



Report

D6.6 OLISSIPO impact assessment and forecast

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Executive Summary

The OLISSIPO project was designed to create an institutional network between INESC-ID (Instituto Superior Técnico/ULisboa), INRIA, ETH, and EMBL to spread excellence in key strategic areas and, consequently, stimulate scientific excellence and innovation capacity in Computational Biology at INESC-ID in Lisbon, Portugal. From January 2021 to June 2024, OLISSIPO actively provided comprehensive training to staff and Early Stage Researchers (ESRs), creating a critical mass at the convergence of computer science and health research. Beyond individual development, the initiative sought to fortify collaborative networks by enhancing proficiency in theoretical modelling, computer science, and statistical learning, directly impacting the fields of biology, medicine, and health applications. Various activities, such as short-term staff exchanges, the organization of joint events, schools, workshops, and conferences, as well as efforts to strengthen research management and administration skills at INESC-ID, were pivotal components of OLISSIPO. Additionally, OLISSIPO was dedicated to effective dissemination, communication, and outreach to maximize the impact of its research outcomes.

This deliverable reports the overall assessment of the impact of OLISSIPO and summarizes future activities after the completion of the project in order to maintain the momentum created and forecast novel projects and actions.

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1. Introduction

Although the impact of Computational Biology never ceased to grow in the last two decades, Portugal experienced a stagnation in the evolution of publications in this area in the past years when compared with the other partners. After a period of significant increase, delayed several years in comparison with the other countries, it is crucial to leverage the developed potential to maintain Portugal's competitiveness in this key area of research. INESC-ID was a pioneer institution where one of the first Bioinformatics groups in Portugal was born: the Knowledge Discovery and Bioinformatics (KDBIO), whose main objective was to integrate competencies from researchers in diverse fields, including computer science, biology, statistics and control. The group was later integrated into the Information and Decision Support Systems (IDSS) Lab.

Some years ago, the INESC-ID PI, Prof. Susana Vinga, identified the need to design a project to create an institutional network between INESC-ID (Instituto Superior Técnico/ULisboa) and the European partners INRIA, ETH, and EMBL. The main aim of the OLISSIPO project is to spread excellence in key strategic areas and, consequently, stimulate scientific excellence and innovation capacity in Computational Biology.

2. Impact Assessment

The main aim of evaluation and impact assessment is to ensure that the project outcomes are accurate and consistent with the planned objectives set out at the beginning. An additional aim is to provide evidence for the envisioned impact and present ways to demonstrate the project's influence beyond the consortium's borders.

During 2021-2023, we organized staff exchanges and joint lab retreats within the Consortium, amounting to more than 25 visits, with more than 30 weeks, involving around 40 participants (PIs, Scientific Advisory Board members, early-stage researchers, co-supervised MSc and PhD students, and administrative staff,). We organized online seminars and workshops (28 available on YouTube, with more than 3000 visualizations), besides four one-week Schools in Lisbon (20 invited speakers, more than 100 participants) and Alumni talks. OLISSIPO supported conference participations, and organized more than 15 outreach activities, participated in five training activities, and more than 10 courses for strengthening the research management and administration skills at INESC-ID. All these activities significantly contributed to achieve the predicted impact of the project.

2.1. Impact 1: Enhanced scientific and technological capacity of INESC-ID and increased scientific profile of its staff

The implementation of the OLISSIPO workplan, especially the staff exchange programme (WP1), the organisation of schools and workshops (WP2) and Early Stage Researchers (ESR) targeted activities (WP4) contributed to an enhanced scientific capacity of INESC-ID and also to the increase of the profile of its researchers and administrative staff. INESC-ID is indeed a flagship institution in the area of Computational Biology which fostered further developments at the interface of computer science and health applications in the four strategic areas defined in OLISSIPO: 1) single-cell analysis, modelling and simulation; 2) mathematical modelling of inter-cell and communities' interactions; 3) computational phylogenetics of cells and communities; and 4) translational bioinformatics, data management and software development.

Additionally, through the strengthening of the research management skills of INESC-ID (WP5), OLISSIPO decisively improved the competitiveness of INESC-ID in the application for research project funding from national and international agencies, thus contributing to the sustainability of its teams and their internationalization.

The Twinning partners INRIA, ETH, and EMBL, with the support of the Scientific Advisory Board (SAB), were crucial in this project. They all have an exceptional track record in highly competitive European grants, high-impact publications in computational biology, and an impressive worldwide strong collaboration with academic and industrial partners, which contributed to enhancing the scientific and technological capacity of INESC-ID and its staff.

2.1.1. Enhancing the scientific profile of INESC-ID Early Stage Researchers (ESR)

Some collaborations among the Twinning partners and INESC-ID were initiated before the project started and will last beyond the event of the OLISSIPO project. This is the case of the two PhD students, whose work was done under the co-supervision of Prof. Susana Vinga (INESC-ID) and Marie-France Sagot (Inria), namely:

- André Veríssimo. Network-based sparse regularization for the identification of disease signatures. PhD in Information Systems and Computer Engineering, IST-UL. Supervisor: S Vinga; Co-supervisors: AL Oliveira, MF Sagot. Feb 2021 (INESC-ID - Inria);
- Marianne Borderes. Characterization of host-gut microbiota interactions and identification of key players based on a unified reference for standardized quantitative metagenomics and

metabolic analysis framework. PhD in Bioinformatics. U Lyon 1. Supervisor: MF Sagot; Co-supervisor: S Vinga. Jul 2021 (INESC-ID - Inria).

The OLISSIPO project was dedicated to strengthening the existing network between the Twinning partners. Staff exchanges significantly contributed to initiating other synergies between institutions. During these visits, ESRs had the opportunity to work in groups according to their interests and research to find complementarities between partners and design possible collaboration plans. Importantly, joint projects were also started to be built during the annual meetings and retreats with SAB members. Two students developed part of their Master's thesis in the partner institutions (including institutions from the SAB members):

- Laura Quintas. Combined distance metric for labelled trees. MSc Biomedical Engineering. IST. Supervisor: S Vinga; Co-supervisor: N Beerenwinkel. Nov 2023 (INESC-ID - ETH);
- Raquel Romão. Detection of expression outliers in terminal exons. MSc Biological Engineering. IST. Supervisor: S Vinga; Co-supervisor: J Gagneur. Nov 2023 (INESC-ID - TUM).

Beyond staff exchanges, the project organised several activities dedicated to ESRs, namely schools, workshops and invited lectures (see WP2 reports), which contributed to enhancing the scientific profile of the ESRs. Additionally, the project supported ESRs' participation in international conferences and other events outside the OLISSIPO project. OLISSIPO supported the participation of nine INESC-ID ESRs in 25 scientific courses and conferences, such as Courses on Computational Data Analysis, Cancer Genomics, and Computational Biology. In addition, the project supported the participation of 10 INESC-ID ESRs in 48 courses and workshops in the areas of Project Management, Communication, Proposal Writing, Human Resources, Data Management Plan and Research Ethics (Annex I).

2.1.2. Enhancing research management skills of INESC-ID staff (administrative staff and researchers)

INESC-ID acknowledges the need for a fully professionalized unit capable of performing numerous essential functions, such as transferring knowledge to/with industry, supporting research grant applications, and liaising with external funding agencies. One of the aims of the OLISSIPO project is to potentiate INESC-ID research management skills and identify the existing best practices which best fit the INESC-ID case and the Portuguese reality.

In order to fulfill this aim, the project supported 14 participations of the OLISSIPO PI, Prof. Susana Vinga, and 54 participations of 14 INESC-ID staff (researchers and administrative staff) in courses and workshops on Project Management, Communication, Proposal Writing, Human Resources, Data Management Plan, and Research Ethics (also in Table 1). The OLISSIPO

team organised three editions focused on European Calls with Dr. Matthieu Py from Inria, one of the Twinning partners, to discuss several aspects of Pre-Award and exchange ideas and good practices. The first edition was dedicated only to INESC-ID staff, the second was also opened to Portuguese institutions and the third was composed of two parts (the first part was dedicated to INESC-ID staff and a seminar opened to IST research institutions).

In summary, the aforementioned activities have played a pivotal role in enhancing our operational effectiveness, demonstrating the criticality of transitioning to a fully professionalized unit.

2.2. Impact 2: Contribution to the Portuguese SMART specialisation strategy and the UN Sustainable Development Goals

Through the organization of conferences, events and training targeted to ESRs (WP2) and communication and outreach activities (WP3), the OLISSIPO project strengthened the link between Information and Communication Technologies and Health, in alignment with Lisbon area's defined priority to work on "Health research, technologies and services". This aspect is also aligned with the Sustainable Development Goals of the United Nations, especially Goal 3 "Ensure healthy lives and promote well-being for all at all ages". This is associated with the increased central role of Computational Biology in Pathology (interpreted as the study of diseases), from personalized healthcare and precision oncology to the analysis of infectious diseases.

The rate of innovation in genomics and medicine is increasing worldwide, with new technologies and much more data being used to create new healthcare paradigms. In this context, the skills of personnel, who work in the healthcare sector, are critical and a key factor in boosting innovation in existing and new institutions. A project like OLISSIPO was an excellent opportunity for INESC-ID and other Portuguese scientific institutions, to increase their knowledge networks and share skills and resources. The project supported Portuguese personnel training in different areas, potentiating their skills and improving research collaboration in Computational Biology.

2.2.1. Creating synergies with other initiatives

As part of Instituto Superior Técnico (IST) and the University of Lisbon (ULisboa), INESC-ID established connections with [EIT Health](#), with 140 leading organisations spanning key areas of healthcare, such as pharma, medtech, research institutions and universities. The EIT Health network is committed to delivering solutions to enable European citizens to live longer,

healthier lives by promoting innovation. INESC-ID also has a strong collaboration with the innovation program of Hospital da Luz, one of the main private hospitals in Portugal.

Additionally, the OLISSIPO PI, Prof. Susana Vinga, was co-chair of redeSAÚDE, one of the areas covered by the thematic networks of the ULisboa to accomplish one of the priorities of the Smart Specialisation Strategies (RIS3) within Portugal2020 framework and Horizon 2020 societal challenges: fostering internationalisation and new collaborations between the different ULisboa Schools.

OLISSIPO has significantly contributed to the positioning of INESC-ID as a national (with application on [BioData.PT](#)) reference concerning the creation and management of DMP and maDMP for the domain of Bioengineering.

Additionally, Data Science and Artificial Intelligence applications to clinical and biological data are gaining increasing interest, due to the envisaged impact it will bring to pharmaceutical, biotechnology, and biomedical companies. The organization of activities targeting the industry, such as the round-table during the OLISSIPO Retreat or our support to the organisation of the [2nd Microbiome PT Summit](#) also contributes to the Contribution to the Portuguese SMART specialization strategy and Sustainable Development Goals of the United Nations.

The project team collaborated during the entire project's lifetime with the Pre-Award offices at INESC-ID and IST and in partner institutions (e.g., Pre-Award Workshops) to target new programs to submit collaborative proposals to Horizon Europe (e.g., EIC Pathfinder, ERA Chairs, Marie Skłodowska-Curie Actions) and National Funds through the Portuguese Foundation of Science and Technology (FCT).

Prof. Susana at INESC-ID integrated the team of several submitted projects, some already with a final decision:

- HD4STARS project (Health Data integration to improve clinical outcomes for stroke, Alzheimer, and immune mediated chronic inflammatory diseases), HORIZON-RIA,, PI: Ana T. Freitas (INESC-ID); Not approved.
- [BioMembrOS](#) project ([Biomimetic Membranes for Organ Support](#)), EIC Pathfinder Open, Approved (starting date: 1 January 2024 - 30 June 2027), Coordinated by Vienna University of Technology.
- Fundação para a Ciência e a Tecnologia - FCT: 3 projects submitted 21 March 2024: <https://www.fct.pt/en/concursos/concurso-de-projetos-de-ic-dt-em-todos-os-dominios-cientificos-2023>

- PABLO - Precision Advances for multi-disease Biomarker discovery and drug repurposing through integrated modeling and Omics. PI: Marta B. Lopes (NOVA FCT Lisbon).
- NEXUS - Nexus of Multidisciplinary Approaches in Explainable and Causal Machine Learning. PI: Alexandra M. Carvalho (Instituto de Telecomunicações, Técnico).
- TRACI - On phylogenetic trees and networks representation and comparison. PI: Alexandre Francisco (INESC-ID, Técnico, ULisboa)

Most of these initiatives and established collaborations will last beyond the OLISSIPO project period and continue contributing to the Portuguese SMART specialisation strategy.

2.2.2. Ensuring awareness of Computational Biology

The OLISSIPO project aimed to engage with Portuguese scientific communities through conferences, seminars, and workshops and collaborate with Portuguese science communication platforms to disseminate project findings to a wider audience (Biodata, [INESC HUB](#), IST). In addition, the OLISSIPO team presented project findings at several outreach activities, such as the PhD Open Days at IST, “The Insider” podcast from INESC HUB, and Science and Technology 2021 Week. Details of these activities can be found in detail in Deliverable 3.5. This raised awareness and interest within the local scientific community and beyond and placed INESC-ID as a key role institution in Computational Biology.

Outreach activities developed in the context of this project ensured proper awareness of Computational Biology among diverse audiences. We targeted communication and dialogue with young students from secondary schools. The OLISSIPO project organised educational sessions to divulge the area of Computational Biology, namely the impact of multidisciplinary activities and challenges, in order to promote interest and curiosity in scientific areas, especially in STEM (Science, Technology, Engineering and Mathematics) applications to Medicine. Students were engaged in thinking, interacting, and debating their ideas formulated during the proposed activities (e.g., Girls in ICT, Summer in Ulisboa). We organised the “Computational Biology to Laboratory” (CB-OpenHouse), which integrated the existing “Dia do Técnico” and/or “Dia Aberto” IST/Ulisboa public events about science in Lisbon (Open Laboratories Initiative). This activity was held for four consecutive years (2021 – 2024).

INESC-ID/IST-Ulisboa participated in the FICA Festival and the 24th anniversary of Pavilhão do Conhecimento. The “Computational Biology to Laboratory” (CB2Lab) was created

to bridge the gap between research and schools. Teachers and students had the opportunity to contact with the basics of computational and molecular biology.

Notably, the OLISSIPO supported the League of Portuguese Bioinformatics. Graduate students and ESRs were invited to participate in this national competition in computational biology - Computational Biology Challenge (CB-Challenge). Participants needed to provide a solution to a particular biocomputational problem. This facilitated the contact and integration of the national community working in the area and possible collaborations. Prof. Susana Vinga was part of the Scientific Committee.

Round-table discussions raised awareness about the impact of Information and Communication Technologies in the Health area (OLISSIPO Retreat, Microbiome Summit, INESC Lisboa Meeting 2023).

2.3. Impact 3: Reinforcement of international collaborative networks, visibility and attractiveness of INESC-ID

All the OLISSIPO's work packages are associated with Impact 3 and the objectives set up for the project. In particular, the project significantly strengthened the institutional network between INESC-ID (IST/ULisboa), INRIA, ETH and EMBL, so as to spread excellence and stimulate scientific development and innovation capacity in Computational Biology. This stronger collaborative network expanded further among the Twinning partners' contacts, enhancing the internationalization of INESC-ID. Due to the existing networks in Lisbon and Portugal, the impact was spread regionally, with the involvement of current partners of INESC-ID, IST and ULisboa. The dissemination, communication, and outreach activities of OLISSIPO (WP3) boosted the INESC-ID's visibility to the public and divulged computational biology. The developed activities significantly increased the attractiveness of INESC-ID and Computational Biology, particularly for ESRs and PhD candidates (WP4).

2.3.1. Expanding international networks

Through the organization of training events (WP2), OLISSIPO has raised awareness and interest within the local scientific community and beyond. Through its activities, OLISSIPO helped give visibility to INESC-ID as a key institution in computational biology.

Through INRIA, Prof. Marie-France Sagot and the organization of Two for a Tango workshops, we had the opportunity to work with Prof. Ariel M. Silber, from the University of São Paulo, Brazil, more specifically the Institute of Mathematics and Statistics and the Institute of Biomedical Sciences – INRIA Associated Team Capoeira. This helped us expand the OLISSIPO

network to South America, with an impact on the visibility and attractiveness of INESC-ID, and to further expand and strengthen collaborations outside Europe, reinforcing Lisbon as a key hub between Europe and non-EU countries. Additionally, it helped us attract ESRs to our activities.

The PI of OLISSIPO, Prof. Susana Vinga, became a member of [ELLIS](#), the European Laboratory for Learning and Intelligent Systems. It builds upon machine learning as the driver for modern AI and aims to secure Europe's sovereignty in this competitive field by creating a multi-centric AI research laboratory. ELLIS wants to ensure that the highest level of AI research is performed in the open societies of Europe and follows a three-pillar strategy to achieve that. Being part of this network will undoubtedly benefit this area and INESC-ID.

One of the examples which demonstrate that INESC-ID and Susana Vinga's group have been highlighted in Computational Biology in Portugal is the invitation from the Luxembourg Centre of Systems Biomedicine to Prof. Susana to integrate the "Mechanistic Modeling and Causal Analysis of Biomedical Data" Lecture Series. This initiative aims to host internationally recognized researchers in biological network analysis, mechanistic disease modelling and related fields who can motivate, challenge and inspire through their own research projects and professional experiences.

2.3.2. Increasing INESC-ID visibility and attractivity

Several participants came to the IST campus and INESC-ID as part of the OLISSIPO training and outreach activities and became interested in future events. Even when the activity was held online, we had the chance to present our institution and the topics on which our research has been developed, increasing the institution's visibility nationally and internationally. Table 2 summarizes the OLISSIPO activities open to national and international institutions (besides the consortium).

Table 2. OLISSIPO activities open to national and international institutions.

Core activities	Date	Participants
OLISSIPO Twin Seminar on Sparse regularization for multi-omics data, Online	May 2021	62
OLISSIPO Inaugural Workshop on Computational Cell Biology, Online	July 2021	140
OLISSIPO Twin Seminar on Towards the clinical utility of polygenic risk scores, Online	September 2021	50
Workshop Metabolism and mathematical models: Two for a Tango 1st Edition, Online	November 2021	150

OLISSIPO Twin Seminar on Protein driven machine learning and network approaches for precision medicine, Online	February 2022	48
Workshop Metabolism and mathematical models: Two for a Tango 2nd Edition, Online	October 2022	141
OLISSIPO Winter School on Modelling and Analysis of Single Cell Multiple Biological Omics, Lisbon, Portugal	February 2023	25
Workshop on EU Research Management and Administration (Pre-Award), Lisbon, Portugal	February 2023	25
OLISSIPO Workshop - Analysis of Single-cell Data from Tumors, INESC-ID, Lisbon, Portugal	April 2023	30
OLISSIPO Workshop - Decoding the genome with deep learning, INESC-ID, Lisbon, Portugal	April 2023	25
OLISSIPO Workshops EMBL Training, INESC-ID, Lisbon, Portugal	May 2023	38
OLISSIPO Summer School on Computational phylogenetics to analyse the evolution of cells and communities, INESC-ID, Lisbon, Portugal	July 2023	26
Workshop Metabolism and mathematical models: Two for a Tango 3rd Edition, Online	November 2023	149
OLISSIPO Workshop - From oncology to cardiology: Spatial omics technologies for topographic biomarker discovery, INESC-ID, Lisbon, Portugal	November 2023	7
OLISSIPO Winter School on Mathematical modelling of inter-cell and communities' interactions with a focus on metabolism, INESC-ID, Lisbon, Portugal	February 2024	43
Seminar on European calls, Open Science & Intellectual Property in ICT	February 2024	14

Due to the projection of Computational Biology at INESC-ID and its relevance in areas such as Molecular Biology and Medicine, Prof. Susana Vinga was contacted during the OLISSIPO project to supervise or co-supervise Master and PhD students (besides those in collaboration):

- Tiago Costa. Cross-talk between immune and stem cells in skeletal muscle ageing and regeneration. Doctoral Programme of the Lisbon Academic Medical Centre. FMUL. Started in January 2023. Supervisors: Susana Vinga, Pedro Sousa-Victor and Domingos Henrique (Instituto de Medicina Molecular João Lobo Antunes);
- Cláudia Constantino. Predicting lung cancer response to radiotherapy based on 18F-FDG PET/CT imaging and machine learning. Doctoral program in Biomedical Engineering. IST. Started in January 2023. Supervisors: Susana Vinga and Francisco Oliveira (Champalimaud Foundation);
- Beatriz Leitão. Transcriptomic Analysis of Protein Coding and Long Non-Coding RNA in Gliomas (LGG and GBM): Unveiling Prognostic Biomarkers via Regularized Cox Regression. Fellowship started in December 2023. Supervisor: Prof. Susana Vinga (INESC-ID);

- Luis Farrolas. Metabolic plasticity in ovarian physiology and reproduction. MSc in Biomedical Engineering. IST. Starting in 2024. Supervisors: Prof. Zita Carvalho Santos (iMM) and Prof. Susana Vinga.

In addition, other students from international institutions demonstrated their interest in visiting INESC-ID with an internship in Lisbon, hosted by Prof. Susana Vinga:

- Mariella Bonomo. University of Palermo, Italy. Knowledge Extraction from Biological and Social Graphs. May – Jul 2022.
- Isis Lorenzo Colina. Université Claude Bernard Lyon 1, France. Modeling omics data using sparse regularization. Jun – Aug 2021.
- Gabriel Abrantes Diaz. University of Bielefeld, Germany. Statistical learning methods to analyse omics data using regularization. Sep 2023 – Jan 2024. Supervisor: Susana Vinga and Jens Stoye.

In this context, Prof. Jens Stoye, SAB member, will visit INESC-ID in April 2024 to discuss new ideas and build a joint project (see more details in Deliverable 1.3—*Final report on staff exchanges*).

OLISSIPO had a consistent and continuous presence in social networks, with 204 followers on X/Twitter, 227 connections on LinkedIn, and 57 subscribers to the project's YouTube channel, where our 28 videos have surpassed the 3000 visualizations.

3. Forecast

The synergies and complementarities identified between teams created a cohesive and sustainable network of collaborations, with planned activities beyond the completion of OLISSIPO, which will include, in the short-term, the co-supervision of MSc and PhD students, and joint organization of online events. It is expected that in the second half of 2024 the Consortium will collaborate in project proposals under Horizon Europe. We are now preparing a bid for the European Conference on Computational Biology (ECCB'2026) in Lisbon.

The collaborations strengthened through the project will serve as a starting point for new project proposals submitted to national and International funding agencies and programmes as described above. We will continue fostering collaborative research initiatives with European computational biology centers, leveraging diverse expertise and resources. Additionally, the researchers, who participated and met at the OLISSIPO events, will build up on these newly established collaborations and potentially work together in the common field of Computational Biology. We are pretty confident that several activities established during the

OLISSIPO project will continue taking place in Lisbon, in the surroundings and other regions in Portugal.

We plan to continue fostering students' mobility activities by co-supervising MSc and PhD theses among the consortium members (Twinning partners) and the SAB's collaborative network of SAB members. The exceptional collaboration between the four institutions will continue, promoting computational biology in Portugal and bringing international expertise to national institutions.

All project results (open-access publications, project reports, deliverables, and videos) will remain freely available on the project's website. This will further increase public awareness of Computational Biology and provide visibility to OLISSIPO's results beyond its completion.

4. Conclusions

The OLISSIPO project not only achieved but also exceeded the proposed objectives and significantly impacted Computational Biology in Lisbon and Portugal. It successfully created awareness for the area and potentiated the collaborations of existing institutions.