



EDIH DATAlife
Project

D6.6. Strategic report on digital & biotechnology

EDIH-DATALife Digital Europe Programme (DIGITAL)



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VERSION CONTROL

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CURRENT STATE OF THE SECTOR: LEVEL OF DIGITALISATION, CAPABILITIES AND BARRIERS.

OVERVIEW AND LEVEL OF DIGITALIZATION

The Galician biotechnology sector is going through a process of progressive digitalization that has experienced significant progress in the last three years. This transformation is part of a broader context of digitalisation of the bioeconomy and strategic sectors in Galicia, driven by European programmes such as the European Digital Innovation Hub (EDIH) DATAlife, which acts as a catalyst and point of reference for the adoption of disruptive technologies in the region.

The level of digitalisation of the Galician biotechnology ecosystem is in an intermediate development phase, with a growing but uneven adoption of the main digital technologies, as reflected in a survey on the digitalisation of the sector carried out by Bioga in 2023 ([Bioga, 2023](#)). The data reflect a sector aware of the transformative potential of digitalisation, although it still faces barriers in practical implementation, specialised training and technological investment.

In general, startups and larger companies are the most advanced in the use of digital tools, while traditional SMEs show a more limited degree of digitalization and focus on basic processes. Universities and technology centres act as poles of digital innovation, especially in the areas of artificial intelligence, biorobotics and advanced computing.

According to the 2023 Bioga Digitalisation Survey, Big Data and Artificial Intelligence are among the most implemented digital technologies in the Galician biotech ecosystem, with adoption levels varying significantly by company size and application area. In larger companies, Big Data is mainly used in industrial process optimization, logistics management and omics data analysis, while in small companies and spin-offs it is oriented towards quality control, analysis of experimental tests or basic interpretation of results.

Artificial Intelligence, with a similar level of use, is mainly applied to tasks such as the design and screening of biomolecules, prediction of biological behaviour and automation of laboratory tasks. However, the "Analysis of new technologies in the biotechnology sector" carried out by AseBio in 2023 ([ASEBIO, 2023](#)) reflects that, at least on a national scale, implementation is still partial and not integrated into complete workflows.

For its part, the Internet of Things (IoT) has a more incipient implementation (around 20% of entities), mainly in environmental monitoring projects, bioprocess monitoring, sample traceability and remote control of equipment.

These results are mostly aligned with the national trends identified in the AseBio report, which shows that 68% of Spanish biotechnology organizations already use Big Data tools, 61% use AI, and around 40% have incorporated IoT ([ASEBIO, 2023](#)). The main limitations for adoption, both in Galicia and in the rest of the country, are the lack of internal training and the insufficient technological maturity of existing solutions.

Similarly, the information obtained after the celebration of the Biotechnology sectorial roundtables within the framework of the EDIH DATAlife (WP6) project reinforces this vision: 48% of the participants pointed to the comprehensive digitalization of the laboratory ("Lab 4.0") as a strategic priority, while 24% highlighted advanced analytics of omics data (DATAomics) as a second line of interest. The attending agents agreed that the Lab 4.0 model – understood as the automation and digitalization of processes through sensors, connected instrumentation, data management software and intelligent analytics – represents the most immediate transformative pillar for the sector.

Despite these advances, the current state of the ecosystem reveals significant asymmetries in digital maturity. There are very advanced players in analytical technologies, AI or data management, along with a large group of SMEs with a low level of digitalization and dependence on manual processes. As a result, the sector is at an intermediate level of digital maturity, characterised by high awareness, but still limited execution.

ENABLING CAPACITIES AND ASSETS IN GALICIA

Galicia has a robust technological and institutional structure that favours the digital transition of the biotechnology sector. On the one hand, the DATAlife hub acts as a one-stop shop for digitalisation, offering services such as *Test Before Invest*, *Skills & Training*, *Ecosystem Building* or *Funding Navigation*, articulated around Artificial Intelligence and advanced data management.

In this context, Bioga leads the implementation of services aimed at the biotechnology sector, connecting companies with specialized knowledge and technology centers largely through the EDIH DATAlife project.

Key assets of the Galician ecosystem include the Galician Supercomputing Centre (CESGA), which provides High Performance Computing (HPC) infrastructure for bioinformatics analysis, molecular modelling, process simulation and massive data storage; technology centres and driving companies such as Gradiant, ITG, AIMEN, Televes or EGA, which offer expertise in applied AI, cybersecurity, artificial vision and industrial automation; and the three Galician universities (USC, UVigo and UDC), with groups and research centres specialising in bioinformatics, biomedical AI and data federation, highlighting among others the Centre for Research in Intelligent Technologies of the University of Santiago de Compostela (CiTIUS) or the atlantTic Research Centre of the University of Vigo.

However, although the regional ecosystem has cutting-edge infrastructures, it needs to strengthen the digital skills of its human capital as reflected in the needs assessment and training offer carried out in the EDIH DATAlife project. That is why a substantial part of the project's activities have been oriented towards technical training and training, with specific programmes in AI, laboratory digitalisation or cybersecurity.



Figure 1. Main R&D players in the Galician Biotech sector

In summary, Galicia has an advanced technological base, coordinated governance and an emerging training offer that position the biotechnology ecosystem as one of the most prepared to move towards comprehensive digitalisation within the set of peripheral European regions.

BARRIERS AND LIMITATIONS

Despite the potential identified, the digitalisation of the Galician biotechnology sector faces multiple barriers, documented in the project's surveys and meetings.

The analysis of new technologies in the biotechnology sector carried out by AseBio identifies two main limitations in the adoption of Big Data and AI: the lack of training of personnel and the degree of technological maturity of the available solutions. These same conclusions are reflected in the digitalisation survey conducted by

Bioga, where more than half of the companies declare that they do not yet use advanced digital tools or have formal digitalisation strategies.

In particular, the results of the Biotechnology sectorial roundtables tables held in the DATAlife project reflect operational barriers specific to the laboratory environment, such as the persistence of the use of paper documentation and manual records, limited interoperability between instruments, software and analytical platforms, the difficulty in quantifying and leveraging experimental data, which limits traceability and analytical capacity, as well as the complexity of digital interfaces, which deters non-technical users.

At the same time, the assessment of training needs and existing offer that was carried out in the project reveals a generalised deficit of digital skills. This is reaffirmed in the results of the satisfaction questionnaire carried out after the training in Artificial Intelligence applied to process optimization in the biotechnology sector organized by Bioga: companies demand basic and applied training in data capture, integration and analysis, as well as in governance, protection of sensitive data and cybersecurity.

Another prominent barrier is financing, especially in SMEs, which report difficulties in accessing resources to acquire technology, hire experts or implement pilot projects. The results generated at the Biotechnology sectorial roundtables within the framework of the project on the needs of companies in the framework of digitalisation confirm that the initial investment and the absence of suppliers adapted to the sector are two of the most limiting factors.

Technological maturity is also mentioned as an obstacle in emerging technologies such as IoT or robotics applied to the laboratory, where there are still doubts about the reliability, compatibility and profitability of commercial solutions. Finally, the absence of a transversal collaborative culture that integrates biological, computer and engineering profiles is highlighted, which hinders the effective transfer of digital knowledge from technology centers to companies.

TRAINING AND ADOPTION NEEDS

The training component is a key element in the EDIH DATAlife strategy for the biotechnology sector. Both the satisfaction survey of Training in Optimised Digital Protocols coordinated by Bioga and the assessment of existing training needs and offer ([EDIH-DATALIFE, 2023](#)) show that the vast majority of companies value training as the main instrument for reducing the digital divide.

The identified needs focus on three main areas: Artificial Intelligence and Big Data: from conceptual introduction to practical application to biological data analysis; IoT and laboratory automation: design of digital workflows, use of electronic laboratory notebooks (ELN) and LIMS systems; and Data governance and cybersecurity: protection of sensitive data, interoperability and regulatory compliance.

Training is in demand in flexible and modular formats, with content adapted to different levels of experience. The most priority profiles are laboratory technicians, quality managers, researchers and management staff who must lead the digital transition.

The conclusions of the existing [training needs and offer assessment document](#) show that the current offer of digital training in Galicia is still insufficient and does not adequately cover the demand of the biotechnology sector. There is a lack of practical content, focused on real cases and with a focus applied to laboratory work.

Likewise, the results of the survey on optimised digital protocols show a high level of satisfaction with the pilot trainings delivered within the framework of the DATAlife project, especially those that combine theory, practice and personalised guidance. This reinforces the importance of maintaining and expanding the continuous training programs promoted by the hub.

In addition, as proposed within the EDIH DATAlife project, digitalisation must be accompanied by support and technical advisory services that help companies define their digital roadmap, assess the viability of solutions and reduce the risks associated with technological investment. The combination of training and mentoring is therefore considered the most effective way to ensure sustained and lasting adoption.

CONCLUSIONS

The joint diagnosis of the sources consulted allows us to affirm that the Galician biotechnology sector has a solid basis for its digitalization, but requires a coordinated and sustained strategy that combines training, investment and accompaniment.

Galicia has first-rate technological and human assets. However, the level of adoption in companies, especially in SMEs, remains moderate and uneven.

Digitalization is advancing with greater intensity in Big Data and Artificial Intelligence, while IoT, laboratory automation and data spaces emerge as upcoming areas of expansion. Lab 4.0 is consolidated as the most relevant strategic challenge, capable of fundamentally transforming the productivity and quality of biotechnological processes.

The main barriers include lack of training, technological maturity of solutions, limited funding, and integration and interoperability difficulties. Overcoming them requires comprehensive action that combines continuous training, financial support, technology demonstration services and public-private cooperation.

KEY TECHNOLOGIES IN THE SECTOR

The digitalisation process of the Galician biotechnology sector is based on a set of disruptive technologies that are grouped around five pillars: Artificial Intelligence (AI), Big Data and advanced analytics, Internet of Things (IoT), High Performance Computing (HPC), cybersecurity and federated data spaces.

The Galician biotechnology sector has a differential degree of maturity in each of them. The Bioga (2023) and AseBio (2023) digitalisation surveys, together with the results of the sectorial roundtables for the biotechnology sector carried out in the EDIH DATAlife project, reveal that Big Data and AI are the most well-known and used technologies, while IoT, robotics, blockchain and augmented reality are still in the early stages of implementation

Next, the main key technologies, their areas of application in biotechnology, the use cases identified in Galicia and the training and support lines promoted within the framework of the EDIH DATAlife project for their effective adoption are described.

ARTIFICIAL INTELLIGENCE (AI)

Artificial Intelligence is the cornerstone of digital transformation in biotechnology. As indicated in the analysis by AseBio and Bioga, and in the analysis of training needs, AI is already applied in the fields of drug discovery, medical diagnostics, omics analysis, process optimization and industrial formulation, and is considered the technology with the greatest cross-cutting potential.

AI enables processing and learning from large volumes of biological data, generating predictive and prescriptive models that improve scientific and industrial decision-making. In the healthcare field, AI is used in disease prediction and personalized medicine, optimizing diagnoses and treatments based on genetic or clinical data. In the biotechnology industry, it is applied to bioprocess optimization, automated quality control, and pattern detection in images or molecular sequences.

The training programme "Applications for data analysis and optimisation of biotechnological processes based on AI" carried out within the framework of the EDIH DATAlife project has deepened this approach, training technicians and researchers in the practical use of AI for genomic, proteomic and metabolomic analysis.

This course, designed by the *Institute of Knowledge Engineering (IIC)* and coordinated by Bioga, covers everything from the fundamentals of *machine learning* to advanced applications such as prediction of pathogenic variants, detection of tumor precursor genes, analysis of protein interaction networks or design of chemical formulations using generative models.

The satisfaction evaluations carried out after the first pilot trainings show a high level of interest and positive assessment, highlighting the direct applicability to real environments and the need to extend the sessions to more advanced levels.

In summary, AI is consolidating itself as the driving technology par excellence of the Galician biotechnology sector, with a rapid expansion towards applications of

computational biology, digital health and industrial bioprocesses, and a local ecosystem prepared for its large-scale adoption through collaboration between regional agents.

BIG DATA AND ADVANCED ANALYTICS

Big Data represents the operational basis on which AI and the digital transformation of the sector are based. According to AseBio (2023), it is the most widespread technology in Spanish and Galician biotechnology, with intensive use in the processing of omics and clinical data.

The biotechnology sector generates large volumes of data – from genomic sequencing, laboratory experiments, industrial sensors or clinical trials – that, without proper management, remain underused. Advanced analytics and data visualization systems (Power BI, Tableau, Cytoscape) make it easy to turn that data into actionable insights.

The case of AMSLab, included in the training catalogue prepared in work package 5 of the EDIH DATAlife project, is illustrative. The company has carried out the integration of tools such as LIMS, OpenLab, Bitrix and PowerBI, allowing the complete digitization of laboratory flows, eliminating the use of paper and having real-time dashboards connected to the production chain.

This example serves to illustrate a smart laboratory case, demonstrating that digitization and data analysis not only optimize efficiency, but also improve traceability, quality, and decision-making.

Likewise, the training program in data visualization for decision-making included in the project's Digital Training Catalog complements the training in analytical tools and interactive dashboards, reinforcing the culture of data-based management.

INTERNET OF THINGS (IOT) AND SMART SENSORS

IoT is emerging as a key technology to connect the physical and digital worlds in biotechnology. Its application focuses on monitoring environmental and process parameters, laboratory automation, remote bioprocess management and sample traceability.

In the review carried out in the project to identify the available technologies and the needs of digitalization Galicia, several specific examples of IoT use in the sector are pointed out: sensors for the control of fermenters and bioreactors, automatic regulation systems of production parameters and remote monitoring of cell or vegetable cultures.

Within the framework of the EDIH DATAlife project, demonstration and training programs on IoT sensors and SCADA systems have been developed. These initiatives seek to automate the acquisition of experimental data and reduce human errors, integrating sensors with analysis platforms (LIMS/ELN/PowerBI).

Although IoT adoption is still at low levels – around 20% of Galician biotechnology companies according to the survey carried out by Bioga – its growth potential is high. Its technological maturity has improved significantly in recent years and its integration with AI and Big Data multiplies the possibilities of application.

HIGH PERFORMANCE COMPUTING (HPC)

High Performance Computing (HPC) is a critical element in the digital infrastructure of the Galician ecosystem. The Galician Supercomputing Centre (CESGA), a strategic partner of DATAlife, offers massive computing capacity and specialised services in bioinformatics analysis, molecular simulation, protein modelling and management of large volumes of data.

CESGA provides direct support to applied AI projects, facilitating the execution of complex algorithms in secure and scalable environments. This infrastructure makes Galicia one of the peripheral European regions with the highest computational capacity per capita in biosciences.

The use of HPC is critical in areas such as in silico drug design, metabolic pathway simulation, comparative genomics, and large-scale AI model training. Its integration with advanced AI training allows users in the biotechnology sector to access computational resources previously reserved for large corporations.

CYBERSECURITY AND PROTECTION OF SENSITIVE DATA

Cybersecurity is a cross-cutting and priority element in the digitalization of the biotechnology sector, where the management of genomic, clinical and industrial data requires high standards of protection. Within the framework of the EDIH DATAlife project, Bioga coordinated the training "Cybersecurity: management of sensitive data", focused on strengthening the culture of digital security in companies and biotechnology laboratories.

The course provided a practical insight into risk management, cyber threat protection, and data protection compliance (GDPR, LOPDGDD, HIPAA). In addition, it promoted the adoption of privacy policies by design, the responsible use of digital tools and the implementation of good organizational practices that reduce exposure to security incidents.

This initiative has made it possible to raise awareness in the biotechnology ecosystem about the importance of integrating cybersecurity into digitalisation processes, consolidating it as a key enabling technology to guarantee the integrity, confidentiality and sovereignty of scientific and industrial data in Galicia.

FEDERATED DATA SPACES

One of the most advanced concepts in the European industrial digitalisation strategy is that of federated data spaces, which allow information to be shared between organisations in a secure and controlled way.

In biotechnology, these spaces have the potential to integrate research, clinical, and industrial data while respecting data confidentiality and sovereignty. Galicia is in the initial phase of exploring these models, as has been confirmed in the training needs assessment carried out in the EDIH DATAlife project, through which the lack of training and practical knowledge on Data Spaces, their governance and data interoperability has been identified.

The progressive implementation of data spaces is essential to move towards biotechnology based on collaboration and the ethical use of information, aligning

Galicia with European initiatives such as European Health Data Space and BioDataNet.

An example is the [DATAlife Data Space](#), developed by CESGA, a secure and federated data-sharing platform focused on a *One Health* approach. It enables public and private organizations to exchange data in an interoperable, sovereign and trustworthy environment, providing core services such as identity management, access control and data governance to support collaborative, data-driven innovation.

ROBOTICS, AUTOMATION AND AUGMENTED REALITY

Although its current level of implementation is limited, robotics applied to biotechnology laboratories represents an emerging vector of innovation. The main intended uses are the automation of sample handling, cell culture and chemical analysis, as well as integration with machine vision and remote-control systems.

In the healthcare field, robotics and augmented reality are applied to telesurgery, 3D organ printing, creation of personalized prostheses, and advanced medical training. Although still in the experimental phase, some Galician companies and research groups (e.g. Kaertor Foundation, Innopharma-CIMUS) are already exploring these technologies in European innovation projects.

In summary, the technologies described – AI, Big Data, IoT, HPC, cybersecurity, Data Spaces and automation – do not act in isolation, but form an interconnected digital ecosystem. Its coordinated application will promote the transformation of Galician biotechnology towards an intelligent, automated, paperless, connected and analytical laboratory, a data-based biotechnology (DATAomics), which uses advanced analytics and HPC to convert biological information into knowledge applicable to drugs, diagnostics or industrial processes; and towards a collaborative data ecosystem (DATAspace), which will allow the secure sharing of information between actors in the innovation system.

TEN KEY RECOMMENDATIONS FOR PUBLIC ADMINISTRATION

1. Promote a specific digital governance framework for biotechnology

The Administration must consolidate a stable public-private governance model that connects the Digital Galicia Strategy 2030 with the new Biotechnology Excellence Strategy 2026-2030. One proposal would be to create a Biotechnological Digital Transformation Coordination Working Group, which articulates initiatives to support digital transformation and monitors indicators.

2. Promote secure infrastructures and data spaces

The creation of data spaces for the sector, in connection with European healthcare and industrial data initiatives, would accelerate data-driven innovation by ensuring GDPR sovereignty and compliance. The sector requires the use of advanced computing (HPC) infrastructures and intensified collaboration with specialized data centers such as CESGA, with whom Bioga has strengthened its collaboration to use high-performance computing as a driver of the Galician biotechnology sector. An example is the **DATAlife Data Space**, which is under development by CESGA as mentioned before.

3. Consolidate a public financing policy aimed at digitalisation

It is necessary to align regional calls with the objectives of the Digital Europe Programme, prioritising projects that combine biotechnology and enabling technologies (AI, IoT, HPC, Blockchain, robotics). The future Agreement to be established between GAIN and Bioga (2026-2027 and 2028-2029) should support this orientation.

4. Strengthen specialized digital training

The training gaps detected in the report of Work Package 5 of the EDIH DATAlife project require a strategy of continuous training in AI, cybersecurity and biomedical data management. It is recommended to incorporate specific itineraries in the Galician university and vocational training system, and to take DATAlife as a reference training centre in digital skills in the sector.

5. Encourage technological adoption in SMEs and startups

78% of Galician companies in the sector consider digitalisation a priority, but only 34% have integrated it in an advanced way. The Administration must maintain lines of advice and incentives aimed at the automation of laboratory processes, analysis of biological data and predictive models of R+D.

6. Promote public procurement of innovation (PPI)

The PPI should be used as a lever to accelerate the validation and adoption of digital solutions developed in Galicia. It is recommended to include interoperability clauses, FAIR standards and data sustainability in the specifications, following the guidelines of the Digital Galicia 2030 Strategy.

7. Create a system of incentives for digital technology transfer

The strengthening of technology transfer mechanisms – patents, licences, *proof of concept* and living laboratories – requires a regional programme of open innovation between universities, technology centres and companies, for example through a fund that finances digital prototypes with high market potential.

8. Strengthen cybersecurity and ethics in biotechnology data management

The protection of sensitive data must be at the heart of the public strategy. The development of a protocol of Good Practices in Biotechnological Cybersecurity is

proposed, based on the training contents of the EDIH DATAlife project. This framework should ensure the integrity and traceability of biomedical information in AI environments.

9. Integrate digitalisation into RIS3 Galicia and sustainability programmes

Biotechnological digitalisation must be aligned with the circular bioeconomy, health and sustainability axes of the RIS3 Galicia 2021-2027. It is recommended that the Xunta promote driving projects that combine artificial intelligence, genomics and green economy, in line with axes 10 and 11 of Galicia Digital 2030 on digital economy and technological specialization.

10. Establish a biotech digitalization observatory

Finally, the creation of an Observatory of Digitalization of the Galician Biotechnology Sector is proposed, which collects indicators, monitors the impact of public policies and guides data-based decision-making. This instrument would contribute to the monitoring of the Biotechnology Excellence Strategy and facilitate the continuous assessment of the sector's digital capabilities.