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## Life Sciences and Biotechnology Industry Clusters in Europe - Series 2 - - Recent Trends and Partnership Strategies for Growth and Expansion -

Global Corporate Advisory Europe  
(+44-20-7012-4381)

**Yuka Omiya**  
[yuka.omiya@mhcb.co.uk](mailto:yuka.omiya@mhcb.co.uk)

**Tohru Noji, Ph.D.**  
[tohru.noji@mizuho-bk.co.jp](mailto:tohru.noji@mizuho-bk.co.jp)

### <Summary>

In Europe, collaborative and strategic partnerships between public and private sector participants are contributing to the development and growth of the life sciences and biotechnology industry, by ways of providing supportive business and financing measures.

Partnership development and strengthening is particularly important for both scientific and business communities, to address the challenges of resources and expertise required to accelerate and optimize the transfer process of research discoveries into clinical practice, commercial applications, business growth and profitability.

Recent trends in business development, investment and partnership strategies indicate increasing importance of risk sharing/mitigation and appropriate profit sharing agreements, between policy makers, academia, pharmaceutical and biotechnology companies and investors.

Examples of emerging collaborative investment and partnership models include 1) pan-European, multi-party/consortium approaches between public and private sector participants for improved funding and medical research environment, 2) cluster-based strategies for regional development and internalization, 3) pharmaceutical company and venture capital joint activities for identifying and developing early-stage biotechnology opportunities, and 4) increased participation of less traditional funding sources and/or structures (e.g., corporate venture capital and charitable organizations).

With some biotechnology companies achieving visible progress, outcomes focused measures based on long-term commitments toward common goals are set to continue to offer realistic growth prospects and improved access to new investment and business development opportunities in Europe.

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## Introduction

Life sciences and biotechnology industry in Europe continues to face challenges, namely global competition, healthcare reforms and cost containment measures, increasing research and development (R&D) costs and uncertain funding environment since the financial crisis.

Despite these challenges the industry is striving to build a supportive research, development and business environment with increased focus on collaborative partnerships.

Partnership formation is of particular importance for both scientific and business communities to mitigate risks and bridge the gaps in knowledge, expertise and funding required for achieving business growth and profitability.

In Europe, collaborative and strategic partnerships amongst public and private sector participants are contributing to industry growth by ways of providing supportive business and financing measures.

For instance, in July 2013, the European Commission (EC), European Union (EU) member states and industries launched a seven-year joint €22 billion innovation initiative to remain globally competitive.

At the industry level, biotechnology and pharmaceutical companies, venture capital investors are notably more visible in their pursuit in exploring new ways to establish strategic relationships for research and business success.

This report provides insights into current status, future directions and potential business opportunities by examining observed trends in collaborative approaches to business development and partnerships in healthcare/red biotechnology, one of the major biotechnology sectors in Europe.

## Chapter 1. Public-Private Collaborations

### 1.1. Pan-European Approach to Biotechnology R&D Funding

*Multi-party and consortium approaches are becoming increasingly important for improving industry competitiveness*

Pan-European research and development initiatives launched based on multi-party/consortium partnership approach amongst public and private sector participants are becoming increasingly important for improving industry competitiveness, by ways of providing supportive measures for integrating resources and knowledge required for the transfer process of research and development into clinical practice and commercial applications.

Partnership development and strengthening is particularly important for the life sciences and biotechnology industry which is research and capital intensive as well as largely composed of small and medium-sized enterprises (SMEs) often dependent on specialized knowledge and funding throughout research and product development and business growth.

*EC, EU member states and industries are working together based on long-term commitments*

In July 2013, the EC, EU member states and industries jointly launched a €22 billion innovation investment package combining public and private funding.

The key program launched through this program is the five public and private partnerships called the “Joint Technology Initiatives (JTIs)”.

Areas of focus include 1) innovative medicines, 2) fuel cells and hydrogen, 3) aeronautics and air transport, 4) bio-based industries (e.g., biofuels/bioenergy, feed/food, chemicals and materials and others), and 5) electronics (table 1).<sup>1</sup>

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<sup>1</sup> European Commission, press release, July 2013.  
[http://europa.eu/rapid/press-release\\_IP-13-668\\_en.htm](http://europa.eu/rapid/press-release_IP-13-668_en.htm) (January 2014).

**【Table 1】 Europe’s funding initiatives for life sciences/biotechnology**

(EUR M)

	EC	Industry and/or EU Member States	Total
<b>Joint Technology Initiatives (EC, EU Member States and Industries)</b>			
<b>Innovative Medicines Initiative 2</b>	€1,725	€1,725	€3,450
<b>Fuel Cells and Hydrogen 2</b>	€700	€700	€1,400
<b>Clean Sky 2</b>	€1,800	€2,250	€4,050
<b>Bio-based Industries</b>	€1,000	€2,800	€3,800
<b>Electronic Components and Systems</b>	€2,415	€2,400	€4,815
<b>Total</b>	<b>€7,640</b>	<b>€9,875</b>	<b>€17,515</b>
<b>Joint Programmes (EC with EU Member States)</b>			
<b>European and Developing Countries Clinical Trials Partnership 2</b>	€683	€683	€1,366
<b>European Metrology Research Programme</b>	€300	€300	€600
<b>Eurostars 2 (for SMEs)</b>	€287	€861	€1,148
<b>Active and Assisted Living Research and Development Programme</b>	€175	€175	€350
<b>Total</b>	<b>€1,445</b>	<b>€2,019</b>	<b>€3,464</b>
<b>Joint Undertaking (EC with Eurocontrol and other members)</b>			
<b>European Air Traffic Management System</b>	€600	€1,000	€1,600

(Source) Mizuho Bank analysis on EU and other public information

Innovative Medicines Initiative 2 (IMI 2), one of the largest public and private sector joint funding in Europe for healthcare R&D, supports research consortia involving participants from various sectors (fig. 1).

IMI 2 is expected to create opportunities for biotechnology in areas such as immunological, respiratory, neurological and neurodegenerative diseases.<sup>2</sup>

The 40 on-going IMI collaborative research projects/programs have helped some players/participants gain achievements.

<sup>2</sup> Innovative Medicines Initiative (IMI), 2013.

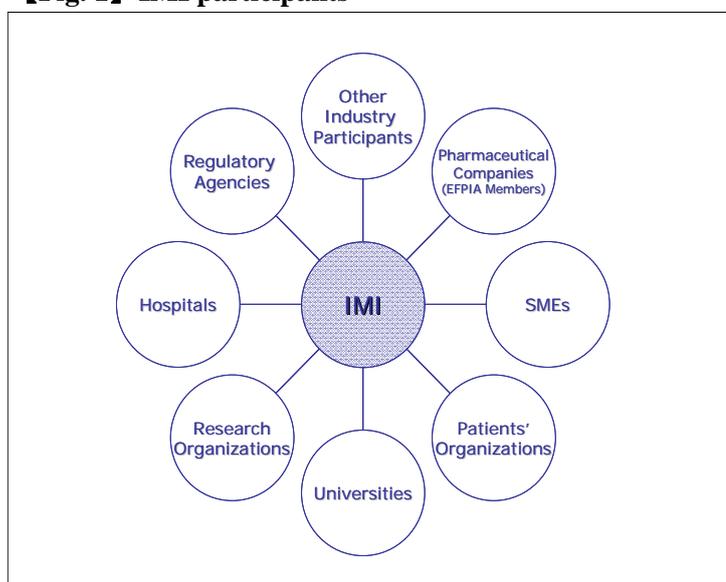
The current Innovative Medicines Initiative was established in 2007/2008 between the EU and the European Federation of Pharmaceutical Industries and Associations (EFPIA) with a €2 billion budget.

One example is the French biotechnology company Endocells, together with academia, developed the first human pancreatic  $\beta$ -cell line that can survive in vitro and is expected to represent a key role in diabetes research.<sup>3</sup>

Another IMI project for biopharmaceuticals, Collaboration on the Optimisation of Macromolecular Pharmaceutical Access to Cellular Targets (COMPACT), is also expected to provide business opportunities for biotechnology companies.<sup>4</sup>

The €30 million project aims to focus on the development of novel innovative medicines based on biological macromolecules, such as proteins/peptides and nucleic acids (e.g., ribonucleic acid: RNA).

**【Fig. 1】 IMI participants**



(Source) Mizuho Bank analysis on IMI and other public information

In addition to healthcare/red biotechnology areas, growth prospects in industrial/white biotechnology and bio-based industries are improving in Europe with increased focus and activities in research programs for sustainably transforming renewable resources into bio-based products or biofuels (table 1).

3 IMI, 2013.  
<http://www.imi.europa.eu/content/imidia> (January 2014).

The  $\beta$ -cell line not only survives in the laboratory, but behaves in much the same way as  $\beta$ -cells in the body. Until now, researchers have had to rely on rodent  $\beta$ -cell lines for studies in the laboratory.

4 COMPACT, <http://www.compact-research.org/> (January 2014).

## 1.2. Government and Industry Joint Initiatives

*The UK government has been active in exploring ways to attract private sector funding*

EU member state government actively exploring translational research partnership models with focus on attracting private sector funding is exemplified by the United Kingdom (UK).

The UK government and charitable foundation Wellcome Trust established a £200 million fund Syncona in June 2012, to invest in businesses and technologies in the healthcare and life sciences sectors.<sup>5</sup>

Another example is the “Biomedical Catalyst”, a £180 million translational funding program co-funded by the Technology Strategy Board (TSB) and Medical Research Council (MRC) in the UK.

Unique point of this program is that it is designed to leverage private financing alongside public funding in the first round.

Since its start, Biomedical Catalyst has leveraged additional £20 million private funding.<sup>6</sup>

The program is open to both academia and business and aims to support commercial activities in pharmaceuticals, medical devices, diagnostics, electronic- and mobile-health, offering grants to various stages of development ranging from seeds, early to late stages.

Additionally, the UK announced the Spending Review 2015-16 in June 2013, to provide additional resource funding of £185 million for the TSB to support innovation, including “Catapult Program”<sup>7</sup> and the Biomedical Catalyst.<sup>8</sup>

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5 Wellcome Trust (UK), media release, 3 January 2013.  
<http://www.wellcome.ac.uk/News/Media-office/Press-releases/2013/WTP041359.htm> (January 2014).

6 The UK Bioindustry Association, 2012.

7 Network of technology and innovation centers where UK's businesses, scientists and engineers work side by side on R&D in areas of high value manufacturing, cell therapies, offshore renewable energy, satellite applications, connected digital economy, future cities and transport systems.  
<https://www.catapult.org.uk/home> (January 2014).

8 The Bioindustry Association (UK), press release, 26 June 2013.  
<http://www.bioindustry.org/newsandresources/bia-news/bia-applauds-continued-funding-of-biomedical-catalyst/> (January 2014).

## Chapter 2. Cluster-Based Strategies

*Biotechnology clusters and cluster organizations play a crucial role in contributing to industry growth and development*

Biotechnology clusters and cluster organizations play a crucial role in contributing to industry growth and development in Europe, by ways of providing platforms for academia, industry, policy makers and investors to interact and collaborate.

Key outcomes and benefits are improved potential for 1) innovation, 2) commercialization, 3) creation of spin-offs and start-ups, 4) funding and investment attraction and 5) business development opportunities.

In Europe, biotechnology companies are typically concentrated in biotechnology clusters located in regions and countries in western and northern European with a long tradition of life sciences and biotechnology research and industry activities such as pharmaceuticals, chemicals, agro-production and medical technologies.

Biotechnology cluster strength and focus areas vary representing Europe's diverse capabilities.

Today, more mature healthcare/red biotechnology focused clusters are located in Belgium, Denmark, France, Germany, Sweden, Switzerland and the UK.<sup>9</sup>

Biotechnology clusters in Spain, Italy, the Netherlands and Austria provide sound case studies on how the government or regional/local authorities together with industries, are fostering the development of clusters (table 2, details are discussed later on in this report in the "Cluster Profiles" section).

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<sup>9</sup> Mizuho Industry Focus vol. 122, February 2013.  
[http://www.mizuhobank.com/fin\\_info/industry/pdf/mif\\_122.pdf](http://www.mizuhobank.com/fin_info/industry/pdf/mif_122.pdf) (January 2014).

**【Table 2】 Biotechnology cluster and cluster organization examples**

Cluster	Region	HO	Key Strengths
<b>Biocat</b>	Catalonia	Barcelona, Spain	<ul style="list-style-type: none"> <li>• Prominent pharmaceutical industry</li> <li>• Established biomedical research centers</li> <li>• Region's economic strength</li> </ul>
<b>bioPmed</b>	Piemonte	Ivrea (Turin), Italy	<ul style="list-style-type: none"> <li>• Established regional public and private partnerships</li> <li>• Nation-wide initiatives supported by a broader view of biotechnology applications</li> </ul>
<b>Amsterdam BioMed</b>	Amsterdam & Metropolitan Area	Amsterdam, Netherlands	<ul style="list-style-type: none"> <li>• Active government policies for promoting life sciences</li> <li>• Base for EU-lead translational research infrastructure</li> </ul>
<b>LISA Vienna</b>	Vienna	Vienna, Austria	<ul style="list-style-type: none"> <li>• Business centric support ranging from pre-seed, seed financing to management</li> <li>• Geographical advantage with access to Central and Eastern Europe</li> </ul>

(Source) Mizuho Bank analysis on public information

### Chapter 3. Pharmaceutical-Biotechnology Partnerships

*Biotechnology plays an important role in drug discovery and development*

Biotechnology plays an important role in drug discovery and development.

Recent study from EvaluatePharma estimates the sales from biotechnology products within the world top 100 products is set to increase from 39 in 2012 to 51 in 2018.

In the broader market, sales from biotechnology products are expected to account for 25% of the global pharmaceutical market (prescription & over-the-counter (OTC) drugs) by 2018.<sup>10</sup>

Research and development focused pharmaceutical companies with appetite for pipeline excellence have been actively seeking drug candidates or platform technologies from external sources such as academia and biotechnology companies, 1) to increase and extend development pipelines and 2) to share risks and expenses of drug development and product commercialization.

This works as a mutual benefit as biotechnology companies are largely dependent on both public grants and private fundings from investors and pharmaceutical companies.

Typical partnership models include, intellectual property (IP) sharing, co-development, in/out-licensing, joint-ventures, investments as well as mergers and acquisitions (M&As).

Notable recent trends observed through a number of large pharmaceutical companies are increase in strategies focused on 1) earlier stage opportunities and 2) cluster proximity.

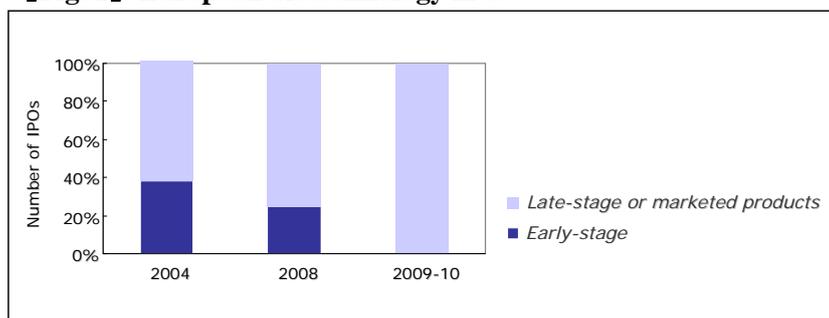
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10 EvaluatePharma 2013 (b).

### 3.1. Earlier Stage Opportunities

The 2007-2009 global financial crisis, as well as biotechnology's high development costs, risks and uncertainty, have had an impact on investors traditionally focused on life sciences and biotechnology companies with earlier stage<sup>11</sup> pipelines, to shift their interests toward later stage<sup>12</sup> companies (fig. 2).

**【Fig. 2】 European biotechnology IPO**



(Source) Mizuho Bank analysis on Ernst & Young (EY) and other public information

*Recent trends observed in strategies suggest some investors are shifting their focus back to earlier stage companies*

However, on the contrary, recent investment trends observed in the United States (US) and Europe suggest some investors are starting to shift their focus back to earlier stage companies.

Pharmaceutical companies are showing interests in earlier stage biotechnology opportunities through strategic alliances and partnerships to increase and extend drug pipelines.

According to Biopharmadealmakers report, bigger dealmakers signed more than 60% at early stages over 2011 and 2012.<sup>13</sup>

<sup>11</sup> Companies with pipelines/projects in discovery and/or Phase I clinical trial, or with platform technologies.

<sup>12</sup> Companies with pipelines/projects in Phase II to Phase III clinical trials, regulatory approval and launch/marketing.

<sup>13</sup> Biopharmadealmakers, 2013.

Notable example of pharmaceutical companies exploring earlier stage opportunities is the developing alliance model and deal structure referred to as “option to acquire”.<sup>14</sup>

Option to acquire deal is a licensing or collaboration agreement that grants the licensee the option to acquire a stake in the licensor company on pre-defined terms providing an incentive for stakeholders committed to a long-term development partnership.

Recent example is the US biotechnology company Celgene’s option to acquire Acetylon Pharmaceuticals (US), developer of small molecule drugs for multiple myeloma and other cancers, with \$100 million upfront payment. In return, Celgene obtained an exclusive option to acquire Acetylon Pharmaceuticals at an estimated pre-defined purchase price of \$500 million. Additionally Acetylon’s shareholders will be eligible to receive potential future milestone payments of \$1.1 billion (\$250 million for regulatory milestones, \$850 million for sales milestones).<sup>15</sup>

Celgene concluded another agreement with VentiRx (US) with \$35 million upfront payment to fund research and development of a cancer immunotherapy pipeline with pre-defined clinical endpoints.

During the option period, VentiRx will be eligible to receive additional funding including a potential equity investment.<sup>16</sup>

Another example of increase in earlier stage opportunities is Roche group company Genentech’s deal with Constellation Pharmaceuticals (US).

The \$95 million funding is comprised of upfront payment and research funding for three year collaboration period.<sup>17</sup>

Growing interests toward earlier stage opportunities are also being demonstrated in Europe amongst pharmaceutical companies and venture capital investors primarily in the UK market (details discussed in Section 1.2 and Chapter 4 of this report).

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14 FiercePharma, Top Biopharma M&A Deals 2012, article, 23 February 2013.  
<http://www.fiercepharma.com/special-reports/top-biopharma-ma-deals-2012> (January 2014).

15 Acetylon Pharmaceuticals, press release, 29 July 2013.  
<http://www.acetylon.com/news/167> (January 2014).

16 VentiRx, press release, 10 March 2013.  
[http://www.ventirx.com/assets/pdfs/FINAL\\_venti\\_celgene\\_release\\_oct\\_3\\_2012.pdf](http://www.ventirx.com/assets/pdfs/FINAL_venti_celgene_release_oct_3_2012.pdf) (January 2014).

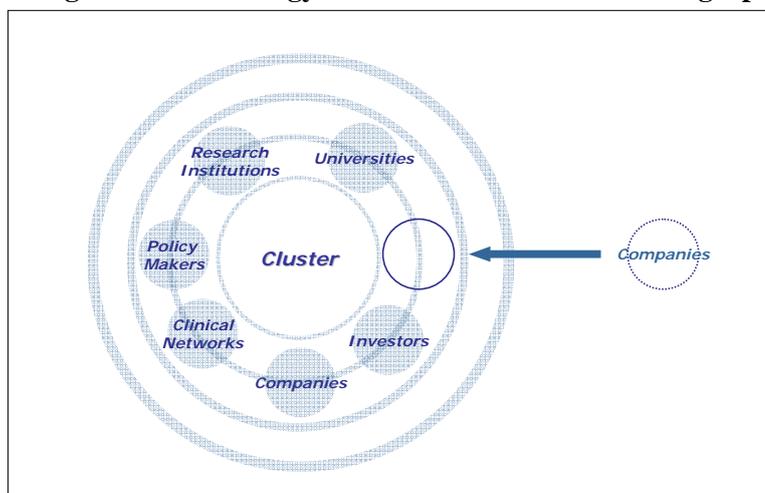
17 Constellation Pharmaceuticals, press release, 17 January 2012.  
<http://www.constellationpharma.com/2012/01/constellation-pharmaceuticals-and-genentech-enter-broad-epigenetics-drug-discovery-collaboration/> (January 2014).

### 3.2. Cluster Proximity

*Increasing focus on earlier stage opportunities is having an impact on companies to consider the importance of “cluster proximity”*

Increasing focus on earlier stage opportunities and potential is having an impact on the pharmaceutical industry to consider the importance of “cluster proximity” (fig 3).

**【Fig. 3】 Biotechnology cluster and interactions amongst participants**



(Source) Mizuho Bank analysis on public information

In 2012, Johnson & Johnson (US) opened Innovation Center in London<sup>18</sup> with a goal to accelerate the best early-stage science and advance the development of new healthcare solutions.

The Innovation Center not only houses science and technology experts but also has the local deal-making capabilities to flexibly adapt deal structures to match early-stage opportunities.

The center is supporting scientists, entrepreneurs and emerging companies deliver innovation through collaboration with business development experts who can drive partnerships across the pharmaceuticals, medical devices & diagnostics, and consumer healthcare companies of Johnson & Johnson.<sup>19</sup>

<sup>18</sup> UK’s leading regions/clusters in terms of number of companies and annual turnover are East and South East of England (London, Cambridge and Oxford, often referred to as the “Golden Triangle”).

<sup>19</sup> Johnson & Johnson, press release, 12 March 2012.

<http://www.investor.jnj.com/releasedetail.cfm?ReleaseID=747730> (January 2014).

In addition to London, similar facilities are established in Boston, San Francisco and Shanghai (planned for mid 2013).

Another pharmaceutical company visible in initiating strategies focused on early-stage opportunities and cluster proximity is AstraZeneca (UK).

In March 2013, AstraZeneca announced the relocation of UK-based global research and development centre and corporate headquarters to the Cambridge Biomedical Campus.

By 2016, the new site will house together AstraZeneca's small molecule and MedImmune's biologics research and development units, to improve innovation and accelerate decision-making.

Another main aim of the relocation is to increase AstraZeneca's proximity to bioscience clusters and bring research, development and commercial people together, allowing researchers to collaborate with external partners and with each other.

Additionally, AstraZeneca plans to 1) increase emphasis on novel biology and personalized healthcare and 2) continue partnering with leading academic institutions to increase understanding of disease biology.<sup>20</sup>

AstraZeneca's interest towards early-stage opportunities is also demonstrated by company's global biologics R&D arm MedImmune's<sup>21</sup> (US) acquisition of an early-stage US biotechnology company AlphaCore Pharma, which is developing a new type of cholesterol medicine a recombinant human lecithin-cholesterol acyltransferase (LCAT) enzyme.<sup>22</sup>

Physical relocation of company's R&D functions and deal-making capabilities to UK's leading bioclusters London and Cambridge signifies clusters' crucial role in contributing to business and industry growth.

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- 20 AstraZeneca, press release, 21 March 2013.  
<http://www.astrazeneca.com/Media/Press-releases/Article/20130321--astrazeneca-outlines-strategy-return-to-growth-scientific-leadership> (January 2014).
- AstraZeneca, press release, 18 June 2013.  
<http://www.astrazeneca.com/Media/Press-releases/Article/20130618--astrazeneca-selects-Cambridge-for-global-research-centre-corporate-headquarters> (January 2014).
- 21 Founded in 1988 as Molecular Vaccines, Inc. and renamed to MedImmune in 1990, acquired by AstraZeneca in 2007.
- 22 AstraZeneca, press release, 3 April 2013.  
<http://www.astrazeneca.com/Media/Press-releases/Article/20130403--medimmune-astrazeneca-biologics-acquires-alphacore-pharma> (January 2014).
- LCAT, an enzyme in the bloodstream, is a key component in the reverse cholesterol transport (RCT) system.

## Chapter 4. Venture Capital Financing

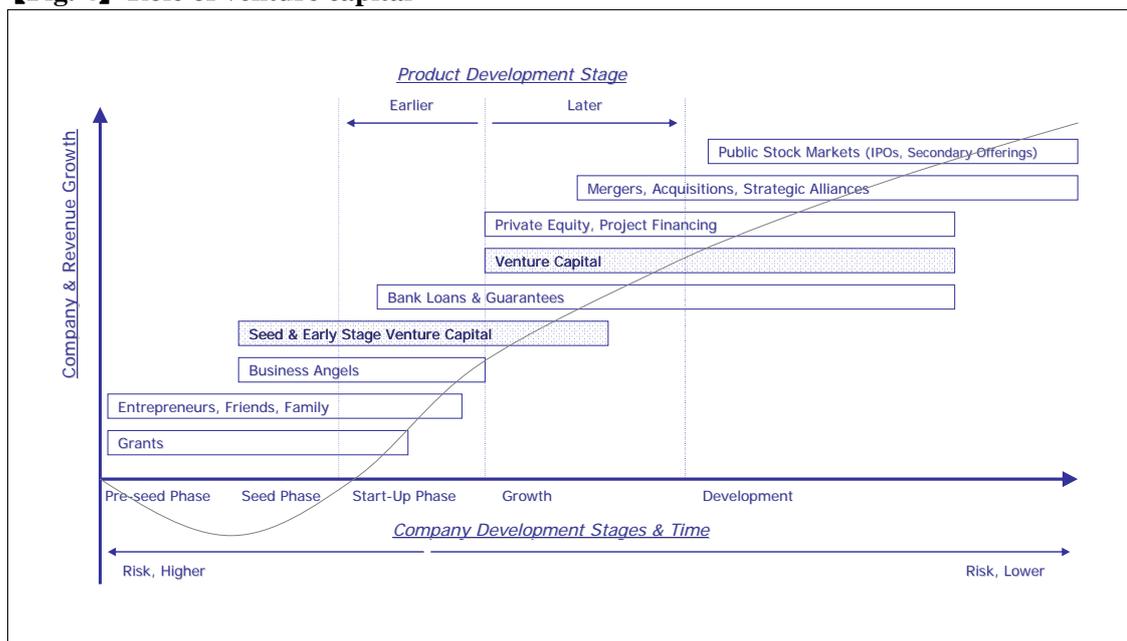
*Biotechnology industry is capital and research intensive, and venture capital plays a key role*

Biotechnology industry is capital and research intensive and is largely dependent on public and private funding throughout business growth, to finance business requirements such as 1) research and development, 2) commercialization and 3) other expenditures.

One of traditional sources of funding for biotechnology companies is venture capital.

Venture capital financing/investment plays an important role throughout early to late stage company growth in the biotechnology industry (fig. 4).

**[Fig. 4] Role of venture capital**



(Source) Mizuho Bank analysis on EU and other public information

#### 4.1. Biotechnology Funding and Investment Environment

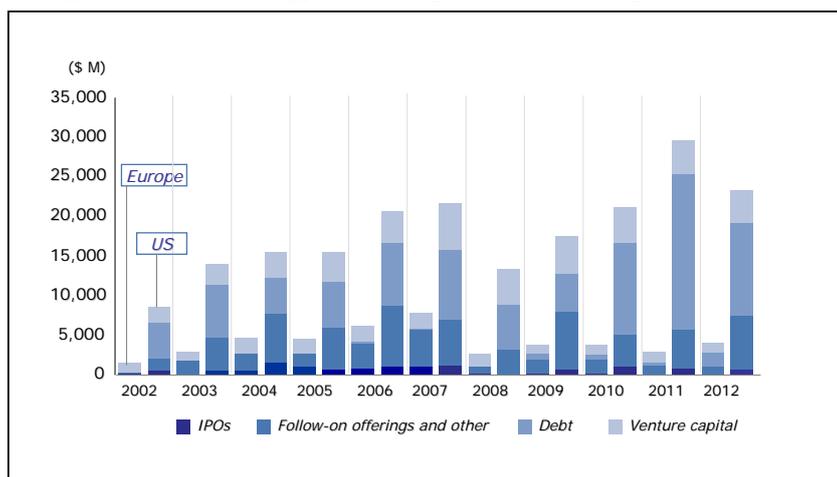
*Biotechnology funding and investment environment remains relatively closed and cautious*

In contrast to the US, Europe’s biotechnology funding and investment environment remains relatively closed and cautious.

Capital raised rose by 44% to \$4.2 billion in 2012, the highest total since before the global financial crisis.

However, the large year-to-year swing was mainly driven by debt financing, which increased by 392%, while every other category was down (fig. 5).

**[Fig. 5] Biotechnology financing trends in Europe and US**



(Source) Mizuho Bank analysis on EY and other public information

The main reasons for the above, other than the impact of the global financial and economic crisis, are reported to be that IPOs and follow-on offerings are more difficult to organise and the amounts raised are usually lower in Europe in comparison to the US.

Other potential factors reported are 1) less developed European venture capital market and 2) fragmented stock markets at the national level.<sup>23</sup>

23 EC Directorate-General Enterprise and Industry, Access to Finance. <http://ec.europa.eu/enterprise/sectors/biotechnology/competitiveness/access-to-finance/> (January 2014).

Mergers and acquisitions activities, considered more traditional and common exit route in Europe, both in terms of volume and value of transactions were also down with 28% value decline to \$2.9 billion and deal numbers 13, the lowest level since 2005.<sup>24</sup>

*New collaborative investment and partnership models are developing*

Whilst the current vulnerable economic environment and uncertainty remain a challenge for biotechnology companies in Europe, new collaborative investment and partnership models between biotechnology companies, pharmaceutical companies and venture capital investors are attracting industry attention.

Two noticeable investment trends observed in Europe are increased 1) participation of less traditional funding sources such as corporate venture capital investors and 2) exploration of consortium approach to early-stage funding.

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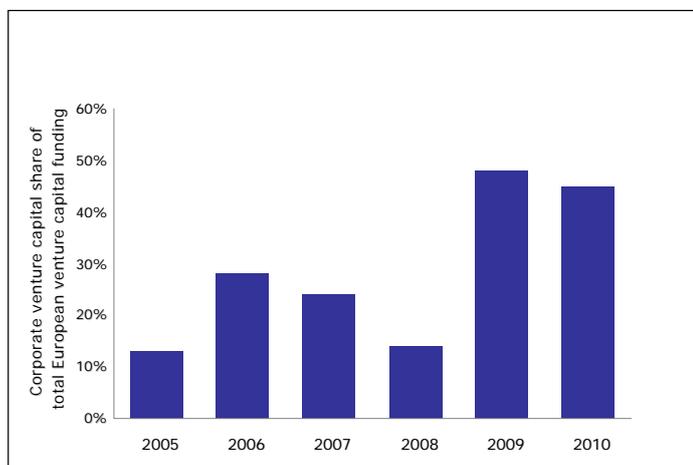
24 EY, 2013.

## 4.2. Corporate Venture Capital Investors

*Corporate venture capital presence and investments are increasing*

Recent trends in the funding and investment environment suggest increased participation of less traditional sources such as corporate venture capital investors, venture capital arms of multinational pharmaceutical and large biotechnology companies (fig. 6).

**[Fig. 6]** Increasing presence of corporate venture capital in Europe



(Source) Mizuho Bank analysis on EY and other public information

More recent study suggests that corporate venture capital investors are increasingly more active in early-stage investments, accounting for 25% of financings at the pre-clinical and series A level.<sup>25</sup>

25 EDG Group, A view from the West: Trends in biotech venture exits, partneringNEWS, 18 March 2013. <http://ebdgroup.com/partneringnews/2013/03/a-view-from-the-west-trends-in-biotech-venture-exits/> (January 2014).  
Biotechnology Industry Organization (US), Venture capital trends, BIOtechNOW, 28 April 2013. <http://www.biotech-now.org/business-and-investments/2013/04/venture-capital-trends#> (January 2014).  
Series A financing is the first round of financing undergone for a new business venture after seed capital. Generally, this is the first time that company ownership is offered to external investors.

### 4.3. Venture Capital-Pharmaceutical Partnerships

*Venture capital investors and pharmaceutical companies are exploring new alliance models*

The trend in exploration of early-stage funding partnership models can also be observed in the new alliance models between venture capital investors and pharmaceutical companies.

For example, a new partnership model intended to stimulate promising early-stage R&D innovation was launched in March 2012 between Index Ventures (UK) and pharmaceutical companies Johnson & Johnson (US) and GlaxoSmithKline (UK).

Index Ventures launched first of its fund solely dedicated to making investments in the life sciences sector.

The €150 million fund includes investments from GlaxoSmithKline and the venture capital affiliate of Janssen Pharmaceuticals (Belgium, subsidiary of Johnson & Johnson).

With this investment in the fund, the two pharmaceutical companies will share their expertise by participating in the scientific advisory board of the fund whilst Index Ventures will maintain full decision making rights to the portfolio companies.<sup>26</sup>

An example of a biotechnology company benefiting from the new scheme is a new spin-out company XO1 Ltd, from the University of Cambridge and Addenbrooke's Hospital in the UK.

XO1 has raised \$11 million to develop ichorcumab, a synthetic antibody to target thrombin, an enzyme responsible for blood clotting.<sup>27</sup>

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<sup>26</sup> Index Ventures, press release, 21 March 2013.

[http://www.indexventures.com/news/index/news\\_id/321](http://www.indexventures.com/news/index/news_id/321) (January 2014).

<sup>27</sup> XO1 Ltd, press release 17 June 2013.

<http://www.xo1.co.uk/pressreleases/XO1PressReleaseJune2013FINAL.pdf> (January 2014).

Anticoagulants, such as warfarin and the newer generation of drugs that directly target thrombin and another coagulation factor, are widely used to prevent thrombosis, a major cause of heart attacks and strokes.

However, as blood clotting is essential to prevent excessive bleeding, the use of these drugs is limited by the bleeding side-effects that they cause.

An anticoagulant drug which does not cause bleeding is considered the 'holy grail' in this area of research. Currently in preclinical development and first human clinical trials targeted for start in 2015.

**Conclusion and Outlook**

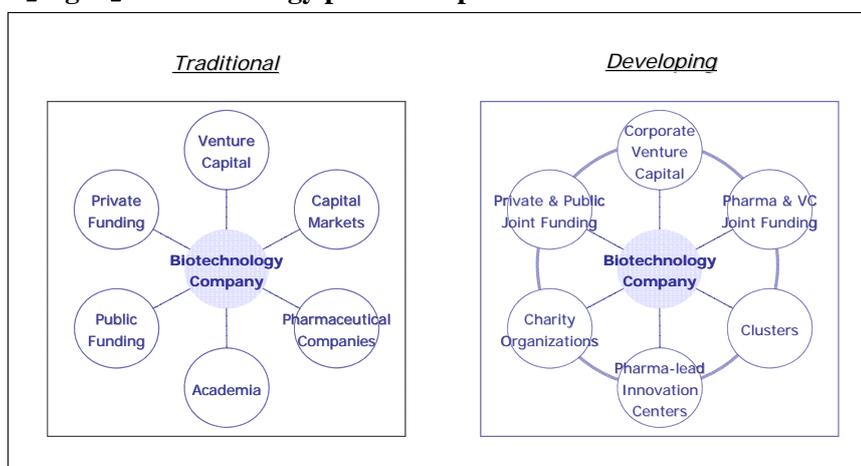
Collaborative partnership approaches at industry, regional, national and pan-European levels are becoming a driving force contributing to the development and growth of the life sciences and biotechnology industry in Europe.

New and exploratory approaches to public and private sector partnerships such as research consortia and joint funding programs demonstrate Europe’s unified approach based on long-term commitment for mutual benefits.

Exploration of new collaborative paths by pharmaceutical companies, venture capital and corporate venture capital investors for continued growth and commercial success are also helping provide unique business opportunities for academia and biotechnology companies.

Examples include 1) public and private joint funding programs and research consortia specifically designed for medical research, 2) cluster-based strategies for regional development and internalization and cluster proximity approaches, 3) pharmaceutical company and venture capital investor lead initiatives to identify and develop early-stage biotechnology opportunities and 4) increase in less traditional funding sources such as charitable organizations and corporate venture capital investors (fig. 7).

**【Fig. 7】 Biotechnology partnership models**



(Source) Mizuho Bank analysis on public information

Europe's long-term commitments based on shared visions and collaborative approaches as demonstrated by several participants through initiatives such as the IMI and development strategies for biotechnology clusters, are expected to continue providing the impetus for growth and business opportunities in life sciences and biotechnology.

### **Contacts**

**Global Corporate Advisory Europe  
Industry Research Division**  
Mizuho Bank, Ltd.  
(+44-20-7012-4381)

**Yuka Omiya**  
[yuka.omiya@mhcb.co.uk](mailto:yuka.omiya@mhcb.co.uk)

**Tohru Noji, Ph.D.**  
[tohru.noji@mizuho-bk.co.jp](mailto:tohru.noji@mizuho-bk.co.jp)

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## Cluster Profiles

### Spain

#### Overview

The Spanish biotechnology industry is relatively young compared to the more mature or long-established countries such as the UK and Germany where the industry started to form in the late 1980s.

Although the National Center for Biotechnology (Centro Nacional de Biotecnología: CNB) was established in 1987 as a strategic research centre with an aim to support research and technology transfer, it took over 10 years for the Spanish Bioindustry Association (la Asociación Española de Bioempresas: ASEBIO) to be established in 1999 and most biotechnology companies were formed after 2000.

Contribution to growth was a range of measures such as the establishment of incubators and science parks.<sup>28</sup>

Today, the highest number of biotechnology companies is concentrated in Catalonia (19%), followed by Madrid Region (15%) and Andalusia (13%) (fig. 8).<sup>29</sup>

In recent years, five bioregions/biotechnology clusters have been created and together established the Spanish BioRegions Network (BioRegiones Españolas); 1) BioBasque (la Bioregión Vasca, Basque Country), 2) Biocat (BioRegió de Catalunya, Barcelona), 3) Bioval (Bioregión de la Comunidad Valenciana, Valencia), 4) Madrid Biocluster (Asociación Madrid Plataforma de Biotecnología) and 5) Andalucía BioRegion (Andalucía BioRegión).

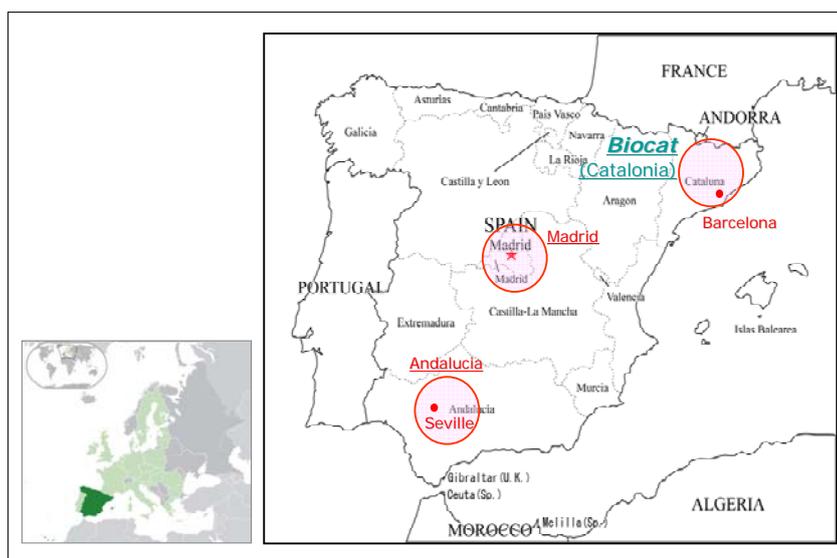
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<sup>28</sup> EY, 2011.

<sup>29</sup> ASEBIO, 2012.

Additionally, more bioregions/biotechnology clusters are currently in the process of being established; 1) Canarias Bioregion, 2) Bioregion of Extremadura, 3) Bioregion of Aragón, 4) Bioregion of Navarra and 5) BIOIB (Cluster biotecnológico de las Islas Baleares, Balearic Islands).

**【Fig. 8】 Biotechnology clusters in Spain**



(Source) Mizuho Bank analysis on Wikimedia Commons and other public information

One of the biotechnology clusters gaining international visibility is Biocat, the cluster management organization for Catalonia region (Catalunya/Cataluña), actively involved in pan-European and internationalization projects.<sup>30</sup>

Catalonia is an economically important region for Spain, representing 20% of Spain’s Gross Domestic Product (GDP), and enjoys an active investment and business environment supported by the presence of more than 3,300 multinational companies.<sup>31</sup>

In the life sciences sector, 60% of Spanish pharmaceutical company headquarters are located in Barcelona, as well as 9 science and technology parks, 12 universities, 400 research centres and 200 hospitals.<sup>32</sup>

30 Examples include European transnational cooperation projects, BIO Crossing Borders of 4 European Clusters (bioXclusters), HealthTIES and Effective Technology Transfer in Biotechnology (ETTBio).

31 Catalonia accounts for 25% of Spanish industry, 30% of Spanish foreign trade and receives approximately 25% of annual foreign investments in Spain.

32 Invest in Catalonia (la Agencia Catalana de Apoyo a la Competitividad : ACCIÓ). <http://www.investincatalonia.com/es/investincatalonia/businessopportunities/sectors/lifesciences.jsp> (January 2014). UK Government, news article, 27 May 2013.

**Biocat**

**Region**

- Catalonia (Catalunya/Cataluña, north east of Spain).

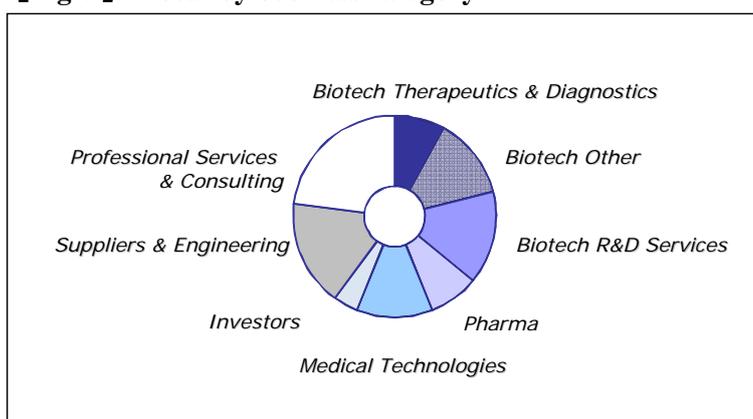
**History**

- Established in 2006, by the Government of Catalonia (Generalitat de Catalunya) and the Barcelona City Council (Ajuntament de Barcelona).

**Structure**

- Total of 520 companies of which 440 research groups and 54 research centers, 10 universities which offer life sciences studies and 15 hospitals.
- Approximately 190 biotechnology companies of which ca 40 dedicated R&D companies (therapeutics and diagnostics) and rest biotechnology services (fig. 9).
- Majority of research institutions are engaged in healthcare with ca 50% in red biotechnology and ca 30% in medical technology.

**【Fig. 9】 Biocat by business category**



(Source) Mizuho Bank analysis on Biocat and other public information

<https://www.gov.uk/government/world-location-news/take-a-look-at-catalonia> (January 2014).

**Key Therapeutic Areas/Target Technologies**

- Pharmaceutical products, followed by medical devices and in-vitro diagnostics.
- R&D focus areas are central nervous system (CNS), oncology, cardiovascular, immunology, dermatology and infectious diseases.

**Strategies, Strengths, Topics and Trends**

- Catalonia carries out over 50% of clinical trials in Spain, of which 25% is in oncology.
- Spain’s leading pharmaceutical companies; Ammirall, Esteve and Ferrer.
- Presence of multinational pharmaceutical companies such as Amgen (US), Bristol-Myers Squibb (US), GlaxoSmithKline (UK), Roche (CH), Novartis (CH), Pfizer (US), Sanofi (FR) and Takeda (JP).
- Recently launched projects include the BioNanoMed Catalonia alliance created in 2011 bringing together R&D centers, hospitals and companies in the field of health-related applied nanotechnology and in biotechnology to identify business opportunities and raise international visibility.
- Another is MOEBIO launched in 2013, a talent development program (8 months training program), providing tools, resources and knowledge to help effectively apply innovation to commercialization.

**Biotechnology Companies**

**【Table 3】 Biocat company examples**

Company	Areas	Est.	References
Archivel Farma	Vaccines Infectious diseases	2005	Specialized in tuberculosis, of which latent tuberculosis infection (LTBI) is of particular focus
Bionure	Nervous system Ophthalmology	2009	Neuroprotective drugs for the treatment of multiple sclerosis, acute optic neuritis and glaucoma
Archivel Farma	Vaccines Infectious diseases	2000	Specializes in injectable products based on microspheres and Liposomes
Gri-Cel	Advanced therapies (cellular, tissue and gene therapy)	2009	Focused on the development of biological blood (plasma)-derived products
Oryzon	Oncology Nervous system	2000	Focused therapeutic programs and discovery of biomarkers for in vitro diagnostics

*Companies active in cluster focus areas, with advanced pipelines, or with recent activity updates.*

(Source) Mizuho Bank analysis on Biocat, company publications and other public information

## Italy

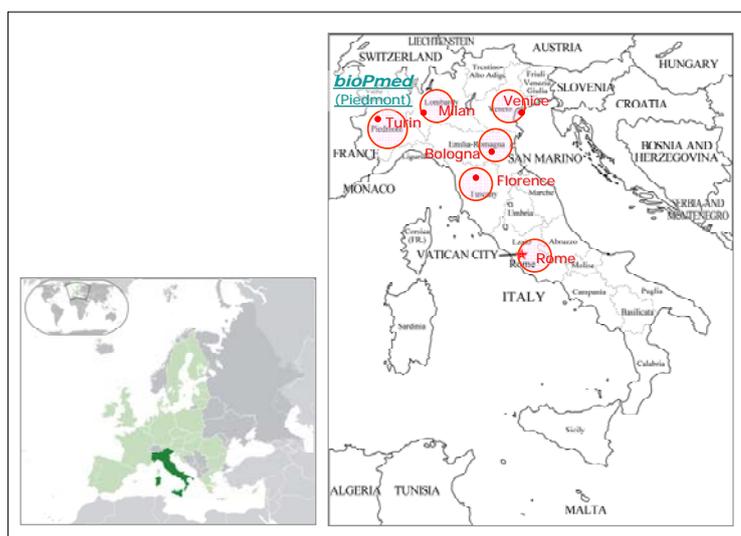
### Overview

Italy ranks third in Europe after Germany and the UK in terms of number of dedicated R&D companies.<sup>33</sup>

In spite of the relatively larger number of ca 400 biotechnology companies of which ca 250 are dedicated R&D companies, the sector is younger compared to UK and Germany, with 75% micro or small-sized entities less than 10 years old with less than 50 employees.<sup>34</sup>

Geographically, companies are concentrated in Lombardy region (Italian name Lombardia, regional capital Milan) historically the highest, followed by Piedmont (Piemonte, Turin), Tuscany (Toscana, Florence) and Lazio/Latium (Lazio, Rome), Emilia-Romagna (Emilia-Romagna, Bologna) and Veneto (Veneto, Venice) (fig. 10).

**【Fig. 10】 Biotechnology clusters in Italy**



(Source) Mizuho Bank analysis on Wikimedia Commons and other public information

<sup>33</sup> EY, 2011.  
Companies whose core business is exclusively related to biotechnology.  
Top 5 European countries are in the order of Germany (403 companies), UK (275), Italy (221), France (177) and Sweden (138).

<sup>34</sup> EY, 2013.

Healthcare/red biotechnology is the main area with 44%, followed by green biotechnology 12% and white/industrial biotechnology 10%.

Italy's biotechnology industry is supported by the Italian Association for the Development of Biotechnology (Associazione nazionale per lo sviluppo della biotecnologie: Assobiotech), established in 1986 and is the oldest biotechnology associations in Europe.

Assobiotech's establishment within the Italian Federation of the Chemical Industry (Federchimica è la Federazione Nazionale dell'Industria Chimica: Federchimica) seems to signify Italy's unique perception and appreciation of biotechnology, as potential area of growth with possibilities 1) to be applied to multiple technology and industry fields as an extension of chemistry and 2) to provide industry and economic growth extending to the national level.<sup>35</sup>

Example of this approach can be seen in Italy's recent government-lead nation-wide initiatives launched to promote the growth of life sciences and biotechnology industries with focus on measures for overcoming hurdles of limited access to financing and life sciences specialized funds (business angels and venture capital investors).<sup>36</sup>

Initiatives include the Growth Act (Decreto Crescita 2.0) launched by the Ministry of Economic Development (Ministero dello Sviluppo Economico: MSE), providing series of facilitating measures for innovative start-up companies such as exceptions from certain corporate law requirements, tax incentives to encourage investors to support R&D activities and easier access to investments.<sup>37</sup>

Italian Ministry of Education, University and Research (Ministero dell'Università e della Ricerca: MIUR) recently announced the development and the strengthening of national technological clusters recognizing the important role of clustering, in the fields of life sciences, agro-food and green chemistry.

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35 Federchimica, 2013.

Italy represents the third main producer of chemicals in Europe with a turnover of about €53 billion (2012).

36 Assobiotech, Italian Biotechnology Parks.

[http://assobiotec.federchimica.it/Libraries/Images\\_CV/Italian\\_Biotechnology\\_Parks.sflb.ashx](http://assobiotec.federchimica.it/Libraries/Images_CV/Italian_Biotechnology_Parks.sflb.ashx) (January 2014).

37 EY, 2013.

Three biotechnology focused national clusters are, the National Life Sciences Cluster (Advanced Life SciencEs in Italy: ALISEI), the National Green Chemistry Cluster and the National Agro-food Cluster (Cluster Agrigood Nazionale: CL.A.N.).

At the regional level, clustering effort can be observed in the history and in the unique public and private sector joint efforts lead by the cluster management organization Bioindustry Park Silvano Fumero S.p.A. near Ivrea (approximagedly 50km north from Torino/Turin) in the Piedmont region of northwest Italy.

Bioindustry Park Silvano Fumero was established as an initiative to help recreate the economic wealth generated and distributed in the region with the business success of Olivetti between 1908-2003.<sup>38</sup>

Originally established with the funding from the European Fund for Regional Development, the government and the Piemonte Regional Authority (Regione Piemonte), today the cluster is active in attracting national/ international venture capital investors and local business angels, as well as in promoting the region as a biotechnology cluster “bioPMed”.

## bioPmed

### Region

- Piedmont (Piemonte, northwest of Italy, region capital is Turin/Torino).

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**38** Olivetti SpA, [http://www.olivetti.com/EN/Page/t04/view\\_html?idp=391](http://www.olivetti.com/EN/Page/t04/view_html?idp=391) (January 2014). Olivetti was established in 1908 a typewriter manufacturer and headquartered in Ivrea (Turin) but was absorbed into Telecom Italia Group in 2003.

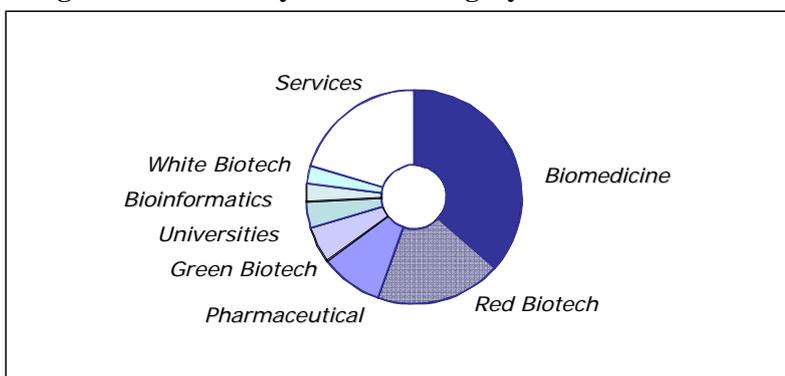
**History**

- Established in 2009.
- Managed by life science park, Bioindustry Park Silvano Fumero founded in 1998 with financial support from the Piemonte Regional Authority and in the framework of European Regional Development Fund.

**Structure**

- There are 3 universities, research centers in the region.
- There are ca 80 core members of which ca 45-50 biotechnology/pharmaceutical companies, with large majority red biotechnology focused (fig. 11).

**【Fig. 11】 bioPMed by business category**



(Source) Mizuho Bank analysis on bioPmed and other public information

**Key Therapeutic Areas/Target Technologies**

- Current focus programs are, stem cells, molecular imaging, immuno-oncology, new medications for the treatment of high impact diseases, regenerative therapy related technologies, materials and devices.

- CellMolDiagIm (CMDI) program for wet technologies such as molecular and cell biology, innovative diagnostic techniques, agents for imaging and others.
- TecInn program for hard technologies including new materials, electronics, information science, precision mechanics, microfluidics, nanotechnology, etc.
- Oncology, cardiovascular diseases, inflammatory and autoimmune diseases, molecular and cellular biology, innovative diagnostic tools and imaging and nanotechnologies.

**Strategies, Strengths, Topics and Trends**

- Active contribution of national and international venture capital investors.
- Seed capital investment support provided by 1) Venture Capital for Innovative Companies in Piedmont (Piemontech) and 2) Eporgen an Italian life science venture capital/private equity company.
- Specialized incubators at research institutions and universities.
- Established science base supported by universities (Università di Torino and del Piemonte Orientale Novara and Alessandria; Politecnico di Torino) and research centres (Centro per la Ricerca sul Cancro in Candiolo, Torino, and Centro di Ricerca di Medicina Sperimentale).

**Biotechnology Companies**

**【Table 4】 bioPmed company examples**

Company	Areas	Est.	References
Bioclarma	Diagnostics	2007	Reagents and equipments for molecular diagnostics
Creabilis Therapeutics	Dermatology	2003	Specialized in dermatological diseases
Genovax	Vaccines	2008	Vaccines for chronic diseases
Nanovector	CNS Oncology	2001	Proprietary platform based on microemulsions and in Solid Lipid Nanoparticles (SLNs)
NatiMab Therapeutics	Infectious diseases	2008	Human monoclonal antibodies for therapy of infectious diseases

(Source) Mizuho Bank analysis on bioPmed, company publications and other public information

## The Netherlands

### Overview

The growth and development of the Dutch life science industry is supported by the Dutch government's increased focus on sectoral approach based on public and private sector partnerships, with an aim to capitalize on Netherland's central geographical position combined with accessibility and established infrastructure as a hub of north-west Europe.<sup>39</sup>

In 2011, recognizing the economic growth potential, the Dutch government identified sectors in the "Towards the top" (Naar de top) policy as key areas of development, knowledge and research, foreign policy, education and training and sustainability (transition to bio-based economy); agri-food, chemicals, creative industry, energy, head offices, high tech, horticulture and propagation materials, life sciences and health, logistics and water.<sup>40</sup> The government plans to allocate €1.5 billion for these priority sectors.<sup>41</sup>

The Netherlands has about 950 companies active in health-related life sciences of which over 400 are active in the biopharmaceutical and 400 in diagnostics.

There are 150 R&D focused companies of which 70 are located in Amsterdam.

The life sciences and biotechnology clusters are concentrated in university regions, namely around Amsterdam, Leiden and Utrecht (fig. 12).

Amsterdam has the highest concentration of life sciences research in the Netherlands and is home to two universities with academic hospitals, a number of research institutes, and a specialised cancer hospital and research center.

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**39** The Port of Rotterdam is Europe's largest seaport.

**40** The Netherlands Foreign Investment Agency (NFIA), media release, 4 February 2011. <http://nfia.co.uk/news/204/Dutch-government-announces-business-support-policy.html> (January 2014).

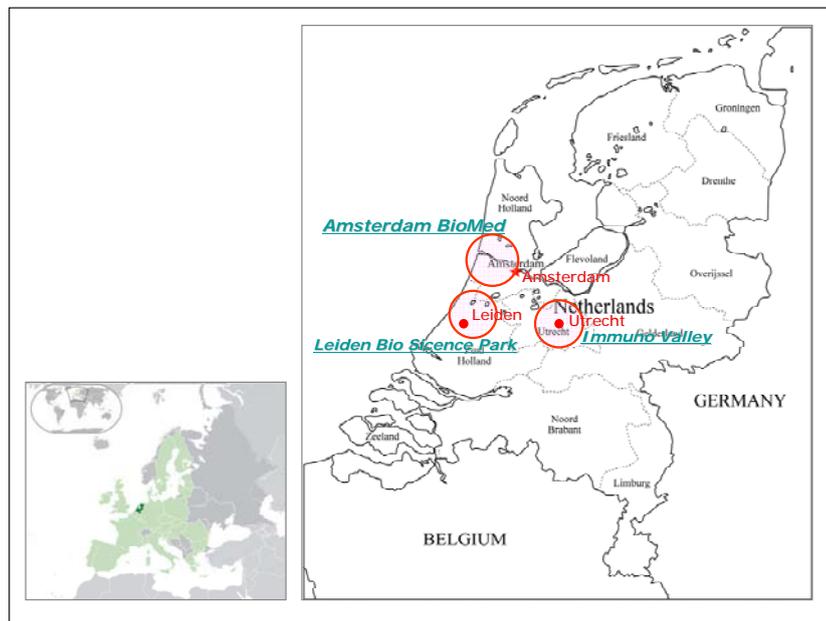
**41** NFIA, media release, 18 April 2011. <http://nfia.co.uk/news/228/Business-opportunities-in-the-Netherlands-with-the-government-investing-in-priority-sectors.html> (January 2014).

More than 60 life sciences companies have chosen to set up office in the Amsterdam region, of which over 20 are university spin offs.

Leiden region is represented by Leiden Bio Science Park which ranks among the top five most successful science parks in Europe with over 60 dedicated medical life science companies.

Immuno Valley is specialized in infectious diseases and immunology representing organizations from the Utrecht region.

**【Fig. 12】 Biotechnology clusters in the Netherlands**



(Source) Mizuho Bank analysis on Wikimedia Commons and other public information

In spite of relatively smaller number of biotechnology companies in comparison to the likes of the UK and Germany, Dutch biotechnology companies are achieving business success as exemplified by Prosensa and uniQure.

Prosensa, focused on the discovery, development and commercialization of RNA modulating therapeutics, achieved a \$60 million initial public offering (IPO)<sup>42</sup> on NASDAQ in June 2013.<sup>43</sup>

uniQure developed gene therapy Glybera® for the treatment of a rare genetic deficiency of the lipoprotein lipase (LPL) gene, the first gene therapy to be approved by the European Medicines Agency (EMA) in October 2012 and is also preparing for IPO in the US.<sup>44</sup>

Amsterdam BioMed, a cluster organization representing Amsterdam Metropolitan Area, was established in 2004 as a result of Amsterdam life sciences delegate visit to Boston with the goal to provide a platform for life sciences and related organizations to meet and interact.

Since 2012/2013 the cluster management organization has been relaunched as Amsterdam BioMed, following the launch of Amsterdam Economic Board's regional knowledge & innovation agenda (Kennis- en Innovatieagenda) where the life sciences and health was identified as one of the seven key areas for innovation and growth.

## Amsterdam BioMed

### Region

- Amsterdam Metropolitan Area.
- Emcompasses Dutch capital Amsterdam, the Dutch provinces of North Holland and Flevoland, as well as 36 further municipalities.

<sup>42</sup> In contrast to the increase in IPOs in the US, Europe's window remains cautious with a few IPOs in 2012, Adocia SAS (FR) and Cardio3 BioSciences (BE).

<sup>43</sup> Prosensa, <http://www.prosensa.eu/about-prosensa> (January 2014).  
The company recently licensed out its lead drug for Duchene Muscular Dystrophy (DMD) to GlaxoSmithKline and also won the Food and Drug Administration's (FDA) breakthrough drug designation.

<sup>44</sup> uniQure, press release, 2 November 2012.  
<http://www.uniqure.com/news/167/182/> (January 2014).  
uniQure, press release, 11 November 2013.  
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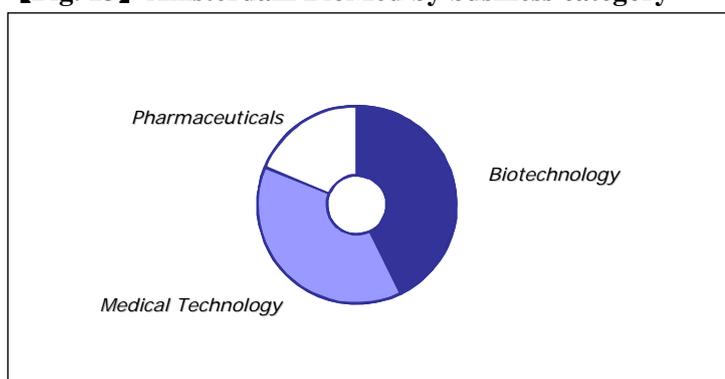
### History

- Established in 2004 as a result of government officials' visit to Boston, one of the leading biotechnology clusters in the US.
- Initially managed by Amsterdam Chamber of Commerce and a selected group of life science companies such as Avantium and Agendia.
- From 2006 to 2012, the cluster was managed by non-profit organization Amsterdam Innovation Motor.

### Structure

- Composed by 120 life science companies with majority biotechnology and pharmaceutical companies (fig. 13).
- About 30% are spin-off companies.

**【Fig. 13】 Amsterdam BioMed by business category**



(Source) Mizuho Bank analysis on Amsterdam BioMed and other public information

### Key Therapeutic Areas/Target Technologies

- Oncology, cardiovascular diseases, infectious diseases and neuroscience.

**Strategies, Strengths, Topics and Trends**

- Strategic alliance partnership with the Amsterdam Economic Board to promote Amsterdam Metropolitan Area internationally.
- Presence of large multinational pharmaceutical and chemical companies in the region.
- Access to pan-European consortium of biomedical translational research institutes, the European Advanced Translational Research Infrastructure in Medicine (EATRIS).

**Biotechnology Companies**

**【Table 5】 Amsterdam BioMed company examples**

Company	Areas	Est.	References
AIMM Therapeutics	Oncology Infectious diseases	2005	Human antibodies for prophylaxis and therapy of infectious diseases
Arthrogen	Gene therapy	2005	Therapeutics for rheumatoid arthritis and related diseases
Prosensa Therapeutics	Neuroscience	2002	Ribonucleic acid (RNA)-modulating therapeutics, with focus on neurodegenerative disorders
uniQure	Gene therapy	N/A	Lead product, Glybera, for the treatment of lipoprotein lipase deficiency was approved by EMA in October 2012

(Source) Mizuho Bank analysis on Amsterdam BioMed, company publications and other public information

## Austria (Republik Österreich)

### Overview

Austria's biotechnology industry is relatively young with the average of the company seven years old.

Austria has over 210 life science companies of which over 90% are small and medium sized companies.

Additionally, there are around 600 companies acting as suppliers to the industry for components and services.

In terms of biotechnology, healthcare and medicine represents 67%, followed by industrial biotechnology 8%, agricultural biotechnology 3% and the rest bio-informatics and others.

Historically, Austria has attracted international companies aiming to capitalize on Austria's geographical proximity to Central and Eastern Europe.

Today more than 300 corporate headquarters and 1,000 international companies coordinate their Central and Eastern European business activities from Austria.<sup>45</sup>

In life sciences industry, multinational companies such as Sandoz (Novartis, CH), Roche (CH), Baxter (US) and Boehringer Ingelheim (DE) are helping support industry competitiveness.<sup>46</sup>

Industry growth was first encouraged by the 1985 establishment of basic biomedical research-oriented Research Institute of Molecular Pathology (IMP) in Vienna, as a joint venture with the US biotechnology company Genetech and the German pharmaceutical company Boehringer Ingelheim.

The initiation of the national biotechnology program in 1999 which eventually lead to the current Life Science Austria (LISA) initiative in 2002 has provided further impetus for growth.

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45 Austrian Investment Agency (Österreichische Industrieansiedlungs- und WirtschaftswerbungsgmbH), 2013.

46 Life Science Austria (LISA), <http://www.lifescienceaustria.at/en/life-science-in-austria/> (January 2014).

The LISA initiative is a 50:50 joint venture funded by the economic development bank Austria Wirtschaftsservice on behalf of the Federal Ministry of Economy, Family and Youth (Bundesministerium für Wirtschaft, Familie und Jugend) and the ZIT-The Technology Agency of the City of Vienna (ZIT-Technologieagentur der Stadt Wien GmbH).

LISA was specifically established for the promotion and financing of innovative local/regional companies as well as for national/international marketing of Vienna as a location for life sciences.

Since 2009, medical technology is included as an additional area of focus.

Clusters are concentrated in five states (Bundesländer), namely Vienna (Wien), Styria (Steiermark, Graz), Tyrol (Tirol, Innsbruck), Lower Austria (Niederösterreich, St. Pölten) and Upper Austria (Oberösterreich, Linz), and are bundled under the umbrella brand name “Life Science Austria (LISA)”. Main biotechnology clusters are: 1) LISAvienna (Vienna), 2) Standortagentur Tirol (Tyrol, oncology), 3) ecoplus (Lower Austria, cross-sector), 4) Health Technology Cluster (Upper Austria, biobanking and biomarkers) and 5) Human Technology Styria (Styria, white biotechnology) (fig. 14).

LISAvienna is Austria’s largest life science cluster and plays an important role in the founding of start-ups and the location of SMEs as well as attracting domestic and international companies.

**【Fig. 14】 Biotechnology clusters in Austria**



(Source) Mizuho Bank analysis on Wikimedia Commons and other public information

LISAvienna

Region

- Vienna (capital of Austria).

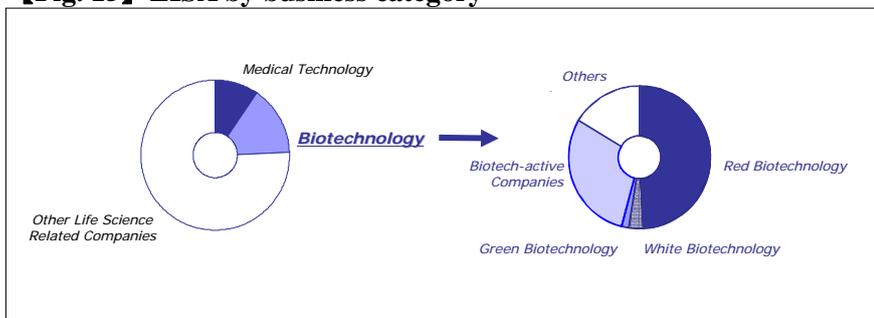
History

- Established in 2002 as a 50:50 joint venture funded by the national promotional bank Austria Wirtschaftsservice (aws) on behalf of the Federal Ministry of Economy, Family and Youth and the ZIT-Technologieagentur der Stadt Wien GmbH (technological agency in Vienna).

Structure

- Total of around 400 life sciences companies of which 60-70 are dedicated biotechnology companies (fig. 15, left).
- Majority of the 60-70 dedicated biotechnology companies are focused in red biotechnology (fig. 15, right).
- Activities are concentrated in the capital city Vienna with 58% of biotechnology companies and 37% of the medical technology companies.

**【Fig. 15】 LISA by business category**



(Source) Mizuho Bank analysis on LISA and other public information

**Key Therapeutic Areas/Target Technologies**

- Oncology, infectious diseases, regenerative medicine.
- Biopharmaceuticals.

**Strategies, Strengths, Topics and Trends**

- Branding and promotion of Austrian life science and biotechnology clusters through a consolidated platform managed by LISA.
- Presence of multinational pharmaceutical companies.
- Geographical advantage of easier access to Central and Eastern European countries/regions.
- One-stop and business-centric support provided by LISA and Austria Wirtschaftsservice.

**Biotechnology Companies**

**【Table 6】 LISAvienna company examples**

Company	Areas	Est.	References
AFFIRIS	Vaccines	2003	Manufacturing technology for synthetic peptide vaccines (Alzheimer's disease and others)
APERION Biologicals	Immunology Oncology	2006	Lead project APN311 is in an ongoing phase III trial in neuroblastoma
Biocrates Life Sciences	Diagnostic Biomarker	2002	Mass-spectrometry-based metabolomics kits for diagnostics
SANOCHEMIA Pharmazuetika	Nuerodegeneration Oncology	1990	Pipelines include new formulation of tolperisone (a centrally acting muscle relaxant), and PVP hypericine (a photoactive substance for the diagnosis and treatment of bladder carcinomas)

(Source) Mizuho Bank analysis on LISA, company publications and other public information

## &lt;List of Abbreviations&gt;

CNS	Central Nervous System
CVC	Corporate Venture Capital
EC	European Commission
EMA	European Medicines Agency
EU	European Union
FDA	Food and Drug Administration
GDP	Gross Domestic Product
IMI	Innovative Medicines Initiative
IP	Intellectual Property
IPO	Initial Public Offering
JTI	Joint Technology Initiatives
M&As	Mergers and Acquisitions
OECD	The Organization of Economic Co-operation and Development
OTC	Over-The-Counter
R&D	Research and Development
RNA	Ribonucleic Acid
SMEs	Small and Medium-sized Enterprises
VC	Venture Capital

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Address: 1-3-3 Marunouchi Chiyoda-ku Tokyo

Tel: (03)5222-5075

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