and Swedish life science exports, whilst Japan is among the ten largest.

Danish life science companies have a far better hold on the American and Chinese markets than the Swedish do. In 2015, Danish life science exported goods worth a total of 26 billion Danish crowns to the USA, and Swedish life science exported for the equivalent of 10 billion Danish crowns. The American market for life science products represents 13% of the growth in Swedish life science exports, but 41% of growth in the export of Danish life science products. The American market plays a vital role for Novo Nordisk's insulin products, since one

DENMARK THE FOURTH LARGEST EXPORTER OF LIFE SCIENCE PRODUCTS, MEASURED IN EXPORT PER CAPITA

Country	Export per capita, USD	Percentage of global life science export
Ireland	8 504	6.2%
Switzerland	8 363	10.8%
Belgium	4 664	8.3%
Denmark	2 410	2.2%
Singapore	1 976	1.7%
Netherlands	1 936	5.2%
Slovenia	1 316	0.4%
Austria	1 166	1.6%
Germany	1 084	13.9%
Sweden	955	1.5%

Source: UN Comtrade

in five Americans is overweight and therefore at an increased risk for developing diabetes. However, LEO Pharma for example also sells well in the USA with their gel for solar keratosis.

It should be noted though that export statistics do not present a complete picture; as in many other sectors, manufacturing is increasingly being established on various local markets. In August 2015, Novo Nordisk announced plans to invest 13.6 billion Danish crowns in two new factories, the larger of which was to be in North Carolina, USA, where the company already has facilities. Other examples are the hearing aid manufacturers Oticon and Widex, which have moved production from Denmark to Poland and Estonia, respectively.

In 2015, Danish life science exports to China were worth 7 billion Danish crowns, whilst goods exported by the Swedish life science sector to China were worth a total of 5.7 billion Danish crowns. The Chinese market comprises more than half of the growth in Swedish life science exports. The value of the exports to the Chinese market have risen almost as much in Denmark as in Sweden.

The large increase in sales in the US is a significant reason for the doubling of Danish life science export during a period of seven years from 2008-2015, amounting to an annual growth of 10.4%. In the same period, Swedish life science exports increased by 2.6% annually. From

13% under Swedish exports in 2008, Danish life science exports are now almost 50% greater than the Swedish.

Overall, life science exports have comprised nearly all of the growth in exports in the period 2008-2015, both in Denmark and in Sweden. The financial crisis caused a violent drop in global trading, and the result of the global recession that followed has been a moderate annual growth of 0.1% in both Danish and Swedish exports without the inclusion of life science. If life science exports are included, the picture is a different one: the annual growth in Danish exports is 1.2%, and the Swedish is 0.2%.

Danish life science exports are well on their way to surpassing exports of food and beverages and becoming Denmark's most important export business. Life science exports made up 94% of exports of food and beverages in 2015, and if the trend continues, it will surpass them in a few years.

Denmark is the fourth largest exporter of life science products per capita. Germany, the USA and Switzerland are – in that order – the world's largest exporters of life science products. However, when the countries' sizes are taken into account, the leading life science exporters per capita are Ireland, Switzerland, and Belgium, with Denmark firmly in fourth place, and Sweden as the tenth largest exporter. Overall, Danish life science exports make up 2.2% of total global life science exports, while the Swedish make up 1.5%. American life science companies' largest market is domestic, which pushes the USA off of the list of leading life science exporters per capita. The same holds true for the leading European life science manufacturers Great Britain and France, while Germany comes in as the ninth largest exporter per capita. According to the CEO of H. Lundbeck Kåre Schultz, the reason that Danish life science companies and Danish exports have developed significantly better than their Swedish counterparts are differences in ownership models (see the interview on page 78).

– Foundation ownership means that the companies are still in Denmark, while the big Swedish companies have been sold off, he explains.

The owner of Ferring, Frederik Paulsen, offered the same explanation in an interview with the Øresund Institute in 2011.

– I remember how Sweden had an incredibly strong pharmaceutical industry in the 1980s and

was a global leader in many fields. In Sweden people would laugh at the Danish pharmaceutical companies that were owned by foundations and couldn't develop as strongly as Astra and Pharmacia, which are listed on the stock market.

Frederik Paulsen pointed out how the Danish foundation-owned companies were able to grow in the long term instead.

– Look at the situation today. The Swedish pharmaceutical industry is almost wiped out. Novo Nordisk had a few tough years but was able to come out of that in one piece because their ownership is stable. I really admire Novo Nordisk.

Pharmacia is no longer in Sweden since the company was bought up by Pfizer in 2002, and Astra merged

with British Zeneca, who closed the research facility in Lund and cut back operations in Södertälje.

According to the Swedish Professor of Economy Bo Carlsson at the Weatherhead School of Management in Ohio, small life science companies believe that it would require too great of an effort to penetrate the American market and thus often concentrate on Europe first; see the interview on page 83.

One explanation for Denmark's success being so much greater than Sweden's in the world's largest pharmaceuticals market – the USA – might be that the large companies are still in Denmark, while the Swedish companies have been sold off.

THE PRINCIPAL EXPORT MARKETS FOR DANISH LIFE SCIENCE

	Exports in millions (DKK) 2015	Annual growth 08-15
USA	26 032	20%
Germany	7 587	9%
China	6 971	30%
Sweden	4 557	2%
Japan	3 677	5%
Great Britain	3 484	8%
France and Monaco	2 866	-1%
Norway	2 236	11%
Italy	2 235	6%
Finland	2 170	6%

Source: Statistics Denmark

THE PRINCIPAL EXPORT MARKETS FOR SWEDISH LIFE SCIENCE

	Exports in millions (DKK) 2015	Annual growth 08-15
USA	10 032	3%
Germany	9 911	7%
China	5 657	33%
Great Britain and Northern Ireland	3 735	5%
Norway	3 155	1%
France	3 025	-7%
Japan	2 795	22%
Australia	2 119	-1%
Finland	2 046	-1%
Denmark	1 712	-3%

Source: SCB/Statistics Sweden

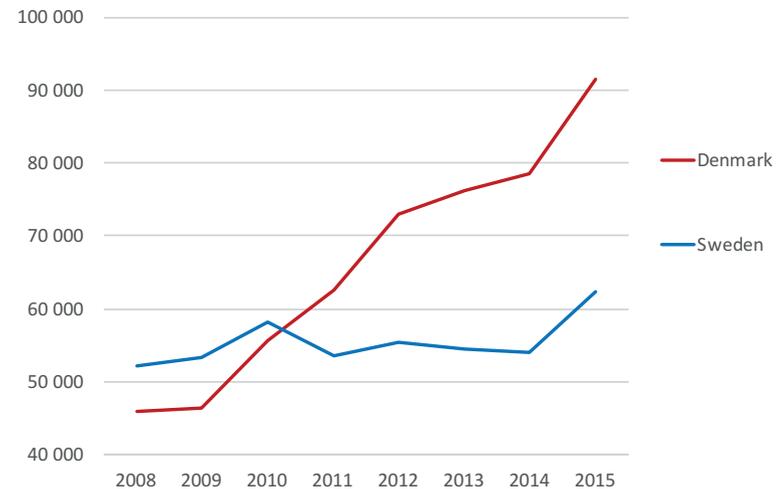


MEDICON VALLEY

Medicon Valley is the bi-national life science cluster spanning the island of Zealand in Eastern Denmark and the Skåne-region of Southern Sweden. Today, the Danish-Swedish region is marketed internationally with the name 'Greater Copenhagen', and its increasing population has almost reached four million residents. In Sweden, the same geographical area is often called the 'Öresund Region'.

DANISH LIFE SCIENCE EXPORT DOUBLED IN SEVEN YEARS

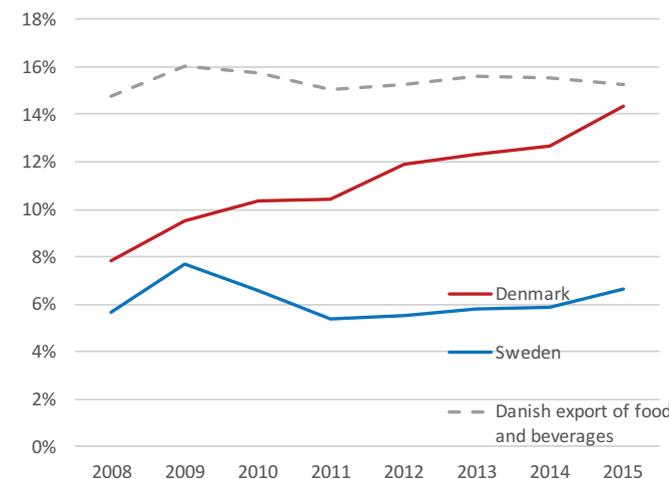
Value of exports of medical and pharmaceutical products and medical instruments, apparatuses etc in millions (DKK)



Source: Statistics Denmark and SCB/Statistics Sweden

DANISH LIFE SCIENCE EXPORT NEARLY EQUAL TO EXPORTS OF FOOD AND BEVERAGES

Exports of medical and pharmaceutical products and medical instruments, apparatuses etc in millions (DKK)



Source: Statistics Denmark and SCB/Statistics Sweden

10.4%

annual growth in Danish life science exports. This corresponds to a doubling in seven years. In the same period, Swedish life science exports have risen by 2.6% annually.



PHOTO: BAWARIAN NORDIC

94%

of the value of food and beverage exports correspond to life science exports in 2015. In a few years, life science exports will surpass exports of food and beverages, if the trend continues.



PHOTO: COLOPLAST

EMPLOYMENT DEVELOPMENT - A MEDICON VALLEY STRENGTH

The balance of power between Danish and Swedish life science has changed over the past ten years. Both Danish life science exports and employments have surpassed their Swedish counterparts. In 2014, 52% of those employed in the life science industry in the two Nordic countries were employed in Denmark. A total of 34 797 are employed in the Danish life science industry, while 32 007 are employed in Sweden (2014). Back in 2008, the Swedish life science industry had a much better position, and employment was more or less equally distributed, but with a slight Swedish dominance.

The number of employees in Danish life science companies has risen by 10% in the period from 2008-2014, while the number of jobs in the Swedish life science industry fell by 15% in the same period. The fall in employment within Swedish life science companies of 5 702 jobs is so large that it cannot be made up for by the substantial increase of 3 123 jobs in Denmark. All in all, Danish-Swedish life science has lost 2 579 jobs.

Behind the falling Swedish life science employment are global cutbacks at the pharmaceutical giant Astra Zeneca, which have resulted in the closure of the research facility in Lund and cutbacks at GE Healthcare BioSciences and Pharmacia. Astra Zeneca's investment of 2.3 billion Swedish crowns in a new facility for the manufacturing of biological medicines in Södertälje, slated for completion in 2018, is seen as a sign that employment rates in the sector have now bottomed out and will soon begin to rise again.

In Denmark, media focus has shifted from progress to hardships after September 2016, when Novo Nordisk announced that they would be cutting 1 000 jobs due to pressures on prices in the USA, 500 of which were in Denmark. Since 2015, a series of decisions have also been made regarding continued expansion. In 2015, Novo Nordisk decided to invest 2.1 billion Danish crowns in a new factory in Hillerød, 500 million in a new Danish central depot for raw materials in Hillerød, 13.6 billion crowns in a factory in North Carolina, USA, and a factory in

Måløv in Denmark, at the same time as plans were being made for an addition to the company's large manufacturing facility in Kalundborg (DK). And last year, their subsidiary Novozymes decided to build a new research centre in Lyngby (DK) with space for 800 employees and the possibility for expansion for 2 500 employees in an area otherwise known primarily for the Technical University of Denmark, DTU. In the autumn of 2016, the pharmaceutical company Ferring announced that it was investing billions in a new research facility, Soundport, which is being built on the Öresund Strait, not far from Copenhagen Airport in Kastrup. There will be space for 750 employees there; i.e. 50% more than those accommodated in the current facilities in Ørestad, which will no longer be used after the move to Soundport in 2019.

"In Denmark and Sweden, those with a higher education increasingly tend to make up a larger part of the employment force."

In both Denmark and Sweden, the life science sector has developed in the opposite direction to other employment. Despite rising employment rates in Denmark in recent years, the total employment has yet to reach pre-crisis levels from 2008; however, employment within the life science sector has risen by 10% in the same period. In Sweden, total employment has risen by 5% compared to 2008, whilst employment in the Swedish life science sector fell by 15% in the six years from 2008 to 2014.

Life science is the only industry in Denmark to generate new jobs between 2008 and 2014. A total

of 3 123 new jobs were created in the life science sector between 2008-2014, which corresponds to an average annual employment growth of 1.6 %.

Medicon Valley has strengthened its position as the Scandinavian life science centre in the period from 2008-2014. Medicon Valley employs a total of 53% of those in the Danish-Swedish life science

sector; this is more than twice as many as the second-largest Scandinavian life science cluster, Stockholm-Uppsala region where 23 % of the Danish-Swedish life science sector was employed in 2014. Between 2008-2014, Stockholm-Uppsala region lost ca. one in five jobs (-18%), whilst the life science companies in Medicon Valley saw a 4%

increase in employees. Medicon Valley is the only area in Denmark and Sweden where the number of employees has increased steadily in the same period. The rest of the two countries have seen a fall in employment or moderate growth.

The creation of jobs in the life science sector has benefited those with a higher education. Between 2008-2014, there was a net increase of 3 205 jobs for people with higher education or research training, whilst there were 82 fewer jobs for those with a lower level of education. These figures encompass large regional differences, however; while 454 positions were created for people without a higher education (manufacturing positions) in the Capital Region of Denmark, 536 positions were eliminated elsewhere in Denmark.

53%

of those employed in the Danish-Swedish life science sector are employed in Medicon Valley. That is more than double the number employed at Scandinavia's second-largest life science cluster Stockholm-Uppsala region.

4%

more have been employed by life science companies in Medicon Valley between 2008-2014, while Stockholm-Uppsala region has lost about one in five jobs (-18%).

34%

of those employed at life science companies in the Capital Region of Denmark have a higher education or research training.

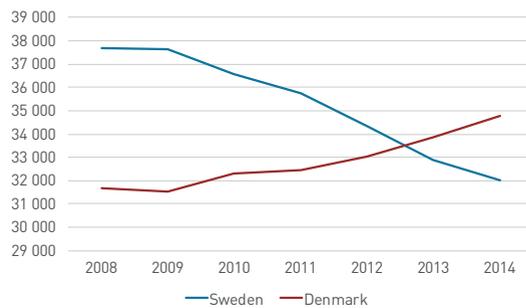
There is a significant difference in the distribution of employees in the Capital Region of Denmark and the rest of the country. In the Capital Region, 34% of employees have higher education or research training; in the rest of Denmark, manufacturing positions and other positions that do not require a minimum higher education are far more common. Only 10% of those employed in life science companies in western Denmark have completed a higher education, compared to 16% in Region Zealand.

The drop in employment within Swedish life science has hit those without a higher education hardest. In Sweden as well as in Denmark, there is a general tendency for those with a higher education to increasingly make up more of the workforce. In 2014, those with a higher education comprised 29% of the people employed in Danish life science, which was an increase from 21% in 2008. The cor-

responding figures for Swedish life science are 40% in 2014 and 36% in 2008.

The larger percentage of highly educated people in the life science industry can be explained by the fact that many manufacturing positions have been moved abroad, whilst companies have concentrated their Nordic activities on research and development. One example is Ferring, who closed its production facility in Vanløse, Copenhagen in 2008 and moved production to the Czech Republic and Switzerland. It appears that this tendency will continue; for example, in August 2016 William Demant Holding (Oticon) announced that the company's hearing aid production would move from Thisted in Jutland to Poland within the next two years. Shortly before that, Oticon's competitor Widex had announced that 400-500 Danish jobs would disappear when the company's production was moved to Estonia.

LIFE SCIENCE EMPLOYMENT



Source: Statistics Denmark and Statistics Sweden



PHOTO: NEWS ØRESUND

ABOUT THE FIGURES

This section will present statistics for the core area of life science, the manufacturing sectors: 21 Pharmaceuticals, 26.60.10 Manufacture of hearing aids and supplies, 26.60.90 Manufacture of irradiation, electro-medical and electrotherapeutic equipment, 32.50.00 Manufacture of medical and dental instruments and supplies and 46.46.10 Wholesale of pharmaceutical and nursing goods. The sources are the Register-based Labour Force Statistics in Denmark (RAS) and in Sweden (RAMS). Statistics Denmark and Statistics Sweden utilise industry coding (DB07) and (SNI2007),

both of which are based on and correspond to the European industry classification NACE. Other industry subdivisions of the life science sector cannot be extracted as they are placed within service sectors such as business services, which covers a significantly broader area than life science. The advantage of using the narrow definition of the sector is that it becomes possible to trace the industry's development over time, as well as to make European and international comparisons. The disadvantage is that the life science industry is not shown in its entirety.

EMPLOYMENT DISTRIBUTED BY REGION IN DENMARK AND SWEDEN

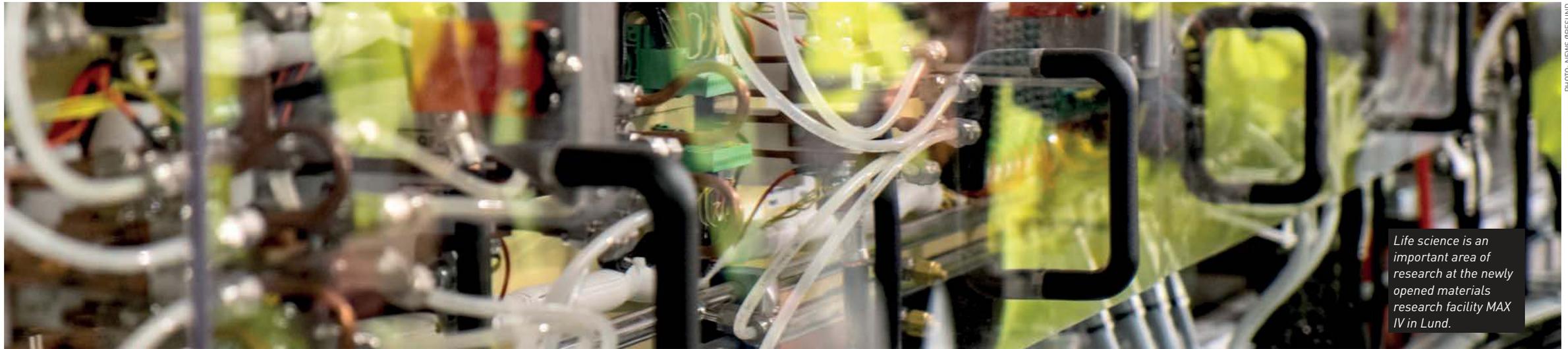


Source: Statistics Denmark and Statistics Sweden

EMPLOYMENT AND CHANGE OVER TIME

	2014	Annual change 2008-14	Change 2008-14
Denmark	34 797	1.6%	10%
- Capital Region of Denmark	25 431	2.3%	15%
- Region Zealand	5 283	0.2%	1%
- Denmark, rest of	4 083	-1.0%	-6%
Sweden	32 007	-2.7%	-15%
- Skåne	4 970	-5.4%	-28%
- Stockholm-Uppsala region	15 588	-3.3%	-18%
- Västra Götaland	6 822	0.4%	2%
- Sweden, rest of	4 627	-1.5%	-9%
Medicon Valley	35 684	0.7%	4%

Source: Statistics Denmark and Statistics Sweden



EMPLOYEES IN COMMERCIAL RESEARCH

National statistics do not place pure research companies in the same industry categories as pharmaceutical manufacturers and medical technology companies. Research companies are categorised with other scientific research, and it is impossible to determine whether the businesses perform research within life science or other scientific research. As research is an integral element, data is presented for the number of employees in businesses whose primary purpose is scientific research in natural sciences.

Companies with research in the natural sciences as main purpose provide employment for 15 000 people in Denmark and 17 600 in Sweden (2014). This includes basic research, applied research and experimental development, but does not include research performed as an integrated part of hospitals' activities, at universities or in life science production companies. The majority (87% in Denmark and 95% in Sweden) are employed in other companies performing natural scientific re-

arch than biotechnology. Companies with research in natural sciences as main purpose reduced their number of employees by 33% between 2008-2014 in Sweden, whilst in Denmark, 6% more people became employed in such companies.

When it comes to business research in the natural sciences, Medicon Valley is the Scandinavian hub. A total of 15 000 (2014) people were employed in companies with scientific research as main purpose in Medicon Valley, which is equal to 46% of all of those in non-academic Danish-Swedish natural scientific research external to universities and the hospitals. The Stockholm-Uppsala region employs 7 400 people (2014). However, the number of employees in commercial research in the natural sciences fell 5% in Medicon Valley between 2008 and 2014, negatively affected by developments in Skåne. The loss of jobs in commercial natural science research was significantly lower than it was in the Stockholm-Uppsala region, which lost 37% of their employees in the sector in the same period.

ABOUT THE FIGURES

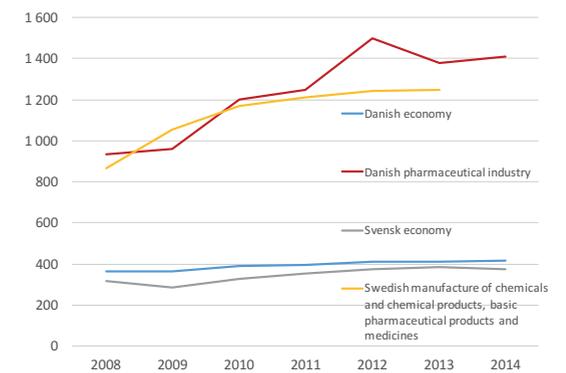
Scientific research companies are defined with the industry codes 72.11 Research and Experimental Development in Biotechnology and 72.19 Other Research and Experimental

Development in Natural Sciences and Engineering. The sources are the Register-based Labour Force Statistics in Denmark (RAS) and Sweden (RAMS).

PRODUCTIVITY

The pharmaceutical industry is one of the most highly productive industries. The hourly productivity measured as gross valued added per hour of labour in the Danish pharmaceutical industry and the sum of the pharmaceutical industry and chemical industry in Sweden is almost three times higher than the general economic productivity. Productivity growth is the single-most powerful factor when it comes to increasing economic growth. With an increase in productivity between 2008-2013/14, the pharmaceutical industry has made a positive contribution to increasing economic growth and thus also economic prosperity. Hourly productivity in the Danish pharmaceutical industry rose by 50% between 2008-2014, and 44% in the Swedish pharmaceutical and chemical industries between 2008-2013.

HOURLY PRODUCTIVITY IN THE PHARMACEUTICAL INDUSTRY



Source: Statistics Denmark and SCB/Statistics Sweden

ABOUT THE FIGURES

Hourly productivity measures the GVA per hour of labour. It is not possible to retrieve statistics for gross value added for the sectors 26.60.10 Manufacture of hearing aids and supplies, 26.60.90 Manufacture of irradiation, electromedical and electrotherapeutic equipment and 32.50.00 Manufacture of medical and dental instruments and supplies, as the level of detail for these is

too high as regards the level of detail on which national accounts are calculated. It is possible to retrieve statistics for the pharmaceuticals industry in the Danish national accounts, whilst the pharmaceuticals industry in Sweden is not calculated separately, but rather in conjunction with the chemicals industry for reasons of confidentiality in the Swedish national accounts.

Most patent applications were from Medicon Valley

In 2012, Medicon Valley filed more than double as many patent applications to the EPO within medical or veterinary science than the Stockholm-Uppsala region (by priority date). Leading life science companies as Novozymes and Novo Nordisk are among the 25 top applicants to EPO – Novo Nordisk in the categories medical technology, biotechnology and pharmaceuticals, and Novozymes in biotechnology. The only life science company with activity in Sweden on the top 25 list is Astra Zeneca, but its presence owes to research activity in other countries than Sweden.

The number of patent applications to the European Patent Office (EPO) for life science (medical technology, biotechnology and pharmaceuticals) rose by 12% between 2008 and 2015; this is measured by publication date, which is 18 months after the filing of the national application. Medical technology is the patent category for which most applications were filed (12 474) to the EPO in 2015, whilst biotechnology and pharmaceuticals hold the last two places on the top ten – with 6 048 and 5 884 respectively. The three technology fields have undergone different developments in the same period, with a 28% increase in patent applications in medical technology, a 9% increase in biotechnology applications and an 8% decrease in the number of patent applications for pharmaceuticals.

There are three Danish/Swedish life science companies among the 25 companies that have filed the most applications to the European Patent Office in their respective fields. Novo Nordisk appears three times and is among the 25 most frequent patent applicants for medical technology, biotechnology and pharmaceuticals.

The other Danish company also hails from the Novo-sphere: Novozymes is the third most frequent applicant in biotechnology at EPO. The only life science company on the list with significant activity in Sweden is Astra Zeneca, which comes in at number 16 on the list of companies that have filed the greatest number of applications in pharmaceuticals to the EPO.

The number of Danish life science patent applications to EPO exceeded the amount of Swedish life science patent applications for the first time in 2012. Here, 2012 is the priority date, i.e. the year for the patent application to the national patent office, which precedes an application to EPO. 2012 is the latest year for which statistics by priority date are available.

The number of Danish and Swedish life science patent applications to EPO hit an all-time high in 2005 with respectively 438 and 662 applications, according to OECD's Patent Statistics. Since then, the number of Danish applications has fallen 21% and the Swedish 50%. Patents applications from other large European life science nations such as Switzerland and Germany have decreased 20% respective 15% in the same period.

Medicon Valley is leading in Denmark and Sweden with the overall highest number of patent applications to the EPO within medical or veterinary science, and more than double as many patents as from the Stockholm-Uppsala region in 2012 (priority date), as figures from Eurostat show. Approximately 50% of the Danish and Swedish life science patents applicants are situated in Medicon Valley.

According to Jens Viktor Nørgaard, European Patent Attorney and Head of Biotech and Pharma at the leading patent firm HOIBERG Medicon Valley is among the leading life science hubs in Europe "The data confirms our experience that Medicon Valley is the leading life science hub in Scandinavia and one of the leading life science hubs in Europe. This is also reflected in a growing interest among overseas applicants in using European Patent Attorneys from Medicon Valley for their European filings.

As for southern Sweden, we have also seen a very vibrant biotech ecosystem growing and prospering in Lund with an increasing number of new patent applications being filed by Lund-based startups. "There are lots of hopes for Swedish biotech."

The five Danish and Swedish life science companies with the most patent applications to the

"The data confirms our experience that Medicon Valley is the leading life science hub in Scandinavia and one of the leading life science hubs in Europe."

EPO between from 2008-2015 are responsible for almost half of the total number of Danish and Swedish patent applications. The five companies with the most patents applications to EPO in the period 2008-2015 are Astra Zeneca, Novozymes, Novo Nordisk, Coloplast and H. Lundbeck. Astra Zeneca applied for the overall greatest number of patents, but the number of patent applications from the Swedish division of Astra Zeneca

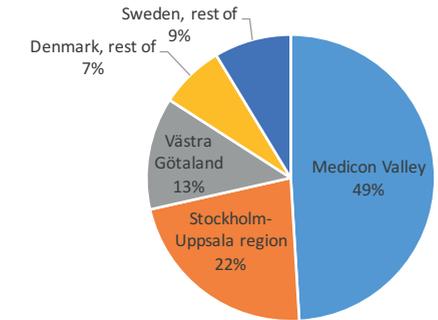
TOP 5 PATENT APPLICANTS IN LIFE SCIENCE FROM DENMARK AND SWEDEN, 2008-15

Astra Zeneca, Sweden only
Novozymes
Novo Nordisk A/S
Neurosearch A/S
H. Lundbeck

Source: European Patent Office and United States Patent and Trademark Organization, from excerpts from the Danish Patent and Trademark Office

has dropped drastically from 2008 until today. In 2015, these figures were less than one-tenth of that – 26. In the same period in 2015, Novozymes had 84 patent applications published in Europe, but significantly more in the USA – 131.

PUBLISHED LIFE SCIENCE PATENT APPLICATIONS TO EPO, 2015



Source: Eurostat

DANISH AND SWEDISH LIFE SCIENCE PATENT APPLICATIONS IN EUROPE

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Denmark	443	438	388	472	385	330	332	341	347
Sweden	518	662	575	569	487	430	372	361	330

Source: OECD

ABOUT THE FIGURES

This section presents data from OECD and EPO for patent applications to the European Patent Office (EPO) distributed by priority date and publication date. Normally, a patent application to EPO is preceded by an application to the national patent office. The filing date for the application to the national patent office is the priority date for the subsequent application to EPO. The publishing date for a patent application to EPO is usually 18 months after the priority date. Patent information from USPTO is rather old at the time of publishing, and for that reason it has been chosen primarily to present data for EPO, even though the interest in patent applications at USPTO has grown as a consequence of the growth of the American medical market. The international patent classification (IPC) has been used in order to

isolate life science patent applications from other categories. The Danish Patent and Trademark Office identified the relevant IPC categories for life science, which have been extracted from the OECD database.

The figures presented use the applicant's country and municipality of residence to distribute the patent applications geographically. Source for the regional distribution of patent application is EUROSTAT. EUROSTAT does not present the figures on detailed IPC categories, therefore, only figures for medical or veterinary science is presented.

The Danish Patent and Trademark Office has extracted patent applications from the EPO database for companies with Denmark and Sweden as the application country; this has been used as source for the company-specific analysis.

LIFE SCIENCE IN MEDICON VALLEY: Key figures and trends

The strongest life science municipalities in Greater Copenhagen reinforced their position in the period from 2008-2014. The development has been powered by a few large Danish companies, whilst employment on the Swedish side has fallen drastically. The picture is another, however, if one looks broadly at natural science research. Here, Copenhagen and Lund are Medicon Valley's flagship with the greatest number of employees within scientific research.

- The Danish part of Greater Copenhagen provides employment for 86% of those employed in life science in the region.
- The Capital Region of Denmark has strengthened its position with employment growth of 15% between 2008 and 2014.
- Cutbacks at Astra Zeneca in Lund explain the dramatic 28% drop in life science employees in Region Skåne.
- The five largest life science municipalities: Gladsaxe, Ballerup, Copenhagen, Kalundborg and Hillerød – employ 25 000.
- Employment growth between 2008-2014 has been concentrated in the municipalities where there were already many employees in the industry.
- 15 000 are employed in companies that perform research in natural sciences (2014). That is 8% less than in 2008; this is primarily due to a slowdown in Skåne. 10 000 are employed in academic research in natural sciences (2015).
- Copenhagen and Lund are at the forefront of research in the natural sciences in Greater Copenhagen.

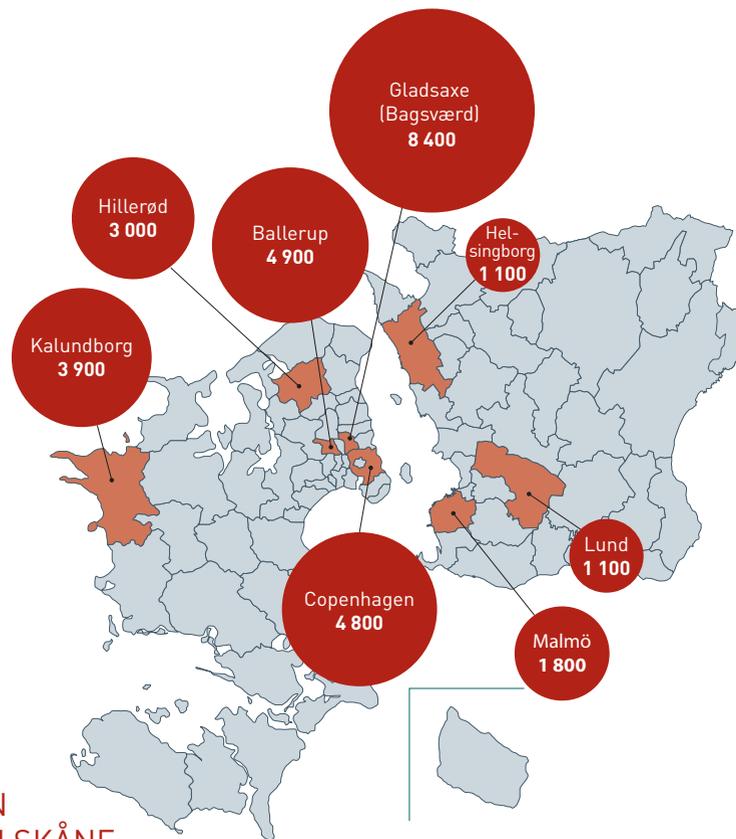
THE LARGEST LIFE SCIENCE MUNICIPALITIES HAVE STRENGTHENED THEIR POSITION

The life science sector is concentrated in a few municipalities that have taken an ever-more dominant position. Between 2008 and 2014 the sector grew in the Capital Region of Denmark, whilst employment rates in Region Skåne dropped, primarily due to the closure of Astra Zeneca in Lund.

The 35 700 employees in the life science sector in Medicon Valley are divided into 5 000 on the Swedish side of the Öresund and 30 700 on the Danish side. The Capital Region of Denmark is predominant in Medicon Valley and has strengthened its position since 2008 with an employment growth of 15%. Employment rates in life science in Region Zealand have also risen between 2008-2014, although the increase has been moderate at 1.3%. As in the rest of Sweden, however, Region Skåne has also lost a number of jobs. In Region Skåne, a total of 28% of the positions within life science

have been eliminated since 2008; the closure of Astra Zeneca in Lund is the primary explanation. 63% of those employed in the life science industry in Medicon Valley are employed within pharmaceuticals, whilst medical technology companies provide employment for 19%, and 18% are employed in wholesale trade businesses.

These figures for 2014 are the most recent official figures for employment in the Register-based Labour Force Statistics at Statistics Denmark and Statistics Sweden.



EMPLOYMENT IN LIFE SCIENCE IN SKÅNE AND ZEALAND BY MUNICIPALITY

Source: Statistics Denmark and Statistics Sweden

ABOUT THE FIGURES

This section presents statistics for the core area of life science – the manufacturing sectors: Pharmaceuticals, 26.60.10 manufacture of hearing aids and supplies, 26.60.90 Manufacture of irradiation, electromedical and electrotherapeutic equipment, 32.50.00 Manufacture of medical and dental instruments and supplies and 46.46.10 Wholesale of pharmaceutical and nursing goods. The sources are the Register-based Labour Force Statistics in Denmark (RAS) and in Sweden (RAMS). Statistics Denmark and Statistics Sweden utilise industrial classification (DB07) and (SNI2007), both of which are based on and correspond to the European industry classification NACE. Note that it is possible that branch codes are assigned to companies differently in Denmark and Sweden.

Other industry subdivisions than the above men-

tioned cannot be extracted as they are placed within service sectors such as business services, which covers a significantly broader area than life science. The advantage of using the narrow definition of the sector is that it becomes possible to trace the industry's development over time, as well as to make European and international comparisons. The disadvantage is that the life science industry is not shown in its entirety. Therefore, the figures on a municipality level are supplemented by figures for employees at life science companies not covered by the national statistical figures from Statistics Denmark and Statistics Sweden; examples are Novozymes and Biogen. The supplementary information has been collected from the relevant companies either via email, telephone or via the company website; from Nordic Business Key; www.allabolag.se; or from news articles.

Whether the positive trend within employment has continued after 2014 is uncertain. In June of 2014, Novo Nordisk announced intentions to employ 6 000 new employees by 2022, but after a disappointing first half of 2016 and the increased pressure on prices on the American market, it chose instead to stop hiring in August of 2016, announcing in September that it would be cutting 1 000 jobs globally, 500 of which were in Denmark. Novo Nordisk has however not revoked the billion-crown investments announced in 2015, see more on p.17. Lundbeck has also cut back its staff. In August of 2015 it presented a global austerity plan that cut the jobs of about 300 employees in Denmark, and in September 2016, Coloplast announced that 300 positions would be eliminated in Denmark due to austerity measures. Its factory in Thisted, Jutland (DK) will be closed, but other positions will also be eliminated in Mørdrup in northern Zealand. There have also been cutbacks on the Swedish side of the Öresund Strait. Active Biotech in Lund has had to cut back its staff from 56 to 17 employees between 2015 and 2016. Baxter (formerly Gambro) announced in March of 2016 that 75 of its research employees would lose their jobs, as the company would be concentrating all of the research and development for its dialysis fluids and dry concentrates in Belgium. Gambro was founded in Lund and based on the invention of a single-use artificial kidney. But like Pharmacia and Astra, Gambro's Swedish company shrunk drastically after it changed owners and was sold off to the American competitor company Baxter, which has since put its own name on the absorbed company.

The life science industry is concentrated in a small number of municipalities. The five largest of these municipalities are all located on the Danish side of the Öresund Strait, and they alone employ 25 000. Employment growth in the period from 2008-2014 has been concentrated in the municipalities where there were already many employees in the industry. In general, companies have consolidated their operations and concentrated their activities in fewer locations than before. Often, manufacturing jobs are the ones being moved abroad, or research activities are being consolidated in larger cities. Novo Nordisk's great success explains the majority of the

rise in employment. Novo Nordisk is established in each of the five largest life science municipalities.

The three largest university cities – Copenhagen, Malmö and Lund – are on the top of the list of the largest life science municipalities on the Danish and the Swedish sides respectively, and four of the five largest Danish municipalities are located in the Capital Region of Denmark. Approximately one-third of those employed in life science companies in the Capital Region of Denmark (34%) and in Region Skåne (38%) have a higher education or research training,

whilst only 16% of those in Region Zealand have the same. The highly educated account for a steadily growing number of employees, particularly in life science companies in the Capital Region of Denmark, where the percentage of highly educated workers rose from 27% in 2008 to 34% in 2014.

The cluster is also important for municipalities that are not dominated by life science companies. In Holbæk Municipality, there are only six life science companies with a total of 220 employees; nonetheless, the industry is an important employer for the community's residents, says business consultant Niels Nielsen. The municipality is close to Kalundborg, where Novo Nordisk and Novozymes have large facilities, and to Nykøbing Sjælland, where H. Lundbeck has its API-factory. Traveling in the other direction, there are a large number of life science companies in and around Copenhagen.

– Holbæk's location between Kalundborg and the other medical companies around the capital means that a lot of our residents work in the medical sector.

While the life science industry has expanded enormously for many successive years, there have also been cutbacks and facility-closures in the region. Two years ago, Takeda closed its factory in Roskilde, which had about 500 employees.

In 2013, Arjo closed its factory in Eslöv (SE), which formed the roots of what is now Arjo Huntleigh and also a part of the stock exchange-listed Getinge Group. It has been almost two years since BASF decided to put its subsidiary Pronova Biopharma's factory with its 60 employees in Kalundborg on ice. In 2012, the medical technology company Dickinson closed its factory with 393 employees in Helsingborg (SE).

"The life science industry is concentrated in a small number of municipalities. The five largest of these municipalities are all located at the Danish side of the Öresund Strait."

MUNICIPALITIES WITH THE MOST EMPLOYEES IN LIFE SCIENCE

**GLADSAXE: 8 400 EMPLOYEES**

Located in the Bagsværd district are the headquarters and large facilities for the pharmaceuticals company Novo Nordisk and its subsidiary Novozymes, which works primarily with industrial biotechnology. Novo Nordisk has expanded its staff in Bagsværd from 2 813 employees in 2011 to 4 506 at the end of 2015. Novo Nordisk also has 1 726 employees in Søborg, a part of Gladsaxe Municipality. A significant number of Novozymes 2 780 employees in Denmark are located in Bagsværd.

BALLERUP: 4 900 EMPLOYEES

Novo Nordisk, LEO Pharma, BASF, GN Hearing and Symphogen are some of the more than thirty life science companies that are active in Ballerup Municipality.

COPENHAGEN: 4 800 EMPLOYEES

Two of Denmark's larger pharmaceuticals companies have large facilities in the Danish capital. H. Lundbeck, which had 1 521 employees in Denmark last

year, has its headquarters and factory in Valby, whilst Ferring Pharmaceuticals with its 478 employees in Denmark has a large research facility in Ørestad.

KALUNDBORG: 3 900 EMPLOYEES

The port city in western Zealand is the location of Novo Nordisk's largest production unit, which had 3 334 employees at the end of 2015. There is also a factory belonging to the subsidiary Novozymes with around 500 employees.

HILLERØD: 3 000 EMPLOYEES

Novo Nordisk is also a major employer in Hillerød, where the company had 2 057 employees at the end of last year. Biogen, with just over 600 employees, is also here, as are PolyPeptide and Zymenex.

MALMÖ: 1 800 EMPLOYEES

Today, Malmö is a larger city for pharmaceuticals than Lund as regards the number of employees in



life science companies. Companies such as Rechon Life Science, PolyPeptide Group, Nordic Drugs, Qpharma and Eurodiagnostica are here; all of them are in some way related to Ferring Pharmaceutical, which still has a sales office in its old hometown after moving to Ørestad and Switzerland. At Medeon Science Park there are companies such as Biora, Galencia, and Tigran. But Malmö has also become a city with numerous national and regional headquarters – from the life science sector; Lundbeck, LEO Pharma and Novo Nordisk are also here.

LUND: 1 100 EMPLOYEES

Pure employment statistics understate Lund's importance as a life science city. If university research, all of the activity at Ideon Science Park and Medicon Village, and the research facilities Max IV and the still in-progress ESS were calculated into the statistics, Lund would indisputably be Skåne's major life science city. Medicon Village runs a kind of amplified science park in Astra Zeneca's former



research premises, with a total of approximately 1 500 employees in member companies from Lund University, Region Skåne, and around 100 businesses, 14 of which are listed on the stock exchange. Among these companies are Alligator Bioscience, Immunovia and Sezagen. Adjacent to the premises is Ideon Science Park with companies such as BioInvent, Camurus and Probi, and Active Biotech in a neighbouring building.

HELSEBORG: 1 100 EMPLOYEES

Despite sharp cutbacks and shutdowns over the years, Helsingborg is one of Medicon Valley's larger life science municipalities. The municipality is home to many life science companies, large and small; one of the very largest today is McNeil, owned by the American Johnson & Johnson, which was formerly known as LEO as well as Pharmacia. Today, the company has a staff of around 650, and last year the owners invested 130 million Swedish crowns in the production of Nicorette stop smoking products.



RESEARCH IN NATURAL SCIENCES - MOST EMPLOYED IN COMMERCIAL COMPANIES

Besides the growing amount of employees in the life science companies in Greater Copenhagen (p. 25) companies with research as primary purpose and universities also employ many people. National statistics do not place pure research companies in the same industry categories as pharmaceutical manufacturers and medical technology companies. Research companies are categorised with other scientific research, and it is impossible to determine whether the businesses perform research within life science or other scientific research.

About 10 000 people in Greater Copenhagen research and educate year-round in the natural sciences, technology, medicine and health sciences at the region's universities. Another 15 000 work in companies with research in natural sciences as primary purpose (not including production companies). As far as employee distribution is concerned, there are slightly

more people working in companies with research in natural sciences as primary purpose in Denmark than in Sweden, but the number of people working in natural science, medical and technological research and education is three times higher in Denmark.

While the number of employees in research in the natural sciences at universities rose by 20% between 2010 and 2015 – on the Danish as well as the Swedish side of the Öresund – the number of people working in companies with research in the natural sciences as primary purpose has fallen in recent years. The decrease from 2008-2014 was primarily in Skåne.

COMMERCIAL RESEARCH

Employment in companies with research in the natural sciences as primary purpose had a negative development between 2008-2014, primarily due to an economic slowdown in Skåne. A total of 15 000 people are employed in companies with research in the natural sciences as a primary purpose; this is 8% less than in 2008. The number of employees in Skåne dropped by 28% in the same period, whilst the corresponding number rose by 10% on the Danish

side of the Öresund Strait. A total of 64% of those employed in companies with research in the natural sciences as primary purpose are employed in the Capital Region of Denmark.

Lund has a large number of employees in companies with research in the natural sciences as main purpose. With two large science parks – Ideon and Medicon Village – (the latter in Astra Zeneca's former research premises), the recently inaugurated materials research facility Max IV and the ongoing construction of the

European Spallation Source in Lund with its data management centre at COBIS in Copenhagen; Lund is one of the two municipalities in Greater Copenhagen with the greatest number of employees in companies with research in the natural sciences as main purpose; a total of approximately 4 300 people. Sony Mobile has one of Europe's largest development units for mobile communications in Lund, with a

staff of approximately 1 200. The company accounts for more than one-fourth of all of the employees in commercial research in the natural sciences in Lund. With competencies in IT as well as life science, emphasis on eHEALTH is obvious, and Region Skåne has also chosen to invest in the area by a strategic advisor for eHEALTH and mHEALTH. Lund is also the hometown of Medicon Village and Ideon Science Park, where many of Lund's smaller scientific research companies are located.

With approximately 4 000 job positions, Copenhagen is the second municipality that provides the most employment of people in companies with research in the natural sciences as primary purpose. The science parks Symbion and COBIS provide structure for start-ups, while national institutions such as the State Serum Institute, as well as the research centre at the brewery enterprise Carlsberg are a few of the larger workplaces. Fermentation has been a primary focus for the Carlsberg Research Center since its establishment, and founded the basis for 2cureX, which was founded in 2006. 2cureX is developing technology for the individual treatment of cancer patients. Fermentation is also the technology behind insulin production.

"Copenhagen and Lund are Greater Copenhagen's spearheads when it comes to research in the natural sciences."

ACADEMIC RESEARCH

Research in the natural sciences, technology, medicine, health and agricultural sciences takes place at a number of universities and institutions in Greater Copenhagen. The greatest number of employees in the field are at the University of Copenhagen, followed by the Technical University of Denmark (DTU) and Lund University.

Statistics from the Swedish Higher Education Authority and Universities Denmark show that a total of 10 339 people worked year-round in research and education at the University of Copenhagen, DTU, Lund University, Malmö University, IT University of Copenhagen, Roskilde University and Kristianstad University in the above mentioned categories.

On top of that are researchers at the Swedish University of Agricultural Sciences (SLU) and Aalborg University in Copenhagen – which only has part of its research in the region – and Copenhagen School of Design and Technology.

SLU estimates that there are about 250 people working in natural and agricultural sciences and technology there. Furthermore, the European research facility ESS, which will be located in Lund with a data centre in Copenhagen, employs 375 people today. When operational, the facility is expected to employ about 500 people.

The Danish side of the Strait is clearly largest in terms of employee numbers in university level research in the natural sciences, with 7 875 year-round employees in 2015.

The number of employees in natural science research and education increased 20% between 2010 and 2015 – the increase was the same on the Danish and Swedish sides of Greater Copenhagen. In 2016 however, reduced government funding has made it necessary for Danish universities to make significant cuts.



EMPLOYMENT IN NATURAL SCIENCES

ACADEMIC RESEARCH – UNIVERSITY EMPLOYEES IN RESEARCH AND EDUCATION

University	Number of year-round employees	Municipality
University of Copenhagen	4 270	Copenhagen
Technical University of Denmark (DTU)	3 300	Lyngby
Lund University	1 960	Lund
Malmö University	360	Malmö
IT University of Cph	180	Copenhagen
Kristianstad University	140	Kristianstad
Roskilde University	130	Roskilde

Source: The Swedish Higher Education Authority (Universitetskanslerämbetet) and Universities Denmark.

ABOUT THE FIGURES

Tabel I: Commercial research

The number of employees in companies with research in the natural sciences as main purpose are defined according to the industry codes 72.11 Research and Experimental Development in Biotechnology as well as 72.19 Other Research and Experimental Development in Natural Sciences and Engineering. The sources for these figures are the Register-based Labour Force Statistics from Statistics Denmark and Statistics Sweden.

Tabel II: Academic research

Information about the Danish universities is for personnel, VIP, and DVIP in Technology, Science and Health Science in 2015. Information about Swedish universities and institutions is for teaching and researching personnel in Science, Technology, Medicine and Health Science and Agricultural Science in 2015.

Research in the natural sciences also takes place at the Swedish University of Agricultural Sciences (SLU) in Alnarp, Aalborg University in Copenhagen, Copenhagen School of Design and Technology, and the research facility ESS.

THE BEACONS OF MEDICON VALLEY: Driving developments forward



PHOTO: LUNDBECK

The companies of Medicon Valley are successful, with the four large groups Novo Nordisk, H. Lundbeck, Ferring and LEO Pharma at the forefront. New biotechnology companies are cropping up the Skåne Region, for example in the relatively new science park Medicon Village, and there is a new beacon being raised in the region: with the materials research facilities Max IV and European Spallation Source, ESS.

- Industrial foundations have contributed to the stable development of Medicon Valley's four largest pharmaceutical groups: Novo Nordisk, H. Lundbeck, Ferring and LEO Pharma, all of which are located in and around Copenhagen.
- The large pharmaceutical companies have nurtured many researchers and company leaders, which has also benefitted many of the new biotechnology companies that have emerged since the end of the 1990s.
- The foundations have also contributed risk capital for new companies and resources for new research, generating a good circular flow in the region.
- Increased pressure on prices and the phasing in of a new generation of technology with biological medicines has led to large companies being forced to make cutbacks as well as new investments. As a result, the situation in Medicon Valley can be difficult to interpret.
- Six large science parks bring know-how and new companies close together. Three of them are located in and around Copenhagen, one is in Malmö and two are in Lund. The result is a new kind of "multicellular" big business.
- The equilibrium between Medicon Valley's Zealand and Skåne Regions will be more even with the new beacon being constructed in Lund: the two materials research facilities Max IV and European Spallation Source with data centre in Copenhagen. Life science will be a crucial area. Lund is growing into an even more significant city for research.

STRONG BEACONS BOOST MEDICON VALLEY

Thriving universities and many successful years for the four largest Danish pharmaceutical groups are the primary reasons that Medicon Valley has become the leading Nordic life science cluster. The region's largest pharmaceutical company, Novo Nordisk, had 16 400 employees in Medicon Valley at the end of 2015. Several new beacons are driving developments forward. Today, the growing group of science parks employs around 4 000 people within life science. The billions of crowns invested in the materials research facilities Max IV and ESS will contribute to further discoveries being made.

There is a historic link between Greater Copenhagen's role as a food cluster and a life science cluster, but there are also ties between the Zealand and Skåne Regions. Knowledge and raw materials from dairies, breweries and slaughterhouses here were used in the 1900s when the new life science cluster developed products based on proteins, fermentation and hormones.

One of the cornerstones of the Danish pharmaceutical wonder was laid in 1908, when Løvens Ke-

miske Fabrik was started. It made its breakthrough in 1912 with the medicine Albyl. In 1914, the company already started the Swedish subsidiary AB LEO in Helsingborg, and in 1925 Løven's insulin production demerged to become the independent Nordisk Insulin Foundation. After the Second World War, Løven became one of the early penicillin manufacturers. Today, the group is called LEO Pharma and is successful in the areas of dermatology and thrombosis.

Nordisk Insulinlaboratorium and Novo Terapeutisk Laboratorium are the foundation of what is now Denmark's largest pharmaceutical company Novo Nordisk, as well as a contemporary Danish growth success story. At the turn of the millennium, Novo Nordisk had just under 15 000 employees. By the end of 2015, that number had grown to almost 40 000 employees, 16 314 in Denmark and 80 in Sweden (Malmö). On top of that is the company's subsidiary Novozymes, which demerged in 2000 and now has over 2 600 employees around the globe.

Løven's Swedish subsidiary AB LEO in Helsingborg was owned by H. Lundbeck and the Swedish Pharmacia and others before it was bought by American Johnson & Johnson and renamed McNeil. The company is still located in Helsingborg and produces stop-smoking products under the brand name Nicorette.

There have always been links between the pharmaceutical industries in the Zealand and Skåne Regions. The four largest Danish pharmaceutical companies still have their Swedish offices in Malmö. Around 700 Swedes work in Danish pharmaceutical companies.

Ownership over the Öresund has made its impression on companies like LEO and Ferrosan. The company with the deepest roots on both sides of the Strait is the rapidly expanding Ferring Pharmaceuticals, which was founded in Malmö in 1950. Operations in Malmö/Limhamn and Copenhagen were consolidated in 2002 and moved into the now-iconic building in Ørestad, while the company headquarters relocated to Switzerland in 2004. Ferring's owner Frederik Paulsen showed that the company's strong ties to the region still remain when he broke the ground at the groundbreaking ceremony for Soundport, the company's new billion-crown investment in a research facility on the shore of the Öresund Strait, near Kastrop, in the beginning of September. A number of Ferring's subsidiaries are still in Malmö.

Ferring, as well as the rest of the Danish life science sector, already had early and strong links to biotechnology, but has also been shaped by stable ownership by active industrial foundations. In addition, the Danish companies have been successful with defined niche strategies; a good example is the Copenhagen company H. Lundbeck, whose focus is on neurological diseases.

But Medicon Valley is so much more than pharmaceutical companies. A growing group of biotechnology companies such as Genmab, Symphogen,

Camurus and Alligator Bioscience have received a great deal of attention and are generating great value, both in terms of research and finance.

Individually however, they do not have the same personnel strength as Medicon Valley's large beacons.

Tucked a bit further away is a large medical technology cluster in Medicon Valley with companies like Coloplast, Nolato Medical, Baxter (Gambro) in Lund. The medical technology cluster around Copenhagen also contains the three successful hearing aid manufacturers William Demant Holding (Oticon), GN Store Nord (Resound) and Widex.

A growing group of new, innovative companies, often with their roots in university research, is growing in Medicon Valley, and more often than not, these companies begin in science parks. A science park can be seen as a kind of multicellular company comprised of many independent companies and where the individual components mutually benefit each other. A larger science park nowadays has space for as many employees as a medium-sized pharmaceutical company.

The greatest change in decades in Medicon Valley is underway on the Swedish side, where two materials research facilities are being built next to each another in Lund. Max IV was inaugurated in the beginning of the summer, and the adjacent European Spallation Source (ESS) is currently under construction; see more on pages 42 and 58.

Although Max IV is a Swedish research facility, Denmark has already decided to invest in its own beamline there. ESS is a European facility hosted by Denmark and Sweden, where the research facilities are being built in Lund; the data management centre DMSC has already been placed at COBIS in Copenhagen.

Max IV and ESS represent a total investment of about 22 billion Swedish crowns, and there are already plans to increase these investment amounts. When both of the research facilities have been completed, approximately 700 people will be employed there, and 5 000 international researchers are expected to visit the facilities annually. Life science will be an important research area for MAX IV and ESS.

For Medicon Valley, the two research facilities will be a new beacon that will not only contribute to regional companies' competitive edge, but also give them a more robust position internationally. Max IV and ESS also mean that the Danish-Swedish equilibrium in Medicon Valley will become more sound.

Göran Ando: "The Region needs to be strengthened"

Risk capital is not what is missing in Greater Copenhagen. It's more a question of not having the right people for the job. What the region needs are more researchers who are willing to take risks and who are passionate about creating new medicines and new companies. And that will demand more experienced CEOs who can develop company after company. The region also needs to become stronger in an international perspective. That's how Göran Ando, Chairman of the Board at Novo Nordisk and Symphogen, sees things.

– I think that people should be more daring. I have been living in the USA and England for the past 35 years and the thing that has impressed me most in the US is their "can do" attitude, says Göran Ando, chairman of Novo Nordisk and Symphogen.

He asserts that it is more probable that the right people for the job are lacking in the Greater Copenhagen area, not the risk capital.

– We have very many talented scientific researchers, but not enough people with the right spark or know-how, who are passionate about accomplishing something that will make that new medicine or that new company happen. The willingness to take risks is lower here than in the USA.

– The other thing that we are lacking is a pool of experienced CEOs who develop company after company. In that respect, we are far behind the USA. Just look at Symphogen, where we realised that the only logical thing to do was to open an office for classic research in New Jersey where we can recruit people who have already done this many times.

– One of Denmark's weak points is the access to competence. It's a small country with a tradition of not recruiting so many people from abroad, even if there are extremely favourable ways of doing so, fiscally speaking. The entire region is attractive, with advantages that we perhaps don't always think about. We have fabulous nature here, and we are open countries where the majority of the population speaks fluent English.

To say that risk capital is lacking for new biotechnology companies in the Greater Copenhagen area is little more than a convenient excuse, according to Göran Ando.

– I do not agree that there is a lack of risk capital. I am also on the board of Novo A/S. Our venture activities are now the largest in all of Europe. And it's not like we find that there are too many companies we feel are worth supporting.

As far as Greater Copenhagen's life science cluster Medicon Valley is concerned, Göran Ando applauds the investment in the Øresund Bridge and the fact that the region has created a fundamental identity.

– But I believe the region needs to become much stronger. It doesn't stand out internationally; people are still talking about individual countries. Medicon Valley needs to be hammered home, especially at biotechnology trade shows.

More than anything else, Göran Ando is nervous about developments on the Swedish side of Medicon Valley.

– My personal opinion is that a new initiative is necessary to get back on the map and into the consciousness of companies that are setting up in the region.

He points out that Lund University needs to make itself more attractive.

– Then I don't think it would be impossible for a larger company to set up a satellite site there.

It's becoming more and more common to establish sites with 100-200 researchers at universities. But it doesn't happen automatically.

Göran Ando points out that one of Denmark and Sweden's shared strengths is their high level of technological knowledge – which is important, not least when it comes to developing and manufacturing biological medicines.

– The more complicated it is, the better competitive edge we have. Novo Nordisk will continue to keep a large part of its production base in Denmark. You can also look at Biogen, which has a big production unit in Denmark that is only a few years old.

When the discussion turns to the industry overlap between life science and IT, Göran Ando urges to careful consideration.

– There is a clash between strictly regulated sectors like pharmaceuticals and extremely open sectors like IT. On the IT side is a certain immaturity and a lack of understanding for our absolute zero-tolerance policy, because otherwise patients can die.



Göran Ando, Chairman of the Board at Danish Novo Nordisk and Symphogen.

"I do not agree that there is a lack of risk capital."

THE BEACONS OF MEDICON VALLEY

Pharmaceutical and biotechnology companies in Greater Copenhagen are a regional success story characterised by a few large companies in pharmaceuticals that are complemented by successful biotechnology companies. But Medicon Valley is more than pharmaceuticals and biotechnology. The region also has successful medical technology companies, growing science parks and

the two large materials research facilities Max IV and European Spallation Source, the latter of which is currently under construction in Lund, and ESS data management centre DMSC in Copenhagen.

In this overview, we have chosen important players from six leading areas in Medicon Valley that demonstrate the cluster's broad scope, in business as in research.

4 PHARMACEUTICAL COMPANIES with headquarters in the Zealand region dominate Medicon Valley's largest groups in pharmaceuticals and biotechnology. All four of the pharmaceutical companies have regional offices in Malmö. The four large groups Novo Nordisk, Lundbeck, Ferring and LEO Pharma and the foundations that own them have also been a risk capital firm and a nursery for many of the researchers in Greater Copenhagen. Since the end of the 1990s, a number of smaller biotechnology companies have emerged, such as Genmab, Zealand Pharma, Bavarian Nordic and Symphogen in Denmark and Alligator Bioscience and Camurus in the Skåne region.



9 UNIVERSITIES. Greater Copenhagen's academic spectrum within life science is broad, with nine learning institutions that perform research in the field. Globally leading diabetes research and neuroscientific research take place at the University of Copenhagen, as well as at Lund University. The learning institutions also have other strong life science research, for example within metabolic diseases and plant biology. In addition, DTU and Malmö University are both highly advanced in areas such as bioengineering and biological surfaces. See page 52.



6 SCIENCE PARKS. A growing phenomenon, not least in biotechnology, is that many small and medium-sized companies group together in some of the region's large and ever-expanding science parks, which can almost be seen as large companies comprised of independent company cells. COBIS, Scion DTU and Symbion are in and around Copenhagen, whilst Skåne is home to Medeon in Malmö and Ideon and Medicon Village in Lund.

FOREIGN-OWNED COMPANIES. Although foundation ownership is an important national model behind many successful Danish companies, there are good examples of large, foreign-owned companies such as Biogen with an office in Copenhagen and factory in Hillerød, and William Cook Europe in Bjærveskov. On the Swedish side are the dialysis company Baxter in Lund, which was founded under the name Gambro, and the pharmaceutical company McNeil in Helsingborg, previously part of the former Pharmacia, but now part of the American Johnson & Johnson.



MEDICAL TECHNOLOGY is everything from so-called plastics companies like Danish Coloplast and Nolato from Skåne to the three large Danish hearing aid manufacturers William Demant Holding (Oticon), GN Store Nord (Resound) and Widex. Here as well, foundation and family ownership is most common.



22 BILLION SEK. That's how much is being invested in Medicon Valley's latest beacon, comprised of the materials research facilities Max IV (pictured), which was inaugurated this summer, and European Spallation Source (ESS), which is currently being constructed adjacent to Max IV and has its data centre DMSC at COBIS in Copenhagen. Life science is expected to be one of the vital research areas in both research facilities. Formally, Max IV is a Swedish facility, but Danish investments have been made in it from the start. ESS is a European venture, and Denmark and Sweden are its host countries.

THE NOVO NORDISK FOUNDATION GROUP

NOVO NORDISK FOUNDATION is an industrial foundation whose objective is to act as majority shareholder in the publicly traded Novonordisk and Novozymes, as well as to support scientific, humanitarian and social causes. In 2016, the foundation will distribute around two billion Danish crowns in grants. Since 2007, the Foundation has given a total of 3.6 billion Danish crowns toward the establishment of four research centres and a national biobank in Greater Copenhagen.

- Danish National Biobank
- Center for Basic Metabolic Research
- DTU Biosustain - Center for Biosustainability
- Center for Protein Research
- Section for Basic Stem Cell Biology

NOVO A/S is the Foundation's wholly owned subsidiary. It manages the Foundation's endowment and its controlling interests in the publicly traded companies Novo Nordisk and Novozymes.

- **Novo Seeds** is the name of the early-stage investment in new biotechnology companies. To date, investments have been made in 17 companies, 11 of which are in Denmark and 3 in Sweden. In Medicon Valley, it is involved in the following companies: Acesion Pharma, Adenium Biotech, Avilex Pharma, Biosyntia, Galecto Biotech, IO Biotech, Minervax, Pcovery and Reapplix.
- **Novo Ventures** invests in companies that are further in the development stage and is currently involved in



27 companies, one of which – Orphazyme – is Danish. The emphasis is on companies in the USA and Great Britain.

- **Novo Large Investments** has eleven larger-scale investments, including investments in five Danish companies – Chr. Hansen, Sonion, Symphogen, Veloxis Pharmaceuticals and Xellia Pharmaceuticals.

NOVO NORDISK is the original company behind the group, and today it is Denmark's largest pharmaceutical company and a globally leading producer of insulin. The company is publicly traded and has its headquarters and a large facility on the outskirts of Copenhagen, in Bagsværd, and several large research and production facilities elsewhere in Zealand. The company also makes drugs for obesity,

haemophilia and growth disorders. The company's growth has been strong; since 2011, its turnover has increased by 63%, and the number of employees has grown 35%. In 2015, the company decided to invest two billion USD in a new pharmaceuticals factory in the USA with 700 new jobs, and one new pharmaceutical factory in Måløv (DK) with 100 jobs. In addition, it also decided to build a new filling plant for medicines in Hillerød (DK), with 450 new production and engineering jobs. In the autumn of 2016, Novo Nordisk cut back its workforce by 1000 employees, 500 of whom were in Denmark. The company will nonetheless have a greater number of employees than at the end of 2015.

Turnover 2015: 107.9 billion DKK

Number of employees 2015: 39 150, of whom 16 314 in Denmark and 80 in Sweden.

Facilities in Medicon Valley: Headquarters in Bagsværd and offices in Ørestad and Malmö. Research facilities in Måløv and Hillerød. Production facilities in Værløse, Søborg, Måløv, Gentofte, Køge, Kalundborg and Hillerød.

NOVOZYMES was founded in 2000 as a demerger from Novo Nordisk. Novozymes is a publicly traded biotechnology company and a globally leading manufacturer of industrial enzymes as well as a major producer of microorganisms. The company's headquarters is in Bagsværd outside Copenhagen. The largest markets are in agriculture, bioenergy, food & beverage, household

care, leather, pulp & paper, textile and water solutions. Enzymes for laundry detergents are the largest goods class, accounting for one-third of the turnover. Since 2011, Novozymes' turnover has increased by 33% and its staff has grown by 11%. In the autumn of 2016 Novozymes gave NCC a 633 million Danish crown contract to build a new research facility in Lyngby-Taarbæk Municipality (near the Technical University of Denmark) for 800 employees. It will be completed in 2018.

Turnover 2015: 14.0 billion DKK.

Pre-tax result: 3.6 billion DKK

Number of employees 2015: 6 485, of whom approx. 2 800 in Denmark.

Facilities in Medicon Valley: Headquarters and R&D in Bagsværd and production facilities in Kalundborg and Copenhagen.

CHR. HANSEN Although Novo A/S is Chr. Hansen's largest shareholder, Chr. Hansen is not a subsidiary of Novo A/S, but instead represents large investments. It is a global biotechnology company with clients in the pharmaceutical industry, food and health industries, and agriculture. Since 2011 its turnover has increased by 35%, and the number of employees has increased by 9%.

Turnover 2014/15: 858.8 million Euros

Pre-tax result 2014/15: 219.7 million Euros

Employees 2014/15: 2 500

Facilities in Medicon Valley: Headquarters in Hørsholm and facilities in Hvidovre and Roskilde.

THE LUNDBECK FOUNDATION

THE LUNDBECK FOUNDATION is an industrial foundation whose objective is to maintain and expand the activities of H. Lundbeck and to provide funding for scientific research. The Foundation annually grants between 400 and 500 million Danish crowns to research, with particular focus on promising researchers who wish to establish their own research groups at Danish universities. The Foundation is the largest shareholder in the publicly traded companies H. Lundbeck and ALK-Abelló, as well as in Falck A/S. The Foundation also invests in life science companies, as well as in the commercial development of scientific projects.

Lundbeck Foundation Emerge:

- Has three investments in Denmark; of these, IO Biotech is located in Copenhagen.

Lundbeck Foundation Ventures:

- Has investments in 20 companies, two of which are in Medicon Valley – Veloxis Pharmaceutical in Hørsholm and Bonesupport in Lund.

H. LUNDBECK is a global pharmaceutical company specialising in psychiatric and neurological disorders. The company is publicly traded and has its headquarters in Valby, Copenhagen. Several new compounds have been launched in recent years against for example depression

and schizophrenia, while other, earlier patents have expired. Since 2011 the company's turnover has dropped 9%, and the number of employees 13%.

Turnover 2015: 14.6 billion DKK

Pre-tax result 2015: -7.0 billion DKK

Number of employees 2015: 5 257, of whom 1 609 in Denmark and 88 in Sweden.

Facilities in Medicon Valley: Headquarters and production in Valby/Copenhagen and production in Odsherred. Office in Malmö.

ALK-ABELLÓ is a publicly traded global company that researches allergies and manufactures vaccines for them. Its headquarters are located in Hørsholm in Zealand. The company's turnover has increased almost 10% since 2011, and the number of employees



has increased by 11%.

Turnover 2015: 2.6 billion DKK

Number of employees 2015: 1 954, of whom 722 in Denmark.

Facilities in Medicon Valley: Headquarters and R&D in Hørsholm.

FERRING PHARMACEUTICALS

FERRING PHARMACEUTICALS is a wholly privately-owned pharmaceutical company with its roots around the Øresund. It was founded in Malmö in 1950 and moved to Limhamn in 1956, with subsidiaries in Denmark and Germany that are now a group. In 2002, operations in Copenhagen and Limhamn were consolidated and moved to the iconic black high-rise in Ørestad, and in 2004 the company headquarters moved to Switzerland. In 2019 Ferring International PharmaScience Center and Ferring Pharmaceuticals will move from Ørestad to the new research facility Soundport (pictured), which is currently being built near the Øresund Strait, walking distance from Copenhagen's airport, Kastrup. Soundport is a 1.1 billion Danish crown-investment and will be able to accommodate 750 employees, which is a 50% increase compared to the facility in Ørestad. Ferring develops and produces peptide-based and biotechnologically developed medicines with a focus on urology, reproductive health, gastroenterology and endocrinology. Ferring is run by Frederik Paulsen through the Dr. Frederik Paulsen Foundation. Since 2011, the turnover has increased by about 50%, and the number of employees has increased by about 50%.

Turnover 2015: 1,8 billion EUR

Number of employees 2015: 6000, of whom 480 in Denmark and 18 in Sweden

Facilities in Medicin Valley: Ferring Pharmaceuticals A/S also named Ferring International Pharma Science centre and Ferring Lægemedler A/S in Ørestad and sales office in Malmö and API-manufacturer Syntese in Hvidovre Kommune. Headquarters in Switzerland.



ILLUSTRATION: FOSTER + PARTNERS

Ferring is still represented in its former home town Malmö, where it has an office with a staff of ten. There are also a number of pharmaceutical companies in Malmö with an indirect link to Ferring.

Ferring's original factory in Limhamn in Malmö is still there, with the name Rechon Life Science. Since 2007, it has been owned by the Chinese pharmaceutical company Dongbao.

Poly Peptide Group is also in Limhamn with its office and production. It is a demerger from Ferring and part of a separate group of companies run by Ferring's owner Frederik Paulsen. Other companies in the group are for example Qpharma, Nordic Drugs and Euro-Diagnostica, all of whom are active in Malmö.

LEO PHARMA

LEO FOUNDATION was established in 1984 to secure LEO Pharma's future as an independent, research-based Danish pharmaceutical company. The foundation also supports international research with focus on dermatology.

LEO PHARMA is a wholly privately/foundation-owned pharmaceutical company with focus on the development and production of medicines for dermatology and thrombosis. The company's turnover has increased by 13% since 2011, and the number of employees has increased almost 10%.



PHOTO: LEO PHARMA

Turnover 2015: 8.5 billion DKK

Number of employees 2015: 4 813

Facilities in Medicin Valley: Headquarters, R&D and production in Ballerup outside Copenhagen.

COLOPLAST

COLOPLAST is a publicly traded medical technology company with its headquarters in Humlebæk in Fredensborg Municipality, south of Helsingør. The company is run by the family Louis-Hansen/Find. The company's original product, stoma bags, remains an important part of the plastics manufacturer's product assortment, which now includes products for ostomy care, urology and continence care, as well as wound and skin care. The company's turnover has increased by 37% since 2011, and the number of employees has increased by 27%. According to the new strategy Lead20, the company will increase its staff by 3 000 employees by 2019/20.



PHOTO: COLOPLAST

Turnover 2014/15: 13.9 billion DKK

Number of employees 2014/15: 9 300, of whom approx. 1 500 in Denmark

Facilities in Medicin Valley: Headquarters in Humlebæk in Fredensborg Municipality and production in Mørdrup in Helsingør Municipality.

NOLATO

NOLATO is a publicly traded, family-run company with roots in Skånska Torekov and business in medical technology. The company's foundation is plastics and silicon know-how. Within medical technology, it produces inhalers, insulin injectors and balloon catheters, among other things. Last year, the business line Nolato Medical had a turnover of 1.5 billion SEK and 1 053 employees.

Turnover 2015: 4.7 billion SEK

Number of employees 2015: 7 759, of whom 773 in Sweden

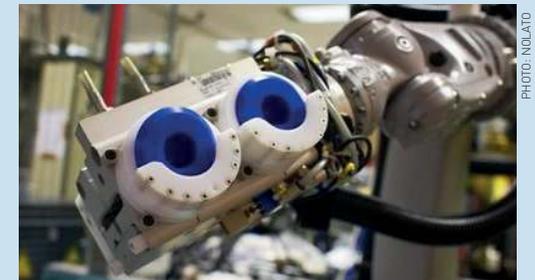


PHOTO: NOLATO

Facilities in Medicin Valley: Torekov, Höör, Lomma, and Næstved

WILLIAM DEMANT HOLDING

WILLIAM DEMANT HOLDING is one of Medicin Valley's three large hearing aid manufacturers (the other hearing aid manufacturers are GN Store Nord / Resound and Widex, located around Copenhagen). William Demant Holding is a publicly traded company with brands such as Oticon, Bernafon, Sonic and Oticon Medical. The company is run by the Oticon Foundation.

Between 2011 and 2015 the company's turnover increased by 33% to 10.7 billion DKK, and the number of employees rose 46% to an average of 10 800.

In 2016 the company decided to move its production and 200 employees from Thisted, Jutland to Poland. The production in Minnesota, USA, was moved to Mexico.



PHOTO: NEWS ØRESUND

Turnover 2015: 10.7 billion DKK

Number of employees 2015: 10 800, of whom 1 330 work in Greater Copenhagen.

Facilities in Medicin Valley: Headquarters in Smørum in Egedal Municipality and R&D in Snekkkersten/Helsingør.

NEW RESEARCH FACILITIES BOOST PHARMACEUTICAL RESEARCH



Sweden's Prime Minister Stefan Löfven (S) and King Carl XVI Gustaf of Sweden at the inauguration of Max IV in Lund this year on 21 June.

PHOTO: LUND UNIVERSITY - KENNETH RUONA

European Spallation Source (ESS), which is currently under construction on the outskirts of Lund, and its neighbour Max IV, which was inaugurated early this summer, are becoming world-class research beacon bringing new possibilities for research as well as business to Greater Copenhagen. Both research facilities are expected to generate an influx of thousands of researchers from abroad, and one of the important fields of research for ESS and Max IV is life science – read more on page 58.

THE SYNCHROTRON LIGHT FACILITY MAX IV was inaugurated in the beginning of the summer and helps researchers study material and life science down to the nano-level. Max IV is a Swedish national research facility that is open to other countries and companies that wish to invest in their own beamline. The Academy of Finland, Estonia and a consortium of Danish universities and regional and national authorities are investing a total of 200 million SEK in beamlines at Max IV. Novo Nordisk has long since been on the list of companies that took advantage

THE NEUTRON SOURCE FACILITY EUROPEAN SPALLATION SOURCE, ESS, is a European venture. The research facility is currently being built adjacent to Max IV in Lund, and the ESS data management centre DMSC was recently inaugurated in the science park COBIS in central Copenhagen.

Investment: The budget is 17.7 billion SEK, or 1 843 billion Euros (2013 price level). Sweden is contributing 35%, and Denmark 12.5%. The two host countries are expected to contribute with 15% of the annual costs of 1.3 billion SEK, or 140 million Euros.

Completion: ESS will produce the first neutrons in 2019 and open for external researchers in 2023, and the construction phase will be complete in 2025. Inauguration date is not yet determined.

Employees: Currently 375, of whom 22 at DMSC in

of the research opportunities at the laboratory's predecessor.

Investment: Around 4 billion SEK incl. the first 14 beamlines. There is space for 26-28 beamlines, and when complete, costs for the facility are expected to reach 6 billion SEK.

Expected completion: 2026

Employees: About 270 employees when the facility is complete.

International researchers: Up to 3 000 researchers are expected to visit the facility annually.



PHOTO: ESS

Copenhagen. When in operations, ESS employ 500 people.

International researchers: Between 2 000 to 3 000 researchers are expected to visit ESS annually to perform experiments when the facility is fully operational.

LARGE FOREIGN-OWNED LIFE SCIENCE COMPANIES

There is a strong international presence in Medicon Valley. Among the largest foreign-owned companies are:

BAXTER (FORMERLY GAMBRO) in Lund, which is an important producer of for example dialysis equipment. Gambro's roots are in Lund, where the company invented the single-use kidney. After changing owners several times, the company was sold to its main competitor Baxter in Lund. The company has approx. 800 employees in Lund.

MCNEIL in Helsingborg manufactures medicines to stop smoking and was once part of the large Swedish group Pharmacia, but is now part of the American pharmaceuticals giant Johnson & Johnson. The company has approx. 600 employees in Helsingborg.



PHOTO: NEWS ØRESUND

BIOGEN has its offices in Copenhagen and production facility in Hillerød. It has around 645 employees in Denmark.

WILLIAM COOK EUROPE in Bjærveskov develops, manufactures and sells medical technology products and distributes products from the rest of the Cook group. The company has approx. 700 employees in Bjærveskov.

SCIENCE PARKS IN THE REGION CONTINUE TO EXPAND

For 33 years now, six large science parks have been growing in Medicon Valley. With almost 500 companies and about 4 000 life science employees, science parks have become a vital beacon in Medicon Valley. The growth is continuing, and since 2009 two new science parks with a pure life science focus have been established: COBIS in Copenhagen, and Medicon Village in Lund.

The region's first science park, Ideon, was founded in 1983 in Lund, and two years later Medicon opened in Malmö. In 1996, six researchers founded Symbion in Copenhagen, and in 2004 Scion DTU saw the light of day. Five years later, Symbion and Scion DTU started the biotechnology park COBIS near Rigshospitalet in Copenhagen, and in 2012 Medicon Village opened the doors of a new science park in Astra Zeneca's former research facility in Lund.

Even if the latest science parks concentrate exclusively on life science, IT-businesses have always been an important part of science parks with a broader scope of focus. Today, there are over 1 000 companies with about 10 000 employees in the Region's six large science parks (see description on the next page). Of these, about half of the companies and some 4 500 of the employees are active in life science. However, not all of these employees work in life science companies; universities and public organisations are also some of those with representation at many science parks.

The science parks' growth offers researchers and entrepreneurs increasing opportunities to start new companies in close proximity to other development companies and the universities' research.

– Openness and networking are a growing trend, says Mats Leifland, CEO of Medicon Village in Lund.

– We have an innovation department where 400 people work in incubator companies, and the other product companies are from the realm of health, from Region Skåne with the biobank, the tumour registry and the Regional Cancer Center South, which is part of the cancer research at the university. The result is a strong dynamic with many decision-makers, which makes it interesting for other people to come here.

Medicon Village is owned by a foundation and was established with the help of a donation by the Scanian entrepreneur Mats Paulsson. In 2012 Astra Zeneca left Lund, and with the help of Lund University, Region Skåne and Mats Paulsson's foundation, Astra Zeneca's former premises could be bought and used as the grounds for Medicon Village, which offers access to 40 000 sq.m. of laboratory space. Today in Medicon Village, about 1 500 people work for companies (14 of which are publicly traded), universities, Region Skåne, and European Spallation Source, ESS (which will rent space there until its own research facility is completed). That is more than the number of people that worked there when it was Astra Zeneca.

Ideon in Lund with the high-rise Ideon Gateway.



PHOTO: NEWS ØRESUND

The science parks of the region have varied profiles. Symbion calls itself 'community offices' on its website, while Medeon in Malmö emphasises its collaboration with COBIS, Medicon Valley Alliance, SmiLe, Lund, KI Science Park in Stockholm and Sahlgrenska Science Park in Gothenburg.

COBIS in Copenhagen has also let space to ESS – it is the location of the research facility's data management centre DMSC. COBIS was founded in 2009 by the science parks Scion DTU and Symbion in order to give Copenhagen's biotechnology companies a good working environment near Rigshospitalet.

– Our ambition is to become the centre for the development for new companies, new technologies and

new research areas within life science, in close collaboration with universities, hospitals and the industry, says COBIS' CEO Morten Mølgaard Jensen.

He believes that activity within life science is increasing and he points to trends such as gene therapy, growing focus on big data and a merging of IT and life science.

Scion DTU's CEO Steen Donner also sees a growing interest in life science companies.

– We find that people are more

interested in investing in life science projects than they were just 3 or 4 years ago. There are also greater demands from the government and individual regions for streamlining in hospitals and related tele-areas, for example telemedicine. We expect that trend to continue.

"Openness and networking are a growing trend."



PHOTO: NEWS ØRESUND



PHOTO: NEWS ØRESUND



PHOTO: NEWS ØRESUND



PHOTO: SCION DTU

COPENHAGEN BIO SCIENCE PARK, COBIS, Copenhagen

Owner: The science parks Symbion and Scion DTU

Incubator: Copenhagen Entrepreneur Lab for Life, CELLS

Number of companies: 81
Number of employees*: 270
Founded: 2009

IDEON SCIENCE PARK, Lund

Owner: The IDEON trademark is owned by a foundation for collaboration between Lund University and businesses, 'Stiftelsen för samverkan mellan Lunds University and Näringslivet, SUN'. The buildings on the original Ideon site are owned by Wihlborgs fastigheter. The trademark company Ideon AB is owned by the real estate companies Wihlborgs, Castellum and Vasakronan. The data below is for the original Ideon site.

Incubators: Ideon Innovation, The Creative Plot, LNC and Venture Lab.
Number of companies: about 350
Number of employees*: >2 700
21% of the companies are active in life science
Founded: 1983

MEDEON SCIENCE PARK, Malmö

Owner: City of Malmö and Wihlborgs Fastigheter

Incubator: Medeon Incubator

Number of companies: 65
Number of employees*: about 450
Founded: 1985

MEDICON VILLAGE, Lund

Owner: Mats Paulsson Foundation for Research, Innovation and Societal Development

Incubator: Smile, formerly Lund Life Science Incubator
Number of companies: >100
Number of employees*: 1 500
Founded: 2012, Foundation est. 2011

SCION DTU, Hørsholm and Lyngby

Owner: Technical University of Denmark, DTU
Incubators: Scion DTU Innovation, The Green Entrepreneur House (Det grønne Væksthus) and DTC. A Biotech incubator is currently being planned. Also makes growth investments such as Vækstmotor and Danish Tech Challenge.
Number of companies: 280, of which about 130 are in life science
Number of employees*: about 3 000, of whom about 1 650 in life science
Founded: 2004

SYMBION, Copenhagen

(also runs The Orbit in Ørestad,

Creators Floor in Frederiksberg and Univate on Amager)

Owner: Symbion Foundation, Nordea, Lønmodtagernes Dyrtdisfond, Magistrenes Pensionskasse, University of Copenhagen and Copenhagen Business School
Incubator: DTU Symbion Innovation
Number of companies: >250
Number of employees*: n/a
Founded: 1986

Sources: Representatives from the science parks and information from their websites.

*Number of employees incl. the employees of the companies renting the space



PHOTO: SYMBION

NEW COMPANIES IN MEDICON VALLEY: A well balanced biotech cluster

From a success story to a more sophisticated and stable sector – that's how the Danish Association of the Pharmaceutical Industry (LIF Denmark) describes the development of Danish biotechnology. Sunstone Capital believes that there is still a lot of potential in Medicon Valley, but wants to get more out of university research.

- According to calculations by the Danish Association of the Pharmaceutical Industry, 200 new jobs are created for every billion crowns that Danish pharmaceutical exports increase.
- Until February 2014, Sunstone Capital had invested 100 million Euros in Danish portfolio investments in life science, leading to down payments of 200 million Euros from industrial agreements, with potential milestone payments of 1.2 billion Euros.
- At the peak, 12-20 biotechnology companies were established in Denmark annually. That number shrunk to 1-2 companies per year during the financial crisis. Now, there are around 6-8 new companies every year, and Danish pharmaceutical biotechnology comprises 100-120 companies, according to the Danish Association of the Pharmaceutical Industry.
- Research ideas are plentiful, but there are too few entrepreneurs who can take over where the researchers leave off. That's what CEO of the Lund-based pharmaceutical company Camurus Fredrik Tiberg believes. He has a positive outlook and points out that there are a number of companies developing very strongly in the Skåne region.

DANISH BIOTECH HAS GROWN UP

Danish biotechnology has gotten its bearings after the financial crisis. New companies have been established, although the pre-crisis levels from before the turn of the millennium have yet to be reached. The Danish Association of the Pharmaceutical Industry (LIF Denmark) finds the biotech cluster well balanced today, but notes that it has grown up and is no longer growing as quickly as before.

– Biotech is modern Danish pharma-history. Development took off in the 90s, when lots of new biotech companies were being established in Denmark. We were up to 12-20 new companies per year. During the financial crisis we were down to 1-2 companies, but now we have a pretty reasonable upstart rate of 6-8 companies every year. Today, Danish pharma biotech is made up of 100-120 companies, and it has for a few years now. It seems that the sector has reached the natural size for a small country like Denmark, and it depends on the size of the research, says Allan Skårup Kristensen, Chief Consultant for Research and Innovation at LIF Denmark.

– I think that Danish biotech is doing well right now. We have a good balance between big compa-

nies like Zealand Pharma and Symphogen and the medium-sized and smaller companies.

Allan Skårup Kristensen believes that it is important to have a realistic picture of what the life science sector has to offer as far as new jobs in Denmark go.

– Our statistics show that on average, 200 new jobs are created for every billion Danish crowns that exports increase.

The new biotechnology companies don't usually have the protection offered by Danish industrial foundations. The companies are more vulnerable for acquisition, he says, pointing out how Gilead Sciences bought the Danish biotech company EpiTherapeutics and Roche bought the Danish Santaris Pharma. He also notes that biotech com-

panies are very international to begin with.

– Biotech companies are born global companies. Take Danish Symphogen, which is based on technology bought in Boston, and where the company now has research activities in the USA, says Allan Skårup Kristensen.

There is a new trend where older and larger biotech companies develop into more traditional pharmaceutical companies with their own manufacturing. Allan Skårup Kristensen uses the vaccine manufacturer Bavarian Nordic in northern Zealand as an example of a company that has already gone in that direction, and points out that Symphogen is now faced with the decision of whether to make the same choice.

As Allan Skårup Kristensen sees it, funding is not the big problem that new biotechnology companies face, even if he recognises that there are certain difficulties for young seed companies to bring in money in the early stage.

– If the idea is good, the money is there. There is no shortage of capital in the world.

He has seen the Danish life science cluster go from being a more peripheral sector to a Danish growth marvel.

– Danish bacon and butter were the largest export products for decades. Then it was oil from the North Sea, and today pharmaceuticals are the single most important export sector in Denmark.

– The pharmaceutical industry has always been here; the big companies are 80-100 years old. But politicians and journalists have only become aware of the sector in the past 10-15 years, and that is because the big Danish pharmaceutical companies have been a growth success.

– All of the companies contributed to the rapid growth. In the past 6-8 years, Novo Nordisk in particular has driven growth. But now they have stopped hiring, and things are looking better for H. Lundbeck. And LEO Pharma has an innovation lab in the USA where the interface between pharmaceuticals and apps for medicine use are being developed.

“We need to get more out of the universities”

There is still a lot of growth potential in Medicon Valley’s biotech cluster, but we need to get more out of the University of Copenhagen and Lund Uni-

versity, take advantage of what the new generation’s leaders have to offer and build better management. Peter Benson, Managing Partner at Sunstone Capital in Copenhagen, is an optimist, but with a rather harsh view of what needs to be changed to boost development. But he also knows the returns that successful investments in biotech companies can bring to both shareholders and society.

Peter Benson has done calculations on the developments in Sunstone Capital’s Danish portfolio investments up to and including 1 February 2014.

– We had invested a total of 100 million Euros, which led to co-investors investing another 248 million Euros. That led to down payments from industrial contracts of 200 million Euros, with potential milestone payments of 1.2 billion Euros.

He remembers a time when Medicon Valley companies like Genmab, Zealand Pharma, Santaris Pharma, Bavarian Nordic and Symphogen were part of the creation of the Danish biotech marvel when they were founded around the turn of the millennium. He was also there when the wave of success ebbed during the financial crisis, but he also sees indications that the direction is changing again, not least for their own investment in the Lund-based Ideon company Alligator Bioscience, which made a multibillion-crown transaction with Janssen

Biotech last year. Peter Benson believes that the biotechnology cluster in Medicon Valley still has a lot to offer and gives a tip that the next star in their investment portfolio can be Galecto Biotech, which is at COBIS in Copenhagen.

– I think that there is still a lot of growth potential in biotech. But we have to get more out of the universities – both the University of Copenhagen and Lund University. We need a better flow from the universities to the industry. And it will take a lot of effort in Skåne, and better access to capital that is still concentrated in the Stockholm-Uppsala region.

– As the company’s owners, we have a lot of responsibility for the internationalisation of the companies, but also to create balance as far as experience from the key areas like production, clinics, price strategies and transactions are concerned, but also as far as the balance in gender, geography and cultural experiences goes. Peter Benson points out that a new generation of leaders is being developed in everything from



Allan Skårup Kristensen,
Chief Consultant – Research
and Innovation, LIF Denmark.

PHOTO: NEWS ØRESUND

research to production and people with transaction experience.

He has a sense that the new generation is gathering international experience, but also that management takes jobs on both sides of the Øresund Strait – just like he himself, who commutes from his home in Båstad to his office in Copenhagen.

– I think that the difficulty traveling between Zealand and Skåne caused by the border controls has an effect on companies with commuting personnel. It’s a practical problem that needs a solution.

Increasing internationalisation has also led to more international investors finding their way to the region. Peter Benson says that in Denmark, more than eight companies’ have been sold for over 100 million dollars in the past ten years.

Based on his Danish-Swedish experience, Peter Benson notes that the neighbouring countries have different strengths and weaknesses.

On the Danish side of Medicon Valley there is functioning seed and early stage funding, with important actors like Novo Seeds, the Lundbeck Foundation and Sunstone Capital.

– Seed funding works well in Denmark and poorly in Sweden. Then there are the two phases of funding, with venture capital that takes the early phase, and then cross-over players who invest in the companies’ IPO, and then the later stage funding, which is mostly found in the USA. As far as stock market listings go, it turns out that there is endless capital in Sweden, while there haven’t been any new listings in Denmark after Zealand Pharma’s listing in 2010.

Another difference that Peter Benson points out concerns the researcher exception, which was removed from the Danish universities in 2000. Whilst Swedish researchers are permitted to keep ownership rights to their innovations at the universities, Danish researchers must rely more on tech-transfer organisations and incubators. According to LIF Denmark, the number of newly started biotechnology companies has been higher in Sweden than in Denmark, whilst the rate of survival has been higher in Denmark – probably due to more highly developed funding possibilities.

When Peter Benson looks back at the Danish pharmaceutical companies’ greatest successes

in the past 10-15 years and then looks forward again, he thinks that people overreacted to Novo Nordisk’s announcement about pressure on prices in the USA and the decision to cut back staff by 1 000 employees.

– I don’t think that Novo Nordisk will lose its position as the market leader for insulin. They will continue to be an economic growth motor for Denmark. I think that people should reflect instead on the fact that Sweden has been lacking a similar growth motor since the 1990s.

“We gladly recruit from Denmark”

Fredrik Tiberg is the CEO of the research-based pharmaceutical company Camurus at Ideon in Lund; a company that was established in 1991 and is currently on the brink of a breakthrough

according to the Swedish business newspaper Dagens Industri. He emphasises the importance of long-term owners.

– Our successes are due to a focus on the long-term, both in ownership and company leadership. We have intentionally developed technologies and products and recently created conditions for continued expansion with our stock market listing last year, says Fredrik Tiberg.

Camurus’ majority shareholder is called Sandberg Development, and

is a family-owned company that was founded by a well-known entrepreneur from the electricity sector in Malmö.

Fredrik Tiberg does not agree with those who talk about the difficulties finding capital for new companies.

– In general, access to capital is relatively good in Sweden, since we have a functioning infrastructure with everything from private investors with interests in the sector to venture capital companies. I think that we hold our own quite well, at least in the early phase. We may not have the financial brawn that they have in the USA. When it comes to large investments I don’t think that Sweden has really had the necessary capacity to scale up operations, acquire and undergo strategic expansion processes.

Even if there are public companies from Lund like Active Biotech and Bioinvent whose development has been less favourable, Fredrik Tiberg believes that there are also companies in the region with very strong indications of growth.



Peter Benson, Managing
Partner of Danish Sunstone
Capital's life science team.

PHOTO: SUNSTONE CAPITAL

– I see no reasons for pessimism in my local environment.

He is more worried about the hefty industrial part of the Swedish pharmaceutical industry being dismantled. In the short-term, it can contribute to positive development with demerger companies, but in the long-term it poses a threat to the sector's development, says Fredrik Tiberg.

Locally in Lund, Astra Zeneca was a sort of nursery, spreading competence to the new development companies. Certainly, the successful Danish pharmaceutical companies are within commuting distance, but the introduction of border controls has restricted mobility between Denmark and Sweden.

– We like to look for international competence and we like to recruit from Denmark, where we still have leading international companies like Novo Nordisk and Lundbeck. But the border controls have definitely affected us. Right now we only have two staff members who live in Denmark.

– But poor mobility is also a classic Scandinavian problem. Recruiting specialist competencies is a challenge.

He points out an important change that took place after the large pharmaceutical companies in Sweden were dismantled.

– Before, smaller biotechnology companies could find more experienced employees in the larger companies. Now, we have to search for and attract younger talents to the sector.

Fredrik Tiberg finds it important that the new materials research facilities MAX IV and European Spallation Source (ESS) will offer an opportunity to perform advanced research. But he emphasises that success is not a given.

– MAX IV and ESS have a lot to show; they are large investments. A strong research and university environment always benefits the industry. However, it is also important that the project develops positively and produces important and interesting results. It is very much up to institutions to vigorously and innovatively show the potential and usefulness that these advanced research facilities can generate.

“Shortage of experienced entrepreneurs”

There are a lot of good research ideas at Lund University, but too few entrepreneurs who can take over

where the researchers leave off. Difficulties raising capital for new biotechnology companies mean that many are enticed to become publicly traded too early – that's how Ebba Fåhraeus, CEO of SmiLe Incubator in Lund, sees it.

She starts the conversation a bit cautiously. “I haven't been in the sector more than one and half years,” says Ebba Fåhraeus. But it's clear she knows what she's talking about. She has a long background in research and research companies, and she's also involved in the networking company Connect, as well in the Faculty of Medicine at Lund University. It doesn't take long before she expresses concern about new, small biotech companies being enticed on to the stock exchange too quickly. “It's not a good thing”. Getting stuck in a quarterly-driven economy and full transparency too early is hard, and it takes up too much of a CEO's time in small companies – time that is needed to push the project forward.

Attracting capital to the new seed companies is a challenge. Access to

seed capital is more limited in the Skåne region than in Stockholm and Copenhagen. Ebba Fåhraeus hopes that the new foundation structure that the Swedish government is working on will include a foundation destined for early stage life science development.

– If the risk involved in investing in early stage life science were smaller and the amount of helpful money from the government larger, then companies could develop more before entering a stock market situation, says Ebba Fåhraeus.

But she also points out the grave shortage of experienced entrepreneurs that can take over the baton from researchers.

–Without entrepreneurs, there is no funding. There is a connection. But even with a good entrepreneur it's hard to find funding.

Otherwise, she finds the biotechnology sector in the Skåne region relatively good.

– My impression is that there is a lot of activity. An enormous amount is happening in the smaller companies. There are a lot of very good ideas from research, but it's difficult to find entrepreneurs with the influence and experience to run these companies. I receive a lot of requests from companies looking for a CEO; perhaps there is



Fredrik Tiberg, CEO of the pharmaceutical company Camurus at Ideon in Lund.

an idea from the university and the need for a CEO to push the project forward.

Ebba Fåhraeus does not find ideas from academic research to be lacking. Instead, she would like to see better incentives for researchers to present more ideas for finished products and companies.

SmiLe Incubator is run by a foundation with funding from the initiators Region Skåne, Lund Municipality, Lund University and Medicon Village.

– Right now we have 25 companies with 130 men and women of 20 different nationalities working in the incubator, says Ebba Fåhraeus.

– In this world, the incubator's role is to create an environment that resembles a large company in so far as the competence of a large company is here, but spread out among different companies.

An indication that the many small companies really can work together and function like a virtual big business is that 60% of the companies at SmiLe buy services from the other companies in the incubator. A large, communal lab environment reinforces the kinship even further.



Ebba Fåhraeus, CEO of SmiLe Incubator at Medicon Village in Lund.



PHOTO: THOMAS ALTHIN ©CAMURUS AB

SOME IMPORTANT INVESTORS IN MEDICON VALLEY

Novo Nordisk Foundation

Novo Nordisk Foundation's holding company Novo A/S is not only the primary shareholder in the publicly noted Novo Nordisk and Novozymes, but also works with investments in Novo Seeds, Novo Ventures and Large Investments.

Lundbeck Foundation

In addition to being the primary shareholder of H. Lundbeck, ALK- Abelló and Falck, the foundation works with investments with the Lundbeck foundation Invest and the Lundbeck Foundation Ventures.

Sunstone Capital

With approximately EUR 700 million Euros in funds, Copenhagen-based Sunstone Capital is an important investor in European start-up companies focused on life science and technology.

DANISH COMPANIES LISTED IN SWEDEN

Saniona

R&D company that chose to stock exchange-listing in Sweden that started at Aktietorget 2014 and has now gone on First North with the aim to reach Nasdaq Stockholm's main list.

Nuevolution

Biotech company listed on Nasdaq Stockholm Stock Exchange's First North list.

BIG COMPANIES INVESTMENTS ARE DOMINANT

Novo Nordisk

In 2015 decisions were made to invest more than 17 billion DKK in a new factory and a new filling plant in Hillerød, two new factories in Måløv and North Carolina, USA, and another factory in Kalundborg.

Novozymes

Will open its new Innovation Campus at the Technical University of Denmark (DTU) in Lyngby-Taarbæk, with room for 800 employments. NCC will build it for 662 million DKK.

Ferring

Investing billions of crowns in its new research facility Soundport near Kastrup with a view of the Öresund.

BENCHMARK OF RESEARCH QUALITY:
9 universities and learning institutions in Medicon Valley conduct life science research



PHOTO: THOMAS ALTHIN ©CAMURUS AB

Not surprisingly, the strongest research in life science in the Greater Copenhagen is at the largest universities. The University of Copenhagen is consistently at the top in terms of rankings, publication volume and frequent citations, and its research of metabolic disorders, diabetes, neuroscience and plant biology are considered some of the areas of excellence. Independent assessments have also acknowledged research in neuroscience and diabetes at Lund University as globally leading. But the spectrum of life science research in the region is broader than that. There are a total of nine learning institutions in Region Skåne and in Zealand that perform research in life science.

- The University of Copenhagen ranks highest on international lists, followed by Lund University and DTU. Copenhagen University also has the most peer-reviewed articles in scientific journals and the greatest number of articles in the most-cited journals, according to CWTS Leiden Ranking.
- Life science research excels at the University of Copenhagen in the areas of metabolic diseases, diabetes, immunology, inflammations, cancer, neuroscience, protein science, plant biology and food science, to name a few.
- Lund University has a thriving research culture in neuroscience and diabetes, as well as in the fields of clinical coagulation, cancer and reproduction, among others.
- The Technical University of Denmark (DTU) is also investing in life science research and will soon inaugurate large, new, buildings for bioengineering, biotechnology, food, veterinary and water research.
- Malmö University performs successful research in the field of biological surface chemistry and biofilm, whilst the Swedish University of Agricultural Sciences (SLU) in Alnarp is strong in chemical ecology and plant biotechnology for the development of specific oil qualities.
- At Roskilde University, Aalborg University in Copenhagen and Kristianstad University (Sweden), life science research takes place on a smaller scale. The Copenhagen School of Design and Technology also has a research project in the field of optometry.
- The research facilities ESS and MAX IV will entail great possibilities for life science research in the region. Life science accounts for the majority of the research performed at existing synchrotron light/radiation facilities such as MAX IV, and ESS will greatly increase the opportunities for life science to also use the source facilities.

EXCELLENT RESEARCH IN NEUROSCIENCE AND DIABETES

Greater Copenhagen has a wide academic spectrum within life science, with nine places of learning where research in the field takes place. There is globally leading diabetes research and neuroscience research at the University of Copenhagen and Lund University. These universities also have other strong areas of life science research, for example in metabolic diseases and plant biology. Furthermore, DTU and Malmö University are highly advanced in fields like bioengineering and biological surface chemistry.

Diabetes, neuroscience, cancer, reproduction and structural biology are some examples of strong research areas on both sides of the Strait. In many cases, they are globally leading.

The fields that have grown strong is in part a question of local traditions, but to a great degree it is also a question of what funding is available. Large foundations like the Novo Nordisk Foundation and the Lundbeck Foundation have contributed to research in for example diabetes and neuroscience, as well as to the creation of research centres like the Novo Nordisk Foundation Center for Protein Research at the University of Copenhagen.

The most prominent of the region's institutions for higher education – if one is to believe the most prestigious of the international ranking lists – is the University of Copenhagen. For a long time, but with increased intensity in the past five years, the university has worked hard and with determination to recruit international researchers. That is one explanation for why the University of Copenhagen has been able to increase its number of publications in prestigious journals and earn a high ranking on the lists, says Morten Pejrup, Associate Dean for Research at the Faculty of Science at the University of Copenhagen.

The university has also worked systematically to hire only people considered to have the potential to become professors within eight to ten years, he reports.

Lund University also places relatively high on most university ranking lists, although generally not as high as the University of Copenhagen – something that Gunilla Westergren-Thorsson, Dean at the Faculty of Medicine at Lund University believes is due in part to Copenhagen being a capital city; it therefore has an advantage over Lund when it comes to resource distribution.

Neither she nor Sven Frøkjær, who was until recently Vice Dean for Business and International Relations at the Faculty of Health and Medical Sciences at the University of Copenhagen, wants to count too much on the university's ranking, since it depends on which parameters are being measured. Success begets success, however, since the ranking lists are often based in part on university's internatio-

nal reputation, which improves with a good ranking result, and thus also influences how many talented international researchers they can attract.

The regional collaboration between the universities is primarily national, between Danish or Swedish places of learning respectively. However, there are also connections across the Strait; of these, the collaboration on reproduction research is one of the best known.

Life science research on both sides of the Strait is also preparing to take full advantage of the research facilities ESS and MAX IV.

University of Copenhagen

Life science research at the University of Copenhagen takes place at the Faculty of Health and Medical Sciences and at the Faculty of Science. Metabolic diseases,

diabetes, immunology, inflammations and cancer are some of the main areas of research at the Faculty of Health and Medical Sciences, says Vice Dean Sven Frøkjær. He also points out neuroscience and stem cell research and protein research in general. A strong, globally leading research group for glycomics is also pointed out. Furthermore, the University of Copenhagen has a strong international profile in the fields of Healthy Aging and Drug Delivery, he reports.

The Faculty's website also mentions the areas cardiology and cardiac disease research and the basic understanding of the body's energy balance.

The Faculty of Science is a fusion of Copenhagen's former Royal Veterinary and Agricultural University and the former Faculty of Life Sciences at the University of Copenhagen, which has also had an influence on what areas have grown strong and successful. Among other things there is a strong research environment for plant and environmental sciences. The Copenhagen Plant Science Center, whose research areas include plant biology and molecular plant biology, was established with internal funds from the University of Copenhagen in 2012 in order to strengthen the field further. Biological production has also been indicated as an overall area of strength for the university.

Research areas also include food – it is a notable area at the Faculty of Science as well as at the Faculty of Health and Medical Sciences. The development of nuclear magnetic resonance spectroscopy (NMR) is also internationally renowned, reports Associate Dean Morten Pejrup. He emphasises the University

"The fields that have grown strong is in part a question of local traditions, but to a great degree it is also a question of what funding is available."



PHOTO: MALMÖ UNIVERSITY

of Copenhagen's research in Big Data, which is an important area for life science, where large quantities of data need to be managed.

Lund University

There are three faculties with research areas in life science at Lund University: The Faculty of Medicine, the Faculty of Science, and the Faculty of Engineering (LTH). Neuroscience research and diabetes research at Lund University are considered globally leading by independent assessors. The research area cardiology, which is linked to a clinic, also has a strong position, says Gunilla Westergren-Thorsson, Dean of the Faculty of Medicine. Neuroscience has been one of Lund's strong areas for a long time, as has coagulation research. The latter is a small, but nonetheless important and successful area at the university. Cancer research at Lund University is also strong, although somewhat more sprawling, says Gunilla Westergren-Thorsson. She also mentions mass spectrometry, which has its very own interdisciplinary centre – the Center of Excellence in Biological and Medical Mass Spectrometry (CEBMMS) – as well as clinical diagnostics with NGS technology.

In addition, there is reproduction research, with various collaborations between Lund University and the University of Copenhagen. One example is the research collaboration and interregional project ReproUnion, in which Lund University, Skåne University Hospital and others participate, along with the pharmaceutical company Ferring, Rigshospitalet and a number of other Danish hospitals.

The university's website also refers to areas such as epidemiology, stem cells and regenerative medicine, as well as nano science and nano technology as strategic research areas at the Faculty of Medicine.

The Faculty of Science also performs research for the development of more effective medicine. The research centres LP3 (Lund Protein Production Platform), CEBMMS (Center of Excellence in Biological and Medical Mass Spectrometry) and MicLU (Microscopy Community at Lund University) are interdisciplinary, with an active and creative collaboration between the three faculties.

The Technical University of Denmark (DTU)

Research within life science at DTU is primarily at the following institutes: DTU Vet/National Veterinary Institute, DTU Food/National Food Institute, DTU Aqua, DTU Biosustain, DTU Bioinformatics and DTU Bioengineering (the latter two were formerly Systems Biology). In addition, a number of other institutions perform some research in life science, namely DTU Chemistry, DTU Chemical Engineering, DTU Electrical Engineering, DTU Nanotech and DTU Mechanical Engineering.

DTU's strategic goal is to strengthen its research in life science and bioengineering. One way that the university is doing this is by investing in a new life science and bioengineering complex at the Lyngby Campus for DTU Aqua, DTU Food and DTU Vet. Another new complex will contribute to bioengineering research. According to DTU it is one of the global leaders of its kind, and it will house DTU Biosustain – Novo Nordisk Foundation Center for Biosustainability (CBF). Both of the buildings will be ready for use at the end of 2016, and they will have space for almost 1 000 employees.

Malmö University

Research in life science takes place at a number of faculties at Malmö University: The Faculty of Health

and Society (HS), the Faculty of Odontology (OD), the Faculty of Technology and Society (TS). All faculties are involved in the cross-faculty research centre Biofilms-Research Center for Biointerfaces (BRCB).

The foremost area of excellence in life science, which is also one of Malmö University's overall strongest areas, is biological interfaces and biofilm. According to Vice Dean Thomas Arnebrant, it is on par with international research of the highest class. The area was established when Malmö University was

founded in 1998, when the strongest research skills at the new college were gathered in one group.

Some of the most prominent research groups research biological interfaces/ biological medicine, microbial biofilms, oral prosthetics, implantations, mathematical modelling, and materials, the university reports. There is also excellent research in the odontological field.

Malmö University will be a formal Swedish university beginning on 1 January 2018. That will entail sizeable resources for research; according to Thomas

ARTICLES, CITATIONS AND CO-PUBLICATIONS

Number of peer-reviewed articles, citations and articles co-published with international researchers are based on information provided by the universities. Figures are for the publications of researchers at the selected faculties/ departments.

Since the number of

citations increases annually, the number of citations for 2010 and 2015 cannot not be compared. Too much emphasis should not be placed on the number of articles in journals with an impact factor (IF) over 30, as certain topics are over-represented in journals of that level. The majority of the jour-

nals focus on publishing overview pieces, which in general contain far more citations than original articles. Impact factor is furthermore merely an indication of how often an average article is cited in a particular journal, not an indication of the individual articles' contribution to that factor.

	2015	2015	2015	2010	2010	2010	2015	2010	2015	2010
	Peer-reviewed articles	of which co-published with international researchers	Per cent co-published	Peer-reviewed articles	of which co-published with international researchers	Per cent co-published	Citations*	Citations*	Articles in journals IF>30**	Articles in journals IF>30**
Lund University	2 861	1 780	62.2	2 340	1 289	55,1	11 651	73 747	41	39
Faculty of Medicine	2 248	1 358	60.4	1 789	941	52,6	9 136	60 030	n.a.	n.a.
Department of Biology	282	202	71.6	252	148	58,7	985	6 349	n.a.	n.a.
Department of Chemistry	325	220	67.7	326	222	68,1	1 175	7 965	n.a.	n.a.
DTU***	868	539	62.1	542	296	54,6	3 520	16 651	39	13
Malmö University	249	121	48.6	166	46	27,7	n.a.	n.a.	0	0
RUC	21	22****	n.a.	16	27***	n.a.	n.a.	n.a.	0	0
SLU in Alnarp	n.a.	ca 75	n.a.	n.a.	ca 75	n.a.	n.a.	n.a.	0	0
Kristianstad University	17	6	0.35	Did not have life science research in 2010	n.a.	n.a.	n.a.	n.a.	0	0

University of Copenhagen was unable to provide information on articles, citations and co-publications for this report but expects to be able to provide them for next year's report. Aalborg University did not provide information and Copenhagen School of Design and Technology did not publish any articles.

Sources: Lund University: Scopus and the university's own database; DTU: Thomson Reuters' Science Citation Index, Malmö University: Web of Science and PubMed (2015); Other: the universities' own registers

*Not comparable due to different periods of comparison
**Number of publications for all researchers at the universi-

ty in one or more of the following scientific journals: Annual Review of Immunology, CA: A Cancer Journal for Clinicians, Chemical Reviews, Chemical Society Reviews, JAMA The Journal of the American Medical Association, The Lancet, Nature Genetics, Nature Medicine, Nature Reviews Cancer, Nature Reviews Drug Discovery, Nature Review Genetics, Nature Reviews Immunology, Nature Reviews Molecular Cell Biology, Nature, New England Journal of Medicine, Physiological Reviews, Science.

*** The figures are based on a search of researchers from the following institutions: DTU Vet, DTU Food, DTU Aqua, DTU Biosustain, DTU Biosustain and DTU Bioengineering
****Also includes articles that have not been peer-reviewed.

Arnebrant, they will most definitely also be used to benefit the life science area.

The Swedish University of Agricultural Sciences (SLU) in Alnarp

SLU has one faculty in Alnarp: The Faculty of Landscape Architecture, Horticulture and Crop Production Science (LTV). Five departments in the faculty – Plant Breeding; Plant Protection Science; Biosystems and Technology; Work Science, Economy and Environmental Psychology; and Landscape Architecture, Planning and Management – perform research that falls into the category life science. Research at each of these departments connects to medicinal issues, but on a smaller scale.

Three areas on the cutting edge of life science research at SLU are chemical ecology, biomass-based material and components and plant biotechnology for the development of new oil qualities, says SLU.

Roskilde University

Life science research at Roskilde University takes place at the Department of Science and Environme-

nt. The research areas are Eukaryotic Cell Biology, Molecules and General Physiology.

Aalborg University in Copenhagen

Two departments at Aalborg University in Copenhagen are dedicated to life science research: The Department of Clinical Medicine, whose research also takes place in Aalborg, and the Department of Chemistry and Bioscience.

Kristianstad University

In the research environment MEAL (Food and Meals in Everyday Life), specifically in the area of Nutrition, is where life science research takes place at Kristianstad University.

Københavns Erhvervsakademi

At the Copenhagen School of Design and Technology there is a research project in life science in Optometry, in the Programme Area of Technology.



Roskilde University.

PHOTO: NEWS BRESUND

CWTS LEIDEN RANKING (BIOMEDICAL AND HEALTH SCIENCES) – BASED ENTIRELY ON PUBLICATIONS AND CITATIONS

CWTS Leiden Ranking is based exclusively on the number of peer-reviewed articles and citations by researchers at an institution. The ranking also shows the percentage of each institution's articles that have been published in the most cited journals for the area and year in question. The University of Copenhagen is at the

top of the institutions in Greater Copenhagen; it claims that this is due in part to its goal-oriented recruitment of international researchers. Most of the region's universities have improved their results in the past five years. Roskilde University and Malmö University are not in the CWTS Leiden Ranking at all.

	2011-2014	2006-2009	2011-2014	2011-2014	2006-2009	2006-2009	2011-2014	2011-2014	2006-2009	2006-2009
	Number of publications	Number of publications	P (top 1 %)	PP (top 1 %)	P (top 1 %)	PP (top 1 %)	P (top 10 %)	PP (top 10 %)	P (top 10 %)	PP (top 10 %)
KU	6864	4406	95	1.4%	59	1.3%	910	13.3%	545	12.4%
LU	3787	3629	27	0.7%	29	0.8%	378	10.0%	311	8.6%
DTU	598	431	9	1.6%	4	1.0%	68	11.4%	48	11.1%
SLU	374	314	4	1.1%	2	0.6%	30	8.1%	21	6.7%
AAU	466	309	2	0.4%	1	0.4%	38	8.1%	20	6.5%

KU = University of Copenhagen, LU = Lund University, DTU = Technical University of Denmark, SLU = Swedish University of Agricultural Sciences, AAU = Aalborg University. Malmö University, Kristianstad University and RUC are not ranked.

The CWTS Leiden Ranking is based exclusively on bibliographic data from the Web of Science database of Thomson Reuters (Scientific), Inc., Philadelphia, PA, USA.

P(top 1%) and PP(top 1%). The number and the proportion of a university's publications that, compared with other publications in the same field and in the same year, belong to the top 1% most frequently cited.

P(top 10%) and PP(top 10%). The number and the proportion of a university's publications that, compared with other publications in the same field and in the same year, belong to the top 10% most frequently cited.

A fractional counting method is used in the above tabel. It gives less weight to collaborative publications than to non-collaborati-

ves ones, which leads to a more proper field normalization of impact indicators. The CWTS Leiden Ranking is based on so-called core publications, which are a subset of all publications in Web of Science. Core publications are publications in international scientific journals in fields that are suitable for citation analysis.

We have chosen to use the sub-category Biomedical and Health Science in this report as it corresponds most closely to the definition of life science that we use. Another possible category, Life and Earth Sciences, corresponds only partially to the topics in our definition of choice.

MAX IV – COUNTING ON A LOT OF LIFE SCIENCE RESEARCH

The synchrotron light facility in Lund, which was inaugurated this June, will give the region's university researchers and life science companies access to new kinds of experiments right on their home turf. A large part of the research performed at other similar faci-

lities around the globe is related to life science, reports MAX IV's Life Science Director Tomas Lundqvist. He expects that there will also be many users from the life science sector in Lund. For the time being, decisions have been made to build five beamlines

or experiment stations at which a significant part of life science research will take place. The first is BioMAX, which is specialised for macromolecular crystallography, in the area of Structural Biology. Experiments with BioMAX will be very fast and highly automated; it

will suffice for users to send in samples, and experiments can then be performed from home via internet.

According to Tomas Lundqvist, MAX IV - whose intensive and more laser-like light will be globally unique - will be an ideal facility for studying biology. From the molecular level, for example with BioMAX, to cells and various tissue types at any of the beamlines that work with imaging technology, or imaging, as it is often called.

However, a number of the beamlines considered crucial for the life science sector have yet to receive full funding. Among these is the beamline BioMedMAX, which will be globally leading in the rapidly expanding area of

technology called bioimaging. Tomas Lundqvist expects that there will be a beamline of this kind at the facility, since interest in it is growing exponentially within medical and other life science research, as more and more realise the unique opportunities to study biological matter and life processes that these kinds of beamlines offer.

The MAX IV facility has been inaugurated, but research will begin to really take off next autumn. The beamlines and experiment set-ups are not quite ready yet, and the large accelerators where the synchrotron light is produced needs optimisations before they are ready for regular use.

It is free to use MAX IV on the condition that research results are published; those who do not wish

to publish their research will have to pay. At other, similar facilities, the industry accounts for between 5 and 10% of the direct use, says Tomas Lundqvist, but if one looks at collaborations between the industry and academia, the number of companies using the facilities is significantly higher. For example, MAX IV's predecessor MaxLab was utilised by Novo Nordisk to further develop insulin treatments for the diabetics.



PHOTO: NEWS ØRESUND

ESS – WILL BE OPEN FOR MANY TYPES OF EXPERIMENTS

European Spallation Source, under construction in Lund with a data centre in Copenhagen, will, when the facility opens to researchers in 2023, provide neutron beams that are up to 100 times stronger than those at the currently leading neutron research facilities. That means that it will be possible for life science researchers to perform significantly more types of experiments than they can today; researchers are thus expected to utilise more of the research time at ESS than the average 10-15% common at similar facilities around the world. Senior Advisor Sindra Petersson Årsköld at ESS expects that the facility will become extremely important for regional research in life science.

ESS will contribute to the

following research areas, among others:

- Structural biology, for which there will be a specifically dedicated instrument. This can for example deliver data necessary for structurally-based pharmaceutical development.
- Methods that enable the study of the structure and dynamics in more complex systems that cannot be crystallised.
- Development of materials that help medicine enter into the body, for example via gels or pills.
- Prosthetic material that can operate in a biological environment.

In addition to the instrument for structural biology, Sindra Petersson Årsköld expects that at least five other instruments will be utilisable for life science research.



PHOTO: NEWS ØRESUND

As with Max IV, those from academia as well as the industry will be able to apply for slots of time to perform research at ESS. The use of ESS will be free for those who publish their research results, but those who would rather keep their results to themselves will have to pay. At other similar facilities, companies purchase 2-3% of the research time, but if one looks at collaborations between universities and the industry it becomes apparent that 30-40% of the time is effectively used for industry-related research projects.

SHANGHAI RANKING

OVERALL RANKING LIST (2016) (Total of 500 on the list)	Field LIFE* (2015) Life and Agriculture Sciences (Total of 200 on the list)	Field MED* (2015) Clinical Medicine and Pharmacy (Total of 200 on the list)
1 Harvard University (USA)	1 Harvard University (USA)	1 Harvard University (USA)
2 Stanford University (USA)	2 Cambridge University (UK)	2 University of California, San Francisco (USA)
3 University of California, Berkeley (USA)	3 Stanford University (USA)	3 University of Washington (USA)
30 University of Copenhagen	31 Karolinska Institutet	12 Karolinska Institutet
44 Karolinska Institutet	39 University of Copenhagen	45 University of Gothenburg
60 Uppsala University	51-75 Lund University	51-75 Uppsala University
65 Aarhus University**	76-100 SLU*	76-100 University of Copenhagen
81 Stockholm University	101-150 Aarhus University**	101-150 Aarhus University**
101-150 Lund University	101-150 DTU	101-150 University of Southern Denmark
151-200 DTU	101-150 University of Gothenburg	151-200 Lund University
151-200 University of Gothenburg	101-150 Stockholm University	151-200 Umeå University
201-300 Aalborg University*	101-150 Umeå University	
201-300 Chalmers	151-200 Uppsala University	
201-300 KTH		
201-300 SLU*		
301-400 Linköping University		
301-400 Umeå University		
301-400 University of Southern Denmark		
401-500 School of Economics, Stockholm		



PHOTO: KU - HEINE PEDERSEN

QS WORLD UNIVERSITY RANKINGS

WORLD UNIVERSITY RANKINGS (2016) (Total of 916 on the list)	By Faculty - Life Sciences and Medicine (2015) (Total of 400 on the list)	By Faculty - Natural Science (2015) (Total of 400 on the list)
1 Massachusetts Institute of Technology (MIT) (USA)	1 Harvard University (USA)	1 Massachusetts Institute of Technology (MIT) (USA)
2 Stanford University (USA)	2 University of Cambridge (UK)	2 Harvard University (USA)
3 Harvard University (USA)	3 University of Oxford (UK)	3 University of Cambridge (UK)
68 University of Copenhagen	9 Karolinska Institutet	54 University of Copenhagen
78 Lund University	24 University of Copenhagen	80 DTU
97 KTH	56 Uppsala University	90 Stockholm University
98 Uppsala University	60 Aarhus University**	93 KTH
109 DTU	86 Lund University	93 Lund University
117 Aarhus University**	99 University of Gothenburg	95 Aarhus University**
139 Chalmers	196 Stockholm University	99 Uppsala University
196 Stockholm University	218 Umeå University	146 Chalmers
264 University of Gothenburg	254 SLU*	333 Linköping University
282 Linköping University	254 University of Southern Denmark	363 University of Gothenburg
294 Umeå University	263 DTU	
374 Aalborg University*	304 Linköping University	
390 University of Southern Denmark	390 Malmö University	

TIMES HIGHER EDUCATION

WORLD UNIVERSITY RANKINGS (2015-2016) (Total of 800 on the list)
1 California Institute of Technology (USA)
2 University of Oxford (UK)
3 Stanford University (USA)
28 Karolinska Institutet
81 Uppsala University
82 University of Copenhagen
90 Lund University
106 Aarhus University**
136 Stockholm University
155 KTH
167 DTU
180 University of Gothenburg
201-250 Aalborg University*
201-250 Chalmers
201-250 CBS**
201-250 SLU*
251-300 Linköping University
251-300 Umeå University
301-350 University of Southern Denmark
301-350 Örebro University

World Reputation Rankings (2016) (Total of 102 on the list)
1 Harvard University (USA)
2 Massachusetts Institute of Technology (USA)
3 Stanford University (USA)
51-60 Karolinska Institutet
91-100 Lund University

* Has a branch in the region.
** Located or has a branch in the region, but does not perform life science research in the region.



PHOTO: LU - NINA RANSKJER



PHOTO: NEWS BRESUND

ABOUT THE RANKING LISTS

The three ranking lists selected are some of the most prestigious in the world. Shanghai Ranking has been published since 2009 by the independent organisation Shanghai Ranking Consultancy, but was already established by Shanghai Jiao Tong University in 2003. Times Higher Education has been published in the eponymous journal since 2004 and is reviewed by PricewaterhouseCoopers (PwC). QS World University Rankings has been released by the British student advisory company Quacquarelli Symonds (QS) since 2011.

SHANGHAI RANKING

The Shanghai ranking rates over 1 200 universities based on several indicators of academic or research performance, including alumni and staff that have won Nobel Prizes and Fields Medals (10 and 20% of the total result respectively); highly cited researchers (20%); papers published in Nature and Science (20%); papers indexed in major citation indices (20%); and the per capita academic performance of an institution (10%).

TIMES HIGHER EDUCATION

Times Higher Education ranks 1 200 universities around the world. The ranking is based on 13 indicators in five areas: Teaching (the learning environment); Research (volume, income and reputation); Citations (research influence); International outlook (staff, students and research); Industry income (knowledge

transfer), of which the first three carry the greatest weight (30% each) and the latter two 7.5 and 2.5% respectively.

World Reputation Rankings

The 2016 rankings are based on a survey carried out between January 2016 and March 2016, which received a total of 10 323 responses from 133 countries.

QS WORLD UNIVERSITY RANKINGS

QS World University Rankings rates more than 3 800 universities based on six performance indicators, two based on major global surveys – academic reputation (40% of the score) and employer reputation (10%) – and four on ‘hard’ data – student-to-faculty ratio (20%); citations per faculty (20%); international faculty ratio (5%) international student ratio (5%).

UNIVERSITIES AND RESEARCHERS IN THE REGION

Nine educational institutions in Greater Copenhagen perform research of some kind in life science. Research activity ranges from a single research group to extensive research in multiple faculties. Life science's broad scope means that life science research often spans multiple educational institutions. The largest of these is the research area for life science at the University of Copenhagen, although exact data for the university is not included in this report.

UNIVERSITY OF COPENHAGEN

Faculty of Health and Medical Sciences, Faculty of Science and other centres.

LUND UNIVERSITY

Faculty of Medicine, Faculty of Science, Faculty of Engineering (LTH). Centres such as: LP3 (Lund Protein Production Platform), CEBMMS (Center of Excellence in Biological and Medical Mass Spectrometry) and MicLU (Microscopy Community at Lund University).

TECHNICAL UNIVERSITY OF DENMARK (DTU)

DTU Veterinary Institute, DTU Food/National Food Institute, DTU Aqua/National Institute for Aquatic Resources, DTU Biosustain, DTU Bioinformatics (formerly Systems Biology), DTU Bioengine-

ering (formerly Systems Biology). Furthermore, life science research also takes place in divisions of these departments: DTU Chemistry, DTU Chemical Engineering, DTU Electrical Engineering, DTU Nanotechnology and DTU Mechanical Engineering.

MALMÖ UNIVERSITY

Faculty of Health and Society (HS), Faculty of Odontology(OD), Faculty of Technology and Society (TS). The cross-faculty research centre Biofilms-Research Center for Bionterfaces (BRCB).

ROSKILDE UNIVERSITY (RUC)

Department of Science and Environment: - research group Eukaryotic Cell Biology

- research group Molecules and General Physiology.

AALBORG UNIVERSITY IN COPENHAGEN

Department of Clinical Medicine and Department of Chemistry and Bioscience.

SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCES (SLU) IN ALNARP

Faculty of Landscape Architecture, Horticulture and Crop Production Science.

KRISTIANSTAD UNIVERSITY

The research environment MEAL.

COPENHAGEN SCHOOL OF DESIGN AND TECHNOLOGY

Programme area Technology, BPS (PBa) in Optometry.

	Lund University	Technical University of Denmark (DTU)	Malmö University	Roskilde University (RUC)	Aalborg University in Copenhagen	Swedish University of Agricultural Sciences (SLU) in Alnarp	Kristianstad University
Number of researchers in life science	2 239	736	80	33	n.a.	n.a.	8
Number of professors	304	52	15	11	n.a.	15-20	3
Number of PhD students	1 340	266	25	15	n.a.	50-100	1
Number of students	ca 3 500	ca 2 150	ca 2 100	230	n.a.	ca 1 000	ca 150

University of Copenhagen was unable to provide information on articles, citations and co-publications for this report but expects to be able to contribute them for next year's report. Aalborg University did not provide complete information and Copenhagen School of Design and Technology has one life science researcher. Figures for Lund University and DTU are from 2015.

Source: Information provided by the universities

Comment Lund University: Information regarding the number of researchers, professors and PhD students is for the Faculties of Medicine, Biology and Chemistry. There is a greater number of life science researchers at Lund University, for example at LTH. The number of students include full-time students and students studying individual courses at the Faculties of Medicine and Biology. There are more life science students at Lund University, for example at the Faculty of Chemistry and LTH.

Comments DTU: Information is for the researchers at the following departments: DTU Food, DTU Vet, DTU Aqua, DTU Systems Biology and DTU Biosustain.

HIGH QUALITY OF LIFE IN THE NORDIC CITIES

When it comes to the recruitment of international researchers to universities and companies, it is not merely a question of attracting them with interesting work and high salaries. Good conditions and quality of life for their families are also an important competitive advantage for a region. There are many different quality of life indexes, but they tend to have one thing in common – the Nordic cities usually place very high in the ranking.

MERCER - EXPATRIATE QUALITY OF LIVING

1. Vienna
2. Zurich
3. Auckland
4. Munich
5. Vancouver
6. Dusseldorf
7. Frankfurt
8. Geneva
9. Copenhagen
10. Sydney

Source: Mercer

Copenhagen places 9th on Mercer's Quality of Living Survey for 2016. The survey is performed annually with the aim to help organisations determine the compensation that should go to employees being stationed abroad. The quality of life in cities around the world is analysed on the basis of 39 different factors that can be categorised in 10 different groups. These different factors are then weighted depending on how important they are for those on international assignments, and they form the foundation on which the final number of points for the respective cities is based.

EUS QUALITY OF LIFE IN EUROPEAN CITIES, 2016

1. Zurich
2. Oslo
3. Belfast
4. Vilnius
5. Aalborg
6. Rostock
7. Hamburg
8. Cardiff
9. Stockholm
10. Braga
14. Copenhagen
17. Malmö

Source: European Commission

EU's Quality of Life in European Cities is released every third year and came out for the fifth time in 2016. More than 40 000 people in more than 79 European cities answered survey questions about their satisfaction with a variety of areas such as education, sports facilities and public transportation, but also with regard to their overall satisfaction with the city in which they live. On the list of European cities where residents report being most satisfied, Copenhagen comes in 14th, and Malmö comes in number 17.

TOP 10 GREEN CITIES, 2016

- GLOBAL GREEN ECONOMY INDEX™

1. Copenhagen
2. Stockholm
3. Vancouver
4. Oslo
5. Singapore
6. New York
7. Berlin
8. Helsinki
9. Paris
10. Tokyo

Source: Dual Citizen

For the third time, Global Green Economy Index has ranked Copenhagen as the world's number 1 green city. Copenhagen won the title for the first time in 2012 and for the second time in 2014.

Global Green Economy Index is released annually. The index is based on a survey of experts' perceptions of the cities' performance within four areas: leadership and climate change, efficiency sector, markets and investment and environment and natural capital.

MONOCLE - MOST LIVEABLE CITIES

1. Tokyo
2. Berlin
3. Vienna
4. Copenhagen
5. Munich
6. Melbourne
7. Fukuoka
8. Sydney
9. Kyoto
10. Stockholm

Source: Monocle

Once every year, the British lifestyle magazine chooses the world's 25 Most Liveable Cities. Copenhagen has topped the list three times, but in 2015 it plummeted from first to tenth place. In 2016, Copenhagen is on its way back up thanks to its clean bathing waters and the city's defining trait par excellence – the good biking.



PHOTO: NEWS@RESUND

ATTRACTING AND KEEPING TALENT: Job market and recruitment in the life science cluster

The rate at which university graduates and researchers are produced at domestic universities is not enough to supply the life science branch with a highly qualified workforce, so it must be recruited in part from abroad. Greater Copenhagen is fortunate to have a high quality of life, but seen in an international context, it offers lower pay to the highly educated, and the tax rates are high. In Denmark in particular, special tax schemes for researchers have become an important competitive parameter in the attraction of international talents.

- A survey of selected recruitment companies shows that finding employees with the right competencies can be a challenge. The survey also reveals a general tendency for companies to demand more broadly qualified employees; researchers are also expected to be good project leaders and communicators, and more academics are needed in production, sales, and marketing.
- In Medicon Valley's six largest life science municipalities (Gladsaxe, Ballerup, Copenhagen, Kalundborg, Hillerød, Gentofte), the number of foreign employees in the industry – both with and without a higher education – doubled between 2008 and 2015
- The Danish tax scheme for foreign employees was used in 5 452 cases in 2015; 2 490 were researchers. In Sweden, where the tax scheme for foreign employees is far less attractive, there were 994 applications to the department for tax relief, 'Forskarskattenämnden', in 2015; 715 were approved.
- There are 1 203 international students enrolled in a life science programme in Greater Copenhagen, 1 060 of them in Region Skåne. Of the 1 203 international life science students, 350 are PhD students.
- Quality of life is high in Greater Copenhagen, and Copenhagen tops several international lists. EU's Quality of Life in European Cities list also includes Malmö, and Copenhagen and Malmö come in 14th and 17th, respectively.

THE NEED FOR INTERNATIONAL EMPLOYEES

A snapshot of the job market for life science presents a picture of progress and cutbacks, shortages in the workforce and a balance between supply and demand.

A survey of selected recruiting companies shows that things are going well in the life science cluster, but that larger companies are cutting back, and finding employees with the right competencies can also prove a challenge. The economic boom that is beginning in both Sweden and Denmark naturally also has an impact on developments in life science businesses. As stated earlier in this report, the pharmaceutical industry has grown steadily since 2008 and has boosted employment in a period where all other sectors in the industry have experienced negative employment growth. Steen Gravers, Director and Team Manager at Mercuri Urval in Denmark, emphasises that long development cycles are characteristic of the development division of the life science industry, and that makes them less sensitive to economic highs and lows than many other industries. However, R&D divisions

can be vulnerable to developments in other sectors, points out Thomas Behrens, Labour Market Analyst at the employment agency Arbetsförmedlingen in Region Skåne. The bank sector in particular can influence the development of the life science sector, since the sector is highly dependent on the funding available for the development of new products. Furthermore, competition for the development of new products on the global market can quickly influence production in the region, since general developments in technology and digitalisation can have a negative streamlining effect, and that can lead to staff cutbacks.

Technological developments can also result in a "quantum leap" for the region, as they did 20 or 25 years ago. We had a serious employee shortage at the time, and all of the companies were competing for a small number of experts." says Thomas Behrens.

In both Sweden and Denmark, there is a tendency for large companies to reduce their number of employees, whilst the number of employees in small and medium-sized companies remains the same or increases.

"Several company headquarters are worried. Besides Novo, Lundbeck and to a degree also LEO are being somewhat more cautious. Development is stuck in reverse right now, and it has been for the past six months," says Kjeld Birch, Managing Partner at SAM Internationals.

He points out that the change is not such a great one as far as branches of the pharmaceutical sector in Denmark is concerned, but he has noted a regionalisation trend where more branches are relocating to Stockholm. Furthermore, according to Kjeld Birch things are going well for medical technology; among other things, Danish success with hearing aids has the wind in its sails, as does biotechnology, where developments in new and established companies have been positive. But according to Kim Raabymagle, who is Country Manager at PharmaRelations, the total number of sales and marketing positions in sales companies is on a slight decline.

"The companies are restructured year after year and there have been more cutbacks in marketing and sales departments in Denmark. It's a question of supply, and price ceiling arrangements that are putting pressure on pharmaceutical and medical technology prices," he says.

Hanna Wendel Diamantoudis, Chief Management Consultant at Mercuri Urval AB, is just about to complete a study about competencies and compatibility problems in the life science industry in Sweden. She points out that even if the number of employees in Swedish life science has been dropping since 2006, it appears that the decline slowed down between 2012 and 2014.

"If Astra Zeneca is not included in the statistics, then the number of employees in the life science industry actually rose by 1.4% between 2012-2014," says Hanna Wendel Diamantoudis.

56% of the employees in the life science industry in Sweden work in large companies, and 46% work in small and medium-sized companies, but Hanna Wendel Diamantoudis points out that the number of employees in small and medium companies increased significantly, whilst in larger companies it continued to decrease between 2012-2014.

There is also a tendency for employees to remain at their positions in larger companies for a longer time – if they can. This is particularly true during economic slumps, whilst there is greater mobility during economic booms, and there are more people who move toward smaller companies, for example in the biotech-sector, where the companies' development is less certain and

more dependent on the ups and downs of the market.

There is a general tendency for companies to demand employees with a broader scope of qualifications. Researchers are also expected to be good project leaders and communicators, and there is also a need for more academics in production, sales, and marketing.

"It is challenging that small and medium-sized companies in particular are looking for employees with multiple areas of competence," says Hanna Wendel Diamantoudis.

Sales and marketing

There is a growing need for highly educated workers with an academic background in sales and marketing within the life science sector; for example in economics and public health. Negotiation processes are becoming more centralised, which means that work in sales requires more skills.

"There is a need for more academics such as health economists for market access, since negotiation agreements now require an ability to look at the overall economy more than they used to," says Steen Gravers from Mercuri Urval in Denmark.

According to Kim Raabymagle, Country Manager at PharmaRelations, sales and marketing in the life science sector in Denmark have been dismantled in recent years, and it has therefore been less difficult to find workers on the Danish side of Öresund.

"I can only speak for us, but at PharmaRelations we have found it easy to find competent and qualified workers. We receive more than 25 new and relevant CVs every week from people who aren't applying for any specific job position, and we interview a lot of interested candidates so we can always find the candidate we are looking for. On top of that, job candidates have grown more willing to work on contract or in substitute positions. The job market right now is such that they don't necessarily need a permanent position; even highly qualified workers. It seems to be a "companies' market" right now, at least as far as sales and marketing in Denmark are concerned. It's a different situation for highly specialised international academics and the production division," he says.

But the Arbejdsmarkedsbalancen, an online tool that shows the job prospects for different job descriptions, does indicate that in general, prospects are good for pharmaceutical consults and pharmaconomists, as well as product specialists and sales consultants in the Capital Region of Denmark and Zealand. A number of job descriptions within marketing have poorer work prospects.

On the Swedish side, however, the demand is greater than the supply when it comes to sales and marketing in the life science sector, according to

Hanna Wendel Diamantoudis.

"This is especially the case at management level, where companies often recruit from the international market."

Generally speaking, there is a shortage of business-to-business salespeople in Sweden, and job prospects are expected to be very good for people in that group in the next five to ten years, according to Yrkeskompassen, which assesses job prospects for various job categories in Sweden.

Research and Development

There is a shortage of doctors in Sweden as well as in Denmark, and the shortage will continue for the next five to ten years.

"There is simply always a shortage of certain profiles in the life science sector, and those are people with a medical background. Companies need a few doctors on board, and medical advisors and medical directors are always in short supply," says Steen Gravers.

Arbejdsmarkedsbalancen shows a shortage of doctors, medical consultants and opticians in Denmark. And there are also good job prospects for R&D employees in the natural sciences and technology and health sciences. Prospects for biomedical engineers, biochemists, bioanalysts and laboratory technicians are also good, and the job prospects for pharmacists are excellent in the Capital Region of Denmark. The job prospects for biologists and laboratory assistants for example are not as good. In Sweden, the employment agency Arbetsförmedlingen's tool to evaluate job prospects Yrkeskompassen shows that there is a shortage of doctors and dentists, as well as a demand for biomedical analysts. There will be a short-term shortage of pharmacists, but the supply will balance out the demand in the next few years. There is an overabundance of biologists, and Arbetsförmedlingen predicts that the demand will increase in the future as a result of an increased focus on the development of biological medicines, among other things; however, the competition for job positions will still be hard.

As far as R&D in the Swedish life science industry is concerned, Hanna Wendel Diamantoudis from Mercuri Urval AB finds that the job market is fairly balanced and employee turnover is relatively low.

"The general picture is that strong and relevant competencies in Sweden are available within research and development, both directly from the universities and at a more experienced level," she says.

Production

Pharmaceuticals production places particularly high demands on its employees. And in Sweden as well as

Denmark, there is a shortage of competent workers in production in the life science industry.

"There is definitely an obstruction in production when it comes to quality assurance, development and project management. There aren't enough people getting the education," says Kjeld Birch.

"It can be difficult to find people with the right skills, and there is a need for continuing education and training to bring people up to the right level to work in pharmaceutical production," says Hanna Wendel Diamantoudis.

Arbejdsmarkedsbalancen in Denmark shows that there is a shortage of biomedical technicians in the Capital Region and prospects are good for workers in chemistry and pharmaceuticals, production engineers, process technicians and process operators, for example. The Swedish Yrkeskompassen shows that chemical engineers, chemical technicians and machinists will be in high demand in the chemical industry in the coming years, but the market is expected to balance out in five to ten years.

Recruitment

Recruitment to the life science industry is international to a degree, particularly at the management level. SAM Internationals finds it difficult to entice people to Denmark. Steen Gravers from Mercuri Urval says that the tax scheme in Denmark that offers a lower tax rate for three to five years can result in researchers choosing to leave when those five years are up. In Sweden, there is a growing tendency to recruit internationally, especially for management positions in sales and marketing, according to Hanna Wendel Diamantoudis, since being able to work the international market is important.

At EuroJobsites, chief executive Lars Peter Svane finds it necessary to recruit researchers from abroad.

"It's clear that smaller countries like Switzerland, Belgium, Denmark and perhaps to some degree Sweden, but also some regions in the UK and Germany (Cambridge and southwestern Germany) have a much greater need for Pharma & R&D candidates than the local universities can produce."

Some of the recruitment actors that Øresunds-instituttet spoke to said that mobility over the Öresund Strait is good in both directions, but particularly from Skåne to Denmark, since the wages there are higher and the choices more.

"It isn't hard to get people to cross over the border in Denmark and southern Sweden, but as soon as you get to Gothenburg, it's almost as hard trying to get someone to come from the USA," says Kjeld Birch, Managing Partner at SAM Internationals.

INTERNATIONAL RESEARCHERS

The recruitment of highly trained workers to the life science sector takes place both nationally and internationally, particularly for recruitment of researchers and for management positions. The rate at which graduates and researchers are produced at domestic universities is not sufficient to supply the life science sector with highly qualified workers, who thus have to be recruited from abroad. Whether or not foreign talents can be attracted depends on the interplay between the attractiveness of the workplace, the financial incentives, and the allure of the region as a place to live.

In Medicon Valley's six large life science municipalities (Gladsaxe, Ballerup, Copenhagen, Kalundborg, Hillerød, Gentofte), the number of foreign employees – both with and without a higher education – doubled between 2008 and 2015, according to statistics from the Danish Agency for Labour Market and Recruitment. Since life science companies provide employment for between 41% (Copenhagen) and

71% (Gentofte) of the employees in the industry in those municipalities, statistics show clearly that there is a great need for foreign employees in the life science industry. It is not possible to connect the work tasks or education of foreign workers in the statistics. No comparable statistics exist for Sweden.

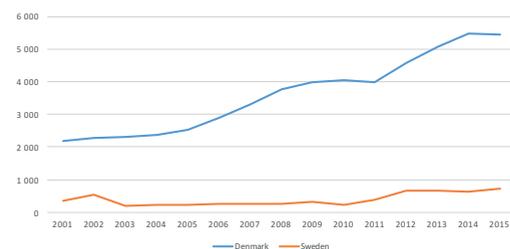
With returns that are considered low from an international perspective, a high tax rate, and a high cost of living, particularly favourable taxation schemes for international talents can be an important tool when seeking to attract talents from abroad. Denmark has had a special tax scheme for foreign employees since 1992, and Sweden has had one since 2001. In Denmark, the scheme is used as an active instrument in the global race to attract highly qualified workers, whilst in Sweden, it has been introduced mostly as a gesture, so as not to appear less attractive than neighbouring countries, which already had a tax scheme for experts.

The Swedish scheme is not nearly as attractive, and nor is it utilised as often as the Danish. While a key employee in the Danish scheme needs to earn a minimum of 62 300 Danish crowns per month including employee benefits, a foreign expert in Sweden needs a monthly salary of 88 300 Swedish crowns to be approved. In 2015, the Danish tax scheme was used 5 452 times; of these, 2 490 were researchers, according to preliminary statistics from the Danish Ministry of Taxation.

In Sweden, 994 applications were made to the commission that deals with the tax relief scheme, Forskarskattenämnden; 715 of these were approved.

The configuration of the two schemes entails that the Danish scheme can be used to attract Danes who have been working abroad for several years to a Danish workplace, whilst the Swedish system can

NUMBER OF RESEARCHERS AND KEY EMPLOYEES ON THE TAX SCHEME FOR FOREIGN KEY PERSONNEL



Source: Forskarskattenämnden and the Danish Ministry of Taxation

ABOUT THE FIGURES

Data for foreigners who have not completed their education in the country are incomplete in the national statistics office's Register of the population's Education. Because of the poor data quality about the education of workers who have come to Denmark from abroad it has been necessary to use additional sources such as the utilisation of the tax relief schemes, and the Danish Agency for Labour Market and Recruitment's database Jobindsats.dk.

It is not possible to extract specific data material for the life science sectors in Greater Copenhagen in the data sources used here, however, by the use of the available complementary Danish sources, the Danish life science sector's need for highly qualified workers from abroad becomes clearly visible. The Danish Ministry of Taxation and the Forskarskattenämnden websites offer statistics about the utilisation of the tax relief scheme.

DENMARK

'Tax relief scheme'

The special tax scheme for foreign researchers and key personnel, widely known as the tax relief scheme, took effect in 1992 and has since changed several times, most recently in 2015; it was relaxed somewhat when the minimum monthly salary was reduced by 10 000 DKK.

Who can use the tax scheme?

Foreign researchers and key personnel employed in a Danish company or at a Danish research institution. Researchers are required to have at least a PhD-level education, and key personnel in the fiscal year 2016 are required to have a monthly salary of at least 62 300 DKK (salary incl. employee benefits).

Configuration

The tax scheme for foreign employees is a taxation rate of 26%, which corresponds to a total tax rate of 31.92 including labour market contributions. Documented expenses for social contributions abroad and foreign social security contributions are the only possible deductions.

Conditions

The foreign employee is not permitted to have worked or

run an independent business in Denmark or received pension from Denmark in the ten years prior. Furthermore, the employee is not permitted to have been part of the management, or have had control or a significant influence on the company where s/he is to be employed in the five most recent years.

Time limit

The tax scheme can be used for a maximum of five years.

SWEDEN

Tax relief scheme

The tax relief regulations for foreign employees were introduced in 2001 and were most recently reviewed in 2012 to include everyone whose earnings are over a set amount.

Who can use the tax scheme?

Foreign researchers, company managers, experts or other key employees employed in a Swedish company or a Swedish research institution. To take advantage of the tax scheme, it must be extremely difficult to recruit employees in Sweden with the required skills.

Configuration

Tax relief for foreign employees is such that only 75% of the salary paid by the employer is taxed. The employer's compensation for expenses related to moving to and from Sweden, children's schools and similar, as well as two annual trips to the country of origin for the foreign employee and her family are also exempt from taxes.

Conditions

The foreign employee may not be a Swedish citizen or have lived in or resided permanently in Sweden within the past 5 years. The employer must be based in Sweden or in a foreign company with a permanent location for operations in Sweden. If these conditions are fulfilled and the foreign employee's monthly salary fulfils the condition of being higher than twice the price basic amount, the employee can be approved. In 2016, that amount is equal to a monthly salary of at least 88 300 SEK, including compensation for employee benefits.

Time limit

The tax relief scheme is valid for the first three years, and the intention should be to remain in Sweden for maximum five years.

only be used by non-Swedes. Additionally, the Danish scheme does not require the employee to reside in Denmark; s/he may also reside in a neighbouring country. That provides Medicon Valley with unique possibilities, as the combination of a high salary on the Danish side and a lower cost of living on the Swedish side can be a further financial incentive in the recruitment process. It is also an advantage that can be used to attract workers from Sweden's other life science clusters to Medicon Valley. Before the most recent revision in 2012, the Swedish tax scheme was criticised because it could not be used in recruitment, as it was impossible to predict whether an application would be approved by Forskarskattenämnden,

which evaluates and approves applications. But the changes made to the scheme in 2012 introduced a salary requirement in order to have an objective criterion and make the outcome more predictable. However, the salary requirement is quite high, and it is believed that many companies recruit employees from abroad without using the tax scheme. Thus, the statistics for applications for the Swedish tax scheme do not provide a complete picture of the number of international researchers and key employees in Sweden, whilst Danish statistics provide a more accurate representation. The number of foreign talents employed in Medicon Valley who use the tax schemes cannot be extracted from the statistics.

INTERNATIONAL STUDENTS

There are a total of 3 187 international students studying in life science programmes in Greater Copenhagen, 1 060 of them in Skåne. 'International students' includes exchange students, foreign PhD students and free mover students who organise their studies in the country of their own accord. Of the 3 187 international life science students, 1 044 are PhD students.

Generally speaking, Lund University is the Swedish university at which the largest number of international students begin a programme or a course. However, if one looks exclusively at life science programmes, there are more international students in Stockholm as well as in Uppsala and in Skåne.

The number of international life science students in Greater Copenhagen has increased 58% since 2008, due to an increase in international life science students in the Capital Region of Denmark. While Denmark has 83% more international life science students in the study year 2014/15, the number has decreased in Sweden since 2010, which can be explained by the introduction of tuition fees in 2011 for foreign students from outside of the EU/EEA who are not part of an exchange programme. Since then, the number of international students in Sweden has decreased. The Swedish government has requested that the Swedish Higher Education Authority review the tuition fees and how they affect student mobility and recruitment to research programmes. The review will be delivered to the Swedish government in January 2017. Since the beginning of the 00's, Denmark has had tuition fees for students from countries outside the EU/EEA.

Because of the structure of the Swedish educational system, which allows students to take individual courses at the universities, the total number of students is significantly higher than in Denmark. For example,

if a student is registered for two single courses at two different educational institutions in the same semester, s/he will be accounted for twice in the statistics. Thus, it is impossible to make a direct comparison of Danish and Swedish education statistics, and the figures presented in this section should be interpreted with that in mind.

Employed in Medicon Valley after completing education

2 011 international students completed a life science programme in Greater Copenhagen between 2010-2014. Of these, 682 were in research programmes. One year after completing their educational programme, 16% of the international life science graduates educated on the Danish side of the Strait had found work, as did 6% of those educated in Skåne. It is necessary to add two provisos for the correctness of the figures. National statistics are not able to register if a graduate has begun working on the other side of the Strait; the graduate in question will continue to be registered as unemployed in the domestic registers.

The second proviso is that in Sweden it is impossible to follow an international student over time if s/he has received a Swedish personal identification number after completed education. In Sweden, foreigners who do not expect to reside in the country permanently are not given a personal identification number, but a coordination number. If the international student later, after the education programme is completed, decides to become a permanent resident and is assigned a personal identification number, s/he can no longer be followed in the registers, as it is not possible to link coordination- and person identification numbers. Both of these two provisos indicate that the number of international students who begin working after completed education in Skåne is higher



PHOTO: NEWS BRESUND

than the numbers presented here.

Attracting international students and keeping them after their education has been completed has been one of several focus areas for Copenhagen Capacity's Talent Attraction project, which began in September 2012 and lasted until the

end of 2015. The international talent development programme Youth Goodwill Ambassadors aimed to make international students in Denmark ambassadors for the country. The programme received a total of 1 517 applications, and 712 completed the programme.

NUMBER OF INTERNATIONAL STUDENTS IN THE ACADEMIC YEAR 2014/15

	Number of students	of whom in research programmes	Change 2008/09 - 2014/15
Skåne	1 060	334	15%
Stockholm-Uppsala region	3 503	1 577	21%
Västra Götaland	838	249	7%
Sweden, rest of	1 732	341	15%
Sweden	7 133	2 501	17%
Eastern Denmark	143	16	-69%
Denmark, rest of	170	12	-68%
Denmark	313	28	-68%

Source: Customised analysis from Statistics Denmark and Statistics Sweden

ABOUT THE FIGURES

The figures for the number of students and their connection to the job market are retrieved from customised analyses by Statistics Denmark and Statistics Sweden. The selection of educational programmes was made from the programme classifications in Denmark and Sweden, and programmes have been chosen within which work in the sector is usually found after education is completed.

The figures for Denmark and Sweden are not directly comparable due to differences in the educational systems and the available data material.

The Danish and Swedish educational systems are structured differently. In Denmark, students, apart from exchange students, register for an entire programme at the bachelor or graduate level. In Sweden, it is possible to register for individual courses, and it is also possible to complete a master's degree by combining individual courses from different programmes. The criterion is that one must earn 120 ECTS points to complete a master's degree. A student who has registered for two courses in the same semester will thus be accounted for two times in the statistics. An attempt has been made to account for this in the extracts from the Swedish data. Students registered for more than

one course at the same institution are only counted as one student; however, if that student is registered for courses at two separate institutions, s/he will be accounted for twice in the data material.

The figures for the number of students are thus not directly comparable between Denmark and Sweden.

The definition of an international student depends on national definitions and the possibilities offered in the dataset at hand. Therefore, the definition varies in Danish and Swedish data extractions. In Sweden, an international student is defined as 1) a person from a country outside of the EU/EEA, who upon moving to Sweden has reported that the move is motivated by studies, and where a residency permit has been issued for less than two years before the commencement of studies 2) students who have moved to Sweden less than six months prior to the commencement of studies, and 3) other individuals lacking a Swedish personal identification number in the educational institutions' study administration systems. In Danish data, an international student is defined as such if s/he came to Denmark within a period from one year prior and three months after commencement of studies, and does not have a Danish secondary education.

ANALYSIS: Dynamic and differences

As regards Greater Copenhagen, there is currently a shift underway in the balance between the Zealand and Skåne Regions. The centre of gravity for the industrial life science cluster is on the Danish side of the Öresund Strait. The scientific research base in Skåne on the other hand is growing with the construction of the new research facilities MAX IV and ESS. In terms of the Nordic countries, Medicon Valley has clearly become a leader.

- Whilst Zealand's role at the industrial forefront of Medicon Valley becomes stronger, Skåne is now growing as a region for scientific research.
- The materials research facilities MAX IV and ESS will place a great deal of focus on life science research and thus become yet another Medicon Valley beacon.
- Statistics for employment, export and patent applications show how Medicon Valley has grown to be the leading Nordic region in life science.
- New biological medicines and other advanced technological production strengthen both Denmark's and Sweden's roles as countries to which life science is central.
- There are numerous important actors in the Copenhagen Areas, such as IBM and Hitachi, who can contribute to a dynamic overlapping of sectors and give the region a new position of strength.
- In a global perspective, researchers seek a more open attitude from the sector in Medicon Valley in the form of more collaboration, but also in improvements as far as thinking along the lines of sales and marketing at the early stage.
- Access to qualified personnel is an important factor for companies in the region, and it poses the challenge of recruiting international talents as well as minimising the obstacles presented by the border between Denmark and Sweden.
- The ability of the sector to adapt to new demands for lower prices and new product opportunities need to be seen from a more constructive, future-oriented perspective, rather than from a crisis perspective.

New beacon for Medicon Valley

Distinct, grand entities. It is already a fact that the large life sciences companies around the Öresund are concentrated on the Danish side of the Strait. The news is that the Skåne Region, and especially Lund, are about to become the region's new research beacon when 22 billion Swedish crowns are being invested in the research facilities MAX IV and ESS. As far as employees within scientific research goes, Lund is already the municipality in Greater Copenhagen with the greatest number external to the hospitals.

A new dynamic is emerging in Medicon Valley. Kåre Schultz, CEO of Lundbeck and Chairman of the Danish government's Growth Team for Life Science, confirms in an interview on page 78 that the structure within Medicon Valley is clear; the big businesses are mainly on the Danish side, whilst research and workforce can be found in the Skåne region. This may sound like a distinctly Danish perspective, but it can also be interpreted as a confirmation that there is a shift underway in the regional structure; a shift that has to do with the new Swedish and European major investments in new research facilities.

Formally seen, the materials research facility MAX IV that was inaugurated this summer is a Swedish facility, but Denmark has already invested in a beamline there. The life science research there is significant. Similarly, the research facility European Spallation Source (ESS), currently under construction, is very much a Danish-Swedish affair with its facility in Lund and data centre in Copenhagen. There will be new, hefty motives for the life sciences cluster to move over the Öresund Strait. From the outset, Lund already has a strong position as one of Greater Copenhagen's larger scientific research

municipality when measured in terms of the number of employees outside of the medical profession, see page 30. Furthermore, Ideon – the region's oldest and largest science park – is in Lund, as is the innovative Medicon Village. Many of the successful new companies in life sciences have their foundation here; Alligator Bioscience is just one example. But the era of big business feels very distant when it comes to life science in the Skåne region.

There is a growing science park structure on the Danish side of the Strait, too. Scion DTU and Symbion have been supplemented by the expansive CO-BIS, where the materials research facility ESS has chosen to place its data centre DMSC. Denmark has also enjoyed early success building up a growing network of new biotechnology companies.

MAX IV and ESS are Medicon Valley's new beacons of scientific research and an important resource for life science companies in the region, see page 42. The research that will take place at both of the facilities will focus a great deal on life science; see page 58. In the long run, these facilities may be where the successful companies of the coming generation are produced.

This analysis shows clearly that Medicon Valley has grown to be the leading Nordic region within life science in the past ten years. In other words, statistics show that Medicon Valley itself is a beacon:

* 53% of those employed in Danish and Swedish life science worked in Medicon Valley in 2014.

* Danish life science exports have doubled in seven years and are now nearly 50% larger than Swedish. The majority of Danish life science companies are located in Medicon Valley.

* Medicon Valley is on top when it comes to the number of patent applications in life science, submitting nearly two times as many patent applications as companies in the Stockholm-Uppsala region last year.

As a sector, life science is difficult to define, and is undergoing changes on a global and national level. In Greater Copenhagen, there is also a lack of equilibrium in the size of companies on both sides

of the Strait, and Danish life science has furthermore experienced more positive development than Swedish in recent years.

Nonetheless, the collaboration across the Öresund is a good one. Many of the big leading pharmaceutical companies are in Denmark, including Novo Nordisk, Lundbeck, Ferring and LEO. The majority of the Danish pharmaceutical sector is located in Zealand. Many of these large companies are foundation-owned, which means that much of the ownership has remained within Denmark, whilst the number of large companies in Sweden has diminished, and Astra Zeneca has cut back its operations. Another result is that the companies have an advantage over publicly owned companies, which have to make a profit all the time. That's the CBS researcher Stine Jessen Haakonsson's take on it – see the interview on page 85.

– In terms of time, foundation-owned companies have a longer horizon for their investments. They can invest in a long-term perspective, which is good when it comes to pharmaceuticals, and especially for innovation. In that respect, time is on their side, she says.

Together, Astra Zeneca and Pharmacia were two of the largest life science companies in Sweden. When Astra Zeneca chose to close its site in Lund in 2012, it hit the region hard. The researcher Bo Carlsson compared the development in Lund and Uppsala after both companies left, and he finds that there has shown to be an advantage for Uppsala. Pharmacia was active early in biotechnology, and it also had many collaborations with researchers and a tradition of spin-off companies. According to Bo Carlsson, what happens in the next few years with the competence that the two companies left behind will determine the future developments of Swedish life science. Read more in the interview with Bo Carlsson on page 83.

The shift within Swedish and Danish life science is part of the global shift within the sector. There is a hot political debate about how much pharmaceuticals should cost that is contributing to more price battles between companies. The processes for bringing new products on the market are also long and expensive, and in many areas, research has made such great strides that small steps have become very costly. Different markets also have different conditions and regulations. However, there are

substantial opportunities associated with technological developments; from IT and biological medicine to other areas of biotechnology and gene research.

In order to take on those developments, Scandinavian companies will have to get better at working together and assimilating new knowledge, according to Stine Jessen Haakonsson. They need to update their business model, think out of the box and be challenged. They also need to be better at management and marketing issues, says Bo Carlsson. Peter Nählstedt, CEO of the company Probi in Lund, thinks along the same lines.

– There are a lot of good ideas, but still very few that make it to becoming larger companies. I think it's because there is too much focus on products and solutions and too little focus on selling them, especially in the early stage, he says in an interview; read it on page 81.

Probi is part of the sector transition underway in life science; functional food is in the borderland. The company works with healthy bacteria – probiotics – that are added to food and used as nutritional supplements. – We are neither a food company nor a pharmaceutical company. We have characteristics of both, and we are a health company that focuses on probiotics, says Peter Nählstedt.

Another part of the sector shift is digital communications technology, which is creating new possibilities within health care. The health guide 1177.se and internet-based CBT-treatments are just two examples of how technology is used in medical services today. New sensor technology and smart phones as a com-

munication bridge and artificial intelligence between patients and health care providers are other examples. These issues are on the national agendas in Sweden as well as in Denmark. In Sweden, there is a board responsible for eHealth, as well as an eHealth strategy in place until the year 2025. In Denmark, there is a digital strategy for the years 2016-2020, for which the Danish Agency for Digitisation Organisation is responsible. The Swedish National Board of Health and Welfare defines the area thus: "Health is physical, psychological and social wellbeing. eHealth is the use of digital tools and information sharing to achieve and maintain health."

There are several important actors in Greater Copenhagen, such as IBM and Hitachi, that move between various industrial sectors, and there are additional possibilities to link actors across the sectors in the region. At the same time, as Novo Nordisk's Chairman Göran Ando noted in the interview on page 35, there are significant cultural differences between life science companies' regulations and prudence with regard to safety and the experimental IT-sector. Life science can very much be a question of life and death.

Min Doktor ('My Doctor') is an early-stage company on the eHealth scene in Sweden. It is a digital primary care centre that has grown rapidly since it was started in 2014. According to its CEO Charlotta Tönggård, it has been met with positive reactions on the whole, but there is also a certain wariness of new things, and she believes that Min Doktor is sometimes seen as a symbol for the transformation underway in the medical profession. Patients are better informed, make



PHOTO: REGION SKÅNE - JENNY BRANDT



active choices and become involved in their health care. Today, Charlotta Tönsgård sees few obstacles on the market.

– It depends on how ready users are. But there is a digital maturity in all age groups in Sweden. People want the same quick access to health care as they have to other services, and that is what we offer to our patients. Around the clock. We are digitalising, the same way the banks did.

Both Min Doktor and Probi are glad to be located in Greater Copenhagen, and they also consider it a good base for further expansion to foreign markets. However, there are also several challenges; for example, the current ID and border controls make it difficult to recruit personnel from the other side of the Øresund, they say.

– Right now, I would say that it is impossible to recruit from Copenhagen because of the border controls, says Charlotta Tönsgård.

Petter Hartman, CEO of the Medicon Valley Alliance, also points to the border controls and other border-related obstructions, such as for example different regulations for social security and taxation issues, as challenges that limit mobility in the region. Read more in the interview on page 99.

– The difficulties for cross-border commuters are a huge threat. Different kinds of obstacles mean that the potential cannot be exploited, and it limits businesses' development opportunities. Naturally this is unfortunate, because the Skåne and Zealand regions need each

other to generate growth and competitive strength.

The new political collaboration in Greater Copenhagen is a new link in Medicon Valley's development. Following a Danish initiative, the political collaboration over the Øresund has put greater focus on global marketing and attracting international talents.

We have a shared life science marketing in Greater Copenhagen and there is increased interest in the region, say Ann-Sofie Andersson and Ulrika Ringdahl, both of whom work specifically with life science matters at Copenhagen Capacity and Invest in Skåne.

They work together often, sharing an exhibition stand at international conferences and working to improve understanding and interest in life science from the region. Together, the region is stronger, they say.

– The focus shouldn't be so much on where something is, but rather what we create together and how we communicate our respective strengths as a whole.

– We are good at telling a common story, which gets a positive reception in a world where competition is tough. Companies appreciate that they can meet with both of us – two organisations and two countries – at the same time.

In 2014, Tillväxtanalys ('Growth Analysis') released a summary of Swedish life science, and it is planning to release an update every second year. The analyst Carl Wadell sees two areas particularly on the advance in Sweden.

– I think that biological medicine and what we somewhat inaccurately call 'precision medicine' are two areas where Sweden has great potential.

That development increases the significance of international collaborations and also influences how we collect data on patients and built up our registers, he says. Opportunities are in opening up new markets, and the challenge is finding them.

Anders Lönnberg, National Coordinator for the Life Sciences for the Swedish Government, also sees pharmaceuticals as a strength for the Nordic life science industry.

– If you had asked me three years ago, I would have replied that pharmaceutical production was not something for Sweden. But as soon as it comes to developing and manufacturing biological medicines, things become more technologically complex, and China and India aren't as strong anymore. Every week I get phone calls from people who want to manufacture their products in Sweden, he says in an interview on page 78.

Denmark's National Coordinator and H. Lundbeck's

CEO Kåre Schultz, believes that we will start seeing more biological medicines being produced in the region.

– I believe that the production units for biological medicines are placed near where the companies are established, he says in an interview on page 78.

A number of big businesses are investing in the production of biological medicine in Sweden, including Astra Zeneca, GE Healthcare and Pfizer. It's an interesting development, says Carl Wadell; we have had so many years now where production has left the country, but now it is coming back. The major challenge is the issue of competent workers, and he has received indications from companies that they are having problems finding the right people in the field.

New EU directive: "For medtech companies that means increasing their competence."

CBS researcher Stine Jessen Haakonsson is uncertain about the growing trend for precision medicine, also known as personalised medicine. If it can't be made more effective, a lot of money will be used to develop products for very few people, she says. The result will be a socioeconomic discussion and political decisions to determine how much a treatment should cost.

Another important trend that Sweden's National Coordinator for the Life Sciences Anders Lönnberg points out is the Nordic countries' access to health data, where the coordination of the

IT-systems used in health care is a key issue.

– Interest in our biobanks is growing. If you don't have 70 years' worth of registers behind you it doesn't make a difference how technologically advanced you are, he says.

Coordinated IT-systems in health care and better exploitation of biobanks can give pharmaceutical companies a competitive edge.

As far as health data is concerned, Ann-Sofie

Andersson from Copenhagen Capacity and Ulrika Ringdahl from Invest in Skåne also see potential in the area. But there is an aspect of time to it that means that other countries can beat us to it. Another challenge is bundling our registers into an attractive offer and reviewing the rules that

are obstacles for their use.

There are also rules and agreements within the EU and on an international level that influence the sector's development. One example is a EU directive relating to medical technology. For medical technology companies, that means increasing their competence.

– It broadens the definition of which products can be classified as medtech and makes stipulations about follow-up when they are on the market. That can mean increased costs for companies that need in-house competence to set up quality systems, says Carl Wadell.

UPCOMING ANALYSES FROM MEDICON VALLEY ALLIANCE

ØresundsInstitutet and Medicon Valley Alliance have initiated a long-term analysis collaboration. State of the Region will be an annual analysis of the developments in Medicon Valley. The aim is to deepen the analytic work year by year, and to concentrate on one topic in depth each year.

In addition to this annual report, we will publish several special reports every year.

The topics for the special reports are still open, but could for example touch on:

* University research – the areas of strength

* Talents and in-depth employment statistics

* Development in current partial clusters

* Publicly financed research

* Development of innovation systems in the Skåne and Zealand Regions

* Funding – foundations, risk capital and donations

* Collaborations

* Patents – the geographical and company connections

Analytic work takes place in an open process, where players from the sector are welcome to contribute with their points of view and reflections.

Biological medicines strengthening Denmark and Sweden

A Swedish politician and a successful Danish company leader are each heading a group of experts that will come up with concrete suggestions about how to reinforce the life science sector in their countries. Anders Lönnberg and Kåre Schultz already have one thing in common – they believe that developments toward more biological medicine can give Sweden and Denmark new competitive advantages.

– If you had asked me three years ago, I would have replied that pharmaceutical production was not something for Sweden. But as soon as it comes to developing and manufacturing biological medicines, things become more technologically complex, and China and India aren't as strong anymore. Every week I get phone calls from people who want to manufacture their products in Sweden, says Anders Lönnberg, National Coordinator for the Life Sciences for the Swedish Government.

His task is as succinct as it is hard to define in a trade magazine: Make Sweden a global leader for life science.

Unlike the Danish Life Science Growth Team, Anders Lönnberg doesn't need to create a strategy for life science, but instead lead a collaborative process that will also encompass everything from the coordination of the IT-systems used in health care to biobanks, testbeds and shared labs where small companies can participate.

The starting point is difficult. First, the large, successful Swedish pharmaceutical companies bought each other, and then the control and a great many jobs disappeared out of the country when the Swedish companies were bought up



Anders Lönnberg, National Coordinator for the Life Sciences for the Swedish government.

or merged. Swedish life science has shrunken. Danish life science has grown, and for the most part organically. The roles have been reversed; today, Denmark is the older brother when it comes to life science.

– My subjective interpretation of the difference between Denmark and Sweden is that it isn't a question of different structural conditions, but rather of the original ownership situation. The Swedish companies were publicly traded with private owners. When things were going well for them it was completely natural that even-bigger English and American pharmaceutical companies merged with them, or bought them. The only reason that the same thing didn't happen in Denmark was the foundation structure: the original owners gave the company to foundations. If you

think about it it's really quite spectacular, and there is no-one who would do that anymore – give away the ownership to a foundation without being able to get their money back, says Kåre Schultz, Chairman of the Danish government's Growth Team for Life Science and CEO of the Danish publicly traded pharmaceutical company H. Lundbeck, which is protected from being bought since the Lundbeck Foundation is its primary owner.

H. Lundbeck develops new biological medicines. Although test production is

outsourced to other manufacturers right now, Kåre Schultz believes it is a distinct possibility that the full-scale production will end up at the company's API-production facility in Nykøbing in western Zealand - if the development work is successful.

– I think that the production units for biological medicines are placed near where the companies themselves are established.

Kåre Schultz points out that the smaller biotech companies work with high risks in a sector where only about 1 in every 100 early-stage research projects will result in a new drug. And for the companies that are successful, the trend is to sell them and outsource the production – which is good for shareholders, but perhaps not for the Danish life science cluster. That's why it's important that there are large companies in the country.

He declines to say what recommendations the Growth Team will make in the beginning of 2017. But he makes it clear that they will address questions about access to qualified workers, how to safeguard high level research, access to risk capital and the various structural conditions for tax, and deduction regulations for research investments, for example.

– The conditions today, with high tax rates and overhead costs, are miserable. No-one would start a pharmaceutical company in Denmark today.

Kåre Schultz emphasises that we cannot become larger than all of the university research if we can't draw in ideas from outside. He also points out that Denmark has a unique strength; there are many historical roots connecting the big Danish pharmaceutical companies like LEO

Pharma, Novo Nordisk and H. Lundbeck, between which ideas and researchers have moved back and forth.

He sees the proximity to the Skåne region as a natural potential to expand the recruitment area for Danish life science companies, and considers it important that the Medicon Valley Alliance works to minimise the obstacles created by the border and the problems related to the border controls.

– As I see it, collaboration in Medicon Valley is primarily based on ideas and workforce come from Sweden to Denmark, and the integration works well. Many of the researchers at Novo Nordisk, as well as at Ferring and Lundbeck, live in Sweden, says Kåre Schultz, and he mentions that the researcher Ulla Hedner studied at Lund University and began working at the University Hospital in Malmö before working for several decades on development of Novo Nordisk's extremely successful drug for treating haemophilia, NovoSeven.

– But I don't think that many companies will cross the Öresund from Denmark to Sweden. I also think that Sweden's biotech environment is naturally concentrated around Stockholm and Karolinska Institutet.

After many difficult years, Anders Lönnberg sees positive developments for life science in Sweden.

– And not least because capital has begun flowing in from abroad, from just over a billion crowns annually to ten billion last year. A big part of that was Alligator Bioscience in Lund, Pfizer's reconstruction of a factory for biological medicine in Strängnäs, Astra Zeneca's construction of a factory for biological medicine in Södertälje and GE Healthcare's doubling of the Uppsala facilities that produce biological medicine.



Kåre Schultz, CEO Lundbeck and Chairman of the Danish government's Life Science Growth Team.

SWEDISH AND DANISH GOVERNMENT INITIATIVES WITHIN LIFE SCIENCE

Both the Swedish and Danish governments directed their attention to the life science sector in the beginning of June. In Denmark, a special growth team was appointed for life science, and in Sweden, so-called strategic collaborations were launched, where life science is one of five areas of emphasis. Furthermore, the Swedish government has appointed Anders Lönnberg as National Coordinator for

the Life Sciences. The task began in 2015 and will continue until the 31st of January next year.

The Danish initiative is being led by the CEO of Lundbeck, Kåre Schultz, and the expert group's recommendations will be presented to the government in the beginning of 2017. There is particular focus on the export of pharmaceuticals and medical products until 2025.

– With exports of around 90 billion Danish crowns and 36 000 jobs, Danish life science companies make a significant contribution to the Danish economy. The government wants to augment Denmark's international position within life science and create the right conditions for the sector to continue the very positive economic development of the past 10 years. That is why the government is engaging a growth team to come up

with concrete recommendations for what is central in order to continue this development until 2025, says Troels Lund Poulsen, Denmark's Minister for Business and Growth, in a commentary.

The Danish government's outline plan Sammen for fremtiden ('Together for the Future') from June 2015, states that: "The government will support a strong Danish research-performing pharmaceutical and medical industry by simplifying conditions and procedures for clinical research as well as prioritising

the improvement of procedures and waiting time for the approval of new pharmaceuticals."

In Sweden, a broader initiative was taken in June, when the prime minister pointed out important societal challenges that the country is facing and launched five collaboration programmes. In addition to life science, these also include travel and transport; smart cities; circular, biobased economy, as well as smart industry and new materials. Among other things, it was asserted that "the collaboration between

health, business and academia is necessary for new innovative pharmaceuticals, health care methods, and medical technology to reach society, many with solutions that make use of the digital technology". The work is expected to continue until the end of 2018.

As national coordinator, Anders Lönnberg will give the Swedish government an outline of the work to "strengthen Sweden's position within life science", and also be a link between actors in the sector and the government's work.

eHealth as a business idea:

Great opportunities for online health care centre

Developments have been swift for the primary care centre Min Doktor ('My Doctor'). It is one of the earliest in eHealth, and CEO Charlotta Tönsgård sees few obstacles for the company's growth. They have begun looking outside of Sweden, and she believes that the company will be in other countries within three years. The proximity to Copenhagen is important for recruitment, as well as for access to more capital.

Min Doktor has developed rapidly since it was started in 2014. The company's founder is a doctor who was working at a primary care centre when he saw the possibility to make health care reception more efficient. He started small, with urinary tract infections, where the first contact is simply a visit to the doctor. After that, more areas were added and now patients can choose on a map where they want to deliver their samples.

– Right now I would say that there are hardly any obstacles in the market. We are in the early stage, even if we think that we have already reached large volumes.

We have 40 000 patients this year and we are one of the largest primary care centres in all of Sweden. However, it is nothing compared to the volumes in primary health care, says CEO Charlotta Tönsgård. She continues:

– It depends on how ready users are. But there is a digital maturity in all age groups in Sweden. People want the same quick access to health care as they have to other services, and that is what we offer to our patients. Around the clock. We are digitalising, the same way that the banks did.

The insurance companies were one of the early customers and last year they accounted for 70% of the volume at Min Doktor; now the private market makes up 60%. Both sides have expanded substantially, she says. This summer, Min Doktor entered its first agreement with the public health services, in the area of acute health care in Halland County. In Jönköping, Min Doktor has agreements with the private Wetterhälsan, which is part of Vårdval Jönköping (Jönköping GPs). As of yet, the company does not have an agreement with Region Skåne, but the region recently pledged investments totalling 200

million Swedish crowns for digitalisation.

– Generally speaking, digitalisation has come far in Sweden, but as far as connecting civic functions goes we haven't come very far. The economies of scale are enormous, but it won't work if every region comes up with its own system. It needs to be coordinated, says Charlotta Tönsgård.

At Min Doktor, patients are in contact with a doctor within half an hour. Today there is a broad scope of complaints for which people contact them, including allergies, skin rashes and tonsillitis.

The reactions on the whole have been positive, says Charlotta Tönsgård. But there is also a certain wariness of new things, and for doctors it is part of a current transformation where patients are better informed, make active choices and become involved in their health care. Sometimes Min Doktor is seen as a symbol for that, she believes.

– It is important for us to be clear about the fact that we are not a replacement for the physical health care entities; we are a complement. If we go 10 or 15 years forward in time, I'm sure that this is what the access to health care will look like. Someday we'll look back and laugh about the fact that we used to go to the doctor's office when we had a stomach virus, the same way we laugh that we used to go to the bank to pay bills, says Charlotta Tönsgård.

Today, Min Doktor has only one significant competitor in Sweden. They are similar in many ways; the difference being that the Stockholm-based company Kry puts a camera between the patient and the doctor. Min Doktor also offers the possibility to video chat, but it is only used for 5% of

"It makes all the difference that we can also recruit from Copenhagen. As a city, Malmö is far too small in terms of the depth of competence."



Charlotta Tönsgård
CEO Min Doktor

PHOTO: MIN DOKTOR

visits, which Charlotta Tönsgård says saves time. – It will take a long time before we feel each other's effect. But it's good to have a competitor; it keeps you on your toes and gives you something to gauge on. I think that it's a good thing that there are two players, and also a sign that the market in Sweden is ready, she says.

The company's founder is from Lund, and until November last year, Min Doktor had its office in Medicon Village. The office is now located centrally in Malmö. Charlotta Tönsgård believes that it is easier to find staff there than in Stockholm; there are more innovative companies to compete with. Today, Min Doktor has 60 employees at the office and about 30 doctors work in the service. Charlotta Tönsgård also looks across the Strait to find the right people with the right competencies for the job.

– It makes all the difference that we can also recruit from Copenhagen. As a city, Malmö is far too small in terms of the depth of competence. It is crucial that integration with Copenhagen works well.

Today we only employ two Danes at Min Doktor.

– Right now, I would say that it is impossible to recruit from Copenhagen because of the border controls, she says.

Min Doktor would like to recruit people with different backgrounds and language skills in order to be able to help a variety of patients, but also for an upcoming expansion into foreign markets.

– We are looking around internationally with keen attention. If we talk again in three years, we will be in more countries. We'll have to see which countries those are and at what rate we start up there, but we have international ambitions, says Charlotta Tönsgård.

The founder and the earliest investors still maintain the largest degree of control over the company.

– We have been able to do it, but in general it's more difficult to raise capital here than in Stockholm. Taking that bigger step is a challenge. The Copenhagen connection is important; the funds there are different, and there are international investors, says Charlotta Tönsgård.

Functional food as a business concept:

Healthy bacteria from Lund on the way to the USA

The company behind the healthy bacteria in food products and fruit beverages like Provisa is expanding. With a growing global market, Probi is investing in its growth with the acquisition of an American company and the hiring of new staff. They will be keeping their base in Lund, says Peter Nählstedt. He believes that in order to get more of the companies in Medicon Valley to grow, there needs to be more investment in sales and marketing at an early stage.

Probi in Lund works with healthy bacteria – probiotics – that are added to foods and used as a nutritional supplement. As a company, they are located in the borderland between two sectors.

– We are neither a food company nor a pharmaceutical company. We have characteristics of both, and we are a health company with a focus on probiotics, says Peter Nählstedt, CEO of Probi.

LP299V is the name of the bacteria strain for which the company is best known, and the one in for example the fruit drink Provisa. Probi originated in a research project at Lund University and Skåne University Hospital that started in the 1980s. The founder's idea was to make a medici-

ne, but when the industry gave it a miss, opportunities began to open in the area of functional food in collaboration with Skånemejerier. Later, technology was developed that allowed the bacteria to be freeze-dried and kept alive in capsules and tablets for use as nutritional supplements, and the company

"We are neither a food company nor a pharmaceutical company. We have characteristics of both, and we're a health company that focuses on probiotics."

suddenly had another leg to stand on: consumer health care. Today, the university connection has diminished.

– The university isn't really as focused on the field today as it was in the 1980s. We have active collaborations that are important for us, but nothing that sets the tone for the company like it used to, says Peter Nählstedt.

Nonetheless, the company's

connection to Lund is still strong. It is here that Probi was founded, and it is here that they have been gaining expertise in probiotics for the past 35 years. Peter Nählstedt points out the positive side like the good accessibility to competence within the market area – people who also have international experience – and the region's geographical placement, as well as the access to business consultants and advisors; this was clear for Probi with its recent acquisition. For that reason, the company has no plans to leave the region.

– We'll have our operations in several locations, and we are on our way to becoming a global company. We need to be close to our customers, but as I see it, we are going to keep the headquarters and the core of the company here in Lund, he says.

Peter Nählstedt believes that global growth is on the way in Probi's area. There are certain regulations in Europe that limit the market, but lifestyle diseases continue to increase in many parts of the world.

– I see it as a considerable problem, but also a great opportunity for probiotics to be part of the solution.

Probi is planning on growing with its existing products, but also through its recent acquisition, which means access to new products and 30 new bacteria strains.

In addition, they will invest about 15% of their profits in R&D. Last year, Probi's turnover increased from 134 million to 215 million Swedish crowns, and they also hired new staff.



Peter Nählstedt
CEO Probi

PHOTO: PROBI

In the past, Probi's growth was primarily reliant on the reinvestment of parts of their profit, but with the acquisition in the USA, which was finalised in the beginning of October, they took in 600 million crowns in new issues. The German majority stakeholder Symrise AG supported the acquisition.

– The probiotics branch is exciting from a global perspective, it's young, and it has yet to be consolidated. That's why it's possible to make acquisitions, says Peter Nählstedt. He finds that the American company Nutraceutix complements Probi in a number of ways: geographically, in the value chain, and with new products.

Probi works with Danish companies, including Chr. Hansen and Danisco, but has only one Danish employee at the office in Lund. He finds it problematic that early integration in the region has slowed to a halt and that the commute over the Öresund has become more difficult. When it comes to life science

companies in the region, he believes that they will have to get better at working together and assimilating marketing and -sales competence early on in order to continue growing.

– There are a lot of good ideas, but there are still very few that make it and become larger companies. I think that it's because there is a lot of focus on products and solutions and too little focus on selling them, especially in the early stage, says Peter Nählstedt.



PHOTO: NEWS ÖRESUND

Researcher interview:

The legacy of Astra Zeneca and Pharmacia in Sweden

How has development been in different parts of Sweden since Astra Zeneca and Pharmacia left? That is the point of departure for a research project in which Bo Carlsson, emeritus Professor in Economics at the Case Western Reserve University in Ohio, is involved.

Two large companies have dominated the Swedish life science sector for many years – Astra Zeneca and Pharmacia. Both of the companies started in the Stockholm region. Pharmacia later moved to Uppsala and Astra Zeneca has been in a number of different locations around the country, including Lund. But the Swedish connection weakened when Astra – as it was formerly known – merged with Zeneca in 1999, and Pharmacia, after several mergers with Upjohn, Monsanto and others was finally bought by Pfizer in 2002.

In 2012, Astra Zeneca in Lund closed, moving its research unit to Mölndal and elsewhere. The closure of the entire unit in Lund as well as the research and development unit in Södertälje two years later meant that 2 000 Swedish jobs in the company disappeared. In the end of the 1990s, Pharmacia was the largest private employer in Uppsala with 4 000 employees. Today, the company in Uppsala that was formerly Pharmacia has been shut down.

According to Bo Carlsson, there are two big differences between the two companies. For one, Astra Zeneca's foundation was in chemistry, while Pharmacia was a pioneer in biotechnology. In addition, Pharmacia collaborated more with researchers and had a tradition of start-ups and spin-off companies that Astra Zeneca did not have. This has also impacted developments after the companies left both cities.

– Pharmacia had a completely different company culture; they left a number of viable companies behind, and Uppsala has a higher employment rate now than when Pharmacia was at its peak. Astra Zeneca didn't have the same culture, says Bo Carlsson.

There are countless ideas and companies being developed in Astra Zeneca and Pharmacia's wake. But it is difficult to predict how things will go for them in the long-term, says Bo Carlsson.

– Right now there is a window of opportunity to take advantage of the competence that was developed

at Astra Zeneca and Pharmacia, which were world-class. The opportunities will be there for five or ten years. If that competence hasn't been reabsorbed in that period of time, things won't go so well for the Swedish life science industry. If new products can be developed things can go brilliantly. There is an enormous gap between those opportunities.

When the newly established companies want to scale up is when the big financial needs come in. The big business tradition has also resulted in a lot of people

who aren't prepared to run companies. Often they lack the know-how for management and market issues, says Bo Carlsson.

Bo Carlsson believes that the life science industry has been of great importance in Sweden, but company relocations and closures have meant a decline

“Pharmacia had a completely different company culture; they left a number of viable companies behind. And Uppsala has a higher employment rate now than when Pharmacia was at its peak.”



PHOTO: GLENDA CARLSSON

Bo Carlsson is emeritus Professor in Economics at Weatherhead School of Management, which is part of Case Western Reserve University in Ohio. He is also a guest professor at the research centre Circle at Lund University. He has published over 20 books on industrial economy, participated in national commissions in Sweden and acted as a consultant for the

World Bank. He co-wrote the report “Industrial Dynamics in the Swedish Life Science Industry, 1991-2015” with the researchers Olof Ejermeo and Cindy Gomez Alder.

since the beginning of the '00s. Sweden is part of the global transition, and in life science there are enormous opportunities for development associated with biotechnology and gene research, as well as information technology, Bo Carlsson points out.

But there are also huge challenges. Among other things, the processes for bringing new products on the market are lengthy and expensive. There is also a political debate raging about how much medicines should cost that can contribute to companies not daring to take risks. Many companies merge or make acquisitions for the synergies and economies of scale, focus on fewer areas and have to adapt to

new technology that changes the process of innovation. Different conditions in different markets also influence companies' strategies and the costs incurred along the way to a finished product.

– There are price controls that prevent people from arbitrarily setting prices. This is not the case in the USA. But getting through the registration process is easier in Europe. Swedish companies don't see the domestic market as important; they have to get out internationally. The small companies that we spoke with say that penetrating the American market takes too great an effort; they try to get into the European market first, says Bo Carlsson.

MEDICON VILLAGE TOOK OVER ASTRA ZENECA'S SITE IN LUND

In Lund, a joint venture by Lund University, Region Skåne and entrepreneur Mats Paulsson from Skåne resulted in the foundation-owned Medicon Village's purchase of Astra Zeneca's

former premises. There are now 14 publicly traded biotechnology companies, an incubator, various activities from within the university and the region, and more.

Furthermore, Danish pharma-

ceutical companies such as Novo Nordisk recruited many of the researchers from Astra Zeneca, and today there are about 400 Swedes working for Novo Nordisk in Zealand. Read more on page 43.



PHOTO: NEWS ØRESUND

Researcher interview:

'We-know-best' mentality is a problem for Scandinavian life science

Scandinavian life science companies need to get better at working together and assimilating new knowledge in order to update their business model. The global transitions are placing new demands, and bringing new products out on the market today is enormously expensive. In that respect, the Danish foundation-owned companies have the advantage that they can look at their investments more in the long-term. That is what Stine Jessen Haakonsson, researcher at CBS in Denmark, thinks.

Research at Scandinavian life science companies is so advanced that all of the low-hanging fruit is gone. Now a little extra knowledge costs a lot of money. That's why new products often make small improvements with hefty costs, according to CBS researcher Stine Jessen Haakonsson. She believes that companies will need to change their outlook in the future.

– Scandinavian companies have been very isolated within specialised areas. They feel that they are at the forefront, and they are, but they have an attitude that says that they know best, says Stine Jessen Haakonsson. She continues:

– Developing new products today takes a lot of innovation. In my research, I look at globalisation and what individual companies do. It is evident that there are good reasons to changing the strategies a bit. To see oneself as part of a network rather than an independent company that will do everything on its own. Companies need closer ties to the universities, and reorganisations are needed to get access to the knowledge they need.

A lot of the Scandinavian companies count on the same markets and the same medicines, including the treatment of lifestyle diseases like diabetes and cardiovascular diseases. In doing so, they are concentrating primarily on the wealthy end of the market and missing the other segments that for example Indian and Chinese markets have been better at getting hold of, says Stine Jessen Haakonsson.

– It's going well for the Scandinavian companies, and they are leaders within their areas, but they are not as good at updating their business model. They aren't really interesting in collaborating. It's all about patents and protecting their intellectual property; the competition is

holding them back. They have all started going after the same diseases and cannibalising each other up in a way.

Developing a new product costs a lot of money, and companies are more or less constrained to aim for the global market. The result is that they are under pressure to find blockbusters that will bring record sales so that they can cover the costs. Companies also try to hang on to their products longer and make another trademark in the same area when a patent runs out, just to keep up sales. But Stine Jessen Haakonsson does think that the Danish foundation-owned big businesses do have an advantage over the publicly owned companies that always have to generate a profit.

– In terms of time, foundation-owned companies have a longer horizon for their investments. They can invest with a long-term perspective, which is good when it comes

to pharmaceuticals, and especially for innovation. In that respect, time is on their side. But the innovation process itself needs to be opened up more, she believes.

– Here in Scandinavia, particularly in Denmark, we're too good at agreeing with each other. We all went to the same schools and when it comes to creating new values, we aren't challenged. We are challenged to make things a little bit better, but not to think radically differently. There is a need for networks where people get asked unexpected questions.

"It's all about patents and protecting intellectual property; competition is holding them back. They have all started going after the same diseases and cannibalising each other in a way."



Stine Jessen Haakonsson is Associate Professor at the Department of Business and Politics, Copenhagen Business School.

PHOTO: CBS - BJARKE MCCARTHY

Life science in two countries – telling of a joint story

When Copenhagen Capacity and Invest in Skåne market life science in Greater Copenhagen and the Skåne region, they do it with one and the same story. They find that interest in the region has grown, and next year they are moving a big life science conference with international participants from Stockholm to Malmö.

The organisations Invest in Skåne and Copenhagen Capacity both work to promote business opportunities on respective sides of the Öresund, and life science is one of the many areas of focus for both of them. Ulrika Ringdahl is responsible for life science interests at Invest in Skåne, and Ann-Sofie Andersson at Copenhagen Capacity. Improving international understanding and interest for the region's life science is high on their list of priorities, as is helping players here in the region see their opportunities. They do this by for example suggesting meetings between researchers and companies and between companies, as well as participating in international conferences around the world in order to position and market the region.

– There is increased interest in the region internationally, which is great. In part it's to establish a base here, but also to invest in R&D. It is most evident when large companies choose to set up here, but it is also a great success when international players see that there is groundbreaking research being done here and choose to invest capital and resources to promote it, says Ann-Sofie Andersson.

There are differences between the life science sectors on both sides of the Strait; for example the Danish Capital Region employs many more people and is made up of more big companies. But together, the region is a whole, and we are stronger together, Ann-Sofie Andersson says.

– We use our respective strengths in our work together, and we put them together in our storytelling, meetings and activities to show that we are a strong, single whole. Looking at the industry, it is easy to see; there is a difference in what is being invested in research and big companies. But seen as a cluster, what we have to show as a whole and the connections that we have are more important. The focus shouldn't be so much on where something

is, but rather what we create together and how we communicate our respective strengths as a whole, says Ann-Sofie Andersson. She goes on:

– We are good at telling a common story, which gets a positive reception in a world where competition is tough. Companies appreciate that they can meet with both of us – two organisations and two countries – at the same time.

But the fact that there are two countries can sometimes be a challenge here at home.

– The collaboration here is unique and not always a matter of course on a national level, says Ulrika Ringdahl.

"The focus shouldn't be so much on where something is, but rather what we create together and how we communicate our respective strengths as a whole."

Ann-Sofie Andersson and Ulrika Ringdahl are in touch every week and meet often. They even share an exhibition stand at many international conferences and both have been instrumental in getting the conference Nordic Life Science Days to move down to Malmö from Stockholm next year.

– It's a feather in our hat that the big pharmaceutical companies and investors are coming here to us. It's a wonderful opportunity for companies in our region to get exposure, says Ulrika Ringdahl.

On the shared website www.mediconvalley.com are some of the areas of strength that have been defined for the region's life science cluster: diabetes, neuroscience, cancer, inflammation and autoimmune diseases, as well as stem cell research.

– Internationally seen, these areas of strength are good and help tell people about Medicon Valley. But it is important for us to be up to date on the whole network, and to have good contact with people working with early-stage projects, says Ann-Sofie Andersson.

In the background is also the report about the region's beacons that Invest in Skåne and Medicon Valley Alliance commissioned in 2012 as part of an Interreg-project. But a number of areas have

changed since then, and the sector is in constant development. The areas of strength aren't the deciding factor on a day-to-day basis.

– When it comes to certain activities, being a critical mass can be an advantage, but we don't exclude helping companies from other areas, of course. With all due respect to the areas of strength, ultimately it's often about the individual company, and it may very well be that we have top candidates from an area that isn't our strongest, says Ulrika Ringdahl.

Ann-Sofie Andersson, Business Development Manager for Life Science at Copenhagen Capacity, and Ulrika Ringdahl, Head of Life Science at Invest in Skåne.



PHOTO: NEWS ÖRESUND

TWO CHALLENGES IN LIFE SCIENCE

HEALTH DATA

The data associated with our personal identification numbers in Scandinavia offers a fantastic opportunity, according to Ann-Sofie Andersson from Copenhagen Capacity. Danish health data has been mapped out in order to give an overview of the registers it contains, but competition will require cooperation, she says.

– We have outstretched a hand to players in the Skåne region and the rest of Scandinavia so that together we can make it known that we are really good at this in the Nordic countries, and so that the USA – which is gathering more and more data and is good at commercialising solutions – doesn't beat us to it. There are many players that need to agree. Politicians, patients and companies need to define their wishes more specifically, so that this position of strength can be taken advantage of. Because the competition is there, and as of yet we haven't been able to bundle our health data into an offer, says Ulrika Ringdahl at Invest in Skåne.

– What people have to realise is that there's no time to lose. It is an enormous resource, but it has been difficult for our own industry to take advantage of it, and it has been primarily used for university research. As it is now, there are national regulations in the way, and that is what is being looked at now.

TESTBEDS

In order to produce new innovations, they need to be developed and tested in realistic conditions. In Copenhagen, there are so-called 'testbeds' for life science that Copenhagen Healthtech Cluster

created with some of the nation's largest hospitals. They haven't come that far on the Swedish side of the Strait, but in the Skåne region, the newly established organisation Innovation Skåne is working to create a place for testbeds in the medical service.

– It has been hard for small, new companies to test their products in the medical service since every clinic has limited funds and time to dedicate to researching. By finding a central solution and new incentives, we hope that it will be easier in the near future, says Ulrika Ringdahl.



PHOTO: NEWS ÖRESUND

APPENDIX: Definitions and facts

PHOTO: BENNAB

Statistics and methodology

Describing the life science sector with statistics is a challenge. The sector is far from homogeneous, and there are shifts over time. There are only five sub-areas included in the national statistics as exclusively life science sectors; the remainder are spread out over a long string of sector codes. The same is true for the universities where life science is not a clearly defined research area. Therefore, the exclusive use of statistics from the national statistics offices cannot provide a satisfactorily complete and comprehensive representation. We have thus also chosen to complement the statistics with facts from the Nordic Business Key, as well as information provided by the companies themselves. This data is now being developed into a separate database.

The macro-level numbers in this report and certain special figures, such as for example domestic and international students, have been specially requested from Statistics Denmark and Statistics Sweden. We have used the following statistic divisions:

SNI and DB07-sector codes are exclusively life science sectors, used for figures regarding employment:

- 21 Manufacture of basic pharmaceutical products and pharmaceutical preparations
- 26.60.10 Manufacture of hearing aids and supplies
- 26.60.90 Manufacture of irradiation, electromedical and electrotherapeutic equipment
- 32.5 Manufacture of medical and dental instruments and supplies
- 46.46.10 Wholesale trade of medical goods and nursing supplies.

The following codes are used for the description of scientific research and employment:

- 72.11 Research and experimental development in biotechnology
 - 72.19 Other research and experimental development in natural sciences and engineering).
- These two industries encompass companies with research in natural sciences as their main purpose and not life science production companies. Information about employment was retrieved from the Register-based Labour Force Statistics in Denmark (RAS) and in Sweden (RAMS). In a number of cases, the statistic data for employment in municipalities has also been cross-checked with data in the business database Nordic Business Key, as well as with the municipalities and a selection of the individual companies. In some cases, exclusively life science companies with a different sector code than those listed above have been added to the statistics.

The commodity groupings (SITC) in trade statistics utilized to describe exports:

- 54 - Medical and pharmaceutical products
 - 872 - Medical Instruments and appliances and similar
- The exports figures are national and cannot be broken down to the regional level. We utilise figures from UN Comtrade for the global export

market. The global market is described with the help of data from the IMS Institute for Healthcare Informatics.

As regards data about patents, we have identified relevant patent categories (IPC) with the assistance of the Patent and Trademark Office and extracted data from EPO and OECD's databases for priority date and publication date. Source for the regional distribution of patent application is EUROSTAT. The Danish Patent and Trademark Office has extracted patent applications from the EPO database for companies with Denmark and Sweden as the application country; this has been used as source for the company-specific analysis. The figures presented use the applicant's country and municipality of residence to distribute the patent applications geographically. A drawback to patent statistics is that there is no standard method for calculating indicators from patent data. As a result, the analytical and policy lessons that can be drawn from patent statistics are widely divergent from source to source.

The national statistics offices' data regarding international researchers is incomplete. We have therefore chosen to use other sources such as the tax relief scheme for foreign employees at the Swedish Forskarskattenämnden and the Danish Ministry of Taxation, as well as the Danish Agency for Labour Market and Recruitment and the databank Jobindsats.dk. Regarding international students, we requested special data computation from Statistics Denmark and Statistics Sweden. There are differences in the educational systems in Denmark and Sweden, for example that students can study individual courses that can be combined to a degree without following an entire programme in Sweden. This entails that a student can be counted multiple times in the statistics if s/he studies at multiple learning institutions. Additionally, there is a difference in the definition of international students in the two countries.

We have used Arbejdsmarkedsbalancen and Yrkeskompassens's snapshots of and prognoses for the work opportunities for various job descriptions to identify examples of where there is a shortage of employees. As the Danish and Swedish job descriptions are not based on the same categories, it is not possible to compare the situations in Denmark and Sweden. Arbejdsmarkedsbalancen shows the job opportunities for about 850 job descriptions and is based

on a combination of register data for available jobs in the Jobs database, job turnover, (un-)employment statistics and a survey of companies' recruitment needs that included 14 000 companies in Denmark. Arbejdsmarkedsbalancen was most recently updated on 30 June and regards the second half of 2016. The job descriptions are based on the DISCO classification, which contains about 1 300 different job descriptions divided into 23 professional groups. The DISCO classification is based on ISCO-08. The Swedish job descriptions are based on the profession classification SSYK96, but will be updated to SSYK2012, which is based on the international standard ISCO-08 classification to enable greater comparability between different countries' statistics. Yrkeskompassen consolidates job opportunities for 200 job descriptions and is put together based on local prognoses for labour market development, facts concerning retirement, the choice of studies and the companies' own analyses of their recruitment needs. The prognoses are made for the coming one, five, and ten years. The most recent update is from June 2016; therefore, the one-year prognosis is valid up until and including the first half of 2017.

To quantify the universities' articles, citations and co-publications, we requested that the institutions submit their own data. They used the following sources: Lund University - Scopus, DTU - Thomson Reuters' Science Citation Index, Malmö University - Web of Science and PubMed (2015); Other - the universities' own registers. Regarding articles in journals with IF>30, the following scientific journals have been included: Annual Review of Immunology, CA: A Cancer Journal for Clinicians, Chemical Reviews, Chemical Society Reviews, JAMA The Journal of the American

SECTOR CLASSIFICATION

The definition of life science that we have used here is considered the most widespread, and is utilised by several trade organisations. For example, as SwedenBIO formulates it:

- **BIOTECHNOLOGY COMPANIES** develop products that are based on biological material such as cells, proteins and DNA.
- **PHARMACEUTICAL COMPANIES** develop pharmaceuticals. These may be large biological molecules or small chemical molecules.
- **MEDICAL TECHNOLOGY COMPANIES** develop technological products to improve people's health or make the everyday easier for those who are ill. Companies that develop diagnostic methods are often assigned to this category. Diagnostics products are used to analyse samples and tests to make a correct diagnosis.

Medical Association, The Lancet, Nature Genetics, Nature Medicine, Nature Reviews Cancer, Nature Reviews Drug Discovery, Nature Review Genetics, Nature Reviews Immunology, Nature Reviews Molecular Cell Biology, Nature, New England Journal of Medicine, Physiological Reviews, Science. In addition, we use CWTS Leiden Ranking to present a picture of the institutions' achievements in terms of articles and citations in relation to each other. This offers a more nuanced representation of how many of the articles were published in the most prestigious journals than the exclusive use of figures for impact factor can provide.

We have selected three of the most prestigious rankings to show how the region's learning institutions rank in an international comparison: Shanghai Ranking, which is released by the independent organisation Shanghai Ranking Consultancy; Times Higher Education, which is published by the eponymous journal and reviewed by PricewaterhouseCoopers (PWC), and the QS World University Rankings, which is released by the British student advisory company Quacquarelli Symonds (QS).

In order to measure attractiveness and quality of life, we utilised some of the most widespread quality indices available: Mercer's Expatriate Quality of Living; EU's Quality of Life in European Cities: Global Green Economy Index Top 10 Green Cities and the British lifestyle magazine Monocle's ranking of the 25 Most Liveable Cities.

The number of employees in health care is based on data from Statistics Denmark; for the number of employees in the sector: QA Sundhedsvæsen in the Capital Region of Denmark and Zealand Region, 2014; and Statistics Sweden for the number of gainfully employed with a job position in the Skåne Region within the sector SNI 86 Hospital activities, 2014.

In addition to the above statistical data and company databases, we have also conducted a number of interviews in which we gathered qualitative data for the report.

Considerations

We have chosen to comment the statistics as well as our mode of procedure and selection in the text. When we present statistic material, we also provide a fact box "About the statistics" with a more extensive commentary. In the following are our remarks about the overall choice of method and considerations regarding the qualitative data that we have gathered.

The chapter 'Benchmark of Research Quality' is based largely on the learning institutions' own data. They were asked to answer eight questions in telephone and email-based interviews; these questions regarded the faculties, departments, and centres at the university/college in which life science research takes place; the number of researchers employed in the area; the number of peer-reviewed articles, citations, co-publications with international researchers and articles in journals with IF>30; outstanding areas of research, and research groups.

This first edition of the annual report State of Medicon Valley contains a comprehensive review and data from most of the region's learning institutions. Next year, we intend to provide a deeper analysis for which the universities will have the opportunity to prepare their contributions. The University of Copenhagen were unable to provide data for the current report due to difficulties retrieving correct and comparable data from the university's various divisions for the relevant span of time. The University of Copenhagen plans to contribute data to next year's analysis. Certain data for Lund University and Aalborg University in Copenhagen is also missing.

Gathering the relevant information has required quite substantial effort from all of the learning institutions, since life science is not a commonly used category in the categorisation of operations. Thus, certain schematic limitations have been unavoidable in certain cases, such as for example the inclusion of an entire institution, although a portion of the research there cannot be defined as life science. The responses from the universities are not comparable, as there can be certain methodological differences. The definition of life science utilised in this report and communicated to the learning institutions is thus: "the basic research and the applied research that are significant for the life science companies in the region, in a broad sense. It is preferable to include too much rather than too little in the umbrella term 'life science'." As regards the number of peer-reviewed articles, citations and co-publications with international researchers, the delimitation was based on the faculty or institution to which the researchers belong. Regarding the number of peer-reviewed articles in journals with IF>30, the delimitation was based on the journals in which researchers at the learning institution as a whole were published. A list of relevant journals was produced in collaboration with the librarian Michael Graffner at Lund University Library (the list can be read in the footnote of the table "Articles, citations and co-publications"), and the same list was used by all of the learning institutions.

The H-index is primarily used to provide a picture of the individual researcher's achievements. While it is certainly possible to calculate the H-index for an entire university or even for a region, it would be close to impossible to analyse the figures and relate them to other figures. This is due to the fact that the index for example disregards differences between how many researchers in various fields usually release publications, or that a researcher whose concentration is in basic research generally publishes more articles than those who concentrated on clinical research. Therefore, the H-index has not been used in this report.

In additional, four in-depth interviews have been conducted with research coordinators at the University of Copenhagen, Lund University, and Malmö University, about the areas of strength within life science research at their respective learning institutions. The opportunity to be interviewed was presented to others. The questionnaire sent to the univer-

sities also included questions about strong research and research environments. The chapter's main text is based on information gathered via interviews and questionnaires and from the learning institutions' own websites.

To get an overview of the job market for the life science sector right now, we interviewed representatives from selected recruitment companies and employment agencies, as well as using the search services Arbejdsmarkedsbalancen, which was created by the Danish Agency for Labour Market and Recruitment, and Yrkeskompassen, which was created by the Swedish employment agency Arbetsförmedlingen. As life science is not defined as a sector in Danish or Swedish statistics, as is for example the construction industry, it is difficult to gain a complete picture. For this reason, our point of departure has been job descriptions that we consider to be recurrently present in the manufacture and research of pharmaceuticals, biotechnology and medical technology, as well as more generally in business-to-business sales and marketing.

In order to identify the job descriptions that should be investigated, we utilised 'Uddannelsesguiden', the guide to higher education released by the Danish Ministry for Children, Education and Gender Equality. We also used the job descriptions provided in Yrkeskompassen and Arbejdsmarkedsbalancen. In addition, we received assistance from the Swedish employment agency Arbetsförmedlingen's analysis division. We have used Arbejdsmarkedsbalancen and Yrkeskompassen's snapshots of and prognoses for the work opportunities for various job descriptions to identify examples of where there is a shortage of employees. As the Danish and Swedish job descriptions are not based on the same categories, it is not possible to compare the situations in Denmark and Sweden.

We also interviewed other investigators, experts, researchers, company leaders and public actors in order to gain a broad view over the life science sector's development with opportunities and challenges on the global, national, and regional levels. Furthermore, we have had contact with – as well as received reports and initiatives from – a number of trade organisations and regional and national players from within life science.

Regarding data for life science companies in Medicon Valley, we utilised many sources in order to obtain the highest possible quality from the input data. We also used data from companies, their websites and annual reports, the databases Nordic Business Key, municipalities, as well as data from the company register on the website www.mediconvalley.com. We chose to report on the largest life science companies in a separate category, together with important research facilities and science parks, under the headline 'Beacons'. Other companies were presented separately to avoid the largest companies' domination of the material.

Read more about ideas for future reports on development in Medicon Valley on page 77.

INTERVIEW LIST

- Ann-Sofie Andersson, Business Development Manager for Life Science Copenhagen Capacity. Meeting, 22 Sept 2016.
- Göran Ando, Chairman of the Board, Novo Nordisk. Telephone, 30 Sept 2016.
- Thomas Arnebrant, Vice Dean, Malmö University. Telephone, 7 Oct 2016.
- Sten Bach Pallesen, Senior Consultant. Telephone, 27 Sept 2016.
- Thomas Behrens, Job Market Analyst, Arbetsförmedlingen. Telephone, 28 Sept 2016.
- Peter Benson, Managing Partner Sunstone Capital. Telephone, 26 Oct 2016.
- Kjeld Birch, Managing Partner SAM Internationals. Telephone, 30 Sept 2016.
- Søren Bregenholt, Corporate Vice President and Head of External Innovation and Stakeholder Relations Novo Nordisk. Meeting, 8 Juni 2016.
- Bo Carlsson, Emeritus Professor, Case Western Reserve University. Telephone, 29 Sept 2016.
- Sven Frøkjær, Professor, University of Copenhagen. Telephone, 7 Oct 2016.
- Ebba Fåhraeus, CEO SmiLe Incubator. Telephone 27 Oct 2016.
- Steen Gravers Nielsen, Director/Team Manager Mercuri Urval Denmark. Telephone, 3 Oct 2016.
- Petter Hartman, CEO Medicon Valley Alliance. Meeting, 22 Sept 2016.
- Stine Jessen Haakonsson, Associate Professor Copenhagen Business School. Telephone, 4 Oct 2010.
- Mats Leifland, CEO Medicon Village. Meeting, 29 Sept 2016.
- Tomas Lundqvist, Life Science Director MAX IV. Telephone, 4 Oct 2016.
- Anders Lönnberg, Coordinator for the Swedish government. Telephone, 4 Oct 2016.
- Peter Nählstedt, CEO Probi. Telephone, 5 Oct 2016.
- Morten Pejrup, Associate Dean for Research at the Faculty of Science, University of Copenhagen. Telephone, 5 Oct 2016.
- Sindra Petersson Årsköld, Senior Advisor Science Directorate ESS. Telephone, 5 Oct 2016.
- Kim Raabymagle, Country Manager Denmark Pharma-Relations Denmark. Telephone, 30 Sept 2016.
- Ulrika Ringdahl, Head of Life Science Invest in Skåne. Meeting, 22 Sept 2016.
- Kåre Schultz, CEO Lundbeck. Meeting, 22 Sept 2016.
- Allan Skårup Kristensen, Chefkonsulent - Forskning og Innovation LIF. Meeting, 25 Oct 2016.
- Lars Peter Svane, Chief Executive EuroJobsites. Email, 4 Oct 2016.
- Gunilla Westergren-Thorsson, Dean at the Faculty of Medicine, Lund University. Telephone, 5 Oct 2016.
- Fredrik Tiberg, CEO Camurus. Telephone, 17 Oct 2016.
- Charlotta Tönsgård, CEO Min Doktor. Telephone, 6 Oct 2016.
- Carl Wadell, Analyst Tillväxtanalys/Growth Analysis. Telephone, 2 Oct 2016.
- Hanna Wendel Diamantoudis, Chief Management Consultant Mercuri Urval AB. Telephone, 4 Oct 2016.

In addition, we received data via email from companies, municipalities, trade organisations and other players.



The Swedish government's National Coordinator for the Life Sciences, Anders Lönnberg.

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LARGER MEETINGS AND CONFERENCES

Below are some of the larger meetings and conferences being arranged in the region in the coming year, as well as a selection of international meeting places where representatives from Invest in Skåne, Copenhagen Capacity and/or the region's life science companies will be participating.

- 7-9 November 2016, Cologne: **Bio-Europe**
- 14-17 November 2016, Düsseldorf: **Medica**
- 1 December 2016, New York: **The Nordic-American Life Science Conference**
- 12 December 2016, Copenhagen: **Medicon Valley Executive Club**
- 30 January 2017, Lund: **Medicon Valley Alliance Oncology Network**
- 30 January-2 February 2017, Dubai: **Arab Health**
- 8 February 2017, Zurich: **Swiss-Scandinavian Bio-Business Seminar**
- 20-22 March 2017, Barcelona: **Bio-Europe Spring**
- 30-31 March 2017, Lund: **The Future of Swedish and Danish Life Science**
- 10-11 May 2017, Malmö: **ReproUnion Research Conference 2017 – When both sexes matters!**
- September 2017, Medicon Valley: **Nordic Life Science Days**
- October 2017, TBD: **The MVA Microbiome Conference 2017**
- October 2017, Yokohama: **BioJapan**
- November 2017, Copenhagen: **Medicon Valley Alliance Annual Meeting**
- 6-8 November 2017, Berlin: **Bio-Europe**



PHOTO: NEWS ØRESUND

In addition to the above arrangements, there are networking events at the region's science parks, such as the above example from Medeon Day in September of this year. Medeon's CEO Ulf Andersson (right) and Arian Shwan from SEB (middle) presenting a grant to Ola Hansson (left), Associate Professor LUDC.

BIO-EUROPE COULD TAKE PLACE IN COPENHAGEN IN 2018

In the beginning of autumn, the news was in that the conference Nordic Life Science Days will be held in Greater Copenhagen next autumn. The main part of the function will take place at Malmömässan, while certain other parts will

be held in Copenhagen. On top of that, Invest in Skåne and Copenhagen Capacity are working on getting the conference Bio-Europe to come to the region, specifically to Bella Center, in 2018, with peripheral activities across the Strait.

REPORTS AND FACTS

In the following is a selection of the recent years' reports from the life science area in Sweden, Denmark and Greater Copenhagen.

The European trade organisation EFPIA, European Federation of Pharmaceuticals Industries and Associations, released a report this year entitled **"The Pharmaceutical Industry in Figures"**. The figures show for example that research and development in the pharmaceutical industry in Sweden is equivalent to 765 million Euros, and in Denmark 1 454 million Euros.

In September of this year, Confederation of Danish Industry released the report **"Sundhedsindustrien er en dansk vækstmotor - Eksporten runder 100 mia. kr"** ('The Health Industry is a Danish Growth Engine - Exports hit 100 billion'), which shows that Danish exports of health care-related welfare solutions have tripled in 15 years.

Last year, Swedish Tillväxtanalys ('Growth Analysis') published the report **"Tillväxten i life science-industri 2012-14"** ('Growth in the Life Science Industry, 2012-2014'), which shows for example which business segment has undergone the most positive development according to the number of employees between 2012 and 2014. Vinnova had previously released a similar report entitled **"Global Trends with Local Effects – The Swedish Life Science Industry 1998-2012"**.

In 2014, Tillväxtanalys took a closer look at trends and policy initiatives related to clinical trials, for instance the question of what Denmark and Sweden can do to improve the climate and system for clinical studies. The name of the report is **"Kliniska prövningar – policyinitiativ och trender"** ('Clinical Trials– Policy Initiatives and Trends').

Earlier this year, the Danish pharmaceutical giant Novo Nordisk presented the publication **"Life Science – en verden af vækst. Strategi for Life Science i Danmark"** ('Life Science – a World of Growth. Strategy for Life Science in Denmark'), which includes both figures for the sector in general and for the company, as well as presenting aspirations for a strong research and national efforts to attract investments and labour force in the future.

In April of this year, the Novo Nordisk Foundation presented the results from three reports on research

investments: **"Forskningsøkonomi – 3 samfundsøkonomiske effektanalyser af investeringer i forskning i Danmark"** ('Research Economy – Three Socioeconomic Effect Analyses of Investments in Research in Denmark').

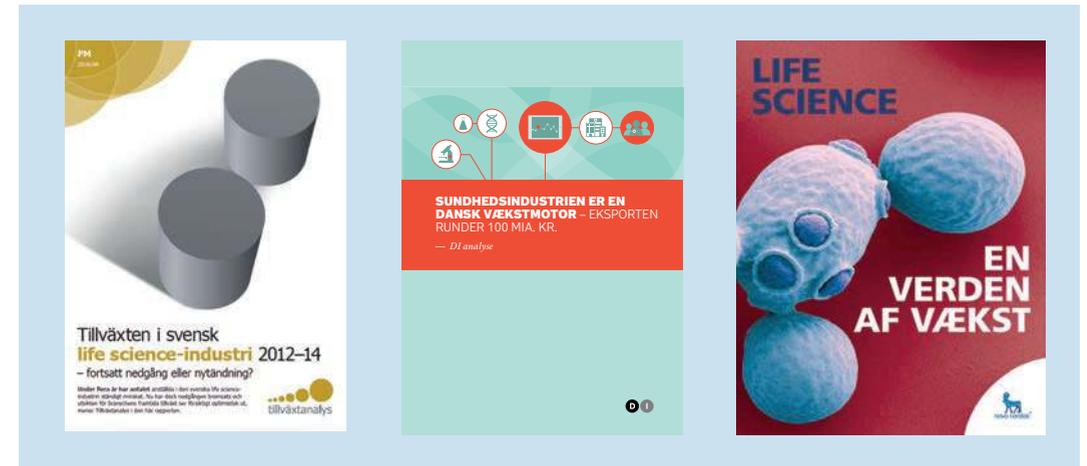
In June 2013, the Danish government brought out **"Danmark i arbejde – Vækstplan for sundheds og velfærdsløsninger"** ('Denmark at Work – Growth Plan for Health- and Welfare Solutions'), which focuses on strengthening the opportunities for companies in life science by exploiting international growth potential.

In 2014, the coordinator Susanne Ås Sivborg submitted the report **"Ett konkurrenskraftigt ekosystem för Life Science"** ('A Competitive Ecosystem for Life Science') to the Swedish government. The assignment was to identify development potential in the life science area. Read more about current national initiatives on page 78.

The Danish Agency for Science, Technology and Innovation has initiated a so-called FORSK2025 process, to identify the most important research areas for the future. Here, various players can make suggestions, and the presentation of the final prioritisation is expected in the spring. To date, 476 suggestions have been submitted. As inspiration for the task, in February of this year an OECD report about future global development tendency was released, entitled **"An OECD Horizon Scan of Megatrends and Technology Trends in the Context of Future Research Policy"**.

The Swedish Research Council's report **"Forskningens framtid! Ämnesöversikt 2014 Medicin och hälsa"** ('The Future of Research! Overview of Topics 2014 Medicine and Health') came out last year and constitutes recommendations about choosing research-political paths, and also forms the outline for the government's research proposition, which is expected this autumn.

In 2015, Medicon Valley Alliance presented an analysis entitled **"Dansk Life Science Industris bidrag till samfundsøkonomien"** ('The Danish Life Science Industry's Contribution to Socioeconomy'). They had previously commissioned a report from Boston Consulting Group on the region's areas of strength, as part of a joint Interreg project with Invest in Skåne. The report came out in 2012 and is entitled **"Evaluation of Future Opportunities in Medicon**



Valley". In 2014, Invest in Skåne also gathered life science companies in the report **"An Introduction to Life Science Companies in Skåne"**.

In December of last year, SwedenBio presented the report **"The Swedish Drug Development Pipeline 2015"**, which is an overview of Swedish R&D companies, and was co-funded by Vinnova. Swedish Medtech, SwedenBio and Lif got together in 2014 and released the report **"En handlingsplan för life science. 25 åtgärder för att stärka Sveriges konkurrenskraft"** ('A Plan of Action for Sweden. 25 Ways to Improve Sweden's Competitiveness').

Last year, Lif and Dansk Biotek released a report based on questionnaire surveys of the organisations' members, with the title **"Resultater fra Lifs og Dansk Bioteks undersøgelse af kliniske forskningsaktiviteter i Danmark 2014"** ('Results from Lif and Dansk Biotek's Investigation of Research Activities in Denmark 2014').

In October 2015 Swedish Medtech updated its compilation **"Medtechbranchen i siffror"** ('The Medtech Sector in Numbers'), which shows for example a decline in export value for medical technology products from 21.3 to 19.9 billion crowns from 2013 to 2014.

ALIS, Association of Life Science Incubators in Sweden, published a report last year called **"Förslag till varaktig finansiering av tidiga life science-bolag och projekt i Sverige"** ('Suggestions for Lasting Funding for Early-Stage Life Science Companies and Projects in Sweden').

In 2014, researchers from DTU collaborated with the Niels Bohr Institute and the University of Copenhagen to map out the application possibilities for ESS and MAX IV for Denmark. Funding contributions came from the EU and the Vækstforum Hovedstaden ('Capital City Growth Forum'), and the report provided **"Indblik i den danske life science industris opfattelse af de kommende muligheder og barrierer ved ESS og MAX IV"** ('Insight into the Danish Life Science Industry's View of the Upcoming Opportunities and Obstacles of ESS and MAX IV').

The politically non-partisan foundation Forska!Sverige ('Research!Sweden'), which came into existence after the founders' worry about negative development in medical research in Sweden, released the report **"Agenda för hälsa och välbefinnande. 14 konkreta åtgärdsförslag med handlingsplaner"** ('Agenda for Health and Welfare. 14 Concrete Suggestions with Plans of Action') in 2015, as well as **"Lägesrapport 2016 - Sveriges satsningar på medicinsk forskning"** ('Status Report – Sweden's Medical Research Investments'), among others.

The consultancy company NY Consulting released the report **"Öresund Investor Climate"** this year, whose point of departure is the identifying potential and areas of improvement for the investment climate in Greater Copenhagen, with focus on ICT and life science.

The website www.mediconvalley.com, which has for example a company database, maps and an overview of product pipelines in the region, is run jointly by Invest in Skåne and Copenhagen Capacity.

ORGANISATIONS

Trade and networking organisations:

- **ASCRO** – Swedish association focused on clinical research and clinical trials
- **CHC**, Copenhagen Healthtech Cluster – Danish organisation that aims to create growth opportunities within health care
- **CHI**, Copenhagen Health Innovation – Danish organisation focused on developing new educational and development activities within health care
- **Dansk Biotek** – Danish trade organisation for companies in biotechnology
- **EuropaBio**, the European Association for Bioindustries – European trade organisation for the biotechnology industry
- **EFPIA**, European Federation of Pharmaceuticals Industries and Associations – European trade association for the pharmaceutical industry in Europe
- **FOIN**, the Association of Innovative Settings in Denmark – Danish trade association for science parks and innovative settings, formerly Forskerparkforeningen/The Science Park Organisation
- **Healthcare Denmark** – Danish organisation with political mandate to market the Danish health care sector
- **IFPMA**, International Federation of Pharmaceutical Manufacturers & Associations – international trade association for pharmaceutical companies and associations
- **Kemi & Life Science** – Danish trade community and network for distributors and manufacturers of chemicals
- **Lif Danmark** – Trade association for the pharmaceutical industry
- **Lif Sverige** (researching pharmaceutical companies) – Trade association for manufacturers of pharmaceuticals
- **Medicoindustrien** – Danish trade association for companies that produce, sell, or have an interest in medical equipment
- **MVA**, Medicon Valley Alliance – Networking and member organisation in the Danish-Swedish life science cluster Medicon Valley in Greater Copenhagen
- **Swecare** – Swedish member organisation that works for broad collaboration with the health and health care sectors
- **SwedenBIO** – Swedish trade association for the life science sector
- **Swedish Labtech** – Swedish trade association for companies working in diagnostics, laboratory equipment, analysis and biotechnology
- **Swedish Medtech** – Swedish trade association for medical technology
- **SISP**, Swedish Incubators & Science Parks – Swedish trade association for incubators and science parks
- In addition, there are the broader trade organisations Dansk Industri (Confederation of Danish Industry) and Dansk Erhverv (Danish Chamber of Commerce) and Handelskammaren (Sweden's Chamber of Commerce) and Svenskt Näringsliv (Confederation of Swedish Enterprise).

Public actors:

- **Copenhagen Capacity** – A public initiative to promote investments and economic development in Greater Copenhagen
- **Erhvervsstyrelsen** – Danish business authority that works to improve companies' competitive strength
- **Innovationsfonden** – Fund from the Danish Ministry of Higher Education and Science that invests in new knowledge initiatives
- **Invest in Skåne** – A public initiative to attract foreign investments to the region, promote exports and internationalisation for companies in the Skåne Region
- **Läkemedelsverket/Medical Products Agency** – Swedish authority that tests and approves pharmaceuticals
- **Lægemiddelstyrelsen /Danish Medicines Agency** – Danish authority that tests and approves pharmaceuticals
- **Patent- och registreringsverket/Swedish Patent and Registration Office** – Swedish authority for intellectual property rights
- **Danish Patent and Trademark Office/Patent- og Varemærkestyrelsen** – Danish authority for intellectual property rights
- **Styrelsen for Forskning og Innovation** – Danish authority that works to strengthen research and innovation
- **Tillväxtverket** – Swedish authority to strengthen companies' competitive strength
- **Tillväxtanalys** – Swedish authority with tasks such as analysing and evaluating Swedish growth policies
- **Vetenskapsrådet** – Swedish authority that works to develop Swedish research
- **Vinnova** – Swedish authority that works to improve opportunities for innovation and research

Media:

- **Dagens medicin** – Swedish journal about the health care sector
- **Dagens medicin, Dagens Pharma, Kommunal Sundhed and Praktisk medicin** – Danish journals about the health care sector
- **European Biotechnology News** – European journal about life science
- **Kemivärlden Biotech** – Scandinavian journal for chemistry, chemical engineering and biotechnology
- **Labitech.eu** – European news site on the biotechnology industry
- **Life Science Sweden** – Journal on the Swedish biotechnology, medical technology and pharmaceutical industries
- **Medwatch** – Danish news site on the medical and pharmaceutical industries
- **Nordic Life Science News** – journal and news site on the Nordic life science industry
- **Pharma Industry** – Swedish trade journal for the pharmaceutical industry

SELECTED CURRENT PROJECTS AND SPECIAL INITIATIVES

ReproUnion – a Danish-Swedish collaboration in the field of reproduction research that is co-funded by EU's Interreg-programme with the aim to increase research capacity in the field and establish a shared centre for reproductive medicine. The project will continue until 31 August 2018 and the leading partner is Lund University.

The innovation programme **Medtech4health**, which aims to support medical technology projects with financial resources, and **Swelife**, which works to increase collaboration and innovation in life science in Sweden, are both funded by Vinnova and began in 2016 and 2014 respectively.

The EU project **Southern Sweden Going Global** is run by Invest in Skåne and the incubators Medeon and Smile. The aim is to increase the competitive strength and visibility of life science companies. The project will run for three years, and it began in September of last year.

The annual conference **The Future of Swedish & Danish Life Science** in Lund is arranged by the journal Kemivärlden Biotech and is co-organised by Medicon Valley Alliance. Medicon Village is a main partner.

The conference and trade show **Nordic Life Science Days** will be taking place in Greater Copenhagen for the first time in 2017, since its organisers SwedenBio and Bionordic decided to move the event from Stockholm to Malmö. The conference has about 1 000 participants from around 30 countries.

The Danish innovation networks **Biopeople** and **Medtech Innovation** are receiving support from the Danish Ministry of Higher Education and Science from

2014-2018. The former is based at the University of Copenhagen and the latter at Scion DTU in Lyngby.

The Interreg project **ESS & MAX IV: Cross Border Science and Society** aims to take advantage of the opportunities offered by the research facilities ESS och MAX IV in Lund. The project has 27 partners and is being headed by Region Skåne and the Capital Region of Denmark.

The biomedical clusters in Cambridge, Leuven, Heidelberg, Maastricht and Copenhagen have formed the alliance **The Health Axis Europe (HAE)**, whose aims include increasing international competitive strength together.

The European Medicines Authority (EMA) is currently located in London. If Great Britain carries through the referendum decision and invokes the article to withdraw from the EU, the authority will move. Sweden and Denmark are both possible new homebases.

Steno Diabetes Center in Gentofte has a staff of 230 and treats 5 700 people for diabetes annually. The centre also trains health care personnel about the disease. The centre is owned by Novo Nordisk A/S, but on 1 January 2017 it will be taken over by the Capital Region of Denmark, which will form a new centre called Steno Diabetes Center Copenhagen (SDCC). In 2020, the centre will move to new premises by Herlev Hospital.

For more information about the Danish and Swedish governments' special initiatives within life science and interviews with some of the people who coordinate them, see page 78.



The Prime Minister of Sweden Stefan Löfven (S) holds an inauguration speech at the research facility Max IV in Lund, 21 June 2016.

PHOTO: NEWS ØRESUND

REFERENCE LIST

The exact sources are provided with the statistics in the respective chapters.

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- Universities Denmark
- The learning institutions' own websites were also used: Aalborg University in Copenhagen, Technical University of Denmark (DTU), Kristianstad University, Copenhagen School of Design and Technology, University of Copenhagen, Lund University, Malmö University, Roskilde University (RUC), Swedish University of Agricultural Sciences (SLU)
- The tables on pages 56-57 and 62 are based on information provided by the universities themselves. Regarding articles, citations, and co-publications, they used the following sources: Lund University – Scopus and the university's own database, DTU – Thomson Reuters' Science Citation Index; Malmö University – Web of Science and PubMed (2015). Other learning institutions: their own records.
- In chapters 4 and 5 information directly from the companies, including their own webpages, was also used.

Behind the report – Medicon Valley Alliance:

Organisation with a new focus

Last year, Medicon Valley Alliance adopted a new strategy that puts more focus on the Danish-Swedish region and less on international activities. In addition, the Alliance is putting efforts into constructing new meeting places and contact areas for its members. CEO Peter Hartman believes that continuing to work on minimising barriers and increasing integration of the Region's life science industry is one of the decisive factors for the cluster's development.

In 2017 it will be 20 years since the networking organisation Medicon Valley Alliance was formed. The organisation is greeting the anniversary year with a new key strategy. The new strategy was adopted in December of last year, and includes a more defined geographical focus on its home territory.

– The Danish-Swedish dimension is the red thread running through all of our activities, and it has become more defined in our new strategy. It is thus also important that we clarify the different actors' roles in the regional innovation system, as well as how we can be a strong partner with respect to Greater Copenhagen. Our unique role as a uniting force for life science in the region gives us an opportunity to support others, such as for example Invest in Skåne and Copenhagen Capacity in their work to generate material and knowledge about the areas of strength here. It also gives us the possibility to send out the messages that we believe can be important to transmit to the outside world, says CEO Petter Hartman.

The new strategy's main focus is on Medicon Valley Alliance using its resources to create stronger networks and supplying a platform for collaboration between the life science sector's players in the Skåne and Zealand Regions. Sometimes it is a question of morning meetings, creating a network in one of the region's areas of strength or more extensive strategic collaboration projects. Altogether, the organisation offers its 240 members around 30 meetings annually.

The Danish life science sector has enjoyed more success than its Swedish counterpart in recent years; that means that the sector's conditions are different on the different sides of the Öresund.

– Naturally we would all like to see a recovery

for the Swedish side, but it's also important not to concentrate too much on the imbalance. The most important thing is that we complement each other and that we can benefit from working together to strengthen our position. Swedish life science is about to be given a new lease of life; things will slowly begin turning around. With just the investments that have been made here in the Region with MAX IV and ESS and the developments at Medicon Village, things have already started happening, says Petter Hartman.

However, there are still big challenges that need to be overcome in order to further reinforce the collaboration. The ID checks have had a negative impact on mobility over Öresund, as have the differences in regulations, for example in social security and tax issues, says Petter Hartman.

– The difficulties for cross-border commuters are a huge threat. Different kinds of obstacles mean that the potential cannot be exploited, and that limits businesses' development opportunities. Naturally this is unfortunate, because the Skåne and Zealand Regions need each other to generate growth and competitive strength.

Petter Hartman believes that the question of finding personnel and the ability to attract talent to our region are decisive for our future.

– Today, we are Scandinavia's hub for highly educated life science personnel, but nothing says that that will last forever. It will be arduous to maintain our attractiveness and keep up the high level of the academic system.



Petter Hartman
CEO Medicon Valley Alliance.

PHOTO: NEWS ÖRESUND

MEDICON VALLEY ALLIANCE

MVA is a Gold Label-certified, non-profit member organisation in the Danish-Swedish life science cluster Medicon Valley. Its 250 members include universities, hospitals, human life science businesses, regional governments and service providers that employ approximately 140 000 people and represent the Region's 'double triple-helix'. The activities in MVA focus on strengthening collaborations for a vibrant life science ecosystem in Medicon Valley through networking events and increased collaboration across borders and sectors.

THE VISION

The vision is to be a well-known and respected member-driven contributor to the realisation and positioning of Medicon Valley as the most competitive and vital life science cluster in Northern Europe.

THE MISSION

MVA is committed to realising Medicon Valley's potential by facilitating networking, knowledge-sharing, and collaboration, analysing challenges and potentials, and mobilising support from key opinion leaders.

CALL TO ACTION

Read more about the Danish-Swedish life science cluster organisation Medicon Valley Alliance's events and activities on www.mva.org, where you can also find more information about how YOUR company can benefit from a membership.



medicon valley alliance

Creating Opportunities