



**MORE THAN 200
CORONAVIRUS-PROJECTS
AT UNIVERSITIES AND
HOSPITALS IN MEDICON
VALLEY, PAGE 44**

STATE OF MEDICON VALLEY 2020

An Analysis of Life Science
in Greater Copenhagen

medicon valley **alliance**

Creating Opportunities

STATE OF MEDICON VALLEY 2020

An Analysis of Life Science in Greater Copenhagen

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PREFACE

The coronavirus pandemic has changed the conditions surrounding many things in Medicon Valley. The number of personal meetings between researchers, clients, investors and companies over national borders has declined, and the development toward more digital meetings has accelerated. Moving between countries has become more difficult for international students. Nevertheless, the region's universities and businesses have demonstrated the vast competence housed in Medicon Valley by actively taking part in the development of vaccines and drugs to prevent and treat covid-19. As pages 44-45 show, over 200 research projects have been launched at universities and hospitals in Medicon Valley. In addition, many businesses in the region are venturing into corona research, either with universities or on their own.

Fortunately, life science exports are going well. In 2019, Danish life science exports reached a record-high of 133 billion DKK – a 25 per cent increase from the previous year, which had also been a record-breaker. Danish life science is often foregrounded as a national strength, as the sector fares well in times of crisis and helps create stability. Swedish life science exports also increased, reaching 112 billion SEK (ca 79 billion DKK) from 2018 to 2019, which is a 26 per cent increase.

For life science companies' Øresund-commuters, working from home has made the question of where tax should be levied a concrete issue. The main rule in the Danish-Swedish tax agreement is that tax should be paid in the country where the work is performed, meaning that commuters who work from home will now have to declare and pay tax in two countries, albeit not at the same time. That means a heavier administrative burden for Swedes who are employed in Denmark, and for Danes who work in Sweden and pay a so-called special income tax it will mean a higher tax rate in Denmark. Regulatory inconveniences of this kind have major consequences on both a regional and a national level and make it more difficult to recruit key employees. This and other border obstacles that affect trans-Øresund collaboration call strongly for national decision-makers to find constructive solutions.

With its 300 members, the Danish-Swedish network organization Medicon Valley Alliance has a unique opportunity to build bridges between national and regional initiatives, as well as to create stronger links between the industry, academia and public healthcare providers in the region. In the years to come, Medicon Valley Alliance will place a strong emphasis on strengthening the organisation's role as a facilitator of increased collaboration between our members, for the benefit of life science in Sweden and Denmark.

Copenhagen and Malmö
2 November 2020

Petter Hartman
CEO Medicon Valley Alliance



133 billion DKK

Danish life science exports hit an all-time high of 133 billion DKK in 2019 – a 25% increase from the previous year. Swedish exports also grew: 26%, to 112 billion SEK (ca 79 billion DKK).

Another striking increase was in Swedish life science companies, which contributed 7.7 billion SEK in corporation tax in 2018 – a 34% climb.

Increased competition for life science companies

The international competition for life science companies has stiffened as the sector has done well in the crisis. That's how Anette Steenberg, director of Investment Promotion at Copenhagen Capacity sees it; see the interview on pages 54-55.



PHOTO: NEWS ØRESUND

18 BILLION. This August, Novo Nordisk announced that it would be investing another two billion DKK in its production facility in Kalundborg in west Zealand. Investments in Kalundborg since the year 2000 will thus total 18 billion DKK. The facility produces the active pharmaceutical ingredients for all of the company's diabetes preparations, including the production of semaglutide/GLP-1 pharmaceuticals.

200

research projects about covid-19 have started up this year in Medicon Valley, at the region's universities, research institutions and hospitals.

The coronavirus pandemic might be changing the way researchers work together, as many have realised just how easy meeting digitally can be. Other important factors for national and international collaborations are funding opportunities, national regulations, geography, traditions – and interpersonal chemistry. That's what a number of actors from the region and around Europe believe. They share their perspectives on research collaboration on pages 32-41.



Olli Kallioniemi,
director of
SciLifeLab.

Fewer international life science student

The corona crisis has meant fewer international life science students at Medicon Valley's universities. The decrease is primarily seen in exchange students; students who have been admitted to longer programmes have chosen to a greater extent to come nonetheless.



PHOTO: NEWS ØRESUND

Medicon Valley's life science sector employs 45 200 people.

STABLE DEVELOPMENT IN MEDICON VALLEY DESPITE UNCERTAINTY

Expansion has continued for a number of Medicon Valley's beacons. Novo Nordisk is investing billions in Denmark and recently readjusted its growth outlook. The region's three life science-oriented science parks are adding on. The most recent available statistics show that employment is on the rise in Medicon Valley, as are life science exports from both Denmark and Sweden. Tax contributions from the life sciences have also continued to increase in both countries. The region's universities and hospitals have proven just how fast they can switch to covid-19 related research.

The coronavirus pandemic has obviously affected Medicon Valley. Some effects are discernible in research, where at least 200 new projects related to covid-19 have started up. It is also apparent in the lower number of international students at the universities. Other examples include modified conditions for marketing Medicon Valley to attract investments, businesses and talents in the field.

At the same time, Professor Torben M. Andersen maintains in an interview that Denmark weathers crises such as the coronavirus pandemic better thanks to the life science sector, as the sector is responsible for a large share of exports and is not very sensitive to cyclical changes in the economy.

As far as research collaborations go, the coronavirus pandemic might be changing the way researchers work together as digital solutions grow more important and physical distance grows less significant, as interviews conducted for this report that describe the conditions for research collaboration show.

There are several positive development trends in Danish and Swedish life science. Exports are rising, as are employee numbers and the total revenue from income tax and corporation tax. 2018 was a record year for Danish life science exports, and the upswing continued in 2019 and reached 133 billion DKK, which was a 25% increase from the previous year. Swedish exports also increased dramatically – 26% – reaching 112 billion SEK (ca 79 billion DKK).

In addition, tax revenue from the sector increased in both countries. In 2018 – which is the most recent year for which tax statistics are available – the Swedish life science industry was responsible for 2.2% of the total revenue from income tax and corporation tax. The Danish life science industry was responsible for 3.3% of the corresponding tax revenue in Denmark. The Swedish life science sector set a new record for corporation tax contributions. Tax revenue from life science companies in Sweden rose 34% between 2017 and 2018, and corporation tax from Danish life science companies dropped 9% in 2018 compared to the record year 2017.

The number of people employed in Medicon Valley was 45 200 in 2018, which is the most recent year for which statistics are available from Statistics Sweden and Statistics Denmark. That is a 2.9% increase from the previous year. The greatest increase was in Skåne, at 4.7%, and following Skåne was the Capital Region of Denmark with a 3.5% increase. Employment increased overall in Sweden and Denmark.

Multiple beacons in Medicon Valley are continuing to expand. After this summer, Scandinavia's largest pharmaceutical company Novo Nordisk raised its outlook for both sales and operational profit. The company also decided to make a two billion DKK investment in its factory in Kalundborg, where it produces the active ingredients for all of its diabetes preparations.

The region's three life science-oriented science parks – COBIS in Copenhagen, Medeon in Malmö, and Medicon Village in Lund – have also added new square meterage in the past two years.

The oldest of the Danish pharma companies, LEO Pharma, is in an intense phase of reorganisation and research, and its owner, LEO Foundation, is now looking for additional shareholders to co-finance the company's continued expansion.

There's a discernible positive trend when it

comes to new startups as well. The investors Novo Seeds and Sunstone Life Science Ventures are seeing increased international interest in Medicon Valley's startup companies. They believe that the success of research in the region is important and can lead to interesting offshoot companies, and they say that this is the case here. In the other direction as well, the industry makes its mark on research.

The growth of new startups is based on the comprehensive research taking place at the region's universities. Five universities from Medicon Valley – Valley – the University of Copenhagen, Lund University, Aalborg University and the University of Southern Denmark – are on all of the major ranking lists. The Swedish University of Agricultural Sciences is generally also included, except on QS World Ranking. Although the ranking lists include more universities all over the world every year, not all of Medicon Valley's seats of learning are represented.

The Leiden review shows that collaboration is vital for getting the best results. For this report, we conducted in-depth interviews to capture other clusters' perspectives on working with researchers in Medicon Valley. 54 % of the scientific publications in Medicon Valley between 2006 and 2016 resulted from international collaborations. 26% were published in cooperation with other researchers in the same country, and 19% were by researchers or groups without collaborative partners. Collaboration in Medicon Valley was greater nationally, within Denmark and Sweden respectively, than between the two countries. This is due to the scarcity of funding for transborder research collaborations in Scandinavia compared to within national borders, say some interviewees.

– A long-term collaboration demands not only interesting results, but also a personal connection. If a collaboration ends, it might be because the project didn't have any natural continuation, because what was being investigated didn't work or the hypothesis was wrong and didn't generate new hypotheses. But there are also people one stops working with because the relationship is no good, says Stefan Jovinge, who has moved to the US, where he has professorships at Van Andel Institute, Michigan State University and a position as an adjunct professor at Stanford University.

– The lone researcher in the basement lab no longer exists. That's why it's important, on a depart-

ment level, to see that collaborations keep research going and help break down barriers. I don't think that's always accomplished. But collaboration is absolutely essential. The best things we do are the things we do with others, he says.

Life science is on the national agenda in both countries. Sweden adopted a new strategy in the area last December, and Denmark is due to present its new national strategy before the year is up.

This July, Denmark's Ministry of Industry, Business and Financial Affairs published the report "Life science-industriens fodaftryk", which reports that

the sector is nine times bigger than it was in 1990, measured in terms of its contribution to the country's BNP. Life science is one of eight sectors to be covered by an export recovery package that the Danish government and parliament agreed to issue to help boost the industry after covid-19. A new cluster – the Danish Life Science Cluster – is being jointly created by 26 private and public actors. It has been selected by the Ministry of Science, Innovation and Higher Education as one of 14 new cluster initiatives, and has also received funding from the Danish Executive Board for Business Development and Growth. The cluster will be located in Copenhagen.

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 seen in a broader context. It includes the pharmaceutical, biotechnology and medical technology

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



Anette Steenberg, director of Investment Promotion at Copenhagen Capacity.



LEO Foundation is considering allowing additional shareholders.



Stefan Jovinge, professor at Van Andel Institute and Stanford University.



Nico van Meeteren, executive director of LSH; Health-Holland.



Fewer international life science students due to the corona crisis.



Ulrika Ringdahl, CEO Invest in Skåne.

FACTS AND FIGURES: Stable growth in Medicon Valley

PHOTO: ASTRA ZENECA

The number of people employed in Medicon Valley rose 2.9% in 2018 from the previous year. Swedish and Danish life science has also made progress: among other things, exports and tax revenue have been on the rise. The number of patent applications submitted to the European Patent Office dropped slightly in 2019, however.

- In 2018 – which is the most recent year for which tax statistics are available – the Swedish life science industry was responsible for 2.2% of the total revenue from income tax and corporation tax. The Danish life science industry was responsible for 3.3% of the corresponding tax revenue in Denmark.
- There were 45 200 people employed in Medicon Valley in 2018 – the most recent year for which statistics from Statistics Sweden and Statistics Denmark are available. That is a 2.9% increase from the previous year. The increase was greatest in Skåne, 4.7%, followed by the Capital Region of Denmark with a 3.5% increase. There was also an increase in employment in both Sweden and Denmark on the whole.
- The number of Danish patent applications to the European Patent Office, EPO, in the life science field decreased by 7% in 2019 from the previous year. However, that was the second highest entry since the most recent available statistics began in 2009, topped only by 2018, which was a record year. Compared with 2018, the number of Swedish applications dropped almost 5% last year.
- Danish life science exports reached 133 billion DKK in 2019; that is a 25% increase from 2018 – another record year. Swedish life science exports also rose significantly from 2018 to 2019 – by 26% – and reached 112 billion SEK (ca 79 billion DKK).
- The life science sector lends a helping hand to the Danish economy during financial crises like the corona pandemic, says Professor Torben M. Andersen in an interview on pages 18-19.

DANISH AND SWEDISH LIFE SCIENCE EXPORTS CONTINUE TO RISE

2018 was a record year for Danish life science exports, but the upswing continued in 2019 and reached 133 billion DKK, which was a 25% increase from the previous year. Swedish exports also increased dramatically – 26% – reaching 112 billion SEK (ca 79 billion DKK). In addition, tax revenue from the sector increased in both countries.

– That such a large part of our exports isn't especially sensitive to cycles means a lot for Denmark. Neither medicine nor food is strongly affected the way other goods are, says Torben M. Andersen, economy professor at the Department of Economics and Business Economics at Aarhus University, in an interview on pages 18-19.

With its large share of the country's exports, Denmark's life science sector lends stability to Danish economy in times of crisis like the current coronavirus pandemic. Danish life science exports

rose 25% in 2019 compared to the previous year. Swedish exports also saw an increase of 26%, though from a lower level.

Swedish life companies contributed 7.7 billion SEK to the state coffers through corporation tax in 2018. That is a significant increase from 2017.

Employment numbers in Medicon Valley continue to rise. According to the most recent statistics available from 2018, the sector employs 45 200 people on both sides of the strait – a 2.9% increase from the previous year.

EMPLOYMENT GROWTH IN MEDICON VALLEY

The number of people employed in Medicon Valley was 45 200 in 2018, which is the most recent year for which statistics are available from Statistics Sweden and Statistics Denmark. That is a 2.9% increase from the previous year. The greatest increase was in Skåne, at 4.7%, and following Skåne was the Capital Region of Denmark with a 3.5% increase. Employment increased overall in Sweden and Denmark.

The number of employees in the life science sector was 44 000 in Denmark in 2018; in Sweden, the corresponding figure was 34 200. That represents a 2.6% rise in Denmark and a 2.3% increase in Sweden from the previous year. In a longer perspective, the annual change from 2008–2018 is 2.0% in Denmark and -1.0% in Sweden.

The number of employees in Medicon Valley increased 2.9% from 2017–2018 to 45 200 people. The greatest number of employees is in the Capital Region of Denmark, 33 800; in Region Zealand there are 6 100, and in Region Skåne there are 5 300 employees. The greatest increase between 2017–18 was in Skåne however – 4.7% – and the rise in the Capital Region of Denmark was 3.5%, while the number of employees in Region Zealand decreased by -1.8%.

These figures are based on statistics from Statistics Sweden and Statistics Denmark and are not directly comparable with figures from earlier reports; the reason is a retroactive revision of figures by Statistics Denmark.

The Capital Region of Denmark is responsible for nearly 75% of the employment in Medicon Valley, and its share of employment in Danish life science is almost exactly the same size. Stockholm-Uppsala is responsible for almost half of the employment in Swedish life science, according to figures from Statistics Sweden. Medicon Valley's part of the total employment in the life science sector in Denmark and Sweden is 58%.

- In Gladsaxe, which is a major municipality for the life sciences in Zealand, are e.g. the headquarters and headquarters and large facilities for Novo Nordisk and Novozymes.
- Located in Ballerup are e.g. Novo Nordisk, LEO Pharma (headquarters, research and production site), GN Hearing, Symphogen, Pfizer and AstraZeneca.
- In Copenhagen there are H. Lundbeck (headquarters and factory), Ferring Pharmaceuticals (research facility), and others. The Danish capital is also the location of Xelia Pharmaceuticals, Genmab and several foreign

- life science companies such as Novartis, Boehringer Ingelheim and Stryker.
- In Kalundborg there are for example production sites for Novo Nordisk and Novozymes.
- Located in Hillerød are for example Novo Nordisk, Fujufilm – formerly Biogen (production site) and Zymenex.
- Malmö is home to e.g. Atos Medical (headquarters), Arjo (headquarters), Rechon Life Science, PolyPeptide Group, Nordic Drugs, Qpharma and numerous national and regional headquarters from the life science sector, including Lundbeck, LEO Pharma and Novo Nordisk and the science park Medeon.
- In Lund are, among others, the medtech company Baxter (Gambro Lundia), Alligator Bioscience, Camurus, Cellavision and several smaller biotech companies at the science parks Medicon Village and Ideon.

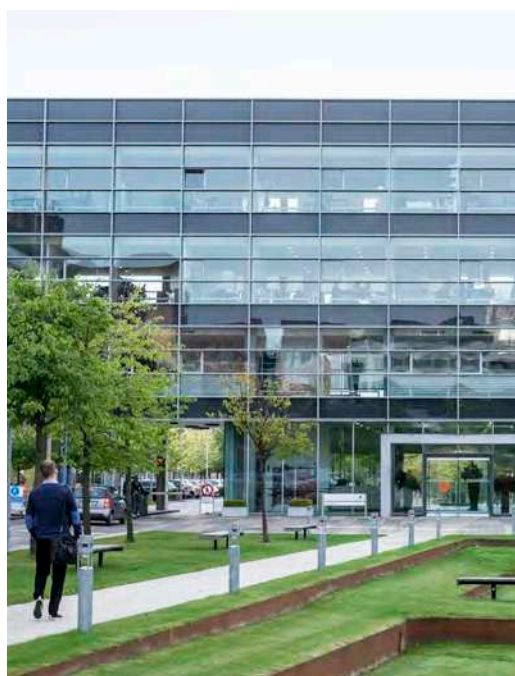
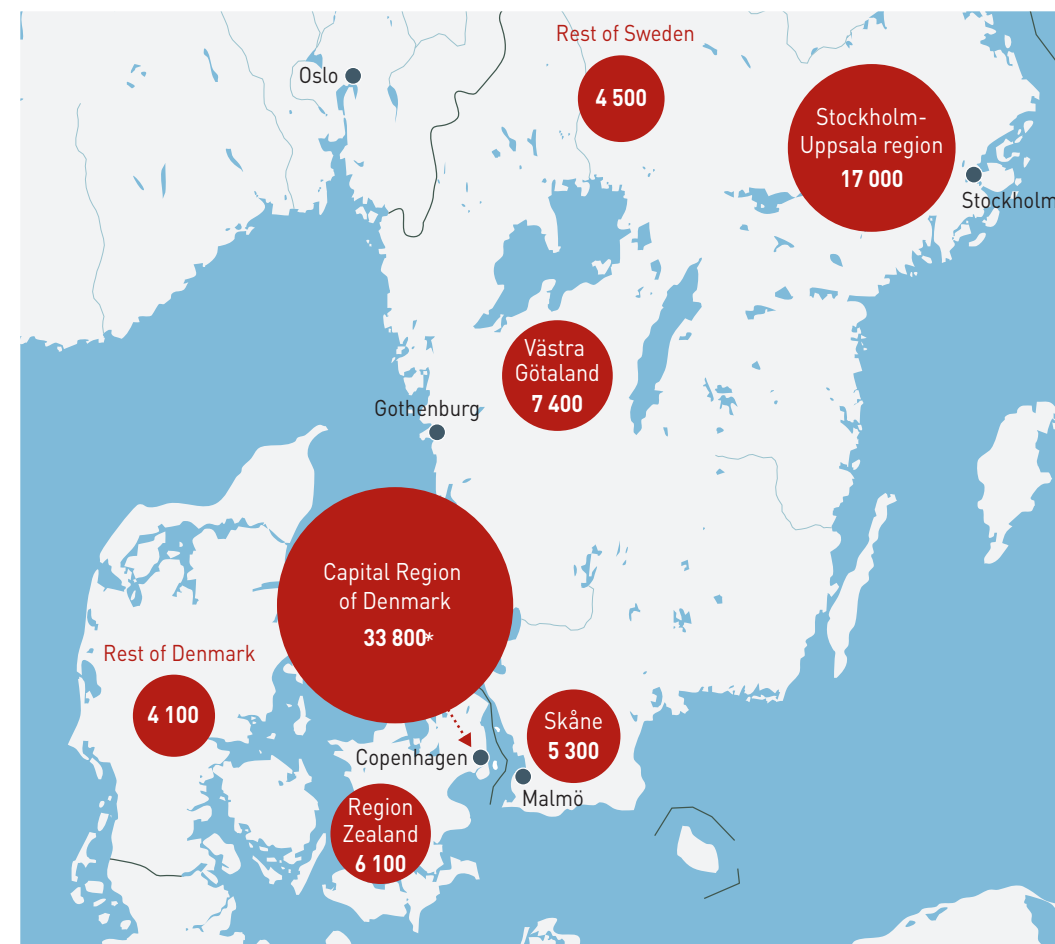


PHOTO: NEWS BRESGUND

EMPLOYMENT IN LIFE SCIENCE BY REGION IN DENMARK AND SWEDEN



Source: Statistics Denmark, Statistics Sweden and information from the biggest life science companies in Denmark.

EMPLOYMENT AND CHANGE OVER TIME*

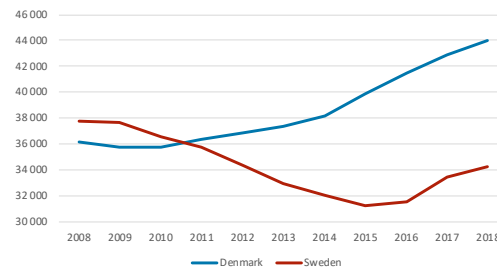
| | 2018 | Change 2017-18 | Annual change 2008-18 |
|---------------------------|---------------|----------------|-----------------------|
| Denmark | 44 000 | 2.6% | 2.0% |
| Capital Region of Denmark | 33 800 | 3.5% | 2.5% |
| Region Zealand | 6 100 | -1.8% | 0.6% |
| Denmark, rest of | 4 100 | 2.2% | 0.0% |
| Sweden | 34 200 | 2.3% | -1.0% |
| Skåne | 5 300 | 4.7% | -2.7% |
| Stockholm-Uppsala region | 17 000 | 2.4% | -1.1% |
| Västra Götaland | 7 400 | 0.6% | 1.1% |
| Sweden, rest of | 4 500 | 2.2% | -1.2% |
| Medicon Valley | 45 200 | 2.9% | 1.5% |

Source: Statistics Sweden, Statistics Denmark and information from the biggest life science companies. * The figures from Statistics Denmark have been adjusted due to a systematic review of the employment figures for the Danish municipalities in Medicon Valley. Read more about the methods used on pages 67-73, in the Appendix. This year the previous years' figures from Statistics Denmark have also been revised.

- In Helsingborg is for example McNeil, which develops and manufactures quit smoking products and is the largest life science company in the city.

In the autumn of 2020 and 2021, Øresundsinstittet will continually present a series of surveys of the companies in Medicon Valley as part of the Interreg-project Greater Copenhagen Life Science Analysis Initiative, which it is jointly leading with Medicon Valley Alliance. The surveys will include a condensed description of the cluster and needs in terms of expertise, as well as more detailed reviews of companies per municipality, as well as for each side of the Øresund Strait.

LIFE SCIENCE EMPLOYMENT



Source: Statistics Sweden, Statistics Denmark and information from the biggest life science companies

RECORD YEAR FOR SWEDISH LIFE SCIENCE TAX REVENUE

In 2018 – which is the most recent year for which tax statistics are available – the Swedish life science industry was responsible for 2.2% of the total revenue from income tax and corporation tax. The Danish life science industry was responsible for 3.3% of the corresponding tax revenue in Denmark. The Swedish life science sector set a new record for corporation tax payments. Tax revenue from life science companies in Sweden rose 34% between 2017 and 2018, and corporation tax from Danish life science companies dropped 9% in 2018 compared to the record year 2017.

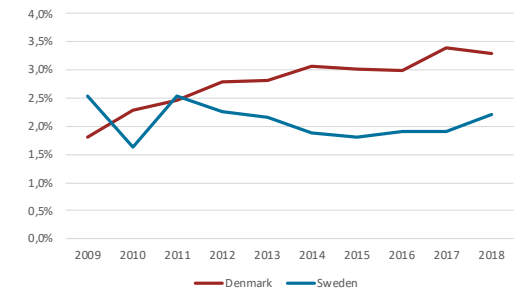
Corporation tax payments by Sweden's life science companies have risen distinctly. Between 2017 and 2018, tax revenue from companies rose 34%. This can be compared with a general growth of 7% for revenue from corporation tax. Tax contributions rose primarily from companies in the wholesale trade of medical equipment and pharmaceutical goods, but there were also significant increases in corporation tax paid from elsewhere in the life science sector. According to Insikt Medicin's 100 life science companies Pharma list, some of the life science companies whose turnover increased greatly in 2018 are Sobi (Swedish Orphan Biovitrum AB), Pfizer Health, Recipharm and Karo Pharma. Employees in the Swedish life science industry paid 3% more income tax in 2018 than in 2017. Seen in a longer-term perspective, tax revenue rose a total of 11% between 2009-2018. A total of 14.9 billion SEK was paid in income- and corporation tax from life science companies in 2018, corresponding to 2.2% of the total tax revenue.

7.7 billion SEK (+34%)

Swedish life companies contributed 7.7 billion SEK to the state coffers through corporation tax in 2018. That is a significant increase from 2017.

2017 was a record year for Denmark in terms of revenue from corporation tax; this was also true for the life science sector. 2018's tax revenue was not entirely on the same level; tax payments from life science companies amounted to 9.4 billion DKK – 9% lower than the previous year. Seen in a longer-term perspective however, the level remained high. Revenue from life science employees' income tax rose

THE LIFE SCIENCE SECTOR'S SHARE OF THE TOTAL INCOME- AND CORPORATION TAXES



Source: Statistics Denmark, the Swedish Tax Agency and Statistics Sweden

1% between 2017 and 2018. Since 2009, the total sum from income- and corporation tax has risen 144%, from 7.7 billion DKK to 18.8 billion DKK in

TAX CONTRIBUTIONS IN LIFE SCIENCE 2018

| | Denmark (billion DKK) | Euro (million) | Sweden (billion SEK) | Euro (million) |
|-----------------------------------|-----------------------|----------------|----------------------|----------------|
| Income tax | 9.4 | 1 260 | 7.3 | 709 |
| Corporation tax | 9.4 | 1 267 | 7.7 | 747 |
| Income and corporation tax | 18.8 | 2 527 | 15.0 | 1 456 |

Source: Sveriges Riksbank and Danmarks Nationalbank. Converted to Euros using the average Euro exchange rate for 2018 (10,2567 SEK for 1 Euro and 7,453166 DKK for 1 Euro). Because of differences in the Danish and Swedish tax systems, the tax figures are not directly comparable. Read more about the sources and differences in the Appendix on pages 67-72.

NEW EMPLOYMENT STATISTICS FOR MEDICON VALLEY UNDERWAY

Øresundsinstittet performed a survey of Skåne's life science companies within the framework of the Interreg-project Greater Copenhagen Life Science Analysis Initiative, which is being carried out jointly by Øresundsinstittet and Medicon Valley Alliance. There is more information on the report's main results on pages 58-59; among other things, it reveals that there are 420 identified life science companies in Skåne. The largest subsector is medtech. Over the past five years, 91

new startup companies have been established; of these, 70% are in Lund.

The next step will be a report with an Øresund focus, due to be published in the beginning of next year. The report will look at commuting, collaboration and investments in the region's life science cluster. Following the report, the survey of companies will continue with focus on Medicon Valley's Danish businesses.

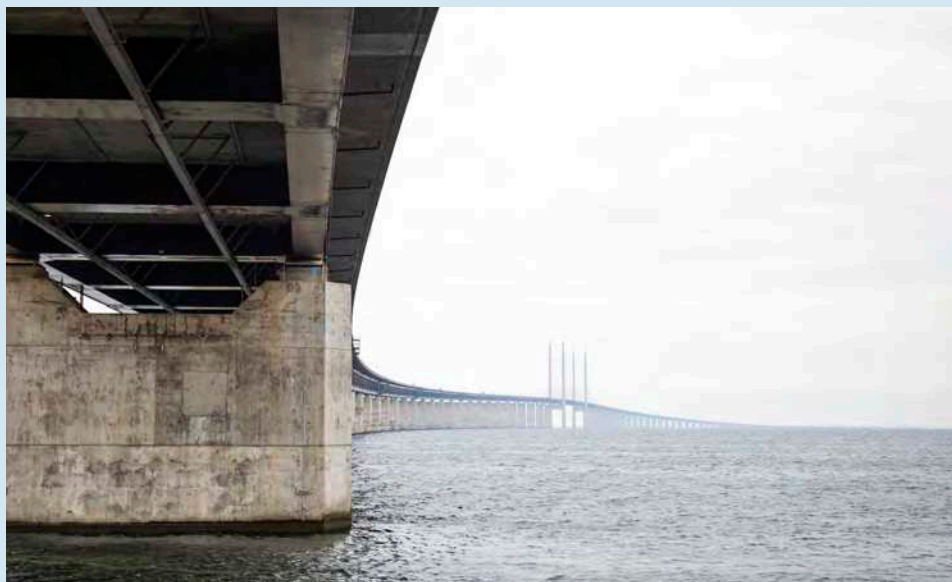


PHOTO: NEWS ØRESUND

2018. That corresponds to a 3.3% share of the total tax revenue from corporation- and income tax.

According to a new analysis of the Danish life science sector by Denmark's Ministry of Finance, the figures pertaining to the industry's contribu-

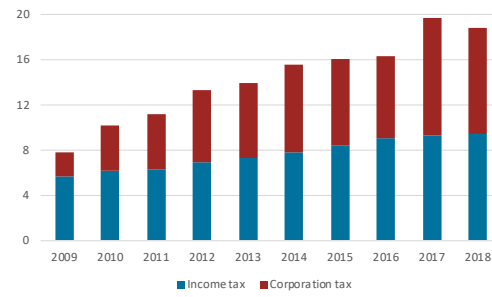
tion to public finance through corporation tax and income tax are slightly higher. This is in part because the figures are from 2017, and also because of a difference in the good codes on which the calculations are based.

THE LIFE SCIENCE SECTOR'S TOTAL CONTRIBUTIONS FROM INCOME- AND CORPORATION TAX IN SWEDEN (IN BILLIONS OF SEK)



Source: Statistics Denmark, the Swedish Tax Agency and Statistics Sweden

THE LIFE SCIENCE SECTOR'S TOTAL CONTRIBUTIONS FROM INCOME- AND CORPORATION TAX IN DENMARK (IN BILLIONS OF DKK)



SLIGHT DROP IN PATENT APPLICATION NUMBERS IN 2019

The number of Danish patent applications to the European Patent Office, EPO, in the life science field decreased by 7% in 2019 from the previous year. However, that was the second highest entry since the most recent available statistics began in 2009, topped only by 2018, which was a record year. Compared with 2018, the number of Swedish applications dropped almost 5% last year.

642 Danish patent applications were submitted to EPO in the life science field last year. That corresponds to a seven per cent decrease compared to 2018, which was the highest recorded year since 2009, the first year for the statistics that are accessible today. In the beginning, there were 456 Danish patent applications. The number of applications dropped ten per cent in 2019 in biotechnology (from 282 to 254 applications) as well as medical technology (from 229 to 206), and increased two per cent in pharmaceuticals (from 179 to 182 applications).

There were 363 Swedish applications for life science patents in 2019; that is nearly five per cent lower than the previous year and four per cent lower than 2009, when the number of applications was 378. In Sweden, the change was greatest in

biotechnology, from 93 to 81 applications from 2018–2019.

On the whole, it should be noted that Sweden and Denmark had approximately the same number of applications in medical technology in 2019. The number of patent applications in biotech-

642

Danish life science patent applications to the EPO in 2019. The number of Swedish patent requests was 363.

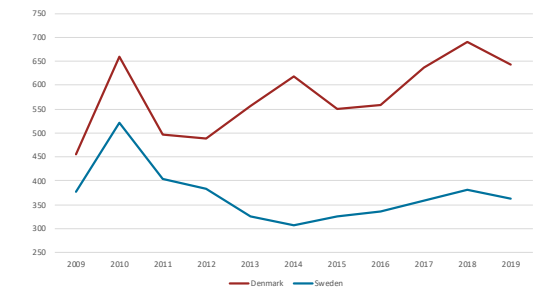
nology differs significantly however, as Denmark submitted 254 applications and Sweden 81 applications last year, and in pharmaceuticals, Denmark submitted 182 and Sweden 87 applications.

There are few of Danish and Swedish companies on the EPO's list of last year's 25 top applicants: Danish Novozymes came in 4th place for

biotechnology with its 90 applications; AstraZeneca, whose roots are in Sweden and the UK, came 24th in pharmaceuticals with 21 applications; Novo Nordisk, which came in number 20 for medical technology and number 19 for pharmaceuticals the prior year, didn't make it to the top 25 this year.



NUMBER OF LIFE SCIENCE PATENT APPLICATIONS TO EPO FROM SWEDEN AND DENMARK



Source: EPO

TOP TEN TECHNOLOGICAL FIELDS REPRESENTED IN DANISH AND SWEDISH PATENT APPLICATIONS FOR THE PERIOD 2009–2019 AND 2019 (IN PARENTHESES)

| SWEDEN | | DENMARK | | |
|--------|------------------------|------------------------|---|------------------------|
| Place | Technological field | Number of applications | Technological field | Number of applications |
| 1 | Digital communication | 10 292 (1 301) | Biotechnology | 2 723 (254) |
| 2 | Transport | 2 959 (301) | Medical technology | 2 129 (206) |
| 3 | Telecommunications | 2 749 (217) | Engines, pumps, turbines | 1 873 (360) |
| 4 | Medical technology | 2 503 (195) | Pharmaceuticals | 1 502 (182) |
| 5 | Computer technology | 2 051 (252) | Civil engineering | 1 348 (105) |
| 6 | Mechanical elements | 1 491 (91) | Audio-visual technology | 1 224 (133) |
| 7 | Measurement | 1 432 (171) | Other special machines | 946 (123) |
| 8 | Civil engineering | 1 415 (157) | Food chemistry | 886 (89) |
| 9 | Machine tools | 1 175 (123) | Electrical machinery, apparatus, energy | 858 (95) |
| 10 | Other special machines | 1 113 (115) | Measurement | 762 (83) |
| ... | | | | |
| 16 | Pharmaceuticals | 872 (87) | | |
| 20 | Biotechnology | 709 (81) | | |

Source: EPO. Understanding this table: The first figure denotes the number of patent applications for the entire period of 2009–2019 within the respective technological fields. The figure for the number of patent applications in 2019 is in parentheses. The year indicates the publication date, which is 18 months after the filing of the national application.

DANISH AND SWEDISH LIFE SCIENCE EXPORTS CONTINUE RECORD GROWTH

Danish life science exports reached 133 billion DKK in 2019; that is a 25% increase from 2018 – another record year. Swedish life science exports also rose significantly from 2018 to 2019 – by 26% – and reached 112 billion SEK (ca 79 billion DKK).

When it comes to life science exports per capita, Denmark and Sweden are among the world's top 20 largest life science exporters. Both countries saw significant market growth in 2019 and are now at record levels.

The corona crisis affects the life science sector both negatively and positively in 2020

The corona crisis has hit the life science industry in different ways. According to reports from the Danish Genstartsteamet for Life Science and the Ministry of Industry, Business and Financial Affairs, the sector has seen increased demand during the crisis, and there have been opportunities to develop new products. At the same time, e.g. medical companies have seen significantly decreased demand during the corona crisis, and some parts of the life science sector have also been affected by e.g. less access to clinical trials, longer delivery times and increased shipping costs, which has an impact on exports. The same challenges were brought to light in a member survey of Swedish life science companies conducted by Swecare. It also

shows that primarily smaller life science companies in Sweden have been impacted negatively by the corona crisis. Global companies on the other hand have seen a predominantly positive effect due to an increase in demand.

Life science: a growing part of the total exports in both Sweden and Denmark

Swedish and Danish life science exports have risen significantly in recent years. In terms of average annual growth between 2009-2019, Danish life science exports have risen 11% per year; Swedish annual growth in the same period was 4%. In coins and bills, Danish life science exports have more than doubled, growing from 46 billion DKK in 2009 – at which time Danish exports were lower than Swedish – to 133 billion DKK in 2019. In Sweden, the life science sectors exports were 76 billion SEK (ca 53 billion DKK) in 2009; in 2019 the sum was 112 billion SEK (ca 79 billion DKK).

The Swedish crown was still weak in 2019,

THE TOP 20 COUNTRIES WITH THE MOST LIFE SCIENCE EXPORTS PER CAPITA

Denmark is the world's fourth largest exporter of pharmaceuticals and medtech measured in exports per capita in 2019, while Sweden holds tenth place on the global list.

| Country | Export per capita, USD | Percentage of global life science export | Country | Export per capita, USD | Percentage of global life science export |
|----------------|------------------------|--|----------------|------------------------|--|
| Ireland | 12 542 | 7,9% | Malta | 763 | 0,0% |
| Switzerland | 10 592 | 11,6% | Hungary | 714 | 0,9% |
| Belgium | 5 317 | 7,8% | Italy | 623 | 4,8% |
| Denmark | 3 418 | 2,5% | France | 593 | 5,1% |
| Slovenia | 2 784 | 0,7% | Costa Rica* | 516 | 0,3% |
| Netherlands | 2 466 | 5,5% | Israel | 490 | 0,6% |
| Singapore | 2 338 | 1,7% | United Kingdom | 467 | 4,0% |
| Austria | 1 465 | 1,7% | Lithuania | 434 | 0,2% |
| Germany | 1 287 | 13,7% | Finland | 370 | 0,3% |
| Sweden | 1 147 | 1,5% | Czechia* | 358 | 0,5% |

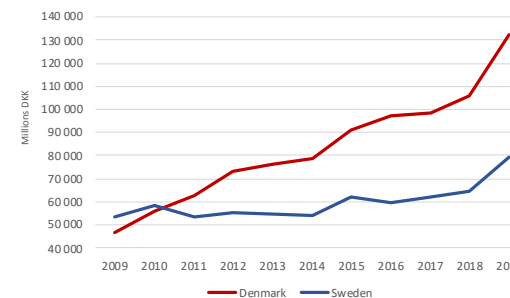
Source: UN Comtrade Database, World Bank and Danmarks Nationalbank.
* Calculated with export figures from 2018; figures for 2019 are not available.

which has impacted Swedish exports. However, increased exports also depend on increased demand, for example from Asia and the USA, and an increased demand for biopharmaceuticals – a field in which Sweden is very advanced, according to LIF and Life Science Sweden. Denmark has seen e.g. a marked increase in exports to the USA. According to an economic report by Denmark's Ministry of Finance from August 2020, pharmaceutical exports to the USA have continued to rise in 2020.

Life science businesses in both Denmark and Sweden contribute a growing share of total exports. Danish life science exports were responsible for 18.1% of the country's total exports in 2019 – 2.6 percentage points more than in 2018 and nearly double what they were in 2009. Swedish life science exports were responsible for a slightly higher share in 2009 than in 2019. While they stayed low in the 2010s, they increased 1.2 percentage points between 2018 and 2019, at which point life science exports made up 7.4% of Sweden's total exports.

In the case of both Denmark and Sweden, export growth has primarily been driven by

VALUE OF EXPORTS IN LIFE SCIENCE, IN MILLIONS (DKK)



Figures are for medical and pharmaceutical products and medical instruments, apparatuses etc.
Source: Statistics Denmark and SCB/Statistics Sweden and Riksbanken.

LIFE SCIENCE EXPORTS IN DENMARK AND SWEDEN IN 2019

| | Millions DKK | Export share 2019 | Growth (one year) | Annual growth 2009-2019 |
|---------|--------------|-------------------|-------------------|-------------------------|
| Denmark | 132 610 | 18.1% | 25.2% | 11.1% |
| Sweden | 79 241 | 7.4% | 26.1% | 4.0% |

Source: Statistics Denmark and SCB/Statistics Sweden and Riksbanken. Figures are for medical and pharmaceutical products and medical instruments, apparatuses etc. Annual growth is calculated with figures in national currency



PHOTO: NEWS BRESUND

THE PRINCIPAL EXPORT MARKETS FOR DANISH LIFE SCIENCE

| | Exports in millions (DKK) 2019 | Annual growth 00-19 |
|-------------------|--------------------------------|---------------------|
| USA | 45 488 | 18% |
| China | 10 945 | 21% |
| Germany | 6 851 | 5% |
| Japan | 5 523 | 8% |
| Sweden | 4 748 | 4% |
| France and Monaco | 4 175 | 6% |
| Great Britain | 3 646 | 6% |
| Norway | 3 079 | 10% |
| Canada | 2 868 | 12% |
| Italy | 2 853 | 7% |

Source: Statistics Denmark

THE PRINCIPAL EXPORT MARKETS FOR SWEDISH LIFE SCIENCE

| | Exports in millions (DKK) 2019 | Annual growth 09-19 |
|------------------------------------|--------------------------------|---------------------|
| USA | 12 658 | 6% |
| China | 12 228 | 27% |
| Germany | 9 304 | 6% |
| Japan | 5 317 | 19% |
| Norway | 3 979 | 3% |
| Australia | 3 540 | 2% |
| France | 3 135 | -6% |
| Great Britain and Northern Ireland | 2 795 | -5% |
| Belgium | 2 762 | -5% |
| Netherlands | 1 995 | 10% |

Source: SCB/Statistics Sweden and Riksbanken.
* Annual growth is calculated with figures in national currency.

medical and pharmaceutical products. The export of medical instruments and devices has not grown as much in Denmark and has even fallen over the past decade in Sweden.

Denmark and Sweden among the world's top 20 largest life science exporters per capita

Germany is the world's largest exporter of life science products, but when calculated per capita, Ireland tops the list with exports of 12 542 USD per capita and a 7.9% share of global life science exports. Denmark comes in fourth with exports of 3 418 USD per capita, and Sweden is number 10 with life science exports of 1 147 USD per capita.

Export growth to a number of countries has been strong from both Denmark and Sweden over the past decade and in the past year. The greatest export growth from the Danish and Swedish life science sectors has been from China. Between 2009-2019, the average annual growth of exports to China was 27% for Sweden and 21% for Denmark. In 2019, the USA was the largest export market for the Danish and Swedish life science sectors. Denmark exported nearly 46 billion DKK worth to the USA in 2019, and the American market was the absolute largest market for Danish life science. China, Germany and Japan were on both countries' lists of top-10 largest export markets. Sweden is Denmark's



PHOTO: NEWS ØRESUND

fifth largest export market for the life science sector. Denmark is number 14 on Sweden's list of the most important export markets. A number of the ten countries to which Sweden exports most have seen negative development over the past decade; exports to France nearly halved between 2009 and 2019. Exports to the UK and Ireland are also far below the levels from 2009, but they have varied greatly from year to year.

There is no standard definition for the subsections and goods codes included in the life science sector. As a result, statistics from e.g. the Danish Ministry of Industry, Life and Life Science Sweden can vary somewhat from the statistics presented in this report.

INCREASED DEMAND IN A SECTOR MORE RESISTANT TO INDUSTRIAL CYCLES

The life science sector is responsible for a large part of Danish exports and makes a large socio-economic contribution. The industry is not very sensitive to cyclical changes in the economy, because the need for medicines does not wane like the demand for other goods during a slump. For that reason, the life science sector lends a helping hand to the Danish economy during financial crises like the corona pandemic, says Professor Torben M. Andersen.

– That such a large part of our exports isn't especially sensitive to cycles means a lot for Denmark. Neither medicine nor food is strongly affected the way other goods are, says Torben M. Andersen, economy professor at the Department of Economics and Business Economics at Aarhus University.

The Danish life science sector's exports have increased significantly in recent years. The demand has

risen in the USA and China in particular. According to a report by the Danish Ministry of Finance in August 2020, the export to the USA of e.g. pharmaceuticals has continued to rise this year. The Danish life science sector has thus been helping keep the Danish economy afloat during the corona crisis.

– The life science sector is not as sensitive to slumps, and it thus has a stabilising effect on the

economy. That means most for income, as the sector is not very employment-intensive, explains Torben M. Andersen.

The life science sector is responsible for a smaller part of Swedish exports.

– In Sweden, exports are more sensitive to economic trends; they are focused on more traditional goods production and industry, machinery and equipment. Those kinds of industries are more sensitive to ups and downs. Denmark and Sweden have used different strategies when it comes to managing the pandemic, but the Swedish economy seems to have been hit just as hard as the Danish, even though there was no lockdown, says Torben M. Andersen, who was also the chairperson of the expert group set up by the Danish government during the corona crisis.

In the figures presented in this report, Swedish life science was responsible for 7.4% of Sweden's total exports, and Danish exports were responsible for 18.1% of exports in 2019. Both countries' exports have risen markedly over the past ten years. Danish life science exports have more than doubled since 2009. In the past year alone, exports have risen around 25% in the life science sector in both Denmark and Sweden. The dramatic rise in exports for the life science sector over the past year are linked to a rising demand for medicine and medical equipment in wealthier countries, including the USA and China.

– As we grow wealthier, the demand for health services also increases; that's why sales are so high to high-income countries. Health is more insatiable than material goods. If we have the money, we might need a new kitchen or garage, but we don't need two. But we want to continue with our activities, even when we're older. We want to stay healthy and fit, Torben M. Andersen explains.

According to Torben M. Andersen, there are a number of explanations for why Danish life science is doing as well as it is.

– It's like being in a running race. Whether you win is linked to several factors; it's about innovation, product development and qualified employees, and also education politics.

– And this is where you see the effects of agglomeration: when you have a strength, it becomes

“That such a large part of our exports isn't especially sensitive to cycles means a lot for Denmark. Neither medicine nor food is strongly affected the way other goods are.”

self-perpetuating. It becomes easier to attract competent staff, and more people find their way to the area. For companies, the labour pool becomes larger and more relevant. For employees, there are more interesting jobs to choose from, and if someone loses a job, it's also easy to find a new one, so people remain in the area, the one people call Medicon Valley. There's also a socioeconomic

advantage to having the cluster formation. But it is also has a long history, and it takes time to build that up. But it can also be pulled down easily, says Torben M. Andersen.

Is it possible that the corona crisis has influenced the life science sector in other ways?

– Of course, there's a race to develop a vaccine. And the corona crisis will probably contribute to us having a different view on the health sector in the future.

People have realised that it's

good to be at the forefront, to be prepared and ready; it's possible that has influenced the sector.

– So, corona has left its mark. A few short years ago, we didn't put much emphasis on being prepared in the event of a pandemic or an epidemic. It was something we had heard of, but we imagined that it was limited to countries that were in a worse position to limit the problem, and we believed it would be manageable with a better healthcare system and higher living standards, but that proved an incorrect interpretation of the situation, says Torben M. Andersen.



PHOTO: LARS KRUSE

Torben M. Andersen, professor Aarhus Universitet.

THE BEACONS OF MEDICON VALLEY: Optimism and overhaul

PHOTO: LUNDBECK

The list of Medicon Valley's beacons is growing ever longer. With nine universities, seven science parks, four major pharma companies, several large medtech firms, a globally-leading hearing aid cluster and a growing flock of biotech companies, the Danish-Swedish region spans a broad scope. Novo Nordisk is still at the top in the region, and it is enjoying new growth from its success with the glp-1 drug semaglutide, which is effective for controlling diabetes, for weight loss and for various diseases.

- The Novo Nordisk Foundation, The Lundbeck Foundation, Dr Frederik Paulsen Foundation and the LEO Foundation control the ownership of Medicon Valley's largest companies: Novo Nordisk, H. Lundbeck, Ferring Pharmaceuticals and LEO Pharma.
- Medicon Valley's biotech companies are thriving. Some of the largest biotech companies are Genmab, Zealand Pharma, Bavarian Nordic, Symphogen, Alligator Bioscience and Camurus.
- There are many medtech companies in the region, such as Coloplast, Ambu, Baxter (formerly Gambro), Arjo, Nolato Medical Solutions and Atos Medical.
- Medicon Valley is also home to a globally leading cluster of hearing aid manufacturers: Oticon, GN Hearing and WS Audiology.
- Medicon Valley's academic spectrum in the life sciences is broad, with nine learning institutions that do research in the field.
- There are seven science parks in the region, three of which are focused on the life sciences: COBIS in Copenhagen, Medeon in Malmö, and Medicon Village in Lund. All three have expanded their premises in the past year to accommodate more businesses.

RESTRUCTURING, EXPANSION AND CHALLENGES FROM NEW ACTORS MARK MEDICON VALLEY

Renewal, success, challenges: these three factors continue to mark the beacon companies of Medicon Valley. This year, Novo Nordisk decided to expand its facility in Kalundborg for two billion DKK. Between 2000 and 2019, 16 billion DKK were invested in the facility. LEO Pharma's owner, LEO Foundation, has opened up for the possibility of allowing shareholders to create financial volume that will allow the high pace of restructuring and development to continue. The region's three science parks with a life science focus – COBIS, Medeon, and Medicon Village – are growing. At the same time, the Copenhagen-based cluster of three globally-leading hearing aid manufacturers will face competition from Apple that could lead to disruptive changes in the sector.

Oticon, GN Hearing and WS Audiology (merger of Widex and Sivantos) share a leading position in the global hearing aid market. However, the technological developments that bring hearing aids and smart phones ever closer also mean that Apple poses a threat to their market position. Danish manufacturers are emphasising the importance of personal consultations; meanwhile, the business journal Børsen pointed out in an analysis that Apple's wireless earbuds may develop into hearing aids at a lower cost in the future, which could lead to a disruptive market change.

Two other companies in Medicon Valley that are facing major pressure to change are H Lundbeck and LEO Pharma. The latter is active in pharmaceuticals

for dermatology, and since 2019 it has been led by a new CEO who has recruited a number of leading decision-makers. 650 positions in the company are set to disappear over the next two years, and new R&D investments are expected to create 400 new positions. The high pace of developments has led LEO Pharma's owner, LEO Foundation, to announce that they are considering allowing additional shareholders.

When asked by the media, the owner of the pharma company H Lundbeck, The Lundbeck Foundation, did not refute that their ownership structure may broaden when the company puts resources into coming out of a downswing when a number of patents expire.

THE BEACONS OF MEDICON VALLEY

THE NOVO NORDISK FOUNDATION GROUP

Novo Nordisk Foundation is an industrial foundation whose objective is to act as majority shareholder in the publicly traded Novo Nordisk and Novozymes, as well as to support scientific, humanitarian and social causes.

Novo Holdings 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. Via the platforms Seeds, Ventures and Principal Investments, investments are made in external biotech companies at various stages of development. Novo Holding also has 11 large, more long-term investments, including investments in the Danish companies Chr. Hansen, Sonion 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 insulin manufacturer. The company also makes drugs for obesity, haemophilia and growth disorders.

Turnover 2019: 122.0 billion DKK

Number of employees 2019: 43 258, of whom 16 700 in Denmark and 70 in Sweden.

Facilities in Medicon Valley: Headquarters in Bagsværd outside Copenhagen 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.

Turnover 2019: 14.4 billion DKK.

Number of employees 2019: 6 125, of whom 2 640 in Denmark.

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

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 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.

H. Lundbeck is a global pharmaceutical company specialising in drugs for psychiatric and neurological disorders.

Turnover 2019: 17.0 billion DKK

Number of employees 2019: 5 475, of whom 1 786 in Denmark and 19 in Sweden.

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

FERRING PHARMACEUTICALS

Is a wholly privately owned pharmaceutical company with its roots around the Øresund. Ferring is run by Frederik Paulsen through the Dr Frederik Paulsen Foundation. There are also a number of pharmaceutical companies in Malmö with a historic link to Ferring: PolyPeptide Group, Qpharma, Nordic Drugs and Svar Life Science. Together, the three companies have just over 550 employees in Malmö.

Turnover 2018: 1.89 billion EUR

Number of employees 2018: 6 500, of whom 576 in Denmark and 18 in Sweden

Facilities in Medicon Valley: Ferring Pharmaceuticals A/S, also called Ferring International Pharma Science Centre, and Ferring Lægemedler A/S in Ørestad (Copenhagen), and a sales office in Malmö and API-manufacturer Syntese in Hvidovre Municipality outside Copenhagen. Headquarters in Switzerland. There is no data for 2019.

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 an entirely privately/foundation-owned pharmaceutical company with focus on the development and production of medicines for dermatology and thrombosis.

Turnover 2019: 10.8 billion DKK

Number of employees 2019: 5 820 of whom 2 112 in Denmark and 34 in Sweden.

Facilities in Medicon Valley: Headquarters, R&D and production in Ballerup outside Copenhagen. Office in Malmö.

GLOBALLY LEADING HEARING AID MANUFACTURERS

Around Copenhagen there is a globally leading cluster of hearing aid manufacturers employing nearly 3 000 in Denmark: Oticon, GN Hearing and WS Audiology.

MEDTECH MORE COMMON IN SKÅNE

Coloplast is the largest medtech company in Zealand, followed by Radiometer and Ambu. Other large medtech companies in Skåne are Baxter (formerly Gambro), Arjo, Nolato Medical, Atos Medical och HemoCue (owned by Radiometer).

GROWING BIOTECH CLUSTER

There are thriving biotech companies on both the Swedish and Danish sides of Medicon Valley, such as Bavarian Nordic, Genmab, Zealand Pharma, Symphogen, Evaxion, Alligator Bioscience and Camurus.

Figures for companies' turnover and number of employees have been supplied by the companies themselves.

THE BEACONS OF MEDICON VALLEY



Novo Nordisk



Ferring



PHOTO: NEWS ØRESUND

4 PHARMACEUTICAL COMPANIES with headquarters or former headquarters in the Zealand region dominate Medicon Valley's largest groups in pharmaceuticals and biotechnology. The four large groups Novo Nordisk, Lundbeck, Ferring and LEO Pharma and the foundations that own them have also acted as a venture capital investor and a nursery for many of the researchers in Greater Copenhagen. A number of biotechnology companies have emerged since the late 1990s, such as Genmab, Zealand Pharma, Bavarian Nordic and Symphogen in Denmark and Alligator Bioscience and Camurus in Skåne.

SUCCESS STORY. Pharmaceutical and biotech companies in Greater Copenhagen are a success story characterised by a few large companies in pharmaceuticals complemented by successful biotechnology companies. But Medicon Valley is more than just pharmaceuticals and biotech. The region also has successful medtech 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.



PHOTO: NEWS ØRESUND

5 SCIENCE PARKS in Medicon Valley completely or significantly focus on the life sciences: COBIS, DTU Science Park, Ideon, Medeon and Medicon Village. Also included are the start-up ecosystem Symbion and the food- and health-oriented science park Krinova, which focuses partially on the life sciences.



Lund University

PHOTO: NEWS ØRESUND

9 UNIVERSITIES. Greater Copenhagen's academic spectrum in the life sciences is broad, with nine learning institutions conducting 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 on metabolic diseases and plant biology. In addition, DTU and Malmö University are both highly advanced in areas such as bioengineering and biological surfaces.



CLUSTER RANKING: Coronavirus pandemic has a major effect on research in Medicon Valley

More than 200 research projects about covid-19 have started up in Medicon Valley this year, at the region's universities, research institutions and hospitals. In addition, the coronavirus pandemic might influence patterns of research collaboration further on.

- Since this spring, over 200 research projects about the novel coronavirus that causes covid-19 have been started at universities and hospitals in Medicon Valley. In addition, many businesses in the region are venturing into corona research, either with universities or on their own.
- The coronavirus will have an important impact on research collaborations in the future, says Olli Kallioniemi, director of the national life science organisation SciLifeLab in Stockholm. He and Nico van Meeteren, executive director of the Bureau of the Top Sector Life Sciences & Health in the Netherlands offer their perspectives on the bibliometric analysis in which the research institute CWTS at Leiden University compared life science research in ten European clusters, as well as on the conditions for collaboration and competition between the clusters.
- The corona crisis has meant fewer international life science students at Medicon Valley's universities. The decrease is primarily seen in exchange students; students who have been admitted to longer programmes have chosen to a greater extent to come nonetheless.
- The investors Novo Seeds and Sunstone Life Science Ventures are seeing increased international interest in Medicon Valley's startup companies. They believe that the success of research in the region is important and can lead to interesting offshoot companies, and they say that this is the case here. It also goes in both directions; the industry makes its mark on research.

RESEARCH COLLABORATIONS GUIDED BY FUNDING, CHEMISTRY, GEOGRAPHY – AND PANDEMICS

The coronavirus pandemic might just be on the way to changing the way researchers work together. Other determining factors when it comes to national and international collaborations are opportunities for funding, national regulations, geography and tradition. And the chemistry between people is not to be forgotten.

Those are a few of the perspectives on research collaboration and competition and the research centre CWTS Leiden's analysis and comparison of ten European research clusters in the life sciences voiced in a series of interviews in this chapter.

Collaboration is vital for getting the best results – there is nothing controversial about that stance in the research world. The bibliometric analysis by the Dutch research centre CWTS at Leiden University, conducted on behalf of Medicon Valley Alliance in 2018, confirms that as well. Something all of the European life science clusters included in the comparison had in common was that their scientific publications that were the result of international collaborations were cited to a far greater extent than

those produced by a single research group. National collaborations did not boost citation frequency the same way, the analysis showed.

In Medicon Valley, a little more than half of the scientific publications in the life sciences between 2006 and 2016 were the result of international collaboration – this proportion was approximately the same for all ten clusters. Finding the best researchers to work with is simply a necessity in a competitive research world, says Stefan Jovinge, >>>

A unique comparison of ten European clusters

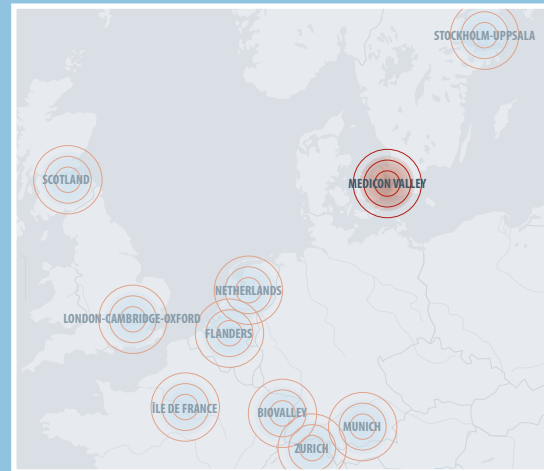
On behalf of Medicon Valley Alliance, the Dutch research institute CWTS at Leiden University performed a bibliometric comparison of ten European life science clusters based on their total influence in the research world. These are some of the main results published in Medicon Valley's annual report for 2018 and 2019.

32 027

scientific publications were produced by researchers in Medicon Valley between 2006-2016, placing the region seventh among the clusters compared. The greatest number of scientific publications in the field were published by researchers in London-Cambridge-Oxford: 116 263, followed by researchers in the Netherlands, who produced 90 779 scientific publications in the same period.

NATIONAL NETWORKS ARE STRONGEST.

A network analysis from the research institute CWTS shows that the region's national networks are significantly stronger than trans-Øresund networks, and in Medicon Valley national cooperation is far more common than cooperation between Denmark and Sweden.



The ten largest areas of research in the life sciences in Medicon Valley

Based on scientific publications from 2006-2016.

1. Biochemistry & molecular biology
2. Endocrinology & metabolism
3. Oncology
4. Neurosciences
5. Medicine, general & internal
6. Public, environmental & occupational health
7. Pharmacology & pharmacy
8. Cardiac & cardiovascular systems
9. Immunology
10. Surgery

MAJOR FIELDS OF RESEARCH.

The 20 largest fields of research were responsible for more than 50% of the total number of scientific publications in the life sciences in Medicon Valley during the period examined.



23%

The increase in the number of scientific publications in Medicon Valley between 2006-2009 and 2013-2016.

Greatest impact of scientific publications 2006-2016/17

(number of citations in relation to the average [=1] for each subject area)

1. London-Cambridge-Oxford (1.46)
2. Scotland (1.35)
3. Zurich (1.34)
4. The Netherlands (1.33)
5. Munich (1.21)
6. Medicon Valley (1.20)
6. Stockholm-Uppsala (1.20)
8. Flanders (1.15)
9. BioValley* (1.14)
10. Île de France/Paris (1.09)

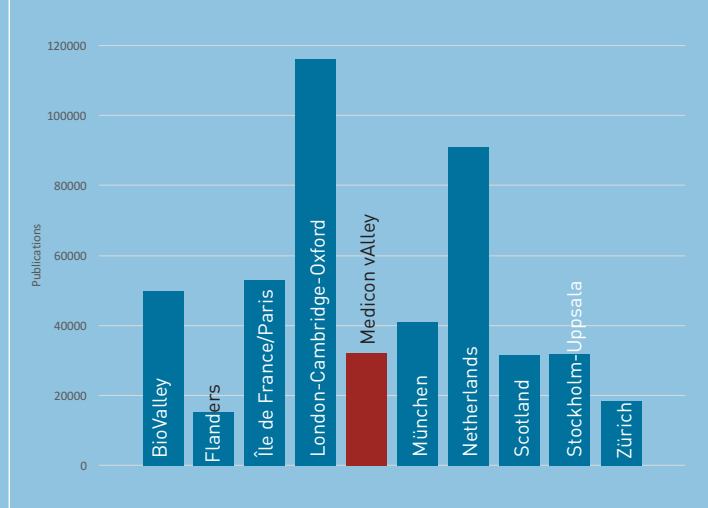
Citations calculated for the years 2006-2017.
*A German-French-Swiss cluster that includes Basel, Alsace, Freiburg, Karlsruhe, Mulhouse and Strasbourg



More than half

54 % of the scientific publications in Medicon Valley resulted from international collaborations. 26% were published in cooperation with other researchers in the same country, and 19% were by researchers or groups without collaborative partners.

Number of scientific publications per cluster 2006-2016



MORE DANISH HOSPITALS WITH CLINICAL RESEARCH. There are more hospitals involved in research in Denmark than in Sweden, a network analysis by CWTS shows. On the Swedish side of the Øresund Strait, clinical research is concentrated almost exclusively at Skåne University Hospital.

professor at Van Andel Institute, Michigan State University and adjunct professor at Stanford University, in an interview on page 32.

But what are the factors that determine which collaborations researchers choose? Olli Kallioniemi, director of the national life science organisation SciLifeLab in Stockholm, points out that the CWTS analysis shows clearly that research collaborations are far more concentrated within Denmark and Sweden than between the two countries in Medicon Valley. The primary reason for that, he believes, is that funding is predominantly national, but there are additional influential factors, such as national regulations and legislation.

Funding is also an important factor mentioned by Nico van Meeteren, executive director of the Top Sector Life Sciences & Health (LSH; Health-Holland) in the Netherlands in an interview

“Covid-19 has meant that everybody is meeting digitally. This leads to internationalization.”

for this report. He also brings up the fact that geography, habits and traditions have an impact on how collaborations develop. In the case of the Netherlands and Belgium, there is a long tradition of working together in the Benelux union that makes their collaboration more likely than a collaboration with e.g. Denmark – although Denmark and the Netherlands have interesting common themes within research.

Looking at it with a somewhat broader perspective and taking into consideration the various spin-off companies that emerge from research, the investors Søren Møller from Novo Seeds and Sten Verland from Sunstone Life Science Ventures (read more on pages 39-41) are both interested in companies in all of Scandinavia – at least. As they see it, Medicon Valley is just one of a number of interesting clusters in Europe, although they have a positive view of the research conducted in the region.

Nico van Meeteren and Olli Kallioniemi both mention the EU as an important actor in terms of research funding. The EU contributes to large research consortia that span the entire continent with its research programmes. At the same time, such consortia make it difficult to directly interpret jointly published scientific works as the result of close research collaborations, Olli Kallioniemi points out. What looks like a collaboration in terms of statistics is not necessarily one – at any rate not in the sense that the researchers know each other and have worked together. Instead, it is a question of large co-publications by a substan-

tial number of researchers, each of whom contributes part of the publication without necessarily having had contact with the others.

Large research consortia of this kind are not exclusive to Europe; this became evident when we sought interview subjects for this analysis. In the diagram of the universities around the globe with which Medicon Valley’s researchers collaborated (see page 35), one sees for example that researchers from Stanford University and Lund University co-published multiple scientific publications during the period in study. Upon closer examination, it was revealed that a large part of them were the result of a collaboration between more

than 20 researchers. There are however also examples of a few researchers whose close collaboration resulted in a very large number of publications.

During the search for interview subjects, another important factor for successful research collaboration became unmistakably clear, namely: the importance of a personal relationship. If one of the collaborative partners retires, for example, the collaboration may well come to an end; at the same time, it may very well continue, even if a colleague relocates to another part of the world. The good relationship between Stefan Jovinge at Van Andel Institute, Michigan State University and Stanford University and Henrik Bjursten, cardiac surgeon and associate professor of thoracic surgery at Lund University, has helped them continue their collaboration long distance. The researchers emphasise the importance of getting on well if a collaboration is to last longer than the duration of a single scientific publication, although the content and results of the research are, naturally, also an important factor.

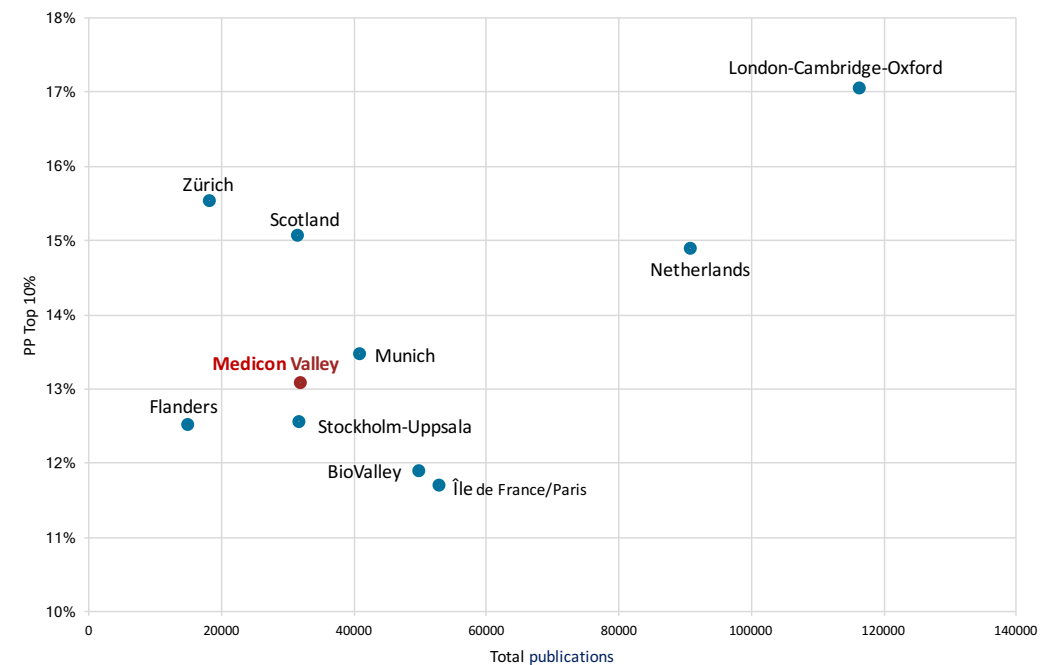
Although these preconditions and limitations remain, there are indications that the research collaboration paradigm is about to change – due to the corona pandemic, says Olli Kallioniemi from SciLifeLab. The key is that digital collaboration is beginning to feel just as easy as meeting in person – for that reason, he believes that the number of international collaborations will increase in the future.

– Covid-19 has meant that everybody is meeting digitally. This leads to internationalization, and democratization in that international contacts will be less dependent on travel in the future, and hence distances will matter less, he says.

OVERVIEW OVER PUBLICATION AND CITATIONS FROM TEN EUROPEAN CLUSTERS (2006-2016/17)

- The clusters that published the greatest number of scientific publications during the period in study are London-Cambridge-Oxford, followed by the Netherlands and Île de France.
- London-Cambridge-Oxford was also cited most frequently. Around 17% of the publications from the cluster were in the 10% most frequently cited for their fields in the entire period of 2006-2017, followed by Zurich and Scotland.

- Researchers in Medicon Valley published 32 027 scientific articles in the field life science between 2006-2016, according to CWTS’ review of Web of Science. Around 13% of the publications from Medicon Valley were in the 10% most frequently cited for their fields in the entire period of 2006-2017. In relation to the nine other life science clusters included in the study, Medicon Valley places in the middle, specifically in sixth place.



Source: CWTS B.V.

The diagram shows the total number of publications from 2006-2016 and the number of these that are among the 10% most frequently cited in their fields (PP Top 10%) from 2006-2017. BioValley is a German-French-Swiss cluster that includes Basel, Alsace, Freiburg, Karlsruhe, Mulhouse and Strasbourg.

FACTS: ABOUT THE REPORT FROM CWTS LEIDEN

- On behalf of Medicon Valley Alliance, the research institute CWTS at Leiden University did a comparison of the bibliometric performance of ten life science clusters in Europe, one of which is Medicon Valley.
- In this report, clusters are defined as areas in which universities and other research institutions are fairly densely located in a specific geographic area, where internal collaboration is customary or

- habitual, and where there is an established cluster organisation of some kind.
- The comparison was done for the years 2006-2016. Citations have also been counted through 2017.
- Read more about how the clusters were selected and compiled and how the analysis was conducted in the Appendix, page 71.

MORE THAN 80 ORGANISATIONS ARE WORKING WITH MICROBIOMES IN GREATER COPENHAGEN

There are many companies and outstanding research in the microbiome field in Greater Copenhagen, and the region measures up well compared to other European clusters. This is evident from a new survey of the transdisciplinary field, which concerns how bacteria and viruses affect humans, animals and plants.

Copenhagen Capacity, Invest in Skåne and Medicon Valley Alliance were behind the recently published overview, which is part of the Interreg-project The Microbiome Signature Project, which strives to gather all of the actors in the field of microbiome in the Greater Copenhagen region, which covers eastern Denmark and southern Sweden – and in both research and the industry. Over 80 actors have been identified thus far, more than 40 of which are businesses. Among them are many companies that are new to the field, such as ImmuneBiotech, SNIPR Biome, and UNION Therapeutics, as well as others that are already established in the region, such as BioGaia, Chr. Hansen, Ferring, Novozymes and Probi.

The microbiome is a community of microorganisms (such as bacteria, viruses and fungi) that exist in a particular environment, and can concern everything from how the bacteria and viruses that live in and on our bodies affect our health – also through diet – to how bacteria in the soil can make it more fertile and reduce the need for artificial fertilisers.

– It's an interdisciplinary field, and there is a lot happening on both the Danish and Swedish sides. Often, actors may not be aware of what's going on outside their own fields of expertise or networks, says Sarah Lidé, Senior Strategy & Project Manager at Medicon Valley Alliance.

In addition to broadening local microbiome networks, another goal is to attract more expertise and funding from abroad to Medicon Valley. When the region is being marketed, it should be easy to refer to the project's new website, where all of the information about the companies and research is gathered. Plans for a campaign focused on attracting research investments to the area from abroad are also underway. Read more on page 57.

– We don't necessarily want to compete with for example Boston, but if an investor is looking at Europe, perhaps Medicon Valley will be the first choice, says Sarah Lidé.

The overview over research was conducted via a PubMed database search for the years 2014-2019. During that time, 898 microbiome-related publica-



Sarah Lidé, Senior Strategy & Project Manager at Medicon Valley Alliance.

tions were released that linked to researchers in Medicon Valley, and in 71% of the publications, researchers from Medicon Valley were the primary authors.

It is also worth noting that the vast majority of the articles were published toward the end of the period in study. Sarah Lidé also points out that the microbiome as its own field of research is a comparatively new one - with pioneering research carried out in the early 2000s – that has gotten a great deal of attention in recent years.

In terms of research, Medicon Valley is strong compared with five other European clusters that are left unnamed in the overview. From 2014-2019, Medicon Valley had the largest number of publications, as well as the largest number of publications in the journal Nature and in Nature's specialised journals. The region is slightly behind the Boston cluster in the USA, which was also included.

Medicon Valley is no island in the scientific community however, and researchers co-published their articles with colleagues from 81 countries – in addition to Denmark and Sweden. The greatest number of collaborations were with researchers in the USA, Germany, the UK, China and the Netherlands.

– That means that our researchers have good international contacts, and that's very important for the quality of the research. Something we'd like to see more is researchers simply looking over the Danish-Swedish border more, says Sarah Lidé.

PHOTO: MEDICON VALLEY ALLIANCE

At least 200 research projects related to the coronavirus

Since this spring, over 200 research projects about the novel coronavirus that causes covid-19 have been started at universities, hospitals and research centers in Medicon Valley. They comprise everything from developing vaccines, tests and various drugs or treatments for covid-19 to basic research on how the virus works, as information compiled from universities and research grants reveals.

“Research is the raw material of the scientific community from which the foundation is built.”

Søren Møller, managing partner at Novo Seeds, underlines that the quality of research is high in Medicon Valley; he draws a comparison with successful American clusters with high-quality research combined with a strong system for funding, which enables ideas to develop into companies.



PHOTO: NEWS ØRESUND

FEWER INTERNATIONAL STUDENTS COME TO MEDICON VALLEY DUE TO CORONAVIRUS. The number of international students at DTU, Lund University and the Faculty of Health and Medical Sciences at the University of Copenhagen has dropped dramatically this year. The most significant decrease has been among exchange students.

More – and less – life science research in the region

Kristianstad University has been granted additional rights related to research training in Health Sciences and taken on its first PhD students in “person-centred care for health and well-being” this year. At the same time, Aalborg University in Copenhagen will be closing down its Section for Sustainable Biotechnology in 2022 and moving its research to Aalborg.

New research endeavours

- **DiaUnion** – a cross-border research project focused on type 1 diabetes and autoimmunity. Medicon Valley Alliance is coordinating the project, that also involves Lund University, Steno Diabetes Center, Capital Region of Denmark and Region Skåne. The initiative is funded by Interreg.
- **Max Planck Center** – next Generation Insect Chemical Ecology (nGICE) – a new research centre to improve understanding of the interplay between insects, humans, and the climate. Lund University, the Swedish University of Agricultural Sciences and the Max Planck Society will run the centre for at least five years.
- **Videnscenter for multisygdom og kronisk sygdom** (Knowledge centre for multimorbidities and chronic diseases) – a research centre founded by Region Zealand.
- **Centre for Evolutionary Hologenomics at the Globe Institute** – a new Center of Excellence at the University of Copenhagen to study how interaction between genes and microbes determine biological evolution.

PHOTO: NEWS ØRESUND



14 500
academic researchers
work in the life sciences
in Medicon Valley.

GOOD CHEMISTRY MAKES FOR GOOD COLLABORATION

They met in the corridors of Skåne University Hospital, and ten years ago they started researching kidney failure related to coronary bypass operations together. The physical distance that separates them is significantly larger today, as Stefan Jovinge has moved to the US, where he has professorships at Van Andel Institute and Stanford University, among others. Distance has not been an obstacle for the collaboration between Stefan Jovinge and Henrik Bjursten, cardiac surgeon and associate professor of thoracic surgery at Lund University. "A long-term collaboration demands not only interesting results, but also a personal connection", says Stefan Jovinge.

Stefan Jovinge was heading the cardiac intensive unit and Henrik Bjursten was a cardiac surgeon at the thoracic surgery clinic at Skåne University Hospital when both became interested in the effects of a new drug on patients who had undergone cardiac surgery.* There was a hypothesis that the drug would be able to prevent reduced kidney function in patients, and it was also used for that purpose, says Stefan Jovinge. According to the two researchers' study however, patients who had been treated with the drug were more likely to be affected by reduced kidney function.

– The results didn't produce a new drug, but they were important nonetheless. One might think that kidneys are a kind of appendage to the body, but in reality, failing kidneys are one of the most important indicators of a risk of death, he says.

The research collaboration has continued although Stefan Jovinge moved to the US seven years ago, where he divides his time between professorships at Van Andel Institute and Michigan State University and a ten per cent position as an adjunct professor at Stanford University. Henrik Bjursten conducted a randomised study in Lund, and Stefan Jovinge contributed with special blood analyses that he was able to carry out in his lab in the USA. With his colleague Per Ederoth, Henrik Bjursten also took over for Stefan Jovinge as PhD supervisor for a doctoral student at Lund University who is working on the same project. Stefan Jovinge is still involved as an assistant supervisor.

– We're now working on the continuation of the projects that have already been published. I work in groups with doctoral students, and Stefan's role is more that of a consultant, but there are also publications by his group, says Henrik Bjursten.

Distance collaboration has been smooth, according

to both of the researchers, who maintain contact via email and digital meetings. Stefan Jovinge feels that a collaboration between Sweden and the USA is just as easy as when both are in the same country. Instead, the great divide is whether or not the researchers are at the same department.

– As soon as you are outside it, legal contracts become a necessity – material transport agreements – and the legal aspects in the US are worse than you think. My basic research lab is at one institute, and my clinical lab is at another, so I have to

have a bunch of contracts with myself. So, the big step is leaving the institute. Whether you're in the US or Sweden doesn't make any difference, he says.

Both procure their own research funding, although they work collaboratively on their projects.

– The general rule is that everyone pays for their own analyses in the project, and no money is sent back and forth. But if we do analyses on Henrik's samples, that's our contribution to the project, we don't get paid for it, says Stefan Jovinge.

In addition, both researchers see advantages to the international collaboration, in part because it gives them an opportunity to work with skilled researchers all over the world, and in part because it is valued highly when it comes to funds being granted.

– It helps somewhat that we can write in the application that the project will be a collaboration between multiple clinics outside Sweden; it comes to our advantage when we're competing for funding, says Henrik Bjursten. Stefan Jovinge adds:

– Historically speaking, I've always had collaborations outside Sweden. They have always been guided by someone having patient material or technology that interested me, or vice versa. The competition is so stiff, you just have to try to bring in the very best players, he says.

"A long-term collaboration demands not only interesting results, but also a personal connection."

Stefan Jovinge has been working with some of his partners for 15-20 years; at the moment he has an active international collaboration with e.g. researchers at the universities in Cambridge and Bonn. Henrik Bjursten also has other active international collaborations, including with colleagues at universities in Leeds and Rotterdam.

– It's always a pleasure to work internationally and have the opportunity to broaden one's scope and meet new people. Of course, if you work at the same place there's the advantage of being able to see each other in the corridor and exchange a few words, he says; for that reason, he believes it is important to put effort into building a relationship with a new collaborative partner, especially if that person is located somewhere else.

– With a new collaboration, it's always a good idea to meet and get to know each other. I haven't had the experience of a completely virtual contact; usually we've met already, for example at a meeting, he says.

While Stefan Jovinge has met collaborative partners that way, he has also reached out to researchers whom he has never met before, but with whom he was interested in working. Among them is the professor in Bonn, with whom he has been working for nearly two decades.

– They had created a mouse model we were interested in, and in research, when you publish



Stefan Jovinge.

Henrik Bjursten.

something new, you're expected to share it. So I contacted him and asked him to send it, but then he said: "shouldn't we work together instead?". So we did. And if you work well together for 20 years, you become personal friends, and in the end even your families spend time together, he says.

As he sees it, there are two deciding factors when it comes to whether a research collaboration will be temporary or continue in the long-term.

– A long-term collaboration demands not only interesting results, but also a personal connection. If a collaboration ends, it might be because the project didn't have any natural continuation, because what was being investigated didn't work or the hypothesis was wrong and didn't generate new hypotheses. But there are also people one stops working with because the relationship is no good, he says.

There are, of course, also collaborations that aren't as close simply because they're arranged differently. Henrik Bjursten, for example, co-authored a larger-scale, international, randomised study with researchers from a number of universities around the world. The aim of the study was to clinically evaluate new products that are used in cardiac care.

– I became involved because they needed my expertise, and I contributed with what I could. I've also been involved in the beginning of product launches, he says.

Regardless of the other conditions, points out Stefan Jovinge, it's important to ensure that there is a give and take for both parties in a research collaboration, and that both parties stand to gain from it.

– When I started out as an independent researcher, I contacted other researchers and thought, everyone is an adult and can look out for their own interests – I didn't think about what the other party could get out of our collaboration. But the people one wants to work with, the good researchers, are very busy, and I noticed that the projects didn't move forward. With time I learned to make certain that the project would have significant advantages for the other party as well, because otherwise our project

Commentary: Collaboration between Lund University and Stanford University

Danish and Swedish life science researchers in Medicon Valley collaborate primarily with colleagues in Scandinavia and the rest of Europe, according to CWTS Leiden's survey of research collaborations (see page 35), but there are also links to universities in the rest of the world. From 2006-2016, e.g. researchers from Lund University and Stanford University co-published a significant number of scientific publications in the life sciences, which is apparent from the line connecting these two institutions in the graphic.

The number of co-publications between the two universities do not give a complete picture, however, which was evident when interview subjects were being sought for this analysis. Collaborations come and go; even close collaborative relationships can come to an end when one of the parties stops or retires. A significant number of co-publications also comprise larger "research consortia" in which each researcher contributes a small part of the whole without necessarily having contact with others in the collaboration.

wouldn't be prioritised highly, he says.

Personally, he considers collaboration with others one of the most rewarding parts of being a researcher, and in that respect, he sees advantages to having moved to the USA.

– Letting nature unfold and reveal its secrets is a lot of fun, but the great thing about research is also the multinational, multicultural collaboration. When I was working in Sweden, I sometimes felt it was all very uniform; the majority of my colleagues were Swedish – but there are people from every culture and

background in the research sphere in the USA, he says.

Furthermore, according to Stefan Jovinge, collaboration is essential in today's competitive research world.

– The lone researcher in the basement lab no longer exists. That's why it's important, on a department level, to see that collaborations keep research going and help break down barriers. I don't think that's always accomplished. But collaboration is absolutely essential. The best things we do are the things we do with others, he says.

* The drug was developed by Magnus Hansson and Eskil Elmér at the Faculty of Medicine in Lund.

RED

The Danish research institutions

1. University of Copenhagen
2. Roskilde University
3. Technical University of Denmark
4. Aalborg University
5. Roskilde Hospital
6. Hillerød Hospital
7. University of Southern Denmark
8. Herlev Hospital
9. Frederiksberg Hospital
10. Gentofte Hospital
11. Bispebjerg Hospital
12. Hvidovre Hospital
13. Aarhus University
14. Aarhus University Hospital
15. State Serum Institute
16. Rigshospitalet
17. Glostrup Hospital

BLUE

Most of the Swedish institutions as well as the Scandinavian institutions

18. Lund University
19. Swedish University of Agricultural Sciences
20. Kristianstad University
21. Malmö University
22. Linköping University
23. Uppsala University

24. University of Gothenburg
25. Karolinska Institute
26. Norwegian University of Science and Technology
27. Haukeland University Hospital
28. University of Bergen
29. University of Iceland
30. University of Oslo
31. University of Helsinki
32. University of Turku

GREY

International research institutions that collaborate with both Swedish and Danish institutions

33. Duke University
34. University of Sydney
35. National Institutes of Health
36. University of California SF
37. University of Toronto
38. Harvard University
39. University of Manchester
40. Maastricht University
41. King's College London
42. VU University Amsterdam
43. Erasmus University Rotterdam
44. Leiden University
45. Max Planck Society
46. University of Washington Seattle
47. University of Bern

48. University of Groningen
49. Katholieke Universiteit Leuven
50. University of Amsterdam
51. University College London
52. Humboldt-Universität zu Berlin
53. Ghent University
54. Stanford University
55. Radboud University Nijmegen
56. Ludwig-Maximilians Universität München
57. Heidelberg University
58. University of Zürich
59. Freie Universität Berlin
60. University of Milan
61. French Institute of Health and Medical Research

YELLOW

international research institutions that primarily collaborate with the Swedish institutions

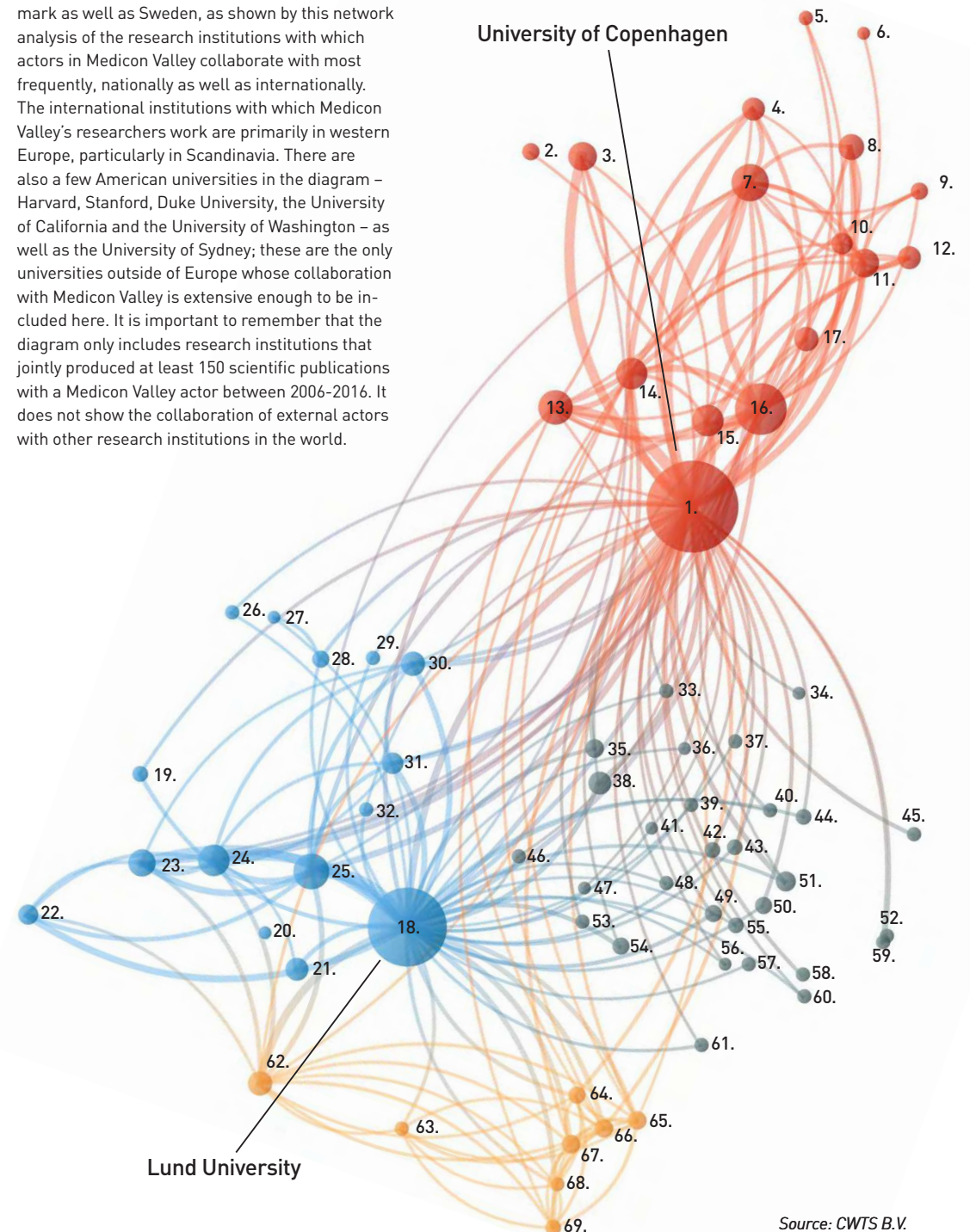
62. Umeå University
63. The Arctic University of Norway
64. University of Cambridge
65. Utrecht University
66. Imperial College London
67. University of Oxford
68. National and Kapodistrian University of Athens
69. German Cancer Research Center

Network analysis of Medicon Valley's international collaboration

- The graphic shows collaborations in the life sciences between research institutions in Sweden and Denmark (at least one of which is located in Medicon Valley) that led to publications between 2006-2016. A minimum of 150 instances of collaboration is required for an institution to be included in the graphic. The thickness of the lines and dots shows the collaboration volume – the larger the dot or the thicker the line, the greater the number of collaborations.
- The colours are generated automatically in the computer program VOSViewer, which classifies groups or networks of research institutions with more frequent joint collaborations. The Danish research institutions are shown in red, while most of the Swedish institutions as well as the Scandinavian institutions are in blue. The (usually) international research institutions that are in a network with closer connections to the Swedish institutions are in yellow, and in grey are the international research institutions that have as many connections to both Swedish and Danish institutions.

INTERNATIONAL COLLABORATIVE PARTNERS IN THE LIFE SCIENCES (2006-2016)

National collaborations are most common in Denmark as well as Sweden, as shown by this network analysis of the research institutions with which actors in Medicon Valley collaborate with most frequently, nationally as well as internationally. The international institutions with which Medicon Valley's researchers work are primarily in western Europe, particularly in Scandinavia. There are also a few American universities in the diagram – Harvard, Stanford, Duke University, the University of California and the University of Washington – as well as the University of Sydney; these are the only universities outside of Europe whose collaboration with Medicon Valley is extensive enough to be included here. It is important to remember that the diagram only includes research institutions that jointly produced at least 150 scientific publications with a Medicon Valley actor between 2006-2016. It does not show the collaboration of external actors with other research institutions in the world.



Source: CWTS B.V.

Ten European life science clusters were compared in the survey conducted by CWTS Leiden. On the following pages, representatives for organisations in two of them – the national research infrastructure SciLifeLab in Stockholm-Uppsala and Top Sector Life Sciences & Health (LSH; Health~Holland) in the Netherlands – offer their perspectives on the results of the analysis and on the conditions for collaboration and competition between the clusters. We also meet two investors who offer additional views on collaboration and research in Medicon Valley.

COLLABORATIONS STEERED NATIONALLY MORE THAN IN CLUSTERS, SAYS HEAD OF SCILIFELAB

Based on data on research collaborations, national context is more important in the life sciences than regional transborder clusters like the Danish-Swedish Medicon Valley, according to Olli Kallioniemi, director of the national life science organization SciLifeLab in Stockholm. He believes that one important explanation for why so many researchers choose to collaborate within national boundaries is the shortage of funds to support transnational research. At the same time, Olli Kallioniemi thinks that the corona- and climate crises are changing research collaboration patterns.

The closest cluster to Medicon Valley in CWTS Leiden's comparison of ten European life science clusters is Stockholm-Uppsala; this is evident in both the comparison of scientific publications and citations, as well as from a closer review of individual subject areas. Furthermore, Stockholm-Uppsala is the closest to Medicon Valley in a geographic sense.

While Olli Kallioniemi notes these similarities with interest, he doesn't entirely accept the preconditions for the comparison – that Medicon Valley is one cluster, and Stockholm-Uppsala another. He thinks – and CWTS' diagram of research collaborations (on page 35 and in Medicon Valley Alliance's 2018 annual report) corroborates this – that academic research collaborations within Sweden and Denmark respectively are more substantial than transborder collaborations.

– Of course, there is a lot of emphasis put on the Medicon Valley region as an economic region. But if we look at the data on scientific publications, the cooperation between Lund and Stockholm is stronger. Personally, I find it good that e.g. Lund cooperates both with Stockholm and Copenhagen and that one does not exclude the

other, but it is important to note how e.g. ethical, legal and regulatory boundaries as well as available research funding make it easier to collaborate within each country, says Olli Kallioniemi.

He also emphasises that SciLifeLab is a national infrastructure for all of Sweden, not only for Stockholm and Uppsala. While SciLifeLab has some international users and many international collaborations, its primary mandate from the government is to serve scientists in Sweden.

Olli Kallioniemi believes that the main reason researchers focus their collaborations primarily in the country in which they are located is that funding is predominantly national. According to him, this is true for both Sweden and Denmark, which he knows from e.g. reviewing grants in both countries.

– A lot of the research is dictated by the available funding and we may lose opportunities when most of the funding is only intended for either Denmark or Sweden. In a Nordic perspective, there is very little transborder funding available. If we really want to promote the regions across borders, this is what is needed, he says.

One actor that has been able to have a strong influence on how researchers collaborate by funding projects that involve research in multiple European countries is the EU, says Olli Kallioniemi. EU funding is usually meant for large consortia across the continent, not for bilateral, transborder or Nordic collaborations.

– I would think that a lot of the collaboration between Lund and Copenhagen happens in a broader EU-context. Importantly, the publication metrics do not indicate who else participated in the collaborative publications between e.g. Lund and Copenhagen. Often there are dozens if not hundred of other sites engaged in multi-centre studies, he says.

Rather than focusing solely on the comparisons between the clusters Medicon Valley and Stock-

holm-Uppsala, Olli Kallioniemi also wants to focus on the similarities and differences between Denmark and Sweden. He notes that other surveys have indicated that the number of scientific publications has increased and other metrics have improved in recent years in Denmark, but remained largely unchanged in Sweden.

– How much of the progress in terms of scientific publications over the past ten years in Medicon Valley is due to Copenhagen rather than Lund? he asks rhetorically.

Olli Kallioniemi also points out that Denmark has a broad life science strategy that encompasses many areas. The Swedish government is now also developing a strategy that focuses more on health.

In addition, he finds it interesting that research collaborations between universities and hospitals appear to be more comprehensive in Denmark than in Sweden, which the comparison by CWTS Leiden indicates (see Medicon Valley Alliance's 2018 annual report).

– In the era of covid-19, we are seeing how important that kind of collaboration is, he says.

Covid-19, along with the current climate crisis, are also factors that may influence how researchers choose their national as well as international collaboration partners in the future, says Olli Kallioniemi. He sees a potential two-pronged development in which local collaboration will continue to have an important role whilst it becomes easier to collaborate over significantly longer distances.

– Covid-19 has meant that everybody is meeting digitally. This leads to internationalization, and democratization in that international contacts will be less dependent on travel in the future, and hence distances will matter less. Lecture series are now easy to arrange internationally for example, and now there can be hundreds of people internationally listening to a local seminar presentation – and the speakers do not need to travel anywhere. I don't know what the future will bring of course, but I believe covid-19 will have long-term consequences. We'll work more with international collaborations, because they're just as easy, he says.

Paradoxically, travel between colleagues who are just a few hours away may be impacted, he thinks. The corona crisis has already led to a significant decrease in travel and Olli Kallioniemi believes that it might be the start of a more permanent development.

– I think that the climate discussion has already made people want to travel less domestically, even before covid-19 there were recommendations like

”don't fly to Gothenburg, take the train”. However, now I would rather have a Zoom meeting than travel three hours in each direction in a shaky train. We've gotten a lot more used to being able to discuss most things digitally, he says.

He believes that local contexts will continue to be important, as people have a need to meet their colleagues. Furthermore, change won't affect all factors at once; funding, legislation, regulatory and ethical and privacy issues concerning health data will continue to impact research collaborations in the future as well, Olli Kallioniemi points out. He believes nonetheless that the broader trend is toward more comprehensive international collaboration that takes place parallel to local work.

– One could say that local collaboration will become less important, but at the same time, since people will be travelling less, they'll have a greater need for a high-quality local environment, he says, and adds:

– When it comes to research on healthcare, being close to a hospital is obviously advantageous. But samples can also be sent to and from researchers elsewhere, so that other types of cooperation are also feasible; this happens today at SciLifeLab, where the analysed samples are acquired all over Sweden. A lot of things can be done without traveling.



Olli Kallioniemi, director of SciLifeLab.

PHOTO: SCILIFELAB

FACTS: SCILIFELAB

SciLifeLab stands for Science for Life Laboratory, and it is the name of a national research infrastructure for the advancement of molecular biosciences in Sweden. SciLifeLab was founded in 2010 by Karolinska Institute, KTH, Stockholm University and Uppsala University, but today it gives support to research activities at all major Swedish universities and is funded by the Swedish Government.

Researchers and companies can use SciLifeLab's infrastructure comprising laboratories and expertise for research in e.g. genomics, proteomics, metabolomics, microscopy, structural biology, bioinformatics, single cell biology, chemical biology and genome engineering, along with diagnostic development as well as drug discovery and development.

DUTCH LIFE SCIENCE DIRECTOR SEES BASIS FOR MORE COLLABORATION WITH DENMARK

Belgium is one of the traditional partners of choice for life science researchers and companies in the Netherlands, and there are also common interests with Scandinavia, according to Nico van Meeteren, executive director of the Bureau of the Top Sector Life Sciences & Health (LSH; Health-Holland) in the Netherlands. For the years ahead, he sees opportunities for more research collaboration involving the people more broadly, universities, the government and companies with the help of "federated learning".

In 2011, the Dutch Ministry of Economic Affairs and Climate Policy designated Dutch Life Sciences & Health as one of the country's "top sectors", selected for its ability to make important contributions to tackle global societal challenges with substantial potential to lead to spin-off companies that benefit society and the economy. In a comparison of life science research in ten European clusters, the entire Netherlands is considered a single cluster, and although Nico van Meeteren believes that comparing an entire country with other clusters that comprise regions can be misleading, he is of the opinion that the "single cluster" image of the Netherlands is fairly accurate.

– We have invested heavily in a more national ecosystem and succeeded quite well, he says.

CWTS Leiden's analysis shows that the Netherlands is the European cluster with the second-largest number of scientific publications during the period studied, 2006-2016, following London-Cambridge-Oxford, and that the number increased throughout the entire period. The Netherlands is also at a high level in terms of citations – on approximately the same level as Scotland and Zurich. Oncology and Endocrinology & Metabolism are some of the subject areas in which the cluster has excelled, both in terms of publications and citations.

To describe the Netherlands' role in life science research in Europe, Nico van Meeteren points to three characteristics that set the country apart. The first is that he believes that Dutch society is open to acquiring and sharing knowledge; this plays into the more general image of the Netherlands and has fuelled research and innovation of many Dutch sectors, one of which is life science and health. The government's prioritisation of this has led to further progress of that sector.

– Secondly, we are a first mover. We have a reputation for liking to take on the heavy stuff, such as discussions about life's end or about gender-transformation. Our society is also very open. You can also see these cultural habits in the life sciences and

health sector. In the Netherlands there is continuous cross-pollination between citizens, business, government, and knowledge institutes – the so-called "quadruple helix". Ideas and research lead to new alliances and spectacular innovations and consequently to resourceful ways to improve health, healthcare and life sciences. We do the things we do boldly, he says.

Thirdly, Nico van Meeteren points out that similarly to the Scandinavian countries, the Netherlands is above the EU- and global averages when it comes to developing for instance enabling technologies and -methodologies.

He feels that among many others, Denmark could be a fitting partner in various areas, not least in research on healthy ageing, elder care and e-health, areas in which the two countries take a similar approach.

– If Belgium weren't so close, I think we'd collaborate more with Denmark. I'm joking of course, but your younger population fits in well in our football teams, and the same is true for science, says Nico van Meeteren with a laugh.

One of the Netherlands' main collaborative partners is Belgium though, which is also related to the countries' long tradition of collaborating in the Benelux-formation. In addition, Dutch researchers frequently collaborate with public and private partners in the USA, the UK, Germany and Switzerland.

He also says that the EU is an important actor when it comes to research collabo-



Nico van Meeteren, executive director of the Bureau of the Top Sector Life Sciences & Health in the Netherlands.

PHOTO: LSH; HEALTH-HOLLAND

rations, not least in Horizon 2020, EU's framework programme for research and innovation for 2014-2020, and its upcoming successor Horizon Europe.

– The amount of collaboration and its progress depends heavily on people's shared interests, of course, but also on for instance whether there are companies involved. Based on this involvement, there's a fine mix of both competition as well as cooperation on a multilateral level. We're already doing fine, but with others, we could definitely enhance this collaboration a lot, for the sake of increasing success, he says.

As Nico van Meeteren sees it, one possibility that can make all quadruple helix partners more inclined to collaborate in the future is a new approach that supports cross-border societal federated learning via a turnaround of data-use and data-analysis.

– In the next few years, the 'antiquated' Internet of Things will become the Internet of Fair Data and Services and this will support federated learning technologically. With the help of federated learning, one can benefit from others' data without requiring the data-sets; instead, algorithms surfing around the internet can simply visit data-stations, when exclusively permitted to do so by the owner, and

OUTSTANDING RESEARCH MAKES INTERESTING COMPANIES, SAY INVESTORS

The investors Novo Seeds and Sunstone Life Science Ventures are seeing increased international interest in Medicon Valley's startup companies. They believe that the success of research in the region is important and can lead to interesting offshoot companies, and they say that this is the case here. They see an important influence in the other direction as well, as the industry makes its mark on research.

As investors in the life science sector, Novo Seeds' and Sunstone's research focus is primarily on the degree to which research will lead to interesting and successful offshoot companies. And in Medicon Valley, it does, according to both Sten Verland, general partner at Sunstone Life Science Ventures, and Søren Møller, managing partner at Novo Seeds. Both are Copenhagen-based venture capital firms with focus on life science startups – Novo Seeds is part of Novo Holdings, and Sunstone Life Science Ventures is an independent enterprise. The companies are also more closely linked since Novo Holdings recent contribution to Sunstone's newest fund.

– From my perspective – the commercial – the cluster is full of life, with lots of startup companies. There are a lot of important actors involved, and in many ways it is a complete ecosystem as

FACTS: LIFE TOP SECTOR LIFE SCIENCES & HEALTH

Top Sector Life Sciences & Health (Health-Holland) is designated by the Dutch Ministry of Economic Affairs and is selected for its ability to contribute substantially to addressing global societal challenges. The Top Sector LSH initiates and stimulates interdisciplinary research and development in public-private partnerships (PPP) to valorise innovation. By attracting funding, sharing best practices, the connective role and communicating as one voice through Health-Holland, the Top Sector is boosting a productive infrastructure, thereby investing in the government's five missions for the Societal Theme of Health and care under the motto: vital functioning citizens in a healthy economy.

without capturing the data, extract the information that another actor needs, for instance for his or her health. History will prove me right or wrong, but I believe this will be a tipping point for innovation and lead to more cooperation, he says.

it has a variety of funding systems, incubators and skilled people. That has a lot to do with the industry's strength on the Danish side, with Novo Nordisk, Leo Pharma and Lundbeck, and AstraZeneca in Sweden, which still influences the region even if they are no longer there, because they gave access to highly skilled people, says Sten Verland.

He immediately brings up the reciprocal relationship between research and industry; research can be commercialised and become the foundation for new enterprises, but the region's large companies also have a strong influence on which research areas become substantial and successful in a particular region, he says.

– In Sweden for example, AstraZeneca had a definite impact, and the level of research on respiratory disorders remains high. In Denmark, our



The Øresund bridge.

level is very high in diabetes and endocrinology in general. There are a few cluster differences that can affect the areas where we find high quality, says Sten Verland from Sunstone.

The image that emerges in the research institute CWTS Leiden's bibliometric comparison of ten European life science clusters corresponds well with his take on things, he says, although there was one area in which the results surprised him.

– One might wonder why neuroscience has a relatively poor position, even when Lundbeck is active in the region. Why doesn't that rub off more on research? But I think it has to do with Lundbeck having had a relatively private research division for many years, with no large networks to the universities, he says.

Both Sten Verland and Søren Møller from Novo Seeds feel that on the whole, a lot of good companies spring up in the Medicon Valley-region. In part, that's because there's an ecosystem for new enterprises that has recently gotten a boost from the Bioinnovation Institute, and it is also due to the successful pharmaceuticals industry on the Danish side of the border, they say.

– We've been investing in biotech companies in the region for the past ten, twelve years, and we've seen an enormous development toward larger-scale funding and larger companies and more mature projects, so as far as the region goes, I'm positive, says Søren Møller.

There has been a huge increase in international investor interest in the region during the same period, according to Sten Verland.

– When we started Sunstone in 2007, there were huge headlines about a foreign venture fund investing in the region. There aren't any anymore; now we coordinate our investments with others as a rule. Usually there are 3-5 other investors, and usually most of them are from abroad. That's very important, he says.

Novo Seeds is currently invested in 25 mostly

Nordic-based startup companies and has invested in e.g. the vaccine developer MinervaX and BioPhero, which works with sustainable pest control. Both of those companies have their offices in Copenhagen, but the venture capital firm also has investments in Sweden.

Novo Seeds and Sunstone's involvement in companies sometime overlap – for example, MinervaX is in Sunstone Life Science Ventures' active investment portfolio, along with around 20 other life science startups around Europe. Another regional is example is the company Alligator Bioscience from Lund, which develops cancer drugs based on antibodies.

Although Novo Seeds and Sunstone are both based in Medicon Valley, their investments reach far broader than that. Søren Møller wants a shifted perspective, where all of Scandinavia is seen as one region.

– We look at all of Scandinavia and see that there is good basic research and a culture of budding entrepreneurship that makes a lot of young people want to be entrepreneurs, he says.

In a European context, he sees Scandinavia is definitely making progress as a life science cluster, and he says it can be considered one of Europe's successful clusters, alongside the "golden triangle" in the UK, and other key clusters in Switzerland and the Benelux countries.

Sten Verland agrees and adds that the region around Munich is another good example.

Both investors consider research quality a determining factor for the quality of the companies started up in the life sciences and believe that it is thus important for Medicon Valley to position itself as such a high quality science region as it does in the comparison by the research institute CWTS Leiden.

– The research quality in Medicon Valley is high, beyond a doubt, but the research volume is lower since we have a smaller population; if it's considered in relation to the population size, the picture changes. And we're primarily attracted to

areas that are interesting from a biotech perspective – that are investment-friendly, for example gene- or cell therapy, oncology and inflammatory disorders, says Søren Møller from Novo Seeds.

To exemplify the importance of high-quality research, he points to the regions around Boston and San Francisco in the USA – on the whole, he believes that the American clusters are on a higher level than the European.

– It's apparent that growth in those cities has been driven by research quality and a strong economic funding system that enables ideas that have emerged from research to become companies and generate value. So research is the raw material of the scientific community from which the foundation is built and if you add management talent and capital you have a strong ecosystem, he says.

Sten Verland from Sunstone also mentions other positive effects of high-quality research. Among other things, he believes it is an advantage for Sunstone that they can turn to top local researchers who can help determine the quality of the companies in which Sunstone is considering investing.

– Research quality is also very important when we're recruiting skilled researchers in our companies, especially research students. They are also a product of the quality of research at universities, he says.

For Sunstone, physical proximity to the companies in which one is investing is important when it comes to companies that are just forming, according to Sten Verland; in part because that proximity means a cultural and verbal closeness and pre-understanding, and in part because the companies need more support at that stage. Physical proximity is unimportant for more mature companies, he says. Søren Møller from Novo Seeds concurs.

– At the same time however, we're seeing significantly fewer opportunities in Sweden than in Denmark. Presumably it's because we don't know Sweden as well; there is probably a regional mindset that we all need to work on, he says.

Another factor is that the Novo Nordisk Foundation – another part of the Novo Nordisk family – is active locally in the region.

– From where we are, we can also see that the foundation's strategy makes its mark on the academic environment, and that mark is significant, says Søren Møller.

Both investors see a value in carrying out comparisons of life science clusters, to bring attention to things that can be improved on one's home turf.

– Oxford-London is good at recruiting internationally and attracting talent – what do we do to



Sten Verland, general partner at Sunstone Life Science Ventures.



Søren Møller, managing partner at Novo Seeds.

make our cluster better at that? And if you look at Boston – besides that they're also good at recruiting international scientific talents, they have a knack for creating attractive financial framework to fund companies, says Søren Møller.

Attracting international talents is one thing that Sten Verland also feels Medicon Valley could be better at. He also finds it positive that two new venture capital firms recently came to the region, since the small number of actors previously was something of an obstacle for companies looking for funding. Compared with many other clusters, Medicon Valley is relatively small, and this is clearly evident in a research comparison, he points out.

– One weakness we have is that we are a small region in many ways. We can't really measure up to the really big regions in terms of scientific publications and international positioning. Sometimes we have to be more opportunistic, we have to make the best of what we have, he says.

Sten Verland believes that collaboration between clusters plays a much greater role than competition, although that can't be ignored:

– There is no competition situation between clusters; for me, it's more about whether one markets oneself against others. As a nation however, one can have the desire for the Swedish-Danish cluster to have a strong position in the world. Scientific competition is always a good thing, and we all feel a certain pride for our own cluster, so yes, certainly – the competition is there, he says.

UNIVERSITIES, REGIONS AND RESEARCH INSTITUTIONS

PHOTO: NEWS ØRESUND



1. REGION ZEALAND*

Life science researchers: 570
of which professors: 32
of which doctoral students: 150
Life science students: -

PHOTO: NEWS ØRESUND



2. ROSKILDE UNIVERSITY

Life science researchers: 55
of which professors: 6
of which doctoral students: 19
Life science students: 459

PHOTO: NEWS ØRESUND



3. TECHNICAL UNIVERSITY OF DENMARK (DTU)

Life science researchers: 1 306
of which professors: 94
of which doctoral students: 430
Life science students: 4 293

PHOTO: NEWS ØRESUND



4. UNIVERSITY OF COPENHAGEN

Life science researchers: 4 350
of which professors: 586
of which doctoral students: 2 190
Life science students: 13 642

PHOTO: NEWS ØRESUND



5. THE NATIONAL INSTITUTE OF PUBLIC HEALTH (NIPH), UNIVERSITY OF SOUTHERN DENMARK

Life science researchers: 107
of which professors: 9
of which doctoral students: 15
Life science students: -

PHOTO: NEWS ØRESUND



6. REGION HOVEDSTADEN*

Life science researchers: 3 927
of which professors: 240
of which doctoral students: 801
Life science students: -

Source: The universities' and research institutions' own numbers. Life science researchers includes professors, associate professors, lecturers, post docs, doctoral students, etc. See footnotes in the Appendix for more information about the figures.
* Researchers at the hospitals in the region often conduct research part-time. Some of the researchers at the hospitals and at the Danish Cancer Society also have part-time positions at the universities in the region.

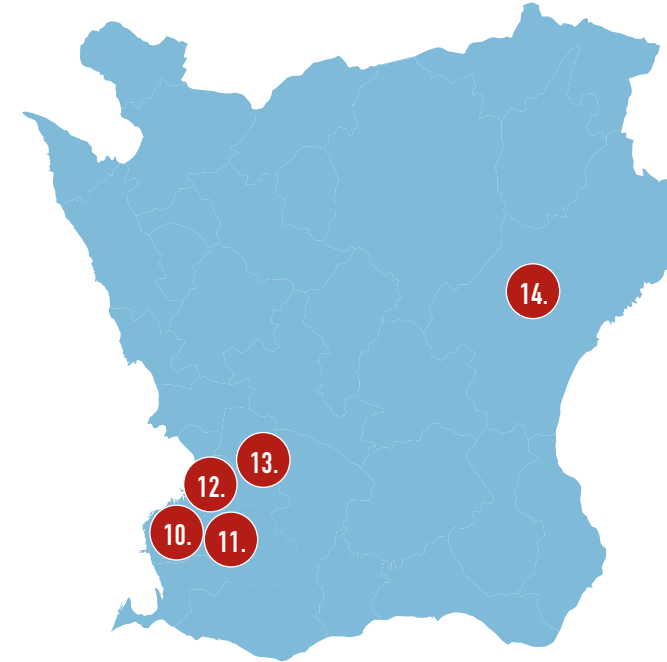


PHOTO: NEWS ØRESUND



7. AALBORG UNIVERSITY IN COPENHAGEN

Life science researchers: 17
of which professors: 10
of which doctoral students: 2
Life science students: 60

Other learning institutions:

Copenhagen Business School (CBS) does not conduct life science research in the traditional sense, but it is touched upon, for example through research in organisation and public management.

PHOTO: NEWS ØRESUND



8. STATE SERUM INSTITUTE

Life science researchers: 150
of which professors: n.a.
of which doctoral students: n.a.
Life science students: -

PHOTO: NEWS ØRESUND



9. DANISH CANCER SOCIETY*

Life science researchers: 153
of which professors: 9
of which doctoral students: 40
Life science students: -

PHOTO: NEWS ØRESUND



10. MALMÖ UNIVERSITY

Life science researchers: 210
of which professors: 37
of which doctoral students: 87
Life science students: 1 995



PHOTO: NEWS ØRESUND

11. REGION SKÅNE*

Life science researchers: ca 1 800
of which professors: 125
of which doctoral students: 750
Life science students: -



PHOTO: NEWS ØRESUND

12. THE SWEDISH UNIVERSITY OF AGRICULTURAL SCIENCE IN ALNARP

Life science researchers: 204
of which professors: 20
of which doctoral students: 71
Life science students: 607



PHOTO: NEWS ØRESUND

13. LUND UNIVERSITY

Life science researchers: 1 618
of which professors: 243
of which doctoral students: 1 211
Life science students: ca 4 222



PHOTO: KRISTIANSTAD UNIVERSITET

14. KRISTIANSTAD UNIVERSITY

Life science researchers: 70
of which professors: 20
of which doctoral students: 14
Life science students: ca 1 600

HUNDREDS OF RESEARCH PROJECTS IN MEDICON VALLEY ABOUT THE NOVEL CORONAVIRUS

Since this spring, over 200 research projects about the novel coronavirus that causes covid-19 have been started at universities and hospitals in Medicon Valley. In addition, many businesses in the region are venturing into corona research, either with universities or on their own.

When it comes to the Danish and Swedish companies that are putting efforts into corona research, the focus is usually on developing a vaccine, a drug, or something else to aid in the treatment of covid-19. The Copenhagen-based pharma company UNION Therapeutics, for example, has initiated clinical studies based on the theory that an optimized salt form of niclosamide can be utilised to treat corona patients, and the Lund-based Viraspec is developing a corona test meant to be easier, rapider and more reliable than those on the market today. The Danish companies Bavarian Nordic, Adaptvac, Expres2ion and the contract manufacturer AGC Biologics are working with researchers from the University of Copenhagen and a number of Dutch and German higher learning institutions to develop a vaccine against the virus.

The research projects at universities, hospitals and other research institutions comprise everything from developing vaccines, tests and various drugs or treatments for covid-19 to basic research on how the virus works and affects people. Furthermore, some projects examine how other patient groups, for example those who have gotten cancer or suffered heart attacks, have been affected in the corona pandemic. Projects also concern how to best organise healthcare to cope with the pandemic and similar questions.

As an example, researchers from Malmö University, Linköping University and Umeå University are working to develop a sensor that will detect new pathogens, such as the novel coronavirus, in a simple and inexpensive way via special surfaces – Reversible Self-Assembled Mono-

layers (rSAMs) – that can be linked to electrochemical or optical transducers. Another example is the Technical University of Denmark (DTU), which has joined up with the healthcare company Konduto in Taastrup to develop a tool based on pattern recognition algorithms to detect where and when covid-19 infections are transmitted in hospitals and care homes.

The Danish and Swedish governments both have specially designated grants for research of the novel coronavirus. In addition, funds have been made available by large foundations such as the Novo Nordisk Foundation, Lundbeck Foundation and the Carlsberg Foundation in Denmark, as well as the Knut and Alice Wallenberg Foundation in Sweden. Some universities have chosen to offer their own grants for research into the coronavirus, and the EU is also granting funds specifically for corona-related research.

Many actors in Medicon Valley have been able to take advantage of these research funds. There are ongoing projects at most of the higher learning institutions in the region, with the exception of some of the smaller actors and universities whose operations are focused elsewhere. We will not provide any figures here for the number of projects at each seat of learning, research institution or in any region, as many of them have reported that it is difficult to supply any exact numbers. Generally speaking however, there are a greater number of projects at larger universities than at their smaller counterparts, and there is a great deal of research being done in the regions. Based on a compilation of the data supplied by the universities

Examples of research projects at universities, hospitals and in the industry

- Researchers at Hvidovre Hospital in the Capital Region of Denmark, the University of Copenhagen and the University of Southern Denmark are studying the effect of covid-19 on pregnant women, fetuses and newborns. Among other things, researchers are investigating whether the infection has any genetic effects. The objective is to formulate guidelines for pregnant women. The project received 5.8 million DKK from the Danish government's special grant fund for corona research.

- Region Skåne has put its obduction facility at the disposal of a research group from Lund University to enable them to study how body tissue has been affected in people who have died from covid-19. The research group will perform analyses on lung tissue and enable the discoveries to be organised according to different blood biomarkers. To the Swedish Ethical Review Authority, Region Skåne states that since the obduction facility is unique in Sweden in terms of size and security, they have an obligation to perform examinations that others are unable to perform.

EXAMPLES OF COMPANIES WITH CORONAVIRUS RESEARCH

Adaptvac, Hørsholm (vaccine development)
AGC Biologics, Søborg (vaccine development)
Bavarian Nordic, Hellerup (vaccine development)
Elplatek, Esbjerg (antibacterial surfaces on e.g. door handles)
Evaxion Biotech, Copenhagen (vaccine development)
Expres2ion Biotechnologies, Hørsholm (vaccine development)
Falck, Copenhagen (see left)
Immunitrack, Copenhagen (contribution to vaccines and tests)
JVS, Greve (shields to protect healthcare workers)
Konduto, Taastrup (contagion tracing via algorithms)
Oncology Venture, Hørsholm (drug development)
Qlife Holding, Helsingborg (development of antibody test)
Synact Pharma, Lund (drug development)
UNION Therapeutics, Copenhagen (drug development)
Xintela, Lund (development of stem cell treatment)

STUDY: HOW HAS COVID-19 AFFECTED FALCK'S EMPLOYEES IN DENMARK AND SWEDEN

Every second week, 4 000 employees of the Danish company Falck, whose business activities include ambulance services, company healthcare, and rescue and fire services, are offered a serological test to detect antibodies for covid-19 in Denmark and Sweden. The research project is being jointly led with researchers from Rigshospitalet, the University of Copenhagen, and Herlev-Gentofte Hospital, and the aim is to investigate how immunity develops in various professions and in two countries that have followed different strategies to manage the coronavirus pandemic.

Preliminary results has showed that employees with more patient contact, e.g. ambulance personnel, developed antibodies against covid-19 more often than the others. 6.6% of the Falck employees in Sweden who participated in the study had developed antibodies, compared to 1.6% in Denmark.

themselves, combined with some review of research grants, there are a total of more than 200 projects being carried out in Medicon Valley. It should be noted that due to multiple participating actors, some of the projects were possibly counted two times or more. Nonetheless, data from some actors has been scarce, and it is thus conceivable that there are a greater number of projects than those that we identified.

In addition to the projects at the region's universities and hospitals, research, as earlier mentioned, is also being conducted at many of the companies based in the region – both Danish and Swedish.

There are registers in both Denmark and Sweden that show how many studies related to covid-19 have received ethical approval. In mid-October, the Swedish Ethical Review Authority's register included 240 approved projects; the vast majority of these

were based in Stockholm. Some of the studies were collaborative however, with multiple participating universities. In 25 of the 240 projects, either Region Skåne or Lund University was the responsible authority, or the southern healthcare region, comprising the regions Blekinge, Kronoberg, Skåne and southern Halland, was involved in the project.

The Danish National Committee on Health Research Ethics' register included 76 ethically approved healthcare-science research projects in all of Denmark in mid-October, with no data on the institution or region behind each individual project.

There are also ongoing coronavirus research projects in both countries that do not require ethical approval, and the information compiled above can thus not be considered an exhaustive list of the research being conducted.

- A research group at the University of Copenhagen is in a research consortium that includes numerous companies, e.g. Bavarian Nordic, Adaptvac and others. The consortium has received 20 million DKK from the EU's research programme Horizon 2020, and the research group was granted 25 million DKK by the Carlsberg Foundation to develop a vaccine against covid-19. The researchers have had promising results from tests conducted on mice. In brief, the technique is based on attaching coronavirus antigens to what are called "capsid Virus Like Particles" – cVLPs – to which the body's immune system reacts, producing antibodies.

- The biotech company Synact Pharma, whose headquarters are in Lund, has developed a potential drug to activate the body's own immune cells, unlike current drugs which inhibit the immune system. The plan has been to use the drug for inflammatory and autoimmune diseases; now Synact Pharma is planning a clinical study to investigate whether the potential drug can also be used to treat patients with covid-19 who have developed severe pneumonia to prevent acute respiratory distress syndrome (ARDS), a serious condition that often requires respiratory therapy.

University of Copenhagen on top

After ranking higher than Lund University in the latest Times Higher Education Ranking, the University of Copenhagen now ranks higher than Medicon Valley's other learning institutions on all three of the major ranking lists. Copenhagen's placement varies from list to list – it is number 33 on Shanghai Ranking and number 84 on the Times Higher Education Ranking. Of the Medicon Valley universities, the next to follow are Lund University, then DTU.

University of Copenhagen comes 18th in life science ranking

In QS World Ranking's subcategory "Life Sciences & Medicine" as well as in CWTS Leiden's "Biomedical and Health Sciences" (for the number of scientific publications), the University of Copenhagen ranks highest in Medicon Valley. The Danish university ranks 18th in the world on QS World Ranking's list.

DTU's researchers cited most

The Technical University of Denmark is the Medicon Valley university whose publications are most frequently among the 10% most cited in the world, according to CWTS Leiden Ranking 2020. 13.2% of the publications released by researchers from DTU from 2015-2018 belong to this category.

Following DTU, researchers from the University of Copenhagen and then the Swedish University of Agricultural Sci-

LUND SLIPS ON THE MAJOR RANKING LISTS. Lund University ranked lower this year than last on the QS World Ranking as well as Shanghai Ranking and Times Higher Education Ranking. While the shift is by no means huge – usually a few slots – the trend is consistent. The picture was different last year, when Lund University held the same place in two lists and placed slightly higher on the third.



PHOTO: NEWS ØRESUND

UK heads European lists

American universities are usually at the top of the international ranking lists like Shanghai Ranking and QS World Ranking, but when it comes to Europe, the UK is in the lead. The two universities that rank highest most often in Europe are Oxford and Cambridge in England, followed by other British universities, as well as Swiss, French and German. A Scandinavian university that frequently ranks highly is Karolinska Institute in Sweden.

ences were cited more than researchers at Medicon Valley's other higher learning institutions, according to that same ranking list.

In CWTS Leiden Ranking's subcategory "Biomedical and Health Sciences" as well, DTU researchers' scientific publications were most often among the 10% most frequently cited, but the University of Copenhagen was at almost exactly the same level.

Three influential ranking lists

| UNIVERSITY | TIMES HIGHER EDUCATION RANKING 2021 (2020) | SHANGHAI RANKING 2020 (2019) | QS WORLD RANKING 2021 (2020) |
|---|--|------------------------------|------------------------------|
| University of Copenhagen | 84 (101) | 33 (26) | 76 (81) |
| Lund University | 103 (96) | 151-200 (101-150) | 97 (92) |
| Technical University of Denmark (DTU) | 187 (184) | 151-200 (101-150) | 103 (112) |
| Aalborg University | 201-250 (201-250) | 301-400 (201-300) | 305 (324) |
| University of Southern Denmark | 251-300 (251-300) | 301-400 (301-400) | 353 (372) |
| Swedish University of Agricultural Sciences | 351-400 (301-350) | 301-400 (301-400) | - |
| Roskilde University | 601-800 (601-800) | - | - |

FIVE UNIVERSITIES FROM MEDICON VALLEY ARE ON ALL OF THE MAJOR LISTS. Although the ranking lists every year are including more universities all over the world, not all of Medicon Valley's seats of learning are represented. The five universities with their base or operations in Medicon Valley included in the five major lists CWTS Leiden Ranking, QS World Ranking, Shanghai Ranking, Times Higher Education Ranking and US News Best Global Universities are the University of Copenhagen, Lund University, Aalborg University and the University of Southern Denmark. The Swedish University of Agricultural Sciences is generally also included, except on QS World Ranking.

A number of smaller institutions in the region are also listed on at least one of the lists. Roskilde University is on Times Higher Education Ranking and US News Best Global Universities for example, and Malmö University is ranked on US News Best Global Universities as well as in QS World Ranking's subcategory "Life Sciences & Medicine".



PHOTO: NEWS ØRESUND

Competition growing for every year

In ten years, Times Higher Education Ranking has gone from listing 200 universities around the world to ranking over 1 527. The other major ranking lists have seen a similar development. In recent years, Shanghai Ranking has ranked 1 000 higher learning institutions, and there are 1 003 on QS World Ranking's latest list.

Number of scientific publications 2015-2018

According to CWTS Leiden Ranking 2020

- University of Copenhagen: 12 651
- Lund University: 8 181
- DTU: 5 860
- University of Southern Denmark: 3 962
- Aalborg University: 3 489
- Swedish University of Agricultural Sciences: 2 565

Footnote: Shanghai Ranking is published by the independent organisation Shanghai Ranking Consultancy. Times Higher Education is published by the eponymous journal and reviewed by PricewaterhouseCoopers (PwC). QS World University Rankings is published by the British student guidance company Quacquarelli Symonds (QS).

FEWER INTERNATIONAL STUDENTS COME TO MEDICON VALLEY DURING THE CORONA CRISIS

The corona crisis has meant fewer international life science students at Medicon Valley’s universities. It will be a few years before comprehensive statistics are available for 2020, but the trend is unmistakable at DTU, Lund University and the Faculty of Health and Medical Sciences at the University of Copenhagen. The decrease is primarily seen in exchange students; students who have been admitted to longer programmes have chosen to a greater extent to come nonetheless. Time will tell whether the same is true for the number of international researchers in Medicon Valley.

Travel restrictions, universities that have suspended on-site teaching, uncertainty about the future and home universities that advise their students to avoid travel – these are just some of the effect of the coronavirus pandemic that have made international students refrain from travelling to study at the University of Copenhagen, DTU and Lund University. DTU and Lund University welcomed around half as many international students than usual at the beginning of this year’s autumn term.

– Most things in Denmark and around the world were shut down this spring, so relatively few students went through with their exchange study programmes. Many universities have suspended their exchange programmes this autumn, and we have done the same – both for ingoing and outgoing students, says Lærke Vester-Andersen, who heads the internationalisation division at the Faculty of Health and Medical Sciences at the University of Copenhagen.

She is hoping that exchanges will start up again in the spring of 2021, but she admits that it doesn’t look promising, as the University of Copenhagen’s partner universities have already started cancelling their exchange programmes for that term as well. DTU has also noted the same trend, and they expect the decrease in student exchanges to continue as long as the pandemic itself.

– The coronavirus pandemic creates widespread worry, and a lot of partner universities are making the decision for their students and have prohibited them from travelling because of the coronavirus. We’re seeing the same thing when it comes to the spring of 2021, reports Bjørn Sparre Johansson, Exchange Admissions Officer at the office for Study Programmes and Student Affairs at DTU.

Admissions to master’s programmes at DTU had increased between 2019 and 2020, but several hundred students chose to postpone the start of their studies

until the spring of 2021, in particular students who are not EU/EEA nationals. The number of students in international programmes at the Faculty of Health and Medical Sciences at the University of Copenhagen also decreased, albeit to a lesser extent than students in exchange programmes.

– In reality of lot of them chose to come to Denmark even though they had to be quarantined, since it’s a two-year programme, says Lærke Vester-Andersen.

Official statistics from Statistics Denmark and Statistics Sweden (SCB) for the number of international students in the life science field do not yet include the year 2020, but statistics for the academic year 2018-2019 show that the number of international students increased in both the Danish and Swedish sides of Medicon Valley compared to the previous year. This is true of students in both undergraduate and graduate programmes. In total, 3 497 international students were enrolled in life science training programmes in Medicon Valley in the last academic year – 2 559 in eastern Denmark, and 1 199 in Skåne.

That means that the number of international students in Medicon Valley has doubled in the last ten years. The greatest increase has been in eastern Denmark –134% – and in Skåne, the increase has been 31%; that is just under the average for Sweden.

The two countries utilise different models, and the Danish system is distinctly more advantageous than its Swedish counterpart; the number of people taking advantage of the tax relief schemes in the respective countries should thus not be compared. In the most recent year for which statistics are available, 6 899 people took advantage of the Danish tax relief scheme (2017), and 1 127 applications were approved for participation in the Swedish scheme (2019), according to figures from the Danish Ministry of Taxation and the Swedish Taxation of Research Workers Board, respectively. This represents an increase in both countries compared to the year prior.

In response to a new EU-directive on the topic, the Swedish government introduced new rules for residency permits given to international researchers and students as of 1 January 2020. Researchers and students at higher learning institutions are now able to e.g. remain in Sweden for up to one year after completing their studies or research in order to seek employment or start a company of their own. They must however supply documentation that they can support themselves for the entirety of the period until they have received a residency permit – in the past, ten of twelve months per year was sufficient.

International researchers

The number of international researchers taking advantage of the Swedish tax relief schemes for researchers has risen over the past decade. In Denmark, the number of researchers who take advantage of the scheme doubled between 2007 and 2017, and the number of applications that were approved in Sweden between 2009 and 2019 tripled.



PHOTO: NEWS ØRESUND

NUMBER OF INTERNATIONAL STUDENTS IN THE STUDY YEAR 2018/19

| | Number of students | of whom in research programmes | Change 2008/09 - 2018/19 |
|--------------------------|--------------------|--------------------------------|--------------------------|
| Skåne | 1 199 | 328 | 31% |
| Stockholm-Uppsala region | 4 181 | 1 552 | 44% |
| Västra Götaland | 1049 | 235 | 34% |
| Sweden, rest of | 1 753 | 240 | 17% |
| Sweden | 8 182 | 2 355 | 34% |
| Eastern Denmark | 2 559 | 953 | 134% |
| Denmark, rest of | 1 422 | 373 | 49% |
| Denmark | 3 981 | 1 264 | 94% |
| Medicon Valley | 3 497 | 1 326 | 95% |

Source: Statistics Sweden and Statistics Denmark

FACTS: TAX RELIEF SCHEMES IN DENMARK AND SWEDEN

- Both Denmark and Sweden offer special tax schemes for foreign employees to make it easier for companies and universities to attract talent from other countries.
- The Danish system is distinctly more advantageous. While a key employee in the Danish scheme needs to earn a minimum of 65 100 DKK per month including employee benefits, a foreign expert in Sweden needs a monthly salary of 94 601 SEK to be approved.
- When comparing the minimum level for the salary

in Denmark and Sweden, it is important to note that the salary on a Swedish payslip is generally lower than its Danish counterpart due to differences in the way the social security systems are financed. In Sweden, employers have to pay employer contributions for the employee in addition to their salary, whilst in Denmark, the social security system is financed via income taxes.

- In Sweden, tax relief can be received for a period of maximum three years, and in Denmark, for seven years.

ANALYSIS: Focus on the life science sector



The coronavirus pandemic has put the life science sector in the spotlight, both because of its steady growth in the crisis and for its ability to rapidly redirect in response to new needs. More than 200 research projects about the novel coronavirus that causes covid-19 been started at universities and hospitals in Medicon Valley.

- Universities, hospitals and businesses in Medicon Valley have the competence and capacity to redirect their efforts – this is clear after this spring, when more than 200 research projects were started up about the novel coronavirus that causes covid-19. More companies are working with projects related to covid-19.
 - The international competition for life science companies is becoming tougher as the sector is faring well in the crisis, according to Anette Steenberg, director of Investment Promotion at Copenhagen Capacity.
 - New life science strategy and a new national cluster in Denmark. This July, the Danish Ministry of Industry, Business and Financial Affairs published the report "Life science-industriens fodaftryk". It asserts that measured from its contribution to the country's BNP, the sector is nine times larger than it was in 1990. The life science sector is on Denmark's agenda.
- A new, Copenhagen-based cluster – the Danish Life Science Cluster – is being jointly created by 26 public and private actors. It has been selected by the Ministry of Science, Innovation and Higher Education as one of 14 new cluster initiatives, and has also received funding from the Danish Executive Board for Business Development and Growth. A new life science strategy for Denmark is expected in 2020.
- Increased optimism at Novo Nordisk, which raised the outlook for sales and operating profit for 2020 and decided to invest a further two billion DKK in its facility in Kalundborg, on top of the 16 billion invested between 2000 and 2019.
 - Renewal is permeating Denmark's oldest big pharma company LEO Pharma. A new CEO, dismissing employees and hiring anew and intensive R&D efforts are redirecting the company toward biopharmaceuticals. The owner foundation is now seeking additional shareholders.

A GROWTH SECTOR THAT LENDS STABILITY

Just like in the financial crisis, the importance of the life science cluster for the Swedish, but above all for the Danish economy is plainly apparent during this coronavirus pandemic. The cluster gives growth and stability in a time when other areas of society are going astern. At the same time, over 200 research projects about the novel coronavirus that causes covid-19 have been started at universities and hospitals in Medicon Valley. In addition, many businesses in the region are venturing into corona research. Increased optimism at Novo Nordisk means that the outlook is raised for turnover and profit this autumn. That doesn't mean all of Medicon Valley's businesses are looking at upward-arching curves. Large-scale renewals are also underway; this is best illustrated by LEO Pharma, which is simultaneously dismissing employees and hiring anew to change competence.

Denmark's life science exports are 67% greater than Sweden's; this is largely due to Danish successes in the USA via Novo Nordisk, which has half of its sales in North America. The value of Danish life science's exports to the USA rose to 45.5 billion DKK in 2019, while Sweden's exports to the USA increased to the equivalent of 12.6 billion DKK. That means that in 2019, the USA stood for 34% of Denmark's total

life science exports of 133 billion DKK, and for 16% of Sweden's total life science exports of the equivalent of 79 billion DKK. Instead, Sweden exports more to China and Germany than Denmark.

The life science sector is responsible for a significant part of Danish exports and makes an important socioeconomical contribution, and this is a strength, according to Professor Torben M. Andersen from

Aarhus University in an interview on pages 18-19.

– That such a large part of our exports aren't especially sensitive to cycles means a lot for Denmark. Neither medicine nor food is strongly affected the way other goods are, he says, and goes on:

– The life science sector is not so sensitive to slumps, and it thus has a stabilising effect on the economy. That means most for income, as the sector is not very employment-intensive.

Optimism at Novo Nordisk

After the uncertainty of the early coronavirus pandemic in the spring of 2020, optimism has begun to grow at the region's largest pharma company, Novo Nordisk. On 8 October, the company announced that it was raising the outlook for both sales and operating profit in 2020. Novo Nordisk has decided to expand its facility in Kalundborg for an additional two billion DKK, on top of the 16 billion invested between 2000-2019.

Companies in an overhaul process

Lundbeck and LEO Pharma are two companies currently in a renewal phase – for Lundbeck, because important patents are expiring and new products are greatly needed; LEO Pharma is restructuring the entire company at high speed with a new CEO, many new heads and soon, most probably, a new shareholder alongside the LEO Foundation. The emphasis on dermatology remains, but the focus is now on biopharmaceuticals.

Copenhagen's cluster of hearing aid manufacturers – Oticon, GN Hearing and WS Audiology – are also part of a quickly developing sector. Lying in wait in the background as a future competitor are Apple and new technological and marketing solutions.

New life science strategy and new national cluster in Denmark

This July, Denmark's Ministry of Industry, Business and Financial Affairs published the report "Life science-industriens fodaftryk", which reports that the sector is nine times bigger than it was in 1990, measured in terms of its contribution to the country's BNP. The life science sector is on the agenda in Denmark. It is one of eight sectors to be covered by an export recovery package that the Danish government and parliament agreed to issue to help boost the industry after covid-19. A new cluster – the Danish Life Science Cluster – is being jointly created by 26 private and public actors. It has been selected by the Ministry of Science, Innovation and Higher Education as one of 14 new cluster initiatives, and has also received funding from the Danish Executive Board

for Business Development and Growth. After some discussion, it was decided that the cluster should be located in Copenhagen. The launch of a new life science strategy for Denmark is expected in 2020.

In Sweden, the government assigned Growth Analysis the task of developing an analytic method for following the life science industry's development. The assignment comes after the completion of the life science strategy that was adopted last December. There is a need for knowledge about the sector's performance in relation to that of comparable countries, they wrote in a press release.

At least 200 research projects related to the coronavirus

Universities, hospitals and companies in Medicon Valley have the competence and capacity to redirect their efforts; this is clear after this spring, when over 200 research projects about the novel coronavirus that causes covid-19 were started up. They comprise everything from developing vaccines, tests and various drugs or treatments for covid-19 to basic research on how the virus works, as information compiled from universities and research grants reveals. Read more on pages 44-45.

Travel restrictions due to the corona crisis have meant fewer international life science students at Medicon Valley's universities. According to interviews with DTU, the Faculty of Health and Medical Sciences at the University of Copenhagen and Lund University, around half as many international students than usual were welcomed at the beginning of this year's autumn term.

– The coronavirus pandemic creates widespread worry, and a lot of partner universities are making the decision for their students and have prohibited them from travelling because of the coronavirus. We're seeing the same thing when it comes to the spring of 2021, reports Bjørn Sparre Johansson, exchange admissions officer for Study Programmes and Student Affairs at DTU.

Homeworking leads to internationalisation and democratisation of research collaborations

Travel and meeting restrictions related to covid-19 mean that researchers around the world can participate in international collaboration on more similar terms; this is evident from interviews conducted for this analysis.

– Covid-19 means that everybody is at home, meeting digitally. This leads to internationalisation, and democratisation. I believe covid-19 will have long-term consequences. We will work more with international collaborations, because they're just as

easy, says Olli Kallioniemi, director of the Swedish life science centre SciLifeLab.

He believes that local cooperation will continue to play an important role in research collaborations, but also that it will become easier to work together digitally over considerably longer distances.

The Leiden review shows that collaboration is vital for getting the best results. In this report, we conducted in-depth interviews to capture other clusters' perspectives on working with researchers in Medicon Valley. According to interviews with the researchers Stefan Jovinge, professor at Van Andel Institute and Michigan State University and adjunct professor at Stanford University, and Henrik Bjursten, cardiac surgeon and associate professor of thoracic surgery at Lund University, collaborations are often personal.

– When I was starting out, I contacted other researchers and thought, we're all adults and can look out for our own interests. I didn't think about what the others could get out of our collaboration. But the people one wants to work with, the good researchers, are very busy, and I noticed that the projects didn't move forward. So I learned to make certain that the project would have significant advantages for the other party as well, because otherwise our project wouldn't be prioritised highly, says Stefan Jovinge, and maintains that a good personal connection is a determining factor for a good collaboration.

Increased competition for life science companies in the coronavirus pandemic

The international competition for life science companies has stiffened as the sector has done well in the crisis, says Anette Steenberg, director of Investment Promotion at Copenhagen Capacity, in an interview on pages 54-55. The organisation works to increase the international visibility of Greater Copenhagen, and the intensified competition is clearly evident in their investment promotion work, she says.

The challenge for us has been that we're small and we have limited resources for going out and spreading the word. But everyone is saying the same thing: the global competition is really tough. Corona has made it harder, and not least in the life sciences, because the field is incredibly attractive.

The coronavirus pandemic has put a stop to travelling to international trade shows and conferences around the world to market the region; instead, work has shifted to digital platforms. In addition, Copenhagen Capacity and Invest in Skåne have both made it a priority to support the foreign-owned businesses that are already located in the region.

– We try to support the local management teams



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 reached four million residents. In Sweden, the same geographical area is often called the 'Øresund Region'.

with help and arguments they can present to their international owners to expand and for example move their production here. During the corona pandemic, we've worked a lot with the companies that are already here, now that there is a risk that production is brought back home, says Ulrika Ringdahl, CEO of Invest in Skåne.

Covid-19 challenges at the border of Danish-Swedish Medicon Valley

This spring, Denmark decided to partially close its borders to control the spread of covid-19. For businesses and commuters in the Danish-Swedish Medicon Valley, that has meant a challenge. Although border control permitted commuters to enter the country, travel times were longer, and employees were encouraged to work at home if possible. This led to the next challenge. According to the Danish-Swedish tax agreement, border commuters pay tax in the country in which they work. Working from home means that border commuters owe tax in a different country.

The life science environments in Denmark and Skåne are connected in a variety of ways: a number of businesses are active with facilities of their own on both sides of the strait, and there are also around 100 Danes working at life science enterprises in Skåne. 20 companies in Skåne have a Danish CEO. The exchange manifests in other ways as well, such as through public equity offers, capital funds, research collaborations and incubator programmes.

INTENSE COMPETITION FOR LIFE SCIENCE COMPANIES IN THE CORONA PANDEMIC

As a sector, the life sciences have fared well during the corona pandemic. That also entails that the international competition for these companies has increased, according to Anette Steenberg, director of Investment Promotion at Copenhagen Capacity. "Everyone wants winners", she says. Since travelling to international trade shows and conferences is impossible, as is receiving visiting delegations in the region, Copenhagen Capacity has adapted its operations with digital solutions and focused more on existing companies to give them reasons to stay in the area.

Copenhagen Capacity works to make Greater Copenhagen more visible internationally, and the life sciences are one of the industries that they highlight; others are cleantech, AI and smart cities.

– Life science is one of our region's major strengths. We work to draw talent as well as foreign investors, says Anette Steenberg, director of Investment Promotion at Copenhagen Capacity.

When it comes to enticing talent to the region, the attractive career opportunities and the balance between work and recreation are highlighted in particular.

– We describe what it's like to work in this region, that it's possible to have a successful career as well as an interesting recreational life. We highlight the lifestyle – being able to ride a bike to work and have time for one's kids – and then we show that we have a life science cluster, and they have companies as well as jobs. We work differently than headhunters and recruitment firms, says Nikolaj Lubanski, director of Marketing & Talent at Copenhagen Capacity, and continues:

– Why move? It's not just about earning money – if it is, you should go to the US or Singapore, where you work a lot, have very little time for your children, two weeks of holiday and a short parental leave. The new generation wants time for family and career, and money is no longer the most important thing. They look for purpose-driven jobs – work where you make a difference and have a balanced life. You can have that in our region, says Nikolaj Lubanski.

The organisation leads e.g. Greater Cph Career Portal, which is aimed at highly educated STEM-specialists. The website was recently redesigned and a number of matchmaking functions were added, and they also do directed cam-

paigns. The campaigns have long been a feature, but corona has pushed them even further in that direction, Anette Steenberg says.

– The area where we see the greatest demand is tech, but life science is also an important field. We target the mid-range and specialist area – not beginners or CEOs. When attracting talent is a challenge, we work together with companies. It can be all over the world; sometimes in the EU, other times in the US or Brazil. We join together with a number of companies that are looking for staff and we do a campaign, she says.

In practice, that means searching for a specific profile on e.g. Facebook and LinkedIn. Copenhagen Capacity and the companies define their target group, which also receives a directed advertisement campaign.

– All of the campaigns have KPIs; how many people have seen our websites, and then how many have downloaded the pages, and how many have seen the job, and then how many applied for it. We don't do the recruiting; it all goes to the companies, who take over from there. The people who don't get the job or who were only interested in it go into our database. We have a big database with 40 000 candidates that we can go in and search in, says Nikolaj Lubanski.

Copenhagen Capacity has no set goal regarding the number of campaigns that should be done; that is determined by demand. Companies pay to be included, but the efforts are subsidised by other funders, including, among others, the Greater Copenhagen Committee. Nikolaj Lubanski estimates that they hold an average of one large-scale talent campaign like that in the life sciences per year.

As far as efforts to promote investments go, Anette Steenberg finds that the corona pandemic has intensified competition in the field of life sciences.

– The challenge for us has been that we're small and we have limited resources for going out and spreading the word. But everyone is saying the same thing: the global competition is really tough. Corona has made it harder, and not least in the life sciences, because they're an incredibly attractive field. It's a field in which things are going well; the companies in it aren't suffering. The challenge will be making those companies even bigger. Everyone wants a winner. It's been tough for traditional industry. The tourist industry has had a hard time, but it's going well for the life sciences, and that means competition.

Since the corona pandemic has put a stop to travel to international trade shows and conferences around the world to market the region, Copenhagen Capacity has shifted to digital platforms and is even more focused on the companies that are already here.

– We're doing what's called expand and retain, where we ask foreign companies how they're doing. We help them stay in the area, to not disappear or outsource. We try to hold on to the clients who are already in the shop – this has been especially important now, in the corona era. It's hard for us to get out and travel and find new companies. We haven't had a lot of visitors, but the need to take care of those we have has become even greater, says Anette Steenberg.

Copenhagen Capacity has arranged webinars as well as taken part – virtually – in international conferences. She also sees potential for the digital solutions in the future.

– Digital conferences are getting better all the time, there are essential differences since before the summer. In the beginning a lot of people thought learning was possible, but networking and getting into discussions was more difficult. But since everyone is in the same boat, it's the only option. I'm actually quite positive about it; even when we can travel again, I think that some parts of it are here to stay. We've spent a lot of time and money on travelling, of course we'll start travelling again – but less, she says.

Copenhagen Capacity usually works with Invest in Skåne, for example when it comes to delegations that visit the region.

– When we're marketing the region, it makes sense for us to join forces. We're a tiny region when we're competing with London; competition between Malmö and Copenhagen doesn't make sense, she says. She continues:



Anette Steenberg, director of Investment Promotion at Copenhagen Capacity.



Nikolaj Lubanski, director of Marketing & Talent at Copenhagen Capacity.

– We go to trade shows together, and when they have visitors, they usually have things scheduled on both side of the Øresund. So we work together in the sense that if a client lands here, well, that client is here and not in Stockholm or Finland or Amsterdam. Usually we're up against Helsinki or Amsterdam. We join together to show what Medicon Valley has to offer, she says.

A large-scale campaign is currently being launched that Copenhagen Capacity and a number of other actors in the region have created to attract research investments from abroad in the field of microbiomes. Its foundation is the Interreg-project Microbiome Signature Project, which is being jointly led by Copenhagen Capacity, Invest in Skåne and Medicon Valley Alliance.

– Together, we analysed the competences we have in Medicon Valley, on both sides, and in terms of academic and industrial expertise. Then we did mapping to detail the concentration of companies and academics in microbiomes around the world. The campaigns will be narrowly focused and directed, so a lot of people will never see them. It has taken a year to develop the project, says Anette Steenberg.

“WHEN IT COMES TO LIFE SCIENCE, IT’S NOT REALLY WORTH TALKING ABOUT ANYPLACE ELSE THAN MEDICON VALLEY”

When Invest in Skåne works to increase the visibility of Skåne’s life science industry, they use the brand Medicon Valley. They started their work in the 1990s, and today the brand is so well known that anything else would be unimaginable, says Ulrika Ringdahl, CEO of the marketing company whose endeavours include promoting internationalisation by attracting investments in the region from abroad. Invest in Skåne will be putting more effort into helping companies recruit talent, and they will be hiring a new team member to work directly with such questions. Support provided to companies during the corona pandemic has included e.g. making material about the public support packages accessible to companies with foreign ownership as well.

The marketing company Invest in Skåne works with international marketing of Skåne as a brand and provides export support to companies in Skåne. Skåne is a strong brand, but in an international context, it’s sometimes warranted to use a common brand for both the Swedish and Danish sides of the strait, says CEO Ulrika Ringdahl.

– When it comes to life science, it’s not really worth talking about anyplace else than Medicon Valley.

That was our starting point in the 1990s. Medicon Valley is known all over the world, and it’s the brand we use to market life science. We often use Greater Copenhagen, but for life science specifically, the brand Medicon Valley is well founded.

When Invest in Skåne goes to international conferences and sets up stands, Medicon Valley is what they market. They also run the website mediconvalley.com with Copenhagen Capacity. A new version of the website will be launched this November.

– We market the region to an international audience, we talk about our common areas of strength. There’s a special page for the microbiome field for example, she says, referring to the Inter-reg-project Microbiome Signature Project, which they are leading jointly with Copenhagen Capacity and Medicon Valley Alliance until 2022.

Their work with Copenhagen Capacity also includes visitor’s programmes for delegations.

– Often we’ll welcome visitors together and set up a visitor’s programme on both sides of the strait. When we have visitors, companies from the

region come to the meetings, and they get a time slot to meet the delegations one by one, she says, adding that no such meetings were possible this spring because of the corona pandemic.

Invest in Skåne and Copenhagen Capacity also work together on campaigns designed to attract talents to the region; this is an area in which Invest in Skåne would like to work more in the future, and discussions are currently underway with the owners to create opportunities to do just that. Ulrika Ringdahl also sees the need to have someone who focuses on such issues working in the organisation.

– We need to have someone in-house who can do that. It’s a question of getting talents to stay here, for example by taking care of the people who have accompanied them here, and also of campaigns to attract new talents. We’ll join forces with the industry so that there are actual jobs. It will be a combination of generally marketing how good the region is and highlighting specific jobs where there’s a shortage of staff, she says.

Within the life sciences, Invest in Skåne’s work – beyond trying to entice companies to relocate to the region – frequently entails helping research collaborations to come about.

– They might be co-development projects, where the industry comes and helps with the clinical phase, for example. At BioEurope for instance, there’s a partnering- and matchmaking section where we promote companies from Medicon Valley. It’s hard for the big international companies to find small, innovative companies and university

“Medicon Valley is known all over the world, and it’s the brand we use to market life science.”

projects, because a lot of them don’t have the time or money to travel; Invest in Skåne can act as an ambassador for them, she says.

The work requires that Invest in Skåne is up to date on what the companies in Medicon Valley and around the world do, says Ulrika Ringdahl.

– When it comes to research collaborations, it’s about being close to the big pharma companies; what products they have right now, what will be needed in the future. Which molecule is it they need? As far as establishing companies goes, it happens seldom in the life sciences. Invest in Skåne works with a lot of sectors, but with the pharma industry it’s usually about establishing marketing- and sales offices. We do however have quite a few smaller biotech- and medtech companies who see moving to an international innovation environment like Medicon Valley as an advantage, she says.

Foreign-owned companies that are already in the region are responsible for a large part of Skåne’s exports and employment opportunities, according to Ulrika Ringdahl. Working to give them support has become even more important during the corona pandemic.

– We try to support the local management team with help and arguments they can present to their international owners to expand and for example move their production here. During the corona pandemic, we’ve worked a lot with the companies that are already here, now that there is a risk that production will be brought back home, she says, and continues:

– The support packages for companies during the pandemic are not something foreign-owned companies have always been informed about; we’ve been able to offer support there, among other things by translating the information to English. It’s been well received. The information has now also been sent out all over the country with Business Sweden, and we’re now have discussions with some 100 companies all over Skåne, where we try to look at the risks linked to the pandemic – if there’s a risk that they will move, then we look at how we can support them with material to convince the company’s leadership that this is where they should be.

The corona pandemic has made it more difficult to establish new contacts, says Ulrika Ringdahl.

– We have a big network, and we stay in contact with the people in it. What has gotten harder is finding new contacts in digital meetings, compared with physical meetings. We’ve become more digitally active, with small campaigns and films. We also use tools via LinkedIn for example, where things



Ulrika Ringdahl, CEO Invest in Skåne.

can be sent to the right target group, she says.

People are more than welcome to spread and use the material that Invest in Skåne produces, she emphasises.

– We could become even better at collaborating even more and standing together as a region behind a message. If we take on the task of creating the image of Medicon Valley, we want as many people as possible to use it, also in the industry. We are happy to share material that others can use. We need to create a common view of what Medicon Valley is. Often when we have meetings with international and regional companies, we open by talking about the region, and the small, local companies sometimes find that they had no idea that it the region was so good as it is. People don’t realise what a fantastic ecosystem they are operating in. They’ve been living here their whole lives. We’re happy to help in that respect; it helps the entire ecosystem.

Like Anette Steenberg from Copenhagen Capacity, Ulrika Ringdahl emphasises that the life sciences are a sector in which positive development has continued, even throughout the corona pandemic.

– It has gone well for life science as an industry, in spite of corona. We’ve seen a lot of activity, and we’ve even seen companies establish themselves here, she says.

Influential factors for how well companies have weathered the current situation are dependent on where a company is at the time, among other things, says Ulrika Ringdahl. Companies that are just starting a clinical study or have been in an investment phase have been more affected by various closures.

– There are a few companies that have really suffered, for example because they were just starting an investment period. We’ve noticed that investors have been a bit cautious, but now people are seeing that it didn’t get that bad. Investors want to invest. From a general point of view, the life sciences as a sector have fared much better than many others, she says.

UPCOMING REPORT: 420 LIFE SCIENCE COMPANIES IN SKÅNE

The life science sector in Skåne is growing, although the past 20 years have been characterised by a small number of large company closures or relocations, which has had a negative effect on employment. This is shown by a survey of the sector conducted as part of the Interreg-project Greater Copenhagen Life Science Analysis Initiative, due to be published shortly. The survey shows that there are 420 companies comprising Skåne's life science sector, 91 new startup companies have been established since 2015.

ØresundsInstitutet performed a survey of Skåne's life science companies within the framework of the Interreg-project Greater Copenhagen Life Science Analysis Initiative, which is being carried out jointly by ØresundsInstitutet and Medicon Valley Alliance. The report reveals that there are 420 identified life science companies in Skåne. The largest subsector is medtech. Over the past five years, 91 new startup companies have been established; of these, 70% are located in Lund.

Of the 420 companies identified in the life science cluster in Skåne, 306 can be categorised as pharma-, biotech-, medtech- and contract research companies. Around 75% of all of the life science companies thus belong to what can be considered a core segment of the life sciences. The remaining ca 25% of the life science companies identified – comprising 114 companies – make up a supplementary segment in the overlap between the life sciences and other sectors. The overlap is primarily between traditional life science and ICT; for example, the software company Capish Nordic AB is active in the life science- and the food sectors, as well as between them; the same is true of other biotech companies such as e.g. Glucanova AB.

Need for STEM expertise

The areas of expertise for which life science companies in Skåne consider it difficult to recruit are predominantly related to the STEM programmes (Science, Technology, Engineering and Mathematics). Companies report that expertise in regulatory affairs and quality assurance, as well as in sales and marketing, also pose a recruitment challenge. There is also a question of expertise in several different areas such as e.g. knowledge of Scandinavian languages. Around 52% of the businesses interviewed report however that they have not experienced difficulties recruiting specific expertise.

If life science companies in Skåne have the

opportunity to recruit new employees despite the uncertain atmosphere caused by covid-19, what they'll need more than anything else are more people with competence in R&D and sales and marketing. Of the 13 potential areas for recruitment, the majority of the 126 companies interviewed would like to recruit more personnel with scientific expertise and skills in sales and marketing.

8 of 10 life science companies in Skåne report that they have not had to reduce their staff since the beginning of the coronavirus pandemic. A smaller group of companies however reports that they have made or expect to make employees redundant as a result of the pandemic, and a few companies expect to or have already recruited more employees as a result of the pandemic.

Danish presence in Skåne

The life science environments in Denmark and Skåne are connected in a variety of ways: a number of businesses are active with facilities of their own on both sides of the strait, and there are also around 100 Danes working at life science enterprises in Skåne. 20 companies in Skåne have a Danish CEO. The exchange manifests in other ways as well, such as public equity offers, capital funds, research collaborations and incubator programmes.

Upcoming reports from the project will describe the Øresund links in the life science sector further, and a survey of the Danish life science companies in Medicon Valley like the survey of companies in Skåne will also be performed.

The survey of companies in the life science sector in Skåne consists of qualitative and quantitative methods; statistics retrieved from SCB combined with our own research and external contacts were the foundation for a manual survey before the companies were contacted and in many cases interviewed.



UPCOMING REPORTS

DANISH COMPANY REVIEW AND ØRESUND FOCUS.

A report with an Øresund focus will be published in the beginning of next year in the framework of the Interreg-project Greater Copenhagen Life Science Analysis Initiative. The report will look at commuting, collaboration and investments in the region's life science cluster. Following the report, the survey of companies will continue with focus on Medicon Valley's Danish businesses.

GREATER COPENHAGEN LIFE SCIENCE ANALYSIS INITIATIVE

Greater Copenhagen Life Science Analysis Initiative is an EU-project that aims to analyse and increase knowledge about the need and demand for competencies and skills (conducted by ØresundsInstitutet) as well as support the development of the integrated labour market in the Danish-Swedish life science cluster (conducted by Medicon Valley Alliance). The project has received funding from the EU-programme Interreg Øresund-Kattegat-Skagerrak.

LARGER MEETINGS AND CONFERENCES

Below are some of the larger meetings and conferences being arranged in the Greater Copenhagen Region in the coming year, as well as a selection of international meeting places where representatives from organizations and companies from the region's life science cluster will be participating. Due to the corona pandemic, most of the events scheduled for the near future have been relocated to digital platforms and will be held virtually.

- 2-6 November 2020, virtual
Int. Forum on Quality & Safety in Healthcare
- 4-6 November 2020, virtual
European Microbiome Congress
- 9-10 November 2020, virtual
European Statistical Forum
- 10 November 2020, virtual
Bioscience 2020
- 16-19 November 2020, virtual
Medica
- 18 November 2020, virtual
NOME Annual Meeting
- 18-19 November 2020, virtual
Drug Development Boot Camp 2020
- 22-23 November 2020, virtual
The Nordic-American Life Science Conference
- 26-29 November 2020, virtual
BIO-Europe
- 3 December 2020, virtual
Healthtech Nordic Investor Forum 2020
- 7-8 December 2020, virtual or in Lille
BioFIT 2020
- 10 December 2020, virtual
Genesis 2020
- January 2021, Copenhagen
Medicon Valley Alliance New Year's Reception
- 10 February 2021, virtual
Swiss Nordic Bio 2021
- 22-24 March 2021, Barcelona
BIO-Europe Spring
- 29-31 March 2021, Amsterdam
SynBio Markets
- 15-16 April 2021, Rotterdam
Innovation for Health
- 20-23 April 2021, Malmö
Nordic Life Science Days
- 25 -26 May 2021, London
Anglonordic Life Science Conference
- 21-24 June 2021, Dubai
Arab Health
- 9-13 July 2021, Milan
EAU21
- 2 September 2021, Lund
The Future of Swedish and Danish Life Science
- 26-29 September 2021, Copenhagen
EuroTox 2021
- November 2021, Copenhagen
Medicon Valley Alliance Annual Meeting

DIGITAL MEETINGS GROW WITH NEW NETWORK SOLUTIONS

For Copenhagen Capacity and Invest in Skåne, the corona pandemic has entailed – among other things – that travelling to international conferences and trade shows around the world to market the region is impossible. Instead, the efforts have moved to digital platforms. Anette Steenberg, director of investment promotion at Copenhagen Capacity, finds that the opportunities for digital networking have already improved since this spring, and as she sees it, the new digital solutions have future potential as well.

– Digital conferences are getting better all the time, there are essential differences since before the summer. In the beginning a lot of people thought learning was possible, but networking and getting into discussions was more difficult. But since everyone is in the same boat, it's the only option. I'm actually quite positive about it; even when we can travel again, I think that some parts of it are here to stay. We've spent a lot of time and money on travelling, of course we'll start travelling again – but less, she says. Read more in an interview on page 54.

APPENDIX: Facts and definitions

REPORTS AND FACTS

The following is a selection of recent reports from the life sciences in Sweden, Denmark and Greater Copenhagen.

This August, life science was selected as one of eight sectors to be covered by an export recovery package that the Danish government and parliament agreed to issue to help boost the industry after covid-19. Each sector was represented by a 'restart team', and in September they each submitted their own account of the situation, complete with suggestions for action. The chairperson of the **Restart team for life science and biotech** was the CEO of Novo Nordisk, Lars Fruergaard Jørgensen. This October, the political agreement to which the work led – **Genstart af dansk eksport** (Restart of Danish Exports) was presented. All in all, it concerns 27 initiatives for just under half a billion DKK. A new life science strategy is also due to be launched in Denmark in 2020.

In July, Denmark's Ministry of Finance published the report **Life science-industriens økonomiske fodaftryk** (The Life Science Industry's Economic Footprint). The report confirms that the life science industry is an area of strength in Denmark. According to the most recent available figures from 2017, the sector comprises a total of 1 518 companies and has an annual turnover of 225 billion DKK. On the authority of the report, the life science industry is nine times the size it was in 1990, measured in terms of its contribution to the country's BNP, and CO2 emissions were halved in the same period.

In the strategy **Erhvervsfremme i Danmark 2020-2023** (Business Promotion in Denmark 2020-2023), the Danish Executive Board for Business Development and Growth indicates life science and healthtech as one of the country's strengths. "Over the past 20 years, life science has established itself as one of Denmark's most competitive industries, with rapid growth and high productivity" asserts the report.

In June, the Danish Association of the Pharmaceutical Industry, Lif, presented **input** to the Danish government with suggestions on how Denmark can become even stronger as a life science nation. Initia-

tives were introduced in eight areas, and a proposal was made for a dialogue forum for life science, innovation and collaboration with representatives from four departments. In August, Lif gave an account of **pharmaceutical exports** for the first half of 2020 and reported a 12.2% increase in the second quartal compared to the same quartal in the previous year.

Also in June, the Confederation of Danish Industry introduced suggestions for **seven initiatives** that can help the life science industry get back on track after covid-19. Among other things were a national strategy for the use of health data and increased capacity to approve medical equipment.

In Sweden, the government assigned Growth Analysis the **task** of developing an analytic method for following the progress of the life science industry this June. The assignment comes after the completion of the life science strategy, which was adopted last December. There is a need for knowledge about the sector's performance in relation to that of comparable countries, they wrote in a press release.

The Swedish coordination programme Hälsa och life science (Health and Life Science), led by the national coordinator for the life sciences Jenni Nordborg, asserts in its **report** from this spring's meetings that more focus is needed on measures to prevent illness and disease to cope with the challenges that welfare is now facing. New ways of working, techniques and treatments are required, and research and innovation are an important part of that, states the report.

Region Skåne published the report **Skånes innovationsstrategi för hållbar tillväxt** (Skåne's Innovation Strategy for Sustainable Growth) via the Research and Innovation Council of Skåne (FIRS). The strategy entails that FIRS will act in e.g. life science and health bland to increase the commercialisation of research, promote internationalisation, and develop research and development environments with a particular focus on test beds and clinical testing opportunities.

The industrial foundation published the report **Funding Report – The Life Science funding landscape in Sweden 2015-2019** in June of this



In July, Denmark's Ministry of Finance published the report *Life science-industriens økonomiske fodaftryk* (The Life Science Industry's Economic Footprint).

year. Swedish life science companies raised a total 35 billion SEK between 2015–2019, according to the report. The majority of the funding – 75% – is from the stock market.

In July, ForskaSverige! published its **Lägesrapport år 2020, Forskning i Sverige – investeringar och kvalitet, fokus life science** (Status Report 2020 – Investments and Quality, Focus Life Science). According to the report, pharma companies invested 11.4 billion SEK in research and development in Sweden in 2017 – an increase from 10.7 billion in 2015 and 8.9 billion in 2009. The number of annual work hours dedicated to internal research and development in pharma companies in Sweden decreased 62% over ten years, however.

The trade association SwedenBio released the report **The Swedish Drug Discovery and Development Pipeline 2020**, which shows 420 currently active

projects, from discovery to Phase III. The overview demonstrates that 148 Swedish R&D pharma and biotech companies are actively developing new drugs. 53% of the companies have projects in clinical phase I-III.

In September, the Scandinavian ministers of enterprise approved **eight initiatives** for 2021–2024 that are intended to boost the economy after covid-19 and to make transnational collaboration easier. The package is worth 250 million DKK. In the life science field, there was emphasis on the necessity of enabling secure sharing of and access to health data across Scandinavian borders.

The consultancy firm Deloitte published the report **2020 Global Life Science Outlook** on the topic of creating new value and building blocks for the future. The compilation shows that there are nearly 180 startups involved in applying AI to drug discovery. "AI startups are specifically working on repurposing existing drugs or generating novel drug candidates using AI, machine learning, and automation", the report says.

The European Federation of Pharmaceutical Industries and Associations, EFPIA, published **The Pharmaceutical Industry in Figures – Key Data 2020**. The report asserts that the Brazilian, Chinese and Indian markets grew by 11.22%, 6.9% and 11.1% during the period 2014-2019. This can be compared to an average market growth of 5.4% for the top 5 European Union markets and 6.1% for the US Market.

NEW REPORT ON SKÅNE'S LIFE SCIENCE COMPANIES

Øresundsinstittet performed a survey of Skåne's life science companies within in the framework of the Interreg-project Greater Copenhagen Life Science Analysis Initiative, which is being carried out jointly by Øresundsinstittet and Medicon Valley Alliance. There is more information on the report's main results on pages 58-59; among other things, it reveals that there are 420 identified life science companies in Skåne. The largest subsector is medtech. Over the past five years, 91 new startup companies have been established; of these, 70% are located in Lund.

This report, "State of Medicon Valley 2020", is an annual report, published for the first time in November 2016. The report has been prepared by the Danish-Swedish knowledge centre Øresundsinstittet and commissioned by the network organisation Medicon Valley Alliance.

ORGANISATIONS

TRADE AND NETWORKING ORGANISATIONS:

- **ASCRO** – Swedish association focused on clinical research and clinical trials
- **BioPeople** – a publicly-funded catalyst for collaboration between companies and public research
- **Cluster Excellence Denmark** – a support function for clusters and innovative networks in Denmark co-funded by the Danish Agency for Institutions and Educational Grants and the regions
- **CHC**, Copenhagen Healthtech Cluster – Danish organisation that aims to create growth opportunities within healthcare
- **CHI**, Copenhagen Health Innovation – Danish organisation focused on developing new educational and development activities within healthcare
- **Danish Life Science Cluster** – one of 14 new cluster organisations in Denmark that was highlighted by the Ministry of Science Innovation and Higher Education and received funding from the Danish Executive Board for Business and Growth in October.
- **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
- **Life Science Law DK** – an independent society that aims to improve legal conditions for the Danish life science industry
- **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

- **Pharma Danmark** – trade union for academics employed in the Danish life science industry
- **Swecare** – Swedish member organisation that works for broad collaboration with the health and healthcare 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
- **Synapse Life Science Connect** – a student-driven, non-profit organisation that strives to link the academic bioscience community and the life science industries
- 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
- **Erhvervsfremmebestyrelse** (The Danish Executive Board for Business Development and Growth) – a part of the Danish Business Authority that promotes and funds decentralized business approaches
- **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



The Swedish government's life science coordinator, Jenni Norberg.

FOTO: NEWS ØRESUND



Hackathon at Novozymes innovation campus in Kgs. Lyngby, arranged by HelloScience and Synapse in November 2019.

FOTO: NEWS ØRESUND

- **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
- **Lægemedelstyrelsen /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
- **The Government Offices of Sweden's coordinating Office for Life Science** – was established in 2018 and is working among other things with a new life science strategy.
- **The Life Science Office at Denmark's Ministry of Industry, Business and Financial Affairs** – the government office responsible for the implementation of the Danish national strategy for life science.
- **Tillväxtverket/ Swedish Agency for Economic and Regional Growth** – Swedish authority to promote companies' competitive strength
- **Tillväxtanalys/Growth Analysis** – Swedish authority with tasks such as analysing and evaluating Swedish growth policies
- **Trial Nation** – Danish organisation that offers a single, national entry point for actors wishing to conduct clinical trials in Denmark.
- **Vetenskapsrådet/Swedish Research Council** – Swedish authority that works to promote Swedish research

- **Vinnova** – Swedish authority that works to improve opportunities for innovation and research
- **Wonderful Copenhagen** – Danish organization working to attract e.g. life science conferences to the Medicon Valley region

MEDIA:

- **Altinget** – News site with a website and newsletter on research, health and more.
- **Dagens medicin** – Swedish journal about the healthcare sector
- **Dagens medicin, Dagens Pharma, Kommunal Sundhed and Praktisk medicin** – Danish journals about the healthcare sector
- **European Biotechnology News** – European journal about life science
- **Greater Copenhagen Life Science Magazine** – Scandinavian life science magazine published by the Danish marketing and advertising agency Nem Media
- **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



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SCIENCE PARKS IN MEDICON VILLAGE THAT COMPLETELY OR SIGNIFICANTLY FOCUS ON THE LIFE SCIENCES:

- **DTU Science Park** – focus on deep tech. Located in Hørsholm and Lyngby. Formerly known as Scion DTU. Incubator: **Futurebox**.
- **Cobis** – focus on life science. Located in Copenhagen. Owned by DTU Science Park and Symbion. Incubator: **BiInnovation Institute**.
- **Symbion** – focus on life science, foodtech, edtech, hardware/makerspace and SaaS. Located in Copenhagen.
- **Ideon** – focus on future transportations, smart cities, smart materials and health tech. Located in Lund. Incubator: **Ideon Open/Beyond**.
- **Krinova** – focus on food, the environment and health. Located in Kristianstad. Incubator:
- **Medeon** – focus on life science. Located in Malmö. Incubator: **Medeons inkubator**.
- **Medicon Village** – focus on life science. Located in Lund. Incubator: **SmiLe**.

LEARNING AND RESEARCH INSTITUTIONS IN MEDICON VALLEY WITH ACTIVITY IN THE LIFE SCIENCES:

- **University of Copenhagen** – A large university with departments for health and medical sciences, science, humanities, law, social sciences and theology.
- **Technical University of Denmark (DTU)** – A technical university in Kongens Lyngby, just north of Copenhagen.
- **Roskilde University** – A university in the middle of Zealand with emphasis on transdisciplinarity.
- **Aalborg University in Copenhagen** – A campus of Aalborg University in Jutland with a broad range of departments.
- **The National Institute of Public Health (NIPH), University of Southern Denmark** – A research institution that is part of the University of Southern Denmark, but also serves the Danish authorities, supporting them with research and counsel on public health.

- **CBS** – A university in Copenhagen with focus on economics, as well as educational training in Business Administration and Bioentrepreneurship.
- **Copenhagen School of Design and Technology** – An institute of higher education in Copenhagen with some research in optometry.
- **Capital Region of Denmark** – The region encompasses a large number of hospitals, predominantly in Copenhagen and northern Zealand. The largest of them is Rigshospitalet.
- **Region Zealand** – The region encompasses a number of hospitals, primarily in Zealand and Lolland. The most important of them is Zealand University Hospital in Roskilde and Køge.
- **The State Serum Institute, Copenhagen** – A research institution of the Danish Ministry of Health. Its focus is on diagnostics, epidemiological monitoring and vaccination research.
- **Steno Diabetes Center Copenhagen** – a hospital specialised in diabetes that offers some education and is part of the Capital Region today.
- **The Danish Cancer Society, Copenhagen** – A patient organisation to fight cancer. With a research centre in Copenhagen.
- **Lund University** – A large university with departments for medicine, science, technology, the humanities, law, economics, theology, art, music and theatre.
- **Malmö University** – A university with a transdisciplinary focus.
- **The Swedish University of Agricultural Sciences in Alnarp** – One of the largest campuses of the Swedish University of Agricultural Sciences, which has campuses throughout Sweden. Its main areas are landscape architecture, horticulture and plant production.
- **Kristianstad University** – A college in north-eastern Skåne with a strong focus on education.
- **Region Skåne** – The region encompasses a number of hospitals in Skåne, the largest of which is Skåne University Hospital in Lund and Malmö.

STATISTICS AND METHOD

Describing the life science sector with statistics is a challenge. The sector is far from homogenous, and it shifts over time. There are only five sub-areas designated 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 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 sufficiently 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 and universities themselves.

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 to define the life science sector and export of life science products:

SNI and DB07-sector codes are exclusive to 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 whose primary purpose is research in natural sciences and not life science production companies.

Some of these are life science companies; however, since the sectors also contain research within other areas than life science, the sectors are not included in the figures for employment in the life sciences, but are instead presented separately.

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

- 54 – Medical and pharmaceutical products
- 872 – Medical Instruments and appliances and similar

ABOUT THE FIGURES

TAXATION, PAGES 8-19

Defining the Danish life science sector to calculate taxes
In the statistics for the number of employees in the life science sector, the sector is defined according to the

sector of the workplaces. This definition cannot be used in the calculation of the sector's tax contributions, since corporation tax is paid on the company/concern level, and the main sector of a workplace does not necessarily correspond to the company's main sector. The following method has thus been used:

1. For each year, the number of full-time employees who work at a workplace whose main sector is life science is tallied.
2. Information is retrieved for the companies/concerns to which these workplaces belong. The number of employees who work in life science branches at these workplaces is tallied, as well as the number of employees on the company/concern level.
3. For a given year, a company/concern in the life science sector is included if:
 - a. The company/concern has employed more than 50% of its employees at workplaces in the life science sector during the year in question; or
 - b. The company/concern meets criterion a) throughout the entire period 2008-2017 for the majority of its active period.

It has been necessary to include criterion b) in order to encompass companies/concerns that pay taxes via a holding company certain years, and in others via the producing company.

The source for the Swedish figures of income and corporation tax is the FRIDA database. FRIDA is a combined individual database and firm register for all Swedish companies. The life science sector has been defined according to the sector of the company's headquarters.

Corporation tax

Corporation tax for Danish life science companies is defined as the corporation tax paid by companies/concerns that fulfil the above criteria. For Sweden corporation tax is the company's final tax, which consists of state tax (bolagsskatt) on the year's result (22% of reported surplus) plus other taxes that may be applicable, e.g. yield tax.

Income tax

Income tax for people employed in the life science sector is defined for people employed in the companies/con-

cerns that fulfil the criteria described in 'Defining the Life Science Sector'. Income tax is determined geographically according to where the income is earned, and not where the employee resides. Thus, border commuters from Sweden are included in the analysis of Danish income tax. Residents of Denmark who work abroad are in turn not included in the analysis of Danish income tax.

Income tax is calculated from the total personal income; i.e. it includes income from salary and self-employment, as well as any transfers of income that are subject to taxation.

In Denmark, income tax is equivalent to the total personal final tax on income, including labour market contributions. The total personal final tax includes state tax, health care tax, municipal tax, preliminary corporation tax, tax on stock dividends and stock profit, and labour market contributions. Final tax is determined after the deductions have been made and various tax additions have been included.

The amount of labour market contributions paid for employees in the life science sector is calculated by inferring that the labour market contributions comprise the same share of the total income tax, including labour market contributions, for the life science sector in its entirety as for the economy as a whole. The income tax, excluding labour market contributions, for employees in the life science sector is divided by the share of the total income tax including labour market contributions, comprised by the labour market contributions for the economy as a whole, to calculate the income tax including labour market contributions for employees in the life science sector.

In Sweden, income tax is equal to the total income tax on gainful employment. The source for this data is the Swedish income register for the period 2008-2017. Income from gainful employment includes income from a position of staff employment including benefits, surplus from business operations, sickness benefits, unemployment benefits and pension income after general deductions. These may be social security duties to another country, alimony or social contributions.

Income and corporation tax comprise only part of the amount contributed to the treasury through taxes and duties; of which value-added tax is the absolute largest in both countries. In Sweden, duties and other taxes include e.g. a municipal property tax, burial tax, duties to religious communities, vehicle tax and a series of excise duties on

e.g. alcohol and tobacco. In Denmark there are a large number of taxes and duties in addition to corporation tax and income tax, for example municipal property tax, which is calculated based on value, registration duties on cars and a number of excise duties on other products such as tobacco, wine, spirits, chocolate and sugar.

EXPORT, PAGES 8–19

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 the information on the global market is IQVIA. The source for the global market export is the UN Comtrade database and figures for the Danish and Swedish life science export are retrieved from Statistics Denmark and Statistics Sweden, respectively.

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.

EMPLOYMENT, PAGES 8–19

The employment figures cover the manufacturing sectors: 21 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 national industry classification (DB07) and (SNI2007), both of which are based on and correspond to the European industry classification NACE. A company can perform business that is within more than one sector classification. In such cases, the company has a main sector and one or more additional sectors. In the register-based Labour Force Statistics, all of a company's employees are registered under the company's primary sector.

Note that it is also possible that branch codes are assigned to companies differently in Denmark and Sweden.

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 draw European and international comparisons. The disadvantage is that the life science industry is not shown in its entirety. Therefore, the



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figures are supplemented by figures for employees at life science companies not covered by the national statistical figures from Statistics Denmark and Statistics Sweden; an example of a company that we have supplemented with employee figures is Novozymes. 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.

PATENTS, PAGES 8–19

For patent applications figures from the European Patent Office (EPO) are used. 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 United States Patent and Trademark Office (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.

UNIVERSITIES, RESEARCH INSTITUTIONS AND REGIONS, PAGES 42–43

Figures for the number of researchers and students have been provided by the universities, regions and research institutions themselves. All figures are headcounts and from 2019 unless otherwise noted.

University of Copenhagen. Number of doctoral students at departments and centres with life science activities.
Lund University. The numbers apply to the total number of researchers at the Faculty of Medicine, and a number of researchers at the Faculty of Science and the following departments at the Faculty of Engineering: Institutionen för immunteknologi, the Department of Biomedical Engineering (figures from 2018) and Chemical Engineering. There are also researchers in the life sciences at

the Department of Computer Science, the Department of Transport & Roads and the Department of Technology and Society at Lund University's Faculty of Engineering. Of the doctoral students, 756 are employed elsewhere and have not been counted in the total number of life science researchers.

Technical University of Denmark (DTU). The information is for the total number of researchers at the following departments: DTU Food, DTU Vet and Centre for Diagnostics, DTU Aqua, DTU Biosustain, DTU Bioinformatics, DTU Bioengineering, DTU Chemical Engineering, DTU Environment and DTU Nutech, and an equivalent selection of students for the academic year 2019/20. Research in the life sciences was also performed at DTU Chemistry, DTU Electrical Engineering, DTU Nanotech, DTU Mechanical Engineering, and DTU Compute.

The Swedish University of Agricultural Sciences in Alnarp. The number of students includes those from Horticultural Science, Landscape Engineering, Agronomics, Plant Biology for Sustainable Production, Agroecology, Lantmästare and Outdoor Environments for Health and Well-being for the academic year 2019/20.

Malmö University. Life science students: full-time equivalents. Includes students of Dentistry, Oral hygiene, Dental technician studies, Welfare work, Social work and related, Nursing – Care, Specialist nursing, Biomedical analysis and related, and independent courses.

Kristianstad University. Number of students for autumn 2019.

Roskilde University. Figures from the turn of the year 2016/17.

Aalborg University in Copenhagen. Figures from 2020. Data on professors includes associate- and assistant professors. All students study Sustainable Biotechnology.

The Capital Region of Denmark. Figures from 2018. The number of researchers indicates people who dedicate at least 10% of their working hours to research – often, but not always – in the life sciences. A number of researchers also have part-time positions at the University of Copenhagen.

SECTOR CLASSIFICATION

The definition of life science often includes:

- BIOTECHNOLOGY COMPANIES
- PHARMACEUTICAL COMPANIES
- MEDICAL TECHNOLOGY COMPANIES

Region Skåne. All professors also have part-time positions at Lund University. Head count for researchers – many conduct research part-time. The number of professors refers to positions funded or partially funded by Region Skåne; there may also be professors with external funding.

Region Zealand. Head count for researchers – many conduct research part-time.

The State Serum Institute. Head count.

INTERNATIONAL RESEARCHERS AND STUDENTS, PAGE 48-49

International students

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 differs 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 reported that the move was 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.

International researchers

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 on 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 Medicon Valley from 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.

THE EFFECT OF SECTOR DRIFT AND SECTOR CHANGE

Statistics for the number of employees in the life science sector are based on figures from the register-based Labour Force Statistics in Denmark (RAS) and in Sweden (RAMS). The employment figures cover the manufacturing sectors: 21 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. Sector drift and sector changes for individual companies can affect

the figures to a greater or lesser degree. The more detailed statistics are for individual sectors and smaller geographic areas, the more visible sector drift and change of sector become. A sector drift is a slow change in a company's product portfolio that eventually leads to it belonging to a different sector than it did originally. A change of sector is the switch to another sector code without changes to the company's product portfolio.

State of Medicon Valley 2017 contains an example (Coloplast) of how sector code can change over time.

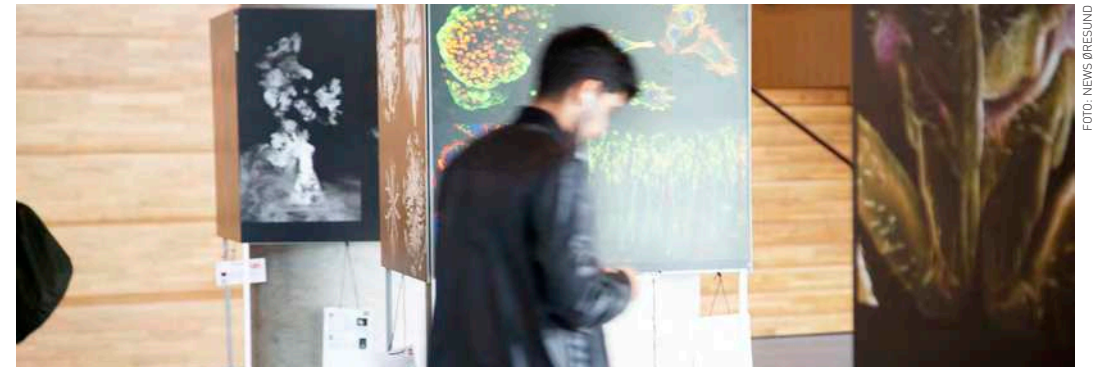


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CLUSTER RANKING:, PAGES 24-49

Selection of life science clusters

Medicon Valley Alliance has chosen to commission an analysis from the Centre for Science and Technology Studies (CWTS) of Leiden University.

For technical reasons, CWTS recommended a comparison of European clusters rather than of clusters around the globe. CWTS uses NUTS-coding to identify European clusters, and would not be able to work with the same precision for clusters around the world. The result is also a more consistent range of clusters with which to compare Medicon Valley. To identify relevant life science clusters in Europe, Øresundsstatistik, which has prepared the report for Medicon Valley Alliance, compiled a number of sources. The selection process was based on the Leiden Ranking from 2012-2015 (which was the most recent available ranking at the time of the selection), which is independent of the consultant report later produced by CWTS. It investigated the locations or geographic areas in which the first 25 universities on the European list of the greatest number of scientific articles in the field "Biomedical and Health Sciences" are situated. While "Biomedical and Health Sciences" does not encompass the area identified as life science in CWTS' analysis completely, it is decisively the category that corresponds most closely. Earlier reports were then consulted with the aim of identifying additional locations or geographic areas with life science clusters. The following reports were consulted:

- "The Leading Life Sciences Clusters in Europe", prepared by SANOFI on behalf of Science Business 2015.
- "Evaluation of Future Opportunities in Medicon Valley", prepared by The Boston Consulting Group on behalf of Medicon Valley Alliance 2012.
- "New Home for the European Medicines Agency", prepared by KPMG on behalf of Novo Nordisk 2017.

Using these reports, we identified cluster areas that were not linked to a university on the top-25 list in Leiden's Ranking of "Biomedical and Health Sciences", or that are transborder, but have strong research in the life sciences on the whole. For each cluster, we conducted online research to en-

sure the existence of a cluster organisation or confirm that the area or location in question is locally recognised as a cluster. As there is no simple definition of a cluster, some clusters have a larger scope than others. A crystal clear definition in this area is almost impossible.

Departing from the above parameters, we compiled the following list of clusters in Europe whose universities published the greatest number of scientific articles in "Biomedical and Health Sciences" from 2012-2015 (currently the most recent available period). Arranged according to the number of articles in the ten per cent most frequently cited articles, the clusters are:

- London-Cambridge-Oxford
- The Netherlands
- Paris / Île de France
- Flanders
- Stockholm-Uppsala
- Scotland
- Medicon Valley
- Zurich
- BioValley (a German-French-Swiss cluster including Basel, Alsace, Freiburg, Karlsruhe, Mulhouse, Strasbourg)
- Munich
- Rome
- Berlin
- Heidelberg
- Barcelona
- Milan

Of these, we have chosen to compare the first ten clusters on the list, which CWTS identified according to the following NUTS code definitions:

- London-Cambridge-Oxford: UKH1, UKH2, UKH3, UKI and UKJ1
- The Netherlands: the entire country
- Paris/Île de France: FR10
- Flanders: BE21, BE22, BE23, BE24, BE25 and BE10
- Stockholm-Uppsala: SE11 and SE12, except Linköping University, Örebro University and Mälardalen University College

- Scotland: the entire country
- Medicon Valley: SE22, DK01 and DK02, except Blekinge Institute of Technology
- Zurich: CH04
- BioValley: CH03, FR42, DE11, DE12, DE13 and DE14
- Munich: DE21 and DE27, except Neu-Ulm University of Applied Sciences and Kempten University of Applied Sciences

All scientific publications in the relevant categories from every region have been included, regardless of whether the research was performed at e.g. a university, a university hospital, or other research institutions or commercial enterprises.

Selection of the bibliometric database

CWTS conducted its analysis in an in-house version of Web of Science:

"Our CWTS Citation Index (CI) system will be used for these analyses. The core of this system is comprised of an enhanced version of Clarivate's citation indexes: Web of Science (WoS) version of the Science Citation Index, SCI (indexed); Social Science Citation Index, SSCI and Arts & Humanities Citation Index, AHCI. We therefore calculate our indicators based on our in-house version of the WoS database. WoS is a bibliographic database that covers the publications of about 12 000 journals in the sciences, the social sciences, and the arts and humanities."

Definition of life science

CWTS has limited its bibliometric analysis to encompass only publications within the category life sciences. They define this category as follows:

Web of Science Categories in 'Medical and Life Sciences'

| | | |
|---|--------------------------------------|---|
| Agricultural engineering | Engineering, biomedical | Ophthalmology |
| Agricultural experiment station reports | Entomology | Ornithology |
| Agriculture, dairy & animal science | Evolutionary biology | Orthopedics |
| Agriculture, multidisciplinary | Fisheries | Otorhinolaryngology |
| Agronomy | Food science & technology | Parasitology |
| Allergy | Gastroenterology & hepatology | Pathology |
| Anatomy & morphology | Genetics & heredity | Pediatrics |
| Andrology | Geriatrics & gerontology | Peripheral vascular disease |
| Anesthesiology | Gerontology | Pharmacology & pharmacy |
| Audiology & speech-language pathology | Health care sciences & services | Physiology |
| Behavioral sciences | Health policy & services | Plant sciences |
| Biochemical research methods | Hematology | Primary health care |
| Biochemistry & molecular biology | Horticulture | Psychiatry |
| Biology | Immunology | Public, environmental & occupational health |
| Biophysics | Infectious diseases | Radiology, nuclear medicine & medical imaging |
| Biotechnology & applied microbiology | Integrative & complementary medicine | Rehabilitation |
| Cardiac & cardiovascular systems | Marine & freshwater biology | Reproductive biology |
| Cell & tissue engineering | Mathematical & computational biology | Respiratory system |
| Cell biology | Medical informatics | Rheumatology |
| Chemistry, medicinal | Medical laboratory technology | Social work |
| Clinical neurology | Medicine, general & internal | Soil science |
| Critical care medicine | Medicine, research & experimental | Sport sciences |
| Dentistry/oral surgery & medicine | Microbiology | Substance abuse |
| Dermatology | Mycology | Surgery |
| Developmental biology | Neuroimaging | Toxicology |
| Emergency medicine | Neurosciences | Transplantation |
| Endocrinology & metabolism | Nursing | Tropical medicine |
| | Nutrition & dietetics | Urology & nephrology |
| | Obstetrics & gynecology | Veterinary sciences |
| | Oncology | Virology |
| | | Zoology |

"... all the publications selected for these regions were limited to those that are designated to the higher level category of 'Medical and Life Sciences'. This category is a derivative of those Web of Science categories that adhere to the moniker that was defined for this higher level field of science. This is to some extent an arbitrary process in which choices are made on the basis of best practice and educated assumption." The complete list of categories is as follows:

For a more detailed description of the methodology, please refer to the report "CWTS Bibliometric Report: Benchmark Life Science Regions Research for Øresund Institute 2006-2016/17" by Erik van Wijk, 2018.

*van Wijk, Erik (2018): "CWTS Bibliometric Report: Benchmark Life Science Regions Research for Øresund Institute 2006-2016/17"

MISCELLANEOUS

We have also collected information from personal interviews, telephone interviews and in e-mail contact with experts and companies. This applies, among others, to the chapter on beacons. Data for the reviews of companies has been retrieved from Bisnode, through contact with the companies and from their websites, as well as from media reports. We have also utilised the public investigations from within life science, as well as other reports from public actors and trade and networking organisations.

ABOUT THE FIGURES - RESEARCH ABOUT THE CORONAVIRUS, PAGES 44-45

Information about the number of research projects on the novel coronavirus are primarily based on information on the number of projects supplied by the

universities, regions, and other research institutions themselves. Multiple actors emphasise however that the figures are approximate, and it is possible that some projects are being conducted at e.g. a university as well as a hospital, and that they have thus been counted twice. To supplement scarce data on the Danish side of the cluster, we also reviewed research projects that had received funding from the Novo Nordisk Foundation, Lundbeck Foundation, Carlsberg Foundation, and the Danish government. (Data from universities on the Swedish side was more thorough, and a corresponding review was thus omitted.) It is however probable that a greater number of research projects than those that we found in this manner are being conducted at the learning institutions that provided scanty information. The figures for the number of research projects here – in spite of some of them possibly being counted twice – are presumably lower than the actual number of projects being conducted.

The higher learning institutions, regions and other research actors in Medicon Valley conducting research projects on the novel coronavirus are the Capital Region of Denmark, Region Zealand, Region Skåne, DTU, the University of Copenhagen, Lund University, Malmö University, Roskilde University, State Serum Institute, National Institute of Public Health (Denmark), which is part of the University of Southern Denmark and the State Serum Institute. Researchers from Aalborg University in Copenhagen were also a contributing partner in an American research project, and the Danish Cancer Society has supported research related to the coronavirus at hospitals all over Denmark.

INTERVIEW LIST

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- **Henrik Bjursten**, cardiac surgeon and associate professor, Lund University, telephone, 30 Sept. 2020
- **Stefan Jovinge**, professor at Van Andel Institute, Michigan State University, adjunct professor at Stanford University, digital meeting, 8 Oct. 2020
- **Olli Kallioniemi**, Director, SciLifeLab, telephone, 14 Sept. 2020
- **Sarah Lidé**, Senior Strategy & Project Manager, Medicon Valley Alliance, digital meeting, 12 Oct. 2020
- **Nikolaj Lubanski**, director of marketing & promotion, Copenhagen Capacity, e-mail 14 Oct. 2020.
- **Nico van Meeteren**, Executive Director, Top Sector Life Sciences & Health (LSH; Health-Holland) in the Netherlands, digital meeting, 14 Sept. 2020
- **Søren Møller**, managing partner, Novo Seeds, digital meeting, 25 Aug. 2020
- **Ulrika Ringdahl**, CEO, Invest in Skåne, digitally, 18 Sept. 2020.
- **Vanita Singh**, Admissions and Recruitment Manager, DTU, e-mail, 14 Oct. 2020
- **Bjørn Sparre Johansson**, Exchange Admissions Officer, DTU, e-mail, 14 Oct. 2020
- **Anette Steenberg**, director of investment promotion, Copenhagen Capacity, digitally, 29 Sept. 2020
- **Sten Verland**, general partner, Sunstone Life Science Ventures, telephone, 20 Aug. 2020
- **Lærke Vester-Andersen**, head of the internationalization division, Faculty of Health and Medical Sciences, University of Copenhagen, telephone, 14 Oct. 2020

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

Behind the report:

MEDICON VALLEY ALLIANCE AND ØRESUNDSINSTITUTTET

ØresundsInstitutet and Medicon Valley Alliance have a long-term analysis collaboration. State of the Region is an annual analysis of the developments in Medicon Valley. Medicon Valley Alliance and ØresundsInstitutet are both member-based, and a selection of the member-actors are represented in the board of directors.

Board of directors:



MEDICON VALLEY ALLIANCE (MVA) is a non-profit membership organization in the Danish-Swedish life science cluster Medicon Valley, which is a part of Greater Copenhagen. Our 300 members represents the region's triple-helix and include universities, hospitals, human life science businesses, regional governments and service providers.



Board of directors:



ØRESUNDSINSTITUTTET is an independent Danish-Swedish centre for analytics and information that brings together more than 100 actors from the industry, the public sector and academic institutions with the aim of strengthening knowledge about societal developments on both sides of the Øresund Strait. As a member of ØresundsInstitutet, you become part of our strong Danish-Swedish network - and gain access to network meetings, facts, analyses and news about developments in the Greater Copenhagen region.



The analysis "State of Medicon Valley" is prepared by ØresundsInstitutet and commissioned by Medicon Valley Alliance.

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www.oresundsinstitutet.org

MEDICON VALLEY ALLIANCE

MVA is a Gold Label-certified, non-profit member organisation in the Danish-Swedish life science cluster Medicon Valley. Its 300 members include universities, hospitals, human life science businesses, regional governments and service providers that 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.
www.mva.org

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.

