

Barcelona Treball

Biotechnology and biomedicine

Sector Report 2013

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Biocat

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The 10 keys to understanding the sector

Over the past 10 years, Catalonia has become a benchmark for biotechnology, biomedicine and medical technology research in southern Europe.

The sector

The biotechnology and biomedicine sector and its activity areas such as medical technologies feature multidisciplinary knowledge and a very high level of skills training for human resources.

Main areas of activity

The main areas of activity in biotechnology are: agro-food, encompassing all activities to improve food quality, crops and production; health, which takes in the biopharmaceutical industry, biomedical research and medical technology; and industrial production and biotechnology, covering activities that generate more efficient industrial products and processes and cleaner and more sustainable energy.

Trends

The combination of the Catalan government's decision to commit to R&D and the knowledge economy has promoted research and the setting up of science and technology parks, which have brought fundamental research closer to applied research and created an environment where entrepreneurs can set up their businesses. This has meant that in the space of 10 years Catalonia has become an economic model and benchmark for biotechnology, biomedicine and medical technology research in southern Europe. Moreover, it has to be considering the progress of individualized medicine and biomarkers as basic tools for the prevention of chronic diseases, treatments to simplify and reduce costs in health system.

Economic importance

In 2010 the turnover of Spanish biotechnology companies exceeded €60.121 million, representing 11% more than the previous year. The turnover stood at 5,73% of Spanish GDP. In Catalonia, companies generated a turnover of approximately €15.600 millions. Spending on biotechnology R&D exceeded €568 million in 2010, approximately 11% more than the previous year.

Employment

In 2010, biotech companies employ more than 163,000 workers in Spain. In a particularly adverse economic situation, 6.000 new jobs were created (an increase of 3,8% per year). In Catalonia, 22.000 people worked in the biotech and 7.981, worked in research groups. Analyzing employment data appears that much of the people employed in this sector carried out activities related to research, as evidenced by the fact that Catalonia there is 18.000 employees in R&D (research and technical staff).

Professional profiles most in demand

There are two types of training profiles in the sector: one for middle and senior positions and another for technical and intermediate positions. The former includes postgraduate education such as master's, doctoral and post-doctoral

programmes, with people going on to occupy positions in research and operations or management business. In the latter group are less qualified profiles such as a university degree or higher vocational training.

Occupations most in demand

It is difficult to delimit the biotechnology and biomedicine industry given the wide range of sectors with which it interacts. The occupations with greatest market demand are in pharmaceutical marketing and clinical development, for example medical advisor, while biological and computing genetic analysis predominates in fundamental scientific research. In all areas it is critical to hire managers who know the business model and the global market and can also work at a more operational level, and these are the people who lead comprehensive projects.

Future scenarios

The future of biotechnology and biomedicine is marked by the change in the production model in Catalonia and Spain towards a high added value economy based on knowledge and R&D. This has led to significant efforts by government to create a business, universities and infrastructure network that will ensure the strong future development of the biotechnology sector. In Catalonia, however, this has been a reality for some years. The biotechnology network, now consisting of small and medium enterprises, will increase its critical mass and medium and large companies will also appear.

Weaknesses

It is a sector made up of numerous companies at an early stage of development, with little critical mass in most cases. This generates a strong dependence on external sources of funding and venture capital. As a result the economic crisis of 2009 has reduced the injection of capital into these companies which usually do project-based work. Furthermore, a system for promoting scientific personnel in order to stop the brain drain to foreign countries has yet to be set up in Spain and Catalonia. In addition, the public research system has still to find ways of promoting technology transfer and turning research into innovation that benefits the general public.

Opportunities

Spain and Catalonia in particular have an excellent scientific infrastructure network, including the ALBA synchrotron, the Mare Nostrum supercomputer and the Institute of Photonic Sciences. The country's science and technology parks combined with investment in research institutes and centres mean that research is done to very high standards of excellence. This, coupled with a high rate of founding new biotechnology and biomedicine enterprises, makes Catalonia into a source of wealth generation and expert employment in Spain and Europe.

01 Introduction to the sector

This sector includes a range of disciplines such as biotechnology, biomedicine, medical technology and the various subsectors that make them up.

The people employed in biotechnology have high levels of training in science and technology. In addition, as in any sector cross-cutting management and technology support services are absolutely essential and are critical for the successful implementation of biotechnology projects.

It is important to grasp the differences between the concepts: biomedicine and medical technologies are spheres of application for many kinds of technology, while biotechnology is a cross-cutting tool applicable to many different sectors.

Hence currently there is no absolute definition of what is meant by biotechnology, the biotech industry or the biotech sector.

Classical biotechnology is defined as technology based on the use of biological systems and living organisms to obtain goods or services. It has been known from time immemorial with winemaking and the use of yeast right up to the modern-day establishment of businesses and research groups that have extended it to many fields. In recent years, with the inclusion of various technical and scientific breakthroughs, modern biotechnology has gradually taken on board a set of genetic engineering techniques to modify and transfer genes from one organism to another, which has given fresh impetus to fundamental research and its use in therapy (e.g. vaccines) and in crops and industrial processes.

Biotechnology is thus a multidisciplinary tool because it includes various sciences and disciplines such as biology, biochemistry, genetics, virology, agronomy, engineering, physics, chemistry, pharmacy, medicine and veterinary medicine. It is used especially in agriculture, pharmacy, food sciences, the environment and medicine.

Three colours are currently used to categorise the various applications of biotechnology:

- Red for biotechnology applied to health, which includes therapeutic, diagnostic, animal health and biomedical research applications, and also including the development of functional foods and nutraceuticals.
- Green for biotechnology applied to agricultural processes, such as the design of transgenic plants able to grow in adverse environmental conditions or to make them resistant to pests and diseases. It is also hoped that green biotechnology can provide solutions to improve the traditional methods used in industrial agriculture to make it more sustainable.
- White for industrial biotechnology applied to industrial processes, such as the design of microorganisms to produce a chemical or the use of enzymes as industrial catalysts to destroy hazardous chemical pollutants. In addition, it can also be applied in the creation of new materials such as plastics and textiles and in the production of non-polluting and much more sustainable biofuels.
- Blue for biotechnology applied to products and industrial processes based on marine resources. The sea has the greatest biodiversity in the earth, so potentially there are some sectors that can take benefit from blue biotechnology. While some products based on blue biotechnology applications are already used, many are still under investigation or inquiry.
- Gray for biotechnology applied to applications on the environment. These applications can be subdivided into two branches of activity: on one hand, the maintenance of biodiversity (such as the application of molecular biology to the genetic analysis of ecosystems species, or cloning techniques to preserve species); on the other hand, the elimination of pollutants by microorganisms and plants which are used for the isolation and elimination of various substances (heavy metals, hydrocarbons, etc.), with the possibility of later use of these substances or products derived from this activity.

Since early 2000 biotechnology has become a business and economic sector in its own right that is highly developed in Catalonia. According to the latest report published by Biocat, 2011, the number of biotechnology and related companies in Catalonia was 481, broken down into 91 in biotechnology, 71 in pharmaceuticals, 106 in medical

technology, 29 in fine chemicals, 45 in food and 9 in bioinformatics. In life sciences research, according to Biocat 2011 report (prepared by Ernst & Young and Biocat), Catalonia has 449 groups (56% belong to universities; 33%, to investigation centers; 7%, to hospitals; and 4%, to the rest). As for the infrastructures, Catalonia has 80 research centres, 19 science and technology parks, 15 hospitals, 12 universities, 9 large infrastructures, 57 technological infrastructures and scientific services, 6 technology centres and 28 support organizations (Biocat Report 2011).

02

Main areas of activity

Agriculture and food

The agro-food system includes all activities related to the cultivation, production, quality control and distribution of food, as well as research and technological innovation in this area. This sector is of great importance in Spain and especially in Catalonia.

In the agricultural sector, biotechnology is geared towards generating new work techniques and procedures in agricultural and livestock processes and carrying out R&D to increase the efficiency and sustainability of crops, water quality, the creation of new plants and more efficient pesticides and pest control.

In the case of the food industry, applications are aimed at ensuring food quality, research and the creation of new ingredients, transgenic products and nutraceuticals, and improving the efficiency of biotechnological processes such as lactic fermentation, curing sausages and the production of alcoholic beverages.

The intention in all these areas is to achieve the ultimate goal of improving the quality of life and health through food, helping to create a food system that improves the economies of production while being sustainable and environmentally friendly.

Health

This area includes the knowledge in the following disciplines and economic sectors: biopharmaceutical industries, biomedical research and medical technology.

Biopharmaceutical industries

The pharmaceutical industry is a sector with a long tradition of investment in research and a high economic impact. In Spain it is mainly located in Catalonia, which produces 49.5% of the entire turnover of the pharmaceutical industry in the country. In addition, the pharmaceutical sector employed 4,576 people in R&D in 2010 in Spain.

However, in recent years pharmaceutical companies have turned to biotechnology to get new therapeutic ideas that add to their own research. Thus pharmaceutical companies' investment in biotechnology came to more than €190 million in 2008.¹ However, in lockstep a new breed of mixed enterprise has been created called biopharmaceutical companies that combine the flexibility and mindset of biotechnology with the ability to develop products to more advanced stages which biotech firms normally cannot reach. This entails the emergence of a large number of jobs designed to develop this area with hybrid profiles and cutting edge knowledge in technical and scientific areas, management and pharmaceutical development.

Biomedical research

Biomedicine encompasses the knowledge and research common to the fields of medicine and biological sciences, primarily applied to health. Biomedicine is largely geared towards fundamental research, mainly in state universities and hospitals. In other words, R&D focuses on research, although it may often have an impact on process innovation and new technologies, rather than on developing new products. Examples of applications include genome research and research into stem cells or in organic regeneration. In Catalonia, biomedical research is devoted mainly to fundamental research, which is then applied in red biotechnology (60%) and medical technology (40%).²

Spain's spending on R&D is still far from being at the top of the league tables. Investment in research by biotech companies in Spain was estimated at €793 million in 2009, up by 11.5% compared to 2008 (INE Biotec 2009).

There are 13,708 biotechnology researchers in Spain (2009). 53.6% of them are women, and 22.9% of researchers work in the private sector (INE Biotec 2009).³

Although the role of researchers and technicians is still a priority given the multidisciplinary nature of applications, new jobs in European project management or technology transfer are becoming necessary to assist these scientific groups to internationalise and turn their projects into patents, licences and future companies.

¹ Biocat 2009.

² Biocat 2009.

³ Asebio Report 2008.

Medical technology

The concept of medical technology encompasses a wide range of areas and specialities which are in addition intertwined with biotechnology. TecMed, as medical technology is commonly known, could be defined as consisting of medical devices, tools for developing telemedicine and e-health and biotechnology and other diagnostic tests that affect clinical and medical treatment, diagnosis, research and practice.

The global market is estimated to produce a turnover of €187 billion, of which the U.S. accounts for 42% and Europe 33%, with an annual growth rate of 5%. Catalonia accounts for 40% of the Spanish market with a turnover of €1.2 billion.⁴

The main defining characteristics of this sector are sustained growth in recent years, high profitability and a very high rate of innovation.⁵ Usually, time to market for a product is between three and five years and investments are between €1 million and €5 million, making it attractive for private equity funds.

According to Eucomed, there are more than 11,000 legal entities in Europe engaged in medical technology, which provide about 435,000 jobs all told. In Catalonia in 2009, the medical technology sector provided work for a total of 30,000 people.⁶ This sector brings together professionals from many different training backgrounds who work with health sector colleagues to develop innovative products.

Production and industrial biotechnology

The biotechnology sector ranges from biorefining organic materials to produce biofuels to making non-polluting biodegradables and the recovery of waste products from chemical or organic synthesis.

The goal is to achieve cleaner and longer-lasting products and energy together with more efficient and sustainable processes. There is great potential in this sector in which many companies will be set up in the future leading to the creation of a large number of jobs over the next few years. In Spain, only 12% of companies engaged in biotechnology have industrial applications.⁷ However, interest in this technology is increasing all the time.

The impact of industrial biotechnology is growing and future projections are exceeded year after year. Thus a figure of over €80 billion in biotechnological production of chemicals will be reached in 2010, which is 10% of total chemical production.⁸

⁴ Biocat 2009.

⁵ Pareras Lluís G., *Innovar y Emprender en el sector sanitario*, 2008. Ed. Ars Medica

⁶ Biocat 2009.

⁷ Pareras Lluís G., *Innovar y Emprender en el sector sanitario*, 2008. Ed. Ars Medica

⁸ Biocat 2009.

03

Sector trends

Over the next five years professionals in bioinformatics, strategic management and biotechnology product sales will be needed in biomedical research.

The clustering of biotechnology

The role of science and technology parks in supporting biotechnology is essential to provide the sector with venues for collaboration between companies and other stakeholders in the system. It is for this reason that the biotechnology sector has tended to form local clusters.

This brings many advantages to sector companies, including a reduction in transaction costs, the development of innovations, transfer of benefits arising from localised economies (specialised labour market, existence of qualified suppliers, etc.), lower learning costs because they can learn by imitation based on the experiences of other companies, first mover advantages arising from an initial territorial specialisation, and other returns derived from the inherent properties of local innovation systems in the context of globalisation.⁹

New needs of the public

The concept of health culture has emerged strongly in countries like the US, Canada and Germany since the beginning of the 21st century. This cultural change is based not only on the absence of disease but also on the presence of physical, psychological and social wellness. Whether as a cause or consequence, this leads to increased consumption of certain goods designed to improve this wellness.

Examples of this culture change in the sector are the enormous growth in the cosmetics, functional foods and pharmaceutical industries, to name but a few. However, the reach of the changes does not only affect the life sciences, but also tourism, food and lifestyle. An example is health tourism, where Spain and Catalonia are a benchmark for other countries in areas such as ophthalmology, oncology and transplants.

Globalisation and internationalisation

In recent years, Spanish enterprises have begun a process of internationalisation. Increasingly expensive development costs mean that companies need to put in place internationalisation strategies in order to get a return on their investment that defrays research costs. This necessarily entails devising new strategies in all areas of the value chain and bringing products to the global market.

Hence Spanish pharmaceutical companies, many of them Catalan as is the case with Almirall, Uriach, Ferrer, Esteve and Grifols, are starting to internationalise (or have already done so) part of their value chains and drug sales. Moreover, biotechnology companies need to open up their business strategies and fields of operations to a much more global level than at present by hiring international research and business management professionals, forging valuable agreements with foreign companies and making their focus far more global.

As for employment, internationalisation and globalisation not only make it possible to hire talent from outside Spain but also lead to a large number of research job opportunities abroad for Catalan professionals, something which enriches their scientific background when they return to the country. There are in fact programmes in place such as ICREA (Catalan Institution for Research and Advanced Studies) which seek to promote research in Catalonia through grants and work contracts for researchers who set the standard in their field of expertise.

Furthermore, bringing foreign talent into business management will make it easier to attract and negotiate with foreign capital and investment groups. To do this a number of schemes have been started up aimed at increasing the ability to attract this talent, including the Ministry of Science and Innovation's INNCORPORA programme for funding research and management staff selection and recruitment costs.

International collaboration for research

The advancement on knowledge forces to invest in high-tech equipment that is often difficult to maintain and amortize by a single research team. On the other hand, the high degree of specialization and interaction between the different

⁹ Biocat Report 2011

branches of biotechnology makes research groups couldn't have specialist researchers in all areas of biotechnology knowledge. This situation incites increasingly more international collaboration between different research groups to create new products and applications. Each of the research groups provide the level of expertise so that the final result is the best possible.

A proof of this trend in international collaboration is the increasing number of articles and publications jointly produced by biotechnology researchers in different countries. Indeed, although most studies are conducted and published without international collaboration, in recent years has significantly increased the percentage of studies that do have a "international" responsibility. For example, in Latin American countries the number of biotechnology publications performed with international collaboration has increased over 170% since 2000.

Convergence of the pharmaceutical and biotech sectors

One aspect that has helped drive the sector has been the convergence between pharmaceutical and biotechnology companies. The sector has helped revive the research catalogues of traditional pharmaceutical firms and as a result several CENIT (National Strategic Consortiums for Technical Research) programmes have been generated in recent times in which large pharmaceutical companies have worked with their biotech counterparts.

It is therefore a sector that in just 10 years has been able to place itself at the forefront of R&D and generate many companies and jobs. The biotechnology sector is expected to create about 100,000 jobs in Spain over the next 5 years,¹⁰ even though the 2009 crisis and reduced investment in the sector have lowered initial expectations. However, it will be necessary to hire new professionals in biomedical research related to genetics, strategic business management and biotechnology product sales.

Emergence and growth of the generics and biosimilars market

In Spain, the emergence and promotion of generic drugs by the National Health System has led to a change in the pharmaceutical sector's business model. Large multinationals with innovative products have seen how the entry into the marketplace of generic and biosimilar companies has meant increased competition.

This has transformed the strategy of "innovative" drug companies which have set up generics divisions or sought alliances with companies that have research portfolios in order to address the loss of patents. This situation has resulted in a large number of mergers and takeovers, but also in the emergence of new companies and new jobs to compete in the generics and biosimilars market. A couple of important figures are worth noting; the sector invests 3,53% of its turnover in R&D, and the generics market generated a total of 32,500 direct and indirect jobs in Spain in 2008.¹¹

Government boost for R&D

In recent years, public and private authorities have been giving a strong boost to investment in R&D in Spain, and particularly in Catalonia. However, the economic crisis has also affected the sector and the budget allocated by the Government of Catalonia to research has been reduced by €100 million. In spite of this, there is a strong commitment to R&D in order to achieve a level of investment similar to that found in the leading European countries and change Spain's economic model from a production economy to one based on innovation and knowledge. Examples of this are the goals and commitments in the Research and Innovation Plan for Catalonia for the period 2010-2013. The central tenets of this plan are part of educational policies designed to produce better professionals, attract and retain talent, internationalise, enhance technology transfer and promote the growth of business networks and critical mass.¹²

It will be important to foster innovative public procurement, give Catalonia a fiscal and legislative framework that promotes technology transfer and investment in R&D, firmly commit to internationalisation and maintain investment while improving the efficiency of the research system to ensure that the biotechnology, biomedicine and medical technology sector can develop its full potential and become the economic driving force of Catalonia and a benchmark in southern Europe.¹³

Hence Catalonia has fostered the creation of research institutions and this has made it possible to increase the creation of new jobs and attract international talent. An example is in the field of nanotechnology, where Catalonia is at the forefront in the number of annual publications in nanomedicine and oncology, ranging from pioneering fundamental research to small biotech or pharmaceutical enterprises and high-level clinical research.

This will result in future increases in the number of research-intensive companies and jobs in different fields, thanks to technology transfer and attracting international investors. Some areas where the offer of employment will grow will be knowledge about the system of subsidies, technology watch, industrial property and management and negotiation with investment funds and venture capital.

¹⁰ Addeco Medical Services Biotechnology Observatory.

¹¹ AESEG (Spanish Generics Association).

¹² Government of Catalonia. Department of Innovation, Universities and Enterprise.

¹³ Biocat Report 2011

Finally, mention should be made of the new Science, Technology and Innovation Act passed in December 2011. It sets out the powers of the central and regional governments in research, seeks to create a scheme for the professional development of researchers, promotes scientific and technical research, innovation, knowledge capital and transfer and scientific and technological culture, and regulates the coordination of research activities where it envisages the creation of a coordinating body at the national level and drawing up an annual National Scientific and Technical Research Plan and a National Innovation Plan.

Reduction in the number of companies that dominate the market

Before the crisis there were 50 multinationals in the market; it is now dominated by a dozen big pharmaceutical companies and three or four medical device companies. The lack of liquidity in capital markets has made it more difficult to support a large portfolio of companies. Hence sector companies have tended to go into partnerships, either through licensing or by directly acquiring smaller companies.

The experts believe that this trend will continue in the coming years, and say that large companies will grow (especially those better equipped and healthier) while smaller companies or with major financial difficulties tend to disappear. It must be said that is also expected to decrease significantly the number of new biotech companies. In short, there is a growth of large companies and a drastic reduction in the total number of companies.

Decreased capacity for innovation

If the downward trend in the number of companies is maintained, there will be a flow of entrepreneurial/researchers from small to large companies. This may reduce innovation capacity because in this process will lose some characteristic items of small companies, such as agility, capability of decision-making or developing products which initially did not bet big companies (traditionally focused on developing products that are guaranteed greater market acceptance).

Biomarkers and individualized medicine: prevention and pharmacological advances

Advances in personalized medicine are a key to predict chronic diseases and treatments to simplify and reduce health systems costs. Biomarkers are a mainstay of individualized medicine. A biomarker is a chemical used as an indicator of a biological state that can detect a disease, follow its evolution or choose a treatment.

04

The sector in figures

Economic data

- In Spain, there are 1.715 companies that have developed activities related to biotechnology (representing an annual increase of 12,8%). Of these companies, 617 say that biotechnology is the main activity and/or exclusive (this figure represents an annual increase of over 30%). In addition, 209 companies suggests that biotechnology is its secondary line of business, and 889 biotechnology companies say that is a necessary tool for production.
- Catalonia has a greater concentration of companies using biotechnology. Indeed, about 20% of Spanish companies using biotechnology are located in Catalonia. It must be said, however, that if it is taken into consideration only biotech companies this percentage drops to 15% (in this case, Madrid exceeds Catalan Region). Specifically, according to the 2011 Biocat report, the Bioregion of Catalonia has 481 companies: 91 of biotechnology; 71 of pharmaceutical, 106 of medical technology, 29 of fine chemistry, 45 of food and 9 of bioinformatics.
- In 2010, the turnover of Spanish companies increased by 11% compared to 2009, surpassing the €60.121 million. This amount represents 5,73% of the Spanish GDP. It should be noted, however, that even these levels of turnover not all firms have profits. In Catalonia, 15% of companies say that have no benefits, while 21% declared a profit less than €100.000 and only €6,7% more than a million of profit.
- Although the Catalan biotech companies represent 20% of Spanish biotech companies, its economic weight is proportionally higher, as they generate a turnover of about €15.600 million, representing 26%.
- The U.S. represent only 10% of Catalan companies market while this country represents 50% of the global pharmaceutical market, which is estimated to reach \$1,1 trillion by 2014.
- In Catalonia in recent years have created an average of 12 new companies per year. This situates Catalonia at the same level of European regions that are tractor industry (Berlin or Oxford). Catalonia generates 23% of the newly established biotech companies in Spain. The entrepreneurial spirit of Catalonia in biotechnology is also demonstrated by the fact that 91% of the Catalan biotechnology companies have less than ten years old. In addition, only 16% of Catalan companies are subsidiaries of multinationals (Biocat Report 2011).
- Regarding the companies sectoral distribution with technological activities, there is a predominance of applications in the food sector (53%) and those related to human health (31%). The areas with less weight are agriculture and forestry production, environmental applications and industrial. If it is taken into consideration only companies devoted exclusively to biotechnology, mostly are oriented to human health (54%) and to food.
- In 2010, there were 969 Spanish companies performing R & D in biotechnology, representing a 13% increase over 2009. 58% of Catalan biotechnology companies focus their R&D activities, and only a third develops activities throughout the value chain.
- Spending on R&D in biotechnology exceeded 568 million in 2010, representing around an 11% increase over the previous year. Regarding the origin of the funds, it should be noted that there has been a reduction in own funds and from universities; however, have increased funding from the government (both Spanish and EU). In any case, it should be noted that there is a higher growth of funds from abroad (EU programs and other funds from abroad) than national (own funds, public administration, university, etc.).
- In the field of life sciences research, Catalan Bioregion has 449 groups and 80 research centers, 19 science and technology parks, 15 hospitals, 12 universities, 9 big infrastructure, 57 technology and scientific infrastructures, and 6 technology centers and 28 support organizations.
- 13% of biotech companies have applied for biotechnology patents in 2010. The number of patents applied is 643, representing an increase of 17,3% over the previous year.
- 85% of R&D companies make collaborations for research projects.

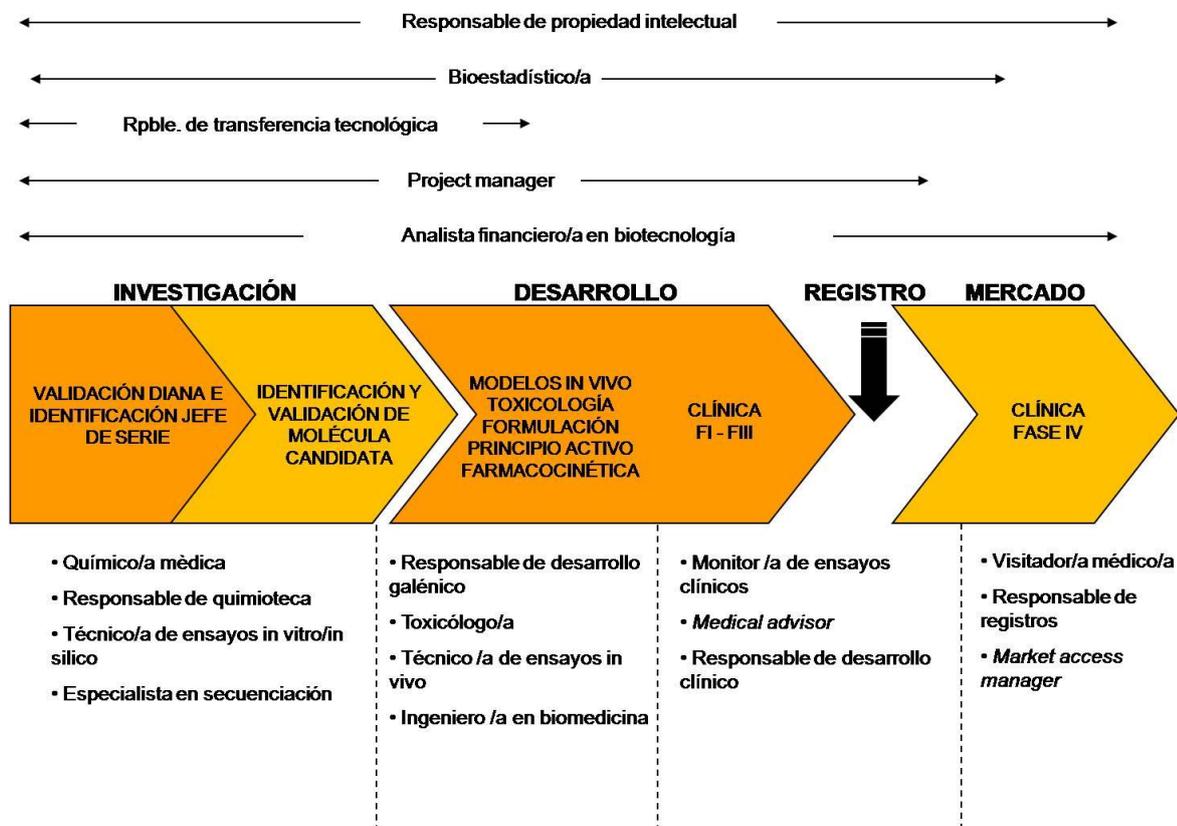
Employment data

- In 2010, biotech companies employed more than 163.000 workers in Spain. In a particularly adverse economic situation, 6.000 new jobs were created (an increase of 3,8% per year). In Catalonia, 22.000 people worked in the biotech companies.
- Private companies are the leading employers with 42,4% of jobs, followed by higher education with 36.8% and government with 20,5% (INE R&D 2009).
- In Spain the number of R&D workers has grown steadily since 2000 (cumulative growth of 44%) to reach 11,69% of total workers in 2009 at 220.777 people. 60,6% are researchers (133.791) who account for 7,08% of the working population (Cotec 2011, INE R&D 2009). It is important to note that R&D Catalan firms employ 14.700 people: 11.000 develop research tasks.
- In the private sector growth was interrupted in 2009 with a fall of 1.5% in research staff compared to 2008, a negative trend that has continued in 2010 (-2.2%). These falls have been offset by growth in R&D personnel in government, with a rise of 10.2% in 2009 and 4.1% in 2010, and in higher education, up by 3% in 2009 (INE R&D 2011 - Avanç 2010, Cotec 2011).
- The percentage of women developing activities in biotechnology R&D field is slightly higher than men percentage (55,46% and 44,54% respectively). It should be noted that the difference is accentuated in companies with more than 250 employees; in these companies women represent a more than 61%.
- The structure of the biotechnology sector is still characterized by a predominance of firms with less than 250 employees: in companies using biotechnology (95,16%) and in biotech companies (96,60%). However, it is important to note that biotech companies with less than 250 employees generate only 11% of sector turnover and 57% and employ 23,35% of the workers.
- As for R&D, from the companies who develop R&D, 70% has a staff of less than 10 employees (ACC1Ó Innovation in 2009, latest data available).
- The most common qualifications in biotechnology sector R&D departments in Catalonia are chemistry and biology at 44% and 22% respectively.
- This sector demands a high level of professional qualifications and a high degree of specialisation in both the public and private sectors, which is why 40% of workers have a PhD. This explains the high percentage of permanent contracts in companies in this sector compared to others: 47,3% versus only 7,5% in temporary contracts.
- Temporary employment is higher in the field of public research at 24% of contracts. In addition, there are a large number of interns (37%), who often have to go abroad to continue their scientific careers and rarely join the companies.

Sources. Latest data available: Biocat Report 2011; ASEBIO 2011 report; CoTec - Foundation for Technological Innovation (www.cotec.es); Genome Spain Foundation (www.gen-es.org); www.cataloniabio.org; www.farmaindustria.es; National Statistical Institute (www.ine.es); Adecco Report on functional structures and compensation systems in the biotechnology sector in Catalonia; ACC1Ó (www.acc10.cat/)

05 Professional profiles most in demand

The biotechnology and biomedicine sector encompasses a range of educational disciplines and economic sectors structured through some common variables, mainly R&D intensiveness. Consequently average educational training is very high in this sector. As a visual example of the multidisciplinary and cross-cutting nature of these professions, the following chart shows the value chain in the field of biotechnology applied to health, including non-exhaustive examples of cross-cutting professional profiles that may act throughout the chain and of profiles focusing on certain scientific and technological fields.



Source: Biocat

Most highly qualified professional profiles

Training profile

Another feature of biotechnology is the multidisciplinary nature of its professions and fields of knowledge. Nowadays a discipline rarely corresponds to a particular type of study but rather contains a great variety of specialised training. Higher qualifications in this professional field are in experimental sciences, health and engineering. However, there are two types of profiles based on their role in an organisation. Firstly there are management profiles filled by scientific experts who also have additional training in business project management. Secondly there are profiles based on technical expertise more geared towards pure research which require doctoral and/or postdoctoral technical training. Another feature common to all profiles is the need to have a very high level of English.

Skills profile

In line with this twofold training focus, profiles differ in skills in the same way. Thus profiles working in the management and administration of organisations, companies or projects usually include skills such as project leadership, team management, controlling budgets and being results-oriented. However, it is crucial to have a global and strategic business vision in this profile. By contrast, the technical and theoretical profiles call for skills such as constant learning, information searches, analytical ability, thoroughness, data interpretation and problem solving which are geared more towards operations than people.

Examples of jobs in the directory of web Barcelona Treball

- ✓ [Drug library manager](#)
 - ✓ [Technology watch manager](#)
 - ✓ [Market access manager](#)
 - ✓ [Pharmacoeconomics manager](#)
-

Less qualified professional profiles

Training profile

The less qualified profiles in this area have several features in common as regards training pathways and structural features. For instance, the average level of education is higher than in other sectors, since R&D is knowledge-intensive. Thus a technician in this sector will normally have a degree, master's or other postgraduate qualification. Higher education in the life sciences, especially biology, chemistry and biotechnology, is the most common along with higher vocational training. Another characteristic feature is the range of sectors for which they are eligible. Unlike medium and high profiles, these profiles can opt for a variety of sectors such as the biopharmaceutical industry, biotechnology production and the agro-food industry, since technology and operations at a technical level are applicable to all R&D-intensive sectors.

Skills profile

Skills such as analytical ability, attention to detail, versatility, learning ability and thoroughness are much in demand at these levels. However, the ability to work in a team is becoming increasingly important due to the multidisciplinary nature of R&D departments.

Examples of jobs in the directory of web Barcelona Treball

- ✓ [Animal house technician](#)
 - ✓ [Laboratory maintenance technician](#)
 - ✓ [Instrument calibration technician](#)
 - ✓ [Stem cell technician](#)
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06

Future scenarios

Weaknesses

- Cuts in investment in innovation due to the economic crisis of 2008. The biotechnology and biomedical sector is not immune to various external threats and certain inherent weaknesses. Obviously, the major economic crisis that began in 2009 has led to major cuts in innovation in both the public and private sectors. In addition, venture capital funds, which constitute a source of funding for new biotech companies, have adopted a cautious investment strategy.
- Problems in taking companies from their beginnings to a more advanced stage of maturity and critical mass. The biotechnology sector in Spain, and specifically in Catalonia, is made up of numerous small companies with little critical mass and in the early stages of development. There are various reasons for this, but there is significant evidence pointing to a lack of the business knowledge necessary to meet challenges and forge alliances to grow critical mass. This makes it impossible to build a strong and economically important sector in the short term.
- Closely related to the previous point, many of Catalan biotech companies are small and grow as other industrial activities, but have characteristics that make them weak. Indeed, these companies often develop high-risk projects and slow maturation (5-10 years), and require significant investments to carry them out. This long period of return on investment may cause that many companies have difficulties to maintain their activity.
- The scientific process requires time, implies a technological risk (there is no certainty of return on investment) and is subject administrative regulations. These aspects may be a barrier for some investors, who see the work and time it takes to get results. The dynamics of the laboratory does not fit with the strategies and interests of banks and investors (and the Administration). Although in recent years the bio sector has gained social presence (both public institutions and financial sector are more sensitive to their needs) this approach does not satisfy the needs of biotechnology companies.
- Lack of a more business-oriented approach in the early stages of company development.
- Much of the biotechnology industry is very focused on developing technology while neglecting the business perspective. Put aside commercial aspects hinders the proper development of companies, as they are capable of creating good products and applications but do not introduce them to the market.
- The need for companies that have a pull effect on start-ups.
- Activities are too focused on the local level and still lack internationalisation. The sector needs to have a more international focus in its early stages. It is currently too inward looking towards Catalonia, Spain, mainly, and Europe (43% of Catalan companies have relationships with other European companies). This is not the case in relations with the US, where only 11% of companies had ties in 2008 despite it being the world's largest biomedical market. This is in marked contrast with the course being taken by a sector that is clearly global.
- The relation between the market and the projects developed at the university level is not sufficiently stable and often many projects are abandoned at the time of making the transition from college to business (the market). Indeed, it is difficult for the industry to accept certain projects developed in universities, unless an intermediary allows saving the gaps between both, university and market, satisfying the requirements of the corporate sector. Some researchers and scientists from university do not take their work beyond the point where they are able to prove their hypotheses, while companies are only interested in research which can display a product development plan.
- Spain lags behind in industrial innovation (patent applications and the number of licences) compared with Europe. Examination of the level of technology transfer to companies, as shown by the number of patent applications, demonstrates that Catalonia is not at the forefront in many areas compared to other more dynamic bioregions. According to data gathered by the Biocat survey of 208 companies and 230 research groups, between 2009 and 2010 they submitted 506 applications (Biocat Report 2011).

Threats

- Reduced investment by venture capital funds in research. One of the factors that may hinder the development of the biotechnology sector as a result of the economic crisis of 2009 is the continuous government cuts in health spending and the list prices the National Health System pays for drugs.
- Cuts in health spending, which means innovative firms lose the ability to innovate. The impact of legislation enacted for the public pharmaceutical market and on the income of Spanish pharmaceutical companies is very noticeable. Public spending on drugs in 2010 fell by -2.38% and is expected to continue falling by another 6% in 2011. This means that by the end of 2011 the total volume of public pharmaceutical expenditure in Spain will be at levels similar to mid-2008, which will force pharmaceutical companies in Spain to carry out a major review of their business plans in terms of jobs and investment in R&D.
- Biotechnology and are still industry leaders. The EU countries began later in this sector and, although they have improved their position, have failed to catch the U.S. Staying behind the U.S. could not only delay the effects of growth potential of this technology, but could also cause the growth of entry barriers that can prevent a process full of balance with the U.S.. Apart from the U.S., are emerging new countries like Canada, Australia or Israel which are offering a growing competition.
- There are threats in human resources, for example the continuous brain drain towards more attractive projects abroad due to a lack of policies for job stability, remuneration and social recognition of the scientific class. There is also something of a gap between what is taught in classrooms under current academic curricula and what the market needs, especially in terms of language skills and business management.
- In the field of biotechnology for human health, which is the dominant area of activity in Catalonia is becoming increasingly necessary to increase the number of patients participating in clinical trials that test new products and permit applications.

Strengths

- High-level infrastructure and structures. Investment in Science Parks, the emergence of business incubators and the government's belief in the importance of the sector with the creation of the first sector organisation in the shape of Biocat have turned Catalonia into a major bioregion comparable to other European science hubs.
- Levels of excellence in public research in Catalonia. The quality of the public system of excellence in fundamental research and hospitals, as evidenced by publications in high prestige journals, means that Catalan now accounts for 2.5% of Europe's scientific production, according to the study "Bibliometric Categorisation of Scientific Production in Catalonia" (Camí et al, 2008).
- Hospitals and universities of high international standing in research, especially in oncology and CNS. Catalan hospitals and universities have a significant international reputation, especially in the fields of oncology and the central nervous system where Hospital Clínic, Vall d'Hebron and Hospital Germans Trias i Pujol are outstanding.
- Business sector that makes a major effort in R&D. Apart from public resources, there is also significant private sector investment in R&D. In 2008, the private sector accounted for 60.9% of all R&D investment in Catalonia.
- Increasing pace of new business creation that is well above the average of other sectors as a result of a very entrepreneurial mindset and new business opportunities and niche research. Many public entities, entrepreneurs and private companies choose to set up their own companies and carry out specific projects.
- High level of scientific training of human resources. The existence of very flat structures where there is no difference between business management and scientific levels is one of the reasons why people who work in the biotechnology and biomedicine sector have very high levels of education.
- In recent years the bio sector has gained social presence and both public institutions and the financial sector are more responsive to their demands.
- There is a clear commitment and institutional support regarding R&D in general, and biotechnology in

particular. This commitment is not only financing specific research projects or infrastructure development by the public sector, it also materialized in the planning of public policies aimed at strengthening the sector (an example would be the adoption of the Plan strategic Research and Innovation 2012-2015 Health of the Generalitat of Catalonia).

- There is a high level of scientific cooperation between public institutions and businesses. Biotech companies believe that this collaboration with R&D public system is vital for the development of its business. Despite the importance of this collaboration, very often doesn't leads to the generation of patents, but in some other types of outputs.
- Have emerged and become established institutions (such as the Genome Spain Foundation, ASEBIO Biocat, etc.) working for the promotion and strengthening of biotechnology programs by funding research and technology transfer; and are working for the creation of networks that enable companies to establish links with research groups. These organizations are also working to identify niches of expertise helping to its develop both scientific and business.

Opportunities

- A future in which the market for health and wellbeing is growing in all industrialised countries. This market will increasingly be dominated by biotechnology products. This is a clear example of how biotechnology is becoming more integrated into everyday life and business and industrial processes. Examples include waste treatment and the creation of biotech-based materials and fuels in the field of white biotechnology, as well as nutritional and agricultural improvements in the case of green biotechnology.
- It is an anti-cyclical sector that is beginning to attract investment from other more traditional sectors. The multidisciplinary nature of the sector makes it possible to interact with and feed off various areas of knowledge. Simultaneously, the health sector has a strong anti-cyclical component and is very resistant to economic cycles. This gives the sector a significant capacity to attract investment.
- Focus of the pharmaceutical industry on biotechnology research. Major pharmaceutical companies are adding to their product catalogues by developing biotechnology products or using technology drawn from this sector. A biotech company may be bought and integrated into the corporate structure or partnerships may be established simply to develop a specific product or use a given technology.
- Policies based on a shift towards a knowledge economy.
- High levels of investment by public stakeholders to promote research and innovation.
- Integration of biotechnology in increasing numbers of business processes and areas to enhance efficiency and which also makes the sector more competitive.
- Emergence of the VIPCO model to promote the biotech sector. The above trends encourage the appearance of companies which outsource much of their value chain and become virtual enterprises which have very few internal resources. This is the VIPCO (Virtually Integrated Pharmaceutical Company) model which is becoming increasingly widespread in the biotechnology sector.

07

City projects

Biotechnology/Medical Technology Cluster

Barcelona City Council's Economic Development Department has been promoting the biotechnology and biomedicine sector in the city for a number of years. Specifically a biotechnology and medical technology cluster has been developed in the 22@Barcelona district and is one of Barcelona's strategic economic development clusters. It is designed to ensure that business development in the sector takes place at the same pace as in other European regions and generate industrial, scientific and innovative activity that makes Barcelona and Catalonia into the main hub in southern Europe in this field.

22@Barcelona promotes the creation and growth of biotechnology and biomedical engineering companies and seeks to persuade companies in the sector to come to Barcelona. The goal is to develop a cluster featuring domestic and foreign stakeholders in coordination with Biocat, the Catalan bioregion which is developing the Catalan biotechnology cluster. These business initiatives run in lockstep with research and development, technology transfer, training, etc.

As a result of the work of 22@, which has so far taken place in the Poblenou district, there are now 27 medical technology companies operating in the area. Some of the major sector companies now located in the 22@ innovation district are Sanofi Aventis, Novartis, Camp i Jové, Telemedicine and Isdin.

22@ works closely with leading biomedical research centres and organisations in order to develop the cluster.

<http://www.22barcelona.com/>

Barcelona Biomedical Research Park (PRBB - UPF)

The PRBB is a large scientific infrastructure set up by the Government of Catalonia, Barcelona City Council and Pompeu Fabra University (UPF). Its site adjoins Hospital del Mar in Barcelona and brings together six closely coordinated public research centres. It is one of the largest biomedical research centres in southern Europe.

The scientific activity of its research groups focuses on biomedical informatics and systems biology, gene regulation and epigenetics, cell biology and development, pharmacology and clinical pathophysiology, human genetics and evolutionary biology, epidemiology and public health. The PRBB's scientific project brings together independent institutions and research centres, each focused on different aspects of biomedicine:

- Municipal Medical Research Institute (IMIM), whose mission is to establish practical links between fundamental research and clinical practice at the university hospital.
- Department of Experimental and Health Sciences at Pompeu Fabra University (UPF-CEXS), which invests in the training of future high-level scientists and runs an interdisciplinary PhD programme taught in English.
- Centre for Genomic Regulation (CRG), which researches the genomic basis of disease to improve quality of life.
- Barcelona Centre for Regenerative Medicine (CMRB), which focuses on research into basic mechanisms of early development and organogenesis, as well as finding applications for treating degenerative diseases.
- Centre for Research in Environmental Epidemiology (CREAL), which identifies the environmental determinants of health and promotes their prevention and control.
- Institute of Advanced Technology (IAT) which delivers PET and cell imaging technology giving live visualisations of biochemical processes for fundamental and clinical research.
- Hospital del Mar (IMAS).

<http://www.prbb.org/>

Barcelona Science Park (PCB - UB)

The Barcelona Science Park is a meeting point for universities, business and society that promotes innovation, mainly in the life sciences.

Set up by the University of Barcelona in 1997, it was the first science park in Spain and today is an international leader in fostering innovation which hosts more than 2,200 professionals.

The Barcelona Science Park seeks to promote research excellence with the support of a wide range of technologies, boost the relationship between universities and industry, drive the creation of new companies and institutes and promote dialogue between science and society and the scientific professions.

It currently hosts 3 research institutes, 75 companies, an incubator for biotechnology companies, more than 70 research groups and a wide range of technological support for research. It also runs more than 120 activities to promote scientific culture and foster new scientific vocations attended by nearly 6,000 people every year.

The Barcelona Science Park completed its expansion project in 2011 that will increase its size to 96,000m². It has research groups from the public and private sectors and a wide range of technological facilities:

- Co.S.Mo. LAB (Computer Simulation & Modelling).
- IDIBAPS-Hospital Clínic Neuroimmunology Group.
- Rheumatology Research Group (Vall Hebron).
- AIDS Research Group (Hospital Clínic).
- Institute of Bioengineering of Catalonia (IBEC).
- Barcelona Institute of Molecular Biology (IBMB-CSIC).
- Institute for Environmental Assessment and Water Research (IDAEA).
- Institute for Research in Biomedicine (IRB Barcelona).

<http://www.pcb.ub.es/>

Centre for Research in Biomedical Engineering (CREB)

The Centre for Research in Biomedical Engineering (CREB) at the Technical University of Catalonia is a multidisciplinary research centre that meets demand for R&D in the field of biomedical engineering. The CREB consists of a team of highly qualified researchers who have solid professional experience. The CREB's main goal is to provide solutions to technological, training, clinical and industrial needs in the field of biomedical engineering.

<http://www.creb.upc.es/>

Blood and Tissue Bank (BST)

The Blood and Tissue Bank is a public company whose mission is the management and administration of the donation, transfusion and analysis of blood and blood plasma, as well as acting as a centre for gathering and processing tissues, in addition to other areas of activity in immunobiology, molecular diagnosis, cell therapy and regenerative medicine. It is the core entity in the haemotherapy system in Catalonia, a centre specialising in selective immunobiology and molecular analysis and research and a research centre in regenerative medicine. The BST is involved in research projects that are either entirely its own or run in partnership with all Catalan Institute of Health centres, the majority of the Public Hospital Network and Catalonia's universities.

<http://www.bancsang.net/>

Catalonia Bio

Catalonia Bio is the Catalan Association of Biotechnology Companies, a biotechnology industry initiative which brings together all companies with interests in the sector that need a common platform to take part constructively, efficiently and inclusively in mapping out the sector's framework for action and in particular public sector incentive policies.

<http://www.cataloniabio.org/>

08

Useful links

International organisations

EMA (European Medicines Agency)

<http://www.ema.europa.eu>

FDA (Food and Drugs Administration)

<http://www.fda.gov>

WHO (World Health Organisation)

<http://www.who.int/es>

EFPIA (European Federation of Pharmaceutical industry and Associations)

<http://www.efpia.eu>

EUROPABIO (The European Association of Bioindustries)

<http://www.europabio.org>

CEBR (Council of European Bioregions)

<http://www.cebr.net>

Spanish organisations

Biocat – BioRegion of Catalonia

<http://www.biocat.cat>

Catalonia Bio (Catalan Association of Biotechnology Companies)

<http://www.cataloniabio.org>

AEMPS (Spanish Medicines and Health Products Agency)

<http://www.aemps.es>

ASEBIO (Spanish Biotechnology Association)

<http://www.asebio.com>

Farmaindustria (Spanish National Association of Pharmaceutical Companies)

<http://www.farmaindustria.es>

SEBIOT (Spanish Biotechnology Society)

<http://www.sebiot.org>

AEFI (Spanish Association of Industry Pharmacists)

<http://www.aefi.org>

International events (fairs, conferences, etc.)

Livestock Biotech Summit

<http://bio.org/livestockbiotechsummit>

BIO Investor Forum

<http://www.bio.org/investorforum>

BIO Intellectual Property Counsels Committee Fall Conference and Committee Meeting

<http://www.bio.org/ipcc/index.asp>

BIO Europe International Partnering Conference
<http://www.ebdgroup.com/bioeurope>

MEDICA
<http://www.medica-tradefair.com>

Spanish events (fairs, conferences, etc.)

BIOSPAIN
<http://www.biospain2010.org>

BIOCAT FORUM
<http://forum.biocat.cat>

TECNIO FORUM
<http://www.acc10.cat>

Spanish Pharmacology Society Congress
<http://www.socesfar.com>

International themed portals

7th Framework Programme
https://cordis.europa.eu/fp7/home_en.html

IMI - Innovative Medicines Platform
<http://www.imi.europa.eu/>

IASP - International Association of Science Parks
<http://www.iasp.ws/>

Spanish themed portals

IMI (Spanish Technological Platform for Innovative Medicines)
<http://www.medicamentosinnovadores.org>

Tecnociencia (Spanish Science and Technology Portal)
<http://www.tecnociencia.es>

XPCAT (Science Parks of Catalonia Association)
<http://www.xpcat.net>

IRTA (Food and Technology Research Institute)
<http://www.irta.es>

Icrea (Catalan Institute for Research and Advanced Studies)
<http://www.icrea.cat>

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