INSTITUTE FOR SYSTEMS
AND COMPUTER ENGINEERING,
TECHNOLOGY AND SCIENCE

INESCTEC

ACTIVITY REPORT 2019

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Editorial Notes

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May 2020

GLOBAL ACTIVITY REPORT 2019

1 INTRODUCTION

This document presents the scientific and technological activities as well as the results of INESC TEC for the year 2019.

Section 2 offers a summarized presentation of the institute's profile, vision, mission, organisational model, policy priorities, institutional objectives and research and innovation goals. Section 3 presents the highlights and main activity indicators for 2019, namely those regarding Human Resources, Activity in Projects and Publications.

Research at INESC TEC is developed in thirteen Research Centres, organised in four core scientific domains denoted as Clusters: Computer Science (CS), Industrial and Systems Engineering (ISE), Networked Intelligent Systems (NIS), and Power and Energy (PE). Section 4 presents these four Clusters and their scientific outcomes in 2019.

Section 5 focuses on the TEC4 initiatives, platforms that articulate the activity towards economic and societal impacts, presenting their main achievements in 2019 for the following domains: AGRO-FOOD, ENERGY, HEALTH, INDUSTRY and SEA.

Section 6 presents the scientific and technological activities developed by the 13 Research Centres, including their research and innovation outcomes.

Section 7 describes the institute's main research infrastructures supported under the Portuguese Roadmap of Research Infrastructures.

Section 8 introduces two special projects running at INESC TEC, the UT Austin Portugal Program and the Digital Competence National Initiative (INCoDe.2030), two significant contributions of the institute to public policies in education and science.

In Section 9, a thorough description of the activities of the Support Services is presented, including the Business Development Services, the Management and Organisation Services and the Technical Support Services.

2 INESC TEC PRESENTATION

2.1 Profile, vision and mission

INESC TEC is a private, non-profit association dedicated to scientific research and technological development, technology transfer, advanced consulting and training, and pre-incubation of new technology-based companies.

The University of Porto, INESC, the Polytechnic Institute of Porto, the University of Minho and the University of Trás-os-Montes e Alto Douro are INESC TEC's associates. Presently, INESC TEC's main sites are located in the cities of Porto, Braga and Vila Real. At the end of 2019, INESC TEC hosted more than 700 integrated researchers (341 PhDs), including R&D employees, academic staff, grant holders and affiliated researchers. INESC TEC's team also includes technical and administrative support staff and trainees.

INESC TEC's vision is to be a relevant international player in Science and Technology in the domains of Computer Science, Industrial and Systems Engineering, Networked Intelligent Systems, and Power and Energy.

As an institution operating at the interface between the academic and business worlds, bringing academia, companies, public administration, and society closer together, through its "managed science" model, INESC TEC leverages the knowledge and results generated as part of its research through technology transfer projects seeking impact in value creation and social relevance.

The dual mission of INESC TEC is to excel in research, seeking social relevance and international influence, and to foster pervasive intelligence, contributing to the competitiveness and internationalisation of Portuguese companies and institutions.

The merit of INESC TEC in the accomplishment of its dual mission has been formally acknowledged by the Portuguese Foundation for Science and Technology, with the institute's recognition as Associate Laboratory, and the Portuguese Ministry of Economy, with its recognition as Technology Interface Centre.

2.2 Managed science model

2.2.1 Knowledge value chain

INESC TEC's management and operational model implements the concept of end-to-end knowledge value chain, driving knowledge from its generation in research activities to its valorisation through a variety of technology transfer processes and tools.

Figure 2.2.1 - End-to-end knowledge value chain: an integrated two-way pipeline

The concept is illustrated in a simplified manner in the figure above, which presents the knowledge value chain as a seamless integration of four stages – knowledge production, applied research, development, and technology transfer. Project activities and outcomes of projects active in 2019 fall in different ranges of Technology Readiness Levels (TRLs) and are linked to different funding typologies. As with any model depicting a complex reality, the transitions between stages are fluid.

2.2.2 Centres, Clusters and TEC4s

Research at INESC TEC is undertaken by its 13 Research Centres, organised in four core scientific domains called Clusters: Networked Intelligent Systems (NIS), Power and Energy (PE), Industrial and Systems Engineering (ISE) and Computer Science (CS). The interaction with the main market areas is articulated by five initiatives called TEC4: TEC4AGRO-FOOD, TEC4ENERGY, TEC4HEALTH, TEC4INDUSTRY and TEC4SEA.

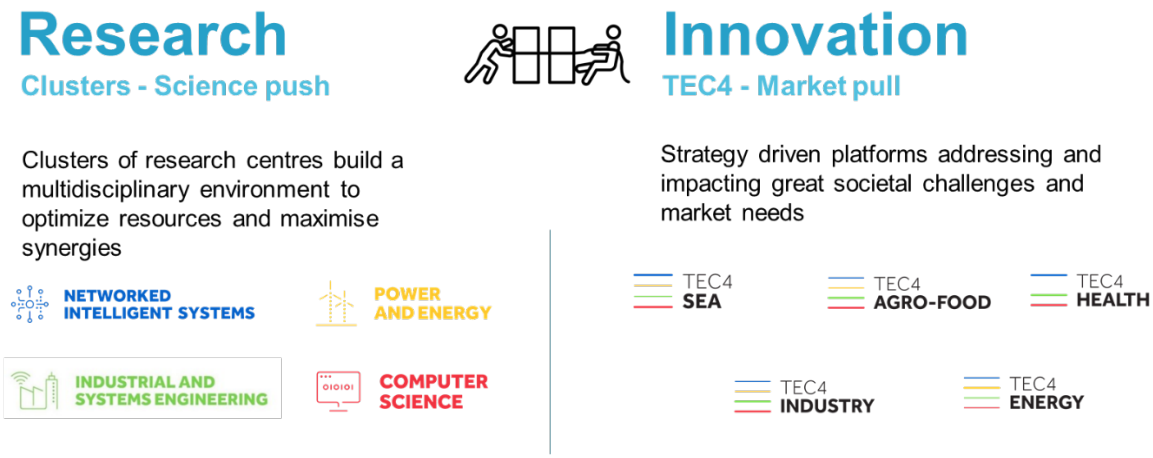

Figure 2.2.2 - Putting pervasive intelligence to work

The Centres are INESC TEC's R&D organisational base units, each focused in specific scientific and technological domains. Each Centre is responsible for its own planning, strategy and resources, and reports directly to the Board regarding its budget, operation and scientific and innovation performance indicators.

The Clusters bring together Centres in specific thematic domains, and are responsible for the research and development strategy and long-term planning in their domains. Performance indicators are consolidated at Cluster level to enable proper planning and follow-up for the forthcoming periods. Each Cluster is directly coordinated by a Member of the Board, with the support of a Cluster Council, composed by the Centres' Coordinators.

The TEC4 initiatives articulate the activities of the institution towards the market, defining market strategies and planning the interaction with INESC TEC's main markets. A TEC4 initiative structures and provides coherence to the activity towards specific markets, integrating and articulating the competencies of the relevant Centres. A TEC4 is fundamentally driven by a market application domain perspective, where multidisciplinary interventions are usually necessary, instead of a more in-depth science perspective. A TEC4 initiative establishes a network of external contacts with industrial partners and brings back major challenges in the shape of opportunities to the multiple Centres. The TEC4s are flexible, dynamic and adaptive to external conditions and internal response. While seeking the impact of research in real world multidisciplinary environments, the TEC4 initiatives allow INESC TEC to address broad societal challenges. Each TEC4 initiative has a management committee, composed by its Coordinator, a Business developer and representatives of the relevant Centres. Each TEC4 reports directly to a Member of the Board.

2.3 Organisational structure

The figure below describes the institution's organisational structure. The high-level management of INESC TEC is undertaken by a Board of Directors, composed of nine members, and an Executive Board, composed of four members from the Board of Directors. The Boards act in coordination with the Council of R&D Centres, meeting every other week with Centre Coordinators and Service Managers. This ensures institution-wide coherence in vision, policy and operations, as well as joint responsibility and commitment in both strategic and operational management decisions. As detailed before, Clusters articulate the long-term strategy of the Centres in core scientific domains and TEC4s articulate the activities of the Centres towards main market domains.

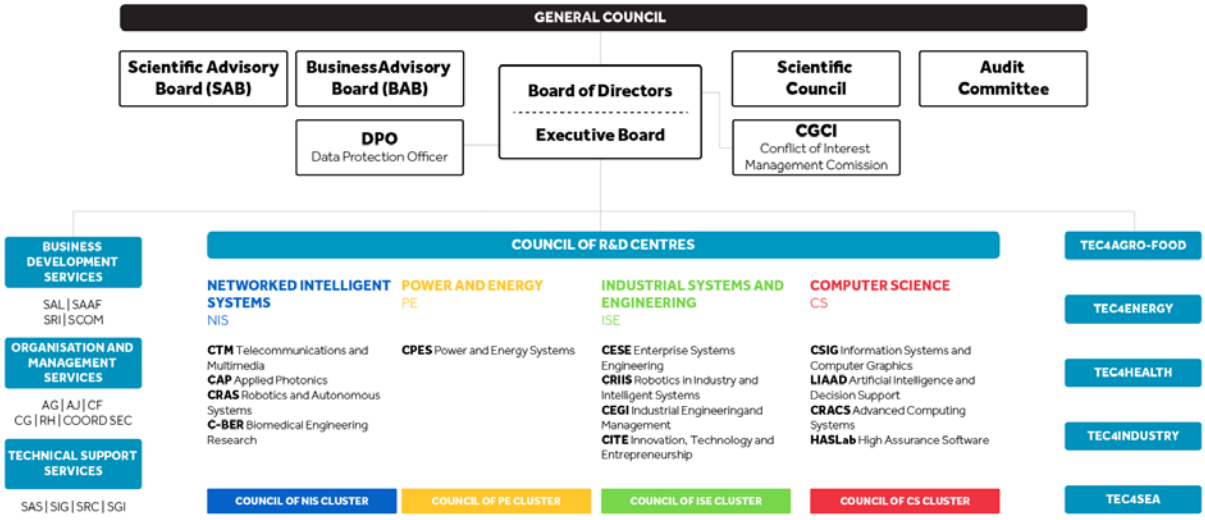

Figure 2.3.1 - Organisational Structure

The external Scientific Advisory Board is composed of internationally recognised scientists from prestigious institutions, experts in INESC TEC's fields of scientific competence, that support the institution in its search for continuous improvement and excellence, as well as in building a vision for future research through a valuable benchmark at an international level. The external monitoring, orientation and evaluation of the innovation and technology transfer activities are entrusted to the Business Advisory Board, whose members represent most of the economic sectors of relevance to INESC TEC.

The Scientific Council is an internal body responsible for monitoring and guiding scientific activity, and it includes one representative from each Centre and three additional members appointed by the Board.

The Conflict of Interest Management Commission is appointed by the Board to implement the institute's Policy on Conflict of Interest.

The Data Protection Officer leads the implementation across INESC TEC of the General Data Protection Regulation.

A streamlined and dynamic team of highly qualified technical and administrative personnel provides support to INESC TEC's activities. A comprehensive set of support services, presented in the table below, is organised to support the R&D Centres across the domains of Business Development, Organisation and Management, and Technical Support.

Table 2.3.1 - Support Services

Business Development	Organisation and Management	Technical Support
SAL: Technology Licencing SAAF: Funding Opportunities SRI : International Relations SCOM : Communication	AG: Management Support AJ: Legal Support CF: Accounting and Finance CG: Management Control RH: Human Resources COORD SEC: Secretarial Coordination	SAS: System Administration SIG: Management Information Systems SRC: Networks and Communications SGI: Infrastructure Management

2.4 Policy priorities

To accomplish its mission, INESC TEC sets the following policy priorities:

- Excellence in research, talent development, and innovation;
- Full coverage of the knowledge value chain;
- Integration and multi-disciplinarity;
- Scale, density, and critical mass;
- International visibility and presence.

2.4.1 Excellence in research, talent development, and innovation

INESC TEC creates new knowledge and technology aiming at improving products, processes, services and business models, contributing to the competitiveness of companies and institutions, and benefiting the economic fabric and society. This knowledge is built upon a base of rigorous scientific research, in a dynamic and multi-disciplinary environment that enables the institute to engage and foster the development of first-rate researchers. The commitment to the reinforcement and internationalization of INESC TEC's research infrastructures is essential to ensure the competitiveness of this research environment. Initiatives such as the creation of a research data repository and the active participation in the Portuguese node of the Research Data Alliance, led by INESC TEC, contributes to such endeavour and also to strengthen the alignment with open science policies. The reinforcement of the international recognition of its researchers, through high impact publication profiles, international awards, or ACM and IEEE Fellowships, plays a major role in maximizing the impact of the institute's research.

As part of its strategic partnership with associated Departments, Schools, and Higher Education Institutions, INESC TEC seeks to continuously bring valuable contributions to their PhD and Master Programmes. INESC TEC assists more than 20 PhD programmes, typically involving over 300 students, about 60 concluding their theses every year. Every year the institute's researchers supervise over 600 master's students. The strengthening of INESC TEC's involvement in PhD and Masters Programmes is essential to attract and involve young talent in conducting and disseminating research results while leveraging the intervention of Higher Education Institutions.

INESC TEC's focus on finding solutions to complex problems, along with its culture of collaboration with industry, provides an ideal environment for innovators. At an international level, the build-up of its positioning as an interface organisation of excellence, is key to expand the collaboration with international organisations to provide them unique knowledge and relevant technology for innovation, generating and transferring socially relevant results. At a national level, the participation in initiatives such as the CoLABs (Collaborative Laboratories) also contributes to the strengthening of the collaboration with other national R&D organisations.

The focus on excellence is a permanent driver for the institution, whose expansion in recent years required a renewed attention to some of its fundamentals, in particular to its human resources management, science management and advanced training models, as well as to research ethics and gender equality policies.

2.4.2 Full coverage of the knowledge value chain

The success of INESC TEC's managed science model relies on the ability to easily enable upstream and downstream flows along the knowledge value chain. In fact, the interaction and collaboration with industry is not only essential for the valorisation of research results, through processes such as technology licensing, collaborative development, advanced consulting, training, and spin-off launching, but also for the identification of novel research topics. This interaction is key to increase the impact of science-based innovation and the economic sustainability of the institute.

In order to excel in this dynamics, INESC TEC is increasingly challenged to ensure that individual researchers focus where they feel more comfortable to perform at their best, while at the same time Centres develop the broad spectrum of activities and the critical mass that allow INESC TEC as a whole to fully accomplish its dual mission.

2.4.3 Integration and multidisciplinarity

INESC TEC pays constant attention to its integration dynamics, as the institution, its resources and its context evolve. The Clusters and the TEC4 initiatives are key instruments to support INESC TEC's policy for achieving institutional cohesion and maximising synergies, differentiation and impact. Overall, this policy seeks to strengthen the ties among Centres, by deepening cross-fertilization, originating new science by fusion of knowledge and skills, and conducting multidisciplinary research and innovation by truly multidisciplinary teams.

The institute strives to foster this meeting of different scientific disciplines, a key enabler of its impact in practice through science-based innovation. The implementation of initiatives that encourage and support the interaction among Centres is essential to enable the integration of the institute's diversity of deep scientific knowledge into multidisciplinary solutions that transcend traditional technological divides. The Clusters and the TEC4 initiatives play a key infrastructural role towards this purpose, as well as other instruments, such as the Internal Seed Projects, which support inter-Centre research, junior researcher development, and proof-of-concept activities.

2.4.4 Scale, density, and critical mass

INESC TEC's ambitious vision and mission require a level of scale and density that are only possible through its multi-institutional base model. The resource endowment collaboratively brought to INESC TEC by its associates is continuously leveraged by the institute to sustain a level of growth and densification in the areas of knowledge that are critical for its activity, at a national and international level. One of the institute's key priorities for the future is a consistent effort to focus its activities and to attract leading researchers to further reinforce its critical mass.

2.4.5 International visibility and presence

Impact in science and technology nowadays requires collaboration and strong partnerships with leading international research institutions and companies. INESC TEC's international projects and activities are crucial for securing the status of international player, ensuring the institution's effective participation and recognition in the international arena. INESC TEC permanently directs significant efforts to its international activities, so that they continue to play a major role in the institution.

In this context, the first and foremost undertaking is the consolidation of the massive presence in European research and innovation, including the strengthening of collaborations with international companies, universities and research organisations. INESC TEC's active participation in the European Knowledge and Innovation Communities (KICs) – EIT Raw Materials, EIT Manufacturing and EIT Digital – has a highly relevant role in this domain. A second step is the strengthening of a base of operations outside Portugal, to increase the capacity to promote projects, secure funding, and attract human resources at an international level. The operation in Brazil, with the creation of INESC P&D Brasil and its recognition by the Brazilian Science and Technology agencies as a Brazilian ICT (Institution of Science and Technology), and the creation of INESC Brussels Hub and a service for international relations must be understood under this perspective. The India Office also aims to develop relevant bridges with important companies and public actors and support the attraction of students and post-docs. The continued involvement in the Portuguese Government's International Partnerships with MIT, CMU and UT Austin, and in particular the hosting at INESC TEC of the national leadership of the UT Austin Portugal Program, play a key role in the development of collaborations with the United States. The participation in other initiatives,

such as the AIR Centre or the CENTRA network of excellence, foster the collaboration with partners from an even broader spectrum of geographies.

2.5 Research and innovation goals

The institution's scientific objectives defined for 2018-2022 are aligned with its vision and mission, and in particular with the commitment to **foster pervasive intelligence**. This is enabled by the structures and processes put in place at INESC TEC to promote and facilitate multidisciplinary cooperation, aiming at linking sensors, communications, hardware and software systems, data, knowledge, models, decision and action.
INESC TEC's high-level scientific objectives, defined at Cluster level, are summarised below with each Cluster's vision and research priorities (more details can be found in the Clusters and Centres sections):

- NETWORKED INTELLIGENT SYSTEMS - For the next years the Cluster envisions smarter and smaller collaborative systems, the convergence of deep learning and communications, and the ubiquity of computer vision. The Cluster will continue addressing futuristic scenarios in which aggregations of networked systems - autonomous, carrying sensors, communications enabled - collect information in extreme environments, such as the deep sea or the human body, and process it using artificial intelligence tools. Four main research lines will be active: sensing, communications, computer vision and autonomous systems. The main expected outcomes include the following: graphene-based sensors and antennas, optical and electrical sensing microdevices, CAD for cancer analysis, automatic audio-visual content manipulation, self-learning communications for extreme and immersive environments, autonomous system for underwater inspection, and a deep-ocean robotics observatory.
- POWER AND ENERGY - The Cluster's vision is aligned with the EU policies for digitalization, energy efficiency and increase in Renewable based Energy Sources (RES) integration, and includes as main challenges the transformation of the energy sector through synergies between advanced mathematical modelling and digital technologies, the full decarbonization of the power system with novel solutions, and the bridging of the gap between research results and industry business cases with a multidisciplinary approach. The Cluster has defined the following main research lines: (1) towards 100% RES integration and massive integration of power electronics-based interfaces; (2) large-scale modelling and optimization of energy systems; (3) data-driven methodologies for energy systems; (4) asset management and predictive maintenance; (5) cybersecurity and Internet of Things (IoT) for critical infrastructures (electricity generation, transmission and distribution).
- INDUSTRIAL AND SYSTEMS ENGINEERING - The Cluster envisions a fully integrated supply chain across different industries (e.g., manufacturing, process industries, retail, health and mobility). The cluster will also consolidate the leadership in knowledge generation and technology transfer on digital transformation, advanced analytics and integration of advanced manufacturing technologies and new business models, helping companies to fully embrace the 4th industrial revolution. Customer-centric and real-time supply chain optimisation, as well the decentralized decision-making, will only be possible with highly flexible, reallocable, adaptable and intelligent automation, control and robotics. The use of collaborative robots (mobile and manipulators), smart sensor networks, industrial vertical IoT-based information architectures, Human-robot interface and responsive collaboration play an important role in these processes. Furthermore, the cluster will focus on the development and implementation of intelligent systems, automation, management and decision support systems, among other technological solutions, fostering the resilience, resource efficiency, competitiveness, circular economy and sustainability towards an effective bio-economy. The Cluster has defined the following strategic research lines: (1) Operations Management in manufacturing and services for responsive, sustainable and resilient operation; (2) Operations Research and Management Science for empowering decision support in a digitised industry; (3) operational and strategic architectures for a data-driven industry; (4) Human Robot Collaborative workstations; (5) Technology-enabled service design and innovation.
- COMPUTER SCIENCE: Computing became fully decentralized, mobile, increasingly autonomous, and ubiquitous reaching all appliances, devices and living beings. As a result, current information and communication systems present many hard and intricate challenges associated to scalability, security and criticality. The ever-increasing amounts of generated data embody a wealth of information that needs to be properly and timely mined and analysed. This challenges our capacity to filter, curate, store,

process, query and visualise unprecedented volumes of data from diverse sources and formats. In addition, the economic value of the data, trade and state secrets, and individual rights require data manipulation to comply with demanding levels of privacy. Smarter and autonomous systems in critical realms such as utilities, health care, transportation and finance require dealing with new, and often unanticipated, sorts of risks that challenge the best practices of software engineering, network and information security and human-computer interaction.

These scientific objectives are complemented by knowledge valorisation and technology transfer targets, structured by TEC4 initiatives. Five initiatives are organised to address innovation challenges in the main target market domains:

- TEC4AGRO-FOOD – Co-shaping the digital (r)evolution in agro-food and forestry;
- TEC4ENERGY – Decarbonization and digitalization of the energy sector;
- TEC4HEALTH – User-centred ICTs to improve health care and personal wellbeing;
- TEC4INDUSTRY – Collaborative value chains for an innovative, human-centred and sustainable industry;
- TEC4SEA - Bringing the digital world to a sustainable sea economy.

The initiative TECPARTNERSHIPS is dedicated mainly to promote and support new projects in all other sectors and to explore new market segments, incubating new potential TEC4's until they reach a qualified maturity level.

3 RESULTS ACHIEVED IN 2019

This section presents a short summary of the results INESC TEC achieved during 2019, including highlights of the activity and the main indicators for human resources, activity in projects and scientific publications. The remaining sections of the document include detailed information for each Cluster and R&D Centre, the TEC4 multidisciplinary initiatives, research infrastructures, special projects, and Support Services.

3.1 Highlights in 2019

The year of 2019 was a year of significant activity and institutional accomplishments. INESC TEC strived to strengthen its fundamentals and consolidate its financial robustness, while reinforcing its international presence and its key role in the Portuguese Science and Technology System.

The main achievements in 2019 are summarized next, under the following categories: INESC TEC as engine of science-based innovation, main initiatives, spin-offs, contributions for public policy, projects and results, and main S&T achievements.

INESC TEC AS ENGINE OF SCIENCE-BASED INNOVATION

- Decisive reinforcement of the institute's multi-institutional base model with the University of Trás-os-Montes e Alto Douro and the University of Minho becoming associates of INESC TEC;
- Sustainable activity growth (3%), consolidating a decade of continuous expansion, contributing to the competitiveness of the economy and benefiting society. In addition to maintaining a high level of R&D contracts with industry (3 M€), and transferring more than 200 highly qualified human resources (26 PhDs) to the labour market, in 2019 the institute opened "iiLab - Industry and Innovation Lab", an infrastructure aimed at facilitating the diffusion of state-of-the-art advanced production technologies through research demonstration, experimentation and advanced training;
- Hosting environment for more than 700 integrated researchers, 341 with a PhD. In 2019 the most noticeable evolution in Human Resources was the significant increase (19%) in the number of R&D employees (reaching a total of 121), as a result of the continued implementation of the Government's policy for scientific employment, aiming at contributing to the strengthening of the National Science and Technology System.

MAIN INITIATIVES

Managed science model

- Definition and implementation of the new R&D organisation model: reaffirmation of the role of the Centres as base R&D organisational units, focusing on specific fields of science and technology, with particular scientific and market intervention competences; reinforcement of the role of the Clusters, as aggregations of Centres with scientific affinities for purposes of strategic planning and management in their specific fields; and the reformulation of the TEC4s as collaborative inter-Centre efforts to articulate INESC TEC's activity in each of its main markets.

Structural initiatives

- Creation of a Gender Equity Work Group to carry out an analysis and develop recommendations regarding gender balance in the institute;
- Assessment of INESC TEC's social responsibility practices, completed by an internal Work Group, leading to the subsequent creation, in October, of the Social Responsibility Technical Committee;
- Preparation by an internal Work Group of a draft Code of Ethics, which was made available for general discussion and feedback, with its final approval and implementation expected in early 2020.

Internationalisation

- Creation of INESC Brussels Hub, the joint representation of INESC TEC, INESC Coimbra, INESC ID, INOV INESC and INESC MN near the European Institutions, in order to reinforce the institutes' positions in European programmes, increase visibility and credibility in key areas, representation in European

platforms, groups and structures, and provide researchers a permanent physical space for support and representation;

- Active participation in European Knowledge and Innovation Communities (KICs), formally joining EIT Manufacturing and EIT Digital, and strengthening the involvement in EIT Raw Materials;
- Launch of an educational and scientific cooperation with Imperial College, and active participation in the creation of a network of Innovation Hubs@AIR CENTRE in Massachusetts and Portugal;
- Admission to the international associations CERVIM - Centre of Research, Studies, Safeguarding, Coordination and Promotion of Mountain Viticulture, EPIC - European Photonics Industry Consortium, and EARTO - European Association of Research and Technology Organisations;
- Growing collaboration with INESC P&D Brasil and continuous development of the India Office, to establish bridges with important companies and public actors, and attract students and post-docs;
- Continued hosting of the national leadership of the UT Austin Portugal Program, with a key role in the development of collaborations with the United States of America.

Internal initiatives

- Announcement of the results of the first call for "Internal Seed Projects", an instrument to support exploratory projects in the categories of inter-centre research, junior researcher development and commercialization proof-of-concept. The Evaluation Committee was composed by Prof. Manuel Ricardo (Chair of the Panel), Prof. Jorge Pinho de Sousa, Prof. João Paiva Cardoso, Prof. José Nuno Fidalgo, Prof. José Soeiro Ferreira and Prof. Paula Viana who conducted a very demanding process with exemplary dedication and rigor. Five promising projects were approved and are now under way in the areas of underwater imaging, neonatal monitoring, blockchain, breast statistical shape modelling, and fish and meat freshness monitoring. After the success of the first call, a second call was opened near the end of 2019;
- Launch of the Data Science Hub, an internally funded initiative to mobilise and structure INESC TEC's skills in the various fields of data science (management, mining, analysis, processing and visualisation) to provide a unified external offer, systematising INESC TEC's approach to new problems, knowledge transfer, and involvement of graduates from the multiple domains of engineering and sciences in data science.

Support structure

- Launch of an assessment initiative to develop a new model for Human Resources management. Its implementation will aim at reinforcing the strategic management and development of careers in the institute;
- Establishment of an innovative collaboration with ISPUP - Institute of Public Health of the University of Porto, with a common team in the field of data protection, to improve shared know-how and best practices in R&D.

Communication and events

- INESC TEC's training initiative on "How will Artificial Intelligence be in 2030?" was chosen for the national launch of the "Ciência Viva in Labs" programme, directed to young people, with the presence of the Portuguese Minister of Science in iiLab;
- In the institute's annual event, INESC TEC Autumn Forum, more than 200 attendants gathered to discuss the theme "Digital (R)evolution in Agri-Food and Forestry";
- In addition to the active participation in multiple events, such as Oceans'19, the European Utility Week and Ciência 2019, INESC TEC organised more than 50 conferences, workshops and scientific sessions, reaching more than 4000 attendants, and participated in more than 60 fairs or exhibitions.

SPIN-OFFS

- Creation of the spin-off Insignals Neurotech, in partnership with Frontier IP Group Plc, to commercialize wearable devices that precisely measure wrist rigidity, helping surgeons to place brain implants more accurately during surgery on patients with Parkinson's, epilepsy, and other neural conditions. The company participated in the EIT Health Germany - Startups Meet Pharma Programme, ranking second place;
- Launch of the spin-off Keyruptive, which develops mobile app solutions for secure cloud storage and management of digital assets such as crypto currencies;
- The development of three new spin-offs is being supported: WeSENSS (Wearable SENSors for Safety); UNEXMIN (underwater mine exploration robotic system); and iLoF (leveraging machine learning to drastically reduce the cost and time of drug discovery), that won the EIT Health's Wildcard award, raising a round of funding of 2 M€.

CONTRIBUTIONS FOR PUBLIC POLICY

- Active involvement in providing contributions to administrative simplification in the area of Science and Technology at a national level;
- In 2019, INESC TEC formally joined or helped establish five national Collaborative Laboratories (CoLABs): B2E (Blue Economy), BUILT (Future Built Environment), CSESI Hub (Smart Energy Services Innovation), VG CoLAB (Vasco da Gama - Energy Storage) and Vortex (Cyber-Physical Systems and Cyber Security), in addition to the initial leadership of ForesWise (Forest and Fire Integrated Management), and active participation in Vines&Wines. The CoLABs were created to enhance the density of knowledge-based activities in Portugal by fostering the collaboration between Science and Technology institutions and the social and economic fabric.

PROJECTS AND RESULTS

- Approval and launch of a large number of new R&D projects, supported by National and European competitive funding, in particular of large European projects coordinated by INESC TEC, such as Interconnect;
- INESC TEC was part of the Top 5 Portuguese organisations in net contribution as well as in participation in H2020 European competitive research funding. In 2019, 34% of INESC TEC's total project funding (~68 projects) came from European programmes;
- Increase of 17% in the number of articles in indexed journals, the majority (62%) in first quartile journals;
- Relevant international awards received by INESC TEC researchers included the "IBM Q Teach Me Quantum Challenge" and best paper awards in several international conferences. A faculty member was elected Fellow of EAMBES, the European Alliance for Medical and Biological Engineering and Science;
- In the area of Intellectual Property protection, in 2019 INESC TEC was among the Top 5 Portuguese applicants to European patents. The institute also filed 16 national applications in geographies such as the U.S., Canada, Japan, China, South Korea, and Australia, strengthening the internationalisation of its patent portfolio. Four patents were also granted, in the U.S., Japan, China, and Europe.

MAIN S&T ACHIEVEMENTS

INESC TEC's Science and Technology achievements in 2019 are described in greater detail later in the report, in the Clusters and Centres sections. This section presents the achievements selected by the Clusters as highlights of the advances carried out by the institute's R&D team in 2019:

- Researchers from the Networked Intelligent Systems Cluster fabricated high-quality broadband (from the visible to infrared) waveguides in fused silica substrates by femtosecond laser direct writing, a result of outmost importance for the demonstration of integrated sensors, for instance based in plasmonics. In the area of Computer Vision, an uncertainty-aware deep learning-based approach was proposed for computer-aided diagnosis and grading. The system supports clinical decision and the assigned pathology

grades by providing a medically interpretable explanation, and the methodology was successively tested in grading Diabetic Retinopathy. Autonomous Systems researchers validated in real experiments an autonomous robot for exploration of flooded mines, endowed with multiple sensors for extended perception of the environment allowing for its autonomous operation inside flooded galleries. New positioning and routing algorithms for aerial networks, enabling significant performance gains (higher throughput, lower delay) when compared to state-of-the-art counterparts, were developed by Communications researchers;

- A research team from the Power and Energy Cluster created genetic and cross-entropy algorithms for energy optimization in a home energy management system, a low computation platform that is the base of a user-centric approach. Focusing on renewable based generation systems, the Cluster's researchers developed a GPU-based implementation for their adequacy assessment via sequential Monte Carlo simulation. A patent was submitted for a data-driven energy optimization methodology for wastewater pumping stations. The work in the development of a methodology, validated by an experimental prototype, that enables the balancing of battery cells and hybridization with supercapacitors, was recognised with the best paper award in the 2019 IEEE Vehicle Power and Propulsion Conference;
- In the Industrial and Systems Engineering Cluster, a best paper award in the "Tools for Sustainable Manufacturing" track was received for work on an industrial digital twin composed by a Simulator and an IoT platform with the capability of automatically collect real-time data from the shop floor and returning performance indicators to support decision making continuously. Researchers from the Cluster also developed predictive maintenance algorithms for power transformers by combining contextual, failure and sensor data. These algorithms are under integration on an advanced analytical platform to support utilities in their decision-making process. This research on asset management has been leveraged by the participation in European projects to define the next generation of health indexes for smart hydro plants. The ColRobot, developed for the automotive and aerospace industries, had its demonstration in the final assessment event of the project that took place in Portugal and France. It combines state-of-the-art technology developed in Europe with user requirements for application in assembly processes, thus creating an integrated collaboration robotics system, in which a mobile manipulator acts as a "third hand" by delivering kits, tools, parts, or by holding work pieces while the operator performs tasks. A research team from the Cluster actively continued to lead during 2019 the development of the R&D&I Agenda for the ForestWISE CoLAB;
- Researchers from the Computer Science Cluster published three scientific articles in the area of high-assurance privacy-enhancing technologies in the ACM Conference on Computer and Communications Security 2019, one of the top conferences in the area of cryptography and information security. During the year, the Cluster's researcher also had three important results on the topic of Natural Language Processing published on the Association for Computational Linguistics conference, the number one forum for NLP, on the Information Processing and Management journal and on the European Conference on Information Retrieval, the top European forum in the topic. The work entitled "Automatically Inferring Class Sheet Models from Spreadsheets" published in 2010 received the Most Influential Paper award at the IEEE Symposium on Visual Language and Human-Centric Computing 2019. Research carried out on the efficiency and optimization of special purpose computing systems was published on ACM Computing Surveys and on IEEE Transactions on Very Large Scale Integration Systems.

3.2 Human Resources

3.2.1 Global Indicators

Table 3.2.1 and Figure 3.2.1 show the breakdown of Human Resources by type of contractual relation with INESC TEC and its evolution since 2017. The number of researchers with PhDs is also shown (341 at the end of 2019).

Table 3.2.1 - Evolution of Human Resources

Type of Human Resources			2017	2018	2019	2018-19	
Integrated HR	Core Research Team	Employees	71	102	121	19	19%
		Academic Staff	203	155	160	5	3%
		Grant Holders and Trainees	449	418	351	-67	-16%
		Total Core Researchers	**723**	**675**	**632**	**-43**	**-6%**
		Total Core PhD	**312**	**259**	**257**	**-2**	**-1%**
	Affiliated Researchers		64	70	72	2	3%
	Administrative and Technical	Employees	69	80	84	4	5%
		Academic Staff	8	9	9		0%
		Grant Holders and Trainees	23	14	7	-7	-50%
		Total Manag, Admin and Tech	100	103	100	-3	-3%
		Total Integrated HR	**887**	**848**	**804**	**-44**	**-5%**
		Total Integrated PhD	**381**	**339**	**341**	**2**	**1%**
Curricular Trainees			26	15	21	6	40%
External Research Collaborators			113	203	216	13	6%
External Administrative and Technical Staff			10	12	7	-5	-42%
External Students			104	121	138	17	14%
Total			**1140**	**1119**	**1186**	**-13**	**-1%**

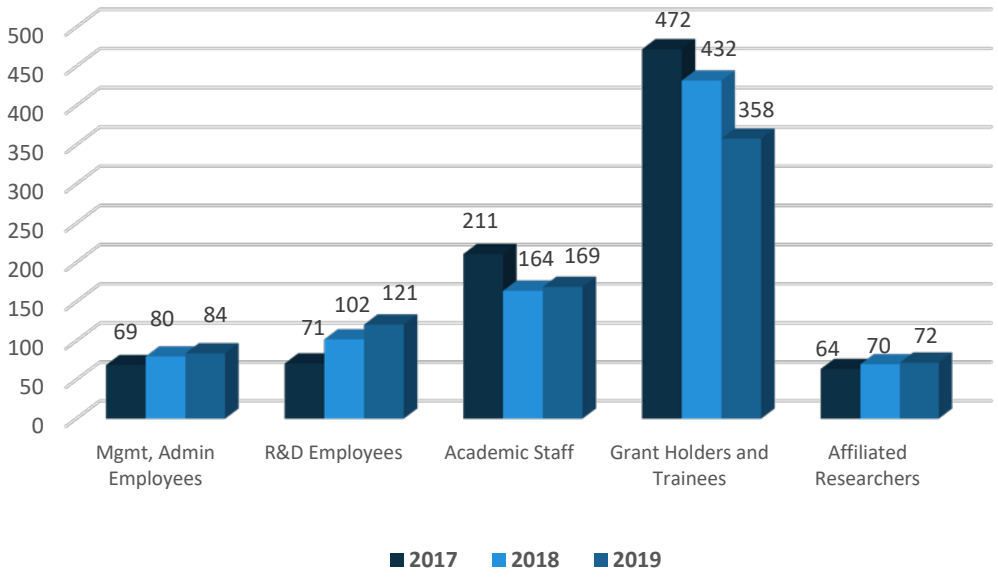

Figure 3.2.1 - Evolution of Human Resources

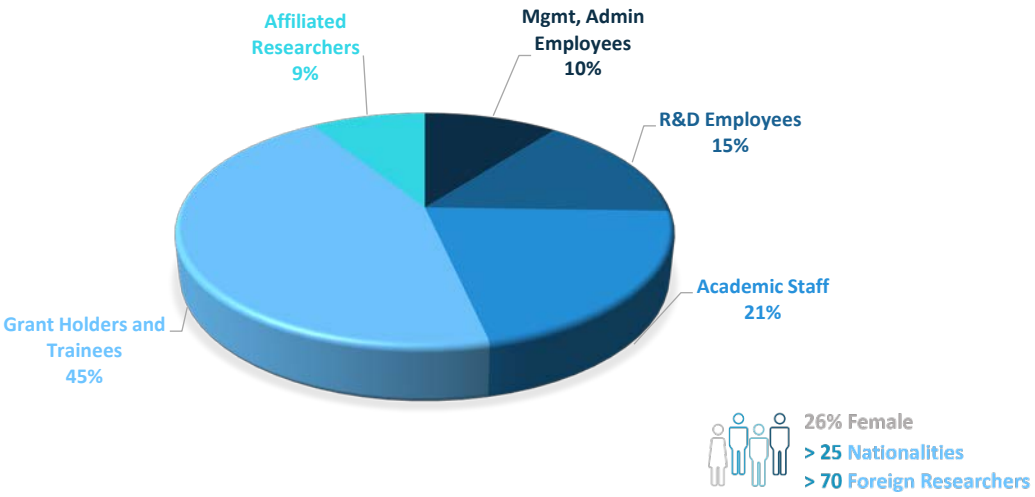

Figure 3.2.2 - Distribution of Human Resources

As seen in Figure 3.2.2, grant holders and trainees are still the largest group of human resources (45%) at INESC TEC, featuring, nevertheless, another noticeable decrease in 2020 (Figure 3.2.1). This decrease is mostly the result of the continued implementation of the Portuguese Government's policy for scientific employment, which has led to a steady rise in the number of R&D employees, namely PhD researchers. The impact of the modified Research Grant Holder Statute that came into force in August 2019 was limited, due to the fact that INESC TEC's Grant Holder Regulation was only altered late in the year, in the month of November.

The increase in Human Resources in the internal Services aims at supporting the continued growth of the institute's activity and the operationalisation of new strategic objectives, such as the implementation of the new TEC4 model, the reinforcement of international relations management, and the implementation of a new model of human resources management.

Overall, the total number of integrated human resources remained relatively stable between 2018 and 2019, as did the size of the academic staff.

3.2.2 R&D Clusters Indicators

This section presents an overview of the relative size and composition of Human Resources in the R&D Clusters in 2019 (Table 3.2.2 and Figure 3.2.3).

Table 3.2.2 - Human Resources by Cluster

Type of Human Resources			Clusters			
			NIS	PE	ISE	CS
Integrated HR	Core Research Team	Employees	36	21	40	24
		Academic Staff	41	10	31	78
		Grant Holders and Trainees	95	48	83	124
		Total Core Researchers	**172**	**79**	**154**	**226**
		Total Core PhD	**66**	**26**	**62**	**103**
	Affiliated Researchers		13	7	19	32
	Administrative and Technical	Employees	7	1	6	3
		Grant Holders and Trainees	0	0	0	1
		Total Admin and Tech	**7**	**1**	**6**	**4**
		Total Integrated HR	**192**	**87**	**179**	**262**
		Total Integrated PhD	**79**	**32**	**82**	**134**
Curricular Trainees			3	0	15	3
External Research Collaborators			35	12	60	80
External Administrative and Technical Staff			0	1	3	1
External Students			39	9	25	61
		Total	**269**	**109**	**282**	**407**

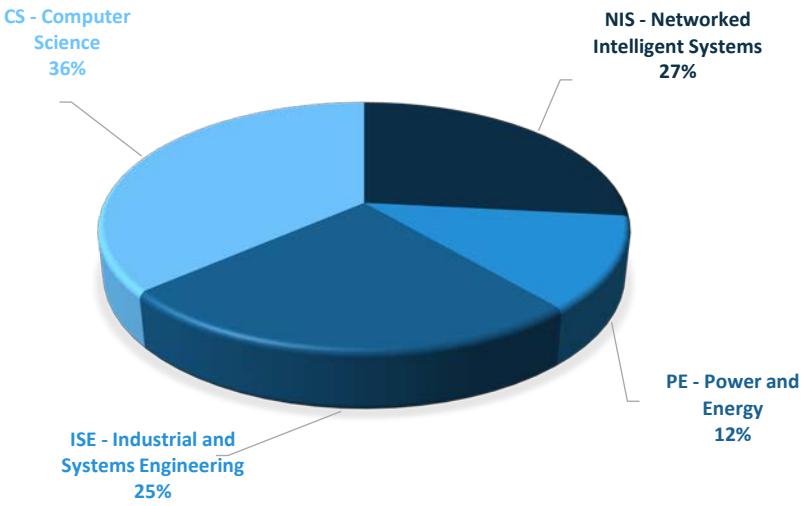

Figure 3.2.3 - Human Resources by Cluster

3.2.3 R&D Centres Indicators

The number and structure of Human Resources in each R&D Centre is detailed in Table 3.2.3.

Table 3.2.3 - Human Resources by type and R&D Centre

Type of Human Resources			Total R&D Centres	R&D Centres													
				CTM	CAP	CRAS	CBER	CPES	CESE	CRIIS	CEGI	CITE	CSIG	LIAAD	CRACS	HASLAB
Integrated HR	Core Research Team	Employees	**121**	13	9	12	2	21	21	8	8	3	13	3	1	7
		Academic Staff	**160**	15	8	11	7	10	5	12	13	1	25	22	15	16
		Grant Holders and Trainees	**350**	46	13	25	11	48	30	23	27	3	46	27	21	30
		Total Core Researchers	**631**	**74**	**30**	**48**	**20**	**79**	**56**	**43**	**48**	**7**	**84**	**52**	**37**	**53**
		Total Core PhD	**257**	**27**	**15**	**14**	**10**	**26**	**15**	**18**	**26**	**3**	**29**	**29**	**18**	**27**
	Affiliated Researchers		**71**	7	5		1	7	7	5	6	1	19	5	2	6
	Administrative and Technical	Employees	**17**	1	2	3	1	1	2	2	1	1	1		1	1
		Grant Holders and Trainees	**1**													1
		Total Admin and Tech	**18**	1	2	3	1	1	2	2	1	1	1		1	2
	Total Integrated HR		**720**	**82**	**37**	**51**	**22**	**87**	**65**	**50**	**55**	**9**	**104**	**57**	**40**	**61**
	Total Integrated PhD		**327**	**34**	**20**	**14**	**11**	**32**	**22**	**23**	**32**	**5**	**48**	**34**	**19**	**33**
Curricular Trainees			**21**	**2**		**1**			**7**		**4**	**4**	**1**	**1**	**1**	
External Research Collaborators			**187**	**17**	**2**		**16**	**12**	**12**	**16**	**19**	**13**	**11**	**44**	**11**	**14**
External Administrative and Technical Staff			**5**					**1**		**1**	**2**		**1**			
External Students			**134**	**15**	**15**	**1**	**8**	**9**	**2**	**8**	**9**	**6**	**7**	**23**	**12**	**19**
Total			**1 067**	**116**	**54**	**53**	**46**	**109**	**86**	**75**	**89**	**32**	**124**	**125**	**64**	**94**

R&D Centres:

CTM	Centre for Telecommunications and Multimedia
CAP	Centre for Applied Photonics
CRAS	Centre for Robotics and Autonomous Systems
CBER	Centre for Biomedical Engineering Research
CPES	Centre for Power and Energy Systems
CESE	Centre for Enterprise Systems Engineering
CRIIS	Centre for Robotics and Intelligent Systems
CEGI	Centre for Industrial Engineering and Management
CITE	Centre for Innovation, Technology and Entrepreneurship
CSIG	Centre for Information Systems and Computer Graphics
CITE	Centre for Industrial Engineering and Management
LIAAD	Laboratory of Artificial Intelligence and Decision Support
CRACS	Centre for Research in Advanced Computing Systems
HASLAB	High-Assurance Software Laboratory

3.2.4 Support Services Indicators

The Human Resources figures by the end of 2019 for the Office of the Board of Directors and the Support Services are provided in Table 3.2.4.

Table 3.2.4 - Human Resources by type and Service

Type of Human Resources		Total	Board and Advisors	Support Services														
				Organisation and Management Services					Business Development Services				Technical Support Services					
				AG	AJ	CF	CG	RH	SAAF	SAPE	SAL	GRI	SCOM	SCI	SIG	SAS	SGI
Integrated HR	Employees	63	9	2	2	9	11	4	1	4	3	1	5	2	3	3	4
	Academic Staff	9	9														
	Grant Holders and Trainees	3	1										2				
	Affiliated Researchers	1	1														
	Total Integrated HR	**76**	**20**	**2**	**2**	**9**	**11**	**4**	**1**	**4**	**3**	**1**	**7**	**2**	**3**	**3**	**4**
	Total Integrated PhD	**14**	**10**			**1**				**1**	**2**						

Support Services:

AJ	Legal Support
CF	Accounting and Finance
CG	Management Control
RH	Human Resources
AG	Management Support [1]
SAAF	Funding Opportunities
SAPE	Industry Partnership
SAL	Technology Licensing
GRI	International Relations
SCOM	Communication
SRC	Networks and Communications
SIG	Management Information Systems
SAS	System Administration
SGI	Infrastructure Management

[1] *Includes Secretarial Coordination*

3.3 Activity in Projects

3.3.1 Global Indicators

Table 3.3.1 shows the breakdown of INESC TEC's funding sources and the evolution from 2015 to 2019.

Table 3.3.1 - Funding sources and evolution

Sources			Value (k€)					Δ (k€ | %)	
			2015	2016	2017	2018	2019	2018-19	
Active Projects	PN-FCT	National R&D Programmes - FCT	775	490	1 143	2 279	3 677	1 397	61%
	PN-PICT	National R&D Programmes - S&T Integrated Projects	785	1 464	2 644	2 428	468	-1 960	-81%
	PN-COOP	National Cooperation Programmes with Industry	316	263	1 060	1 251	928	-323	-26%
	PUE-FP	EU Framework Programmes	4 040	4 494	3 306	3 628	3 910	282	8%
	PUE-DIV	EU Cooperation Programmes - Other	290	632	686	707	713	6	1%
	SERV-NAC	R&D Services and Consulting - National	3 033	2 259	2 538	2 525	2 527	2	0%
	SERV-INT	R&D Services and Consulting - International	173	287	355	509	410	-99	-19%
	OP	Other Funding Programmes	802	703	1 040	841	1 067	226	27%
		Total Active Projects	**10 214**	**10 592**	**12 773**	**14 168**	**13 699**	**-469**	**-3%**
Closed Projects			229	418	140	309	185	-124	-40%
National Strategic Programme - Pluriannual			2 191	2 615	3 003	2 485	2 307	-179	-7%
National Strategic Programme - EEC			0	0	0	0	368	368	
National Strategic Programme - CIT			0	0	0	13	961	947	
National Strategic Programmes - Other			140	112	130	170	73	-97	-57%
Other Revenues			411	270	260	383	375	-8	-2%
		Total Revenues	**13 184**	**14 008**	**16 305**	**17 529**	**17 966**	**438**	**2%**

Figure 3.3.1 illustrates the distribution of funding for the projects carried out in 2019, and its evolution since 2015. The activity level has grown steadily, with oscillations in the relative importance of the different funding sources, typically reflecting the cyclic nature of national and international financing programs.

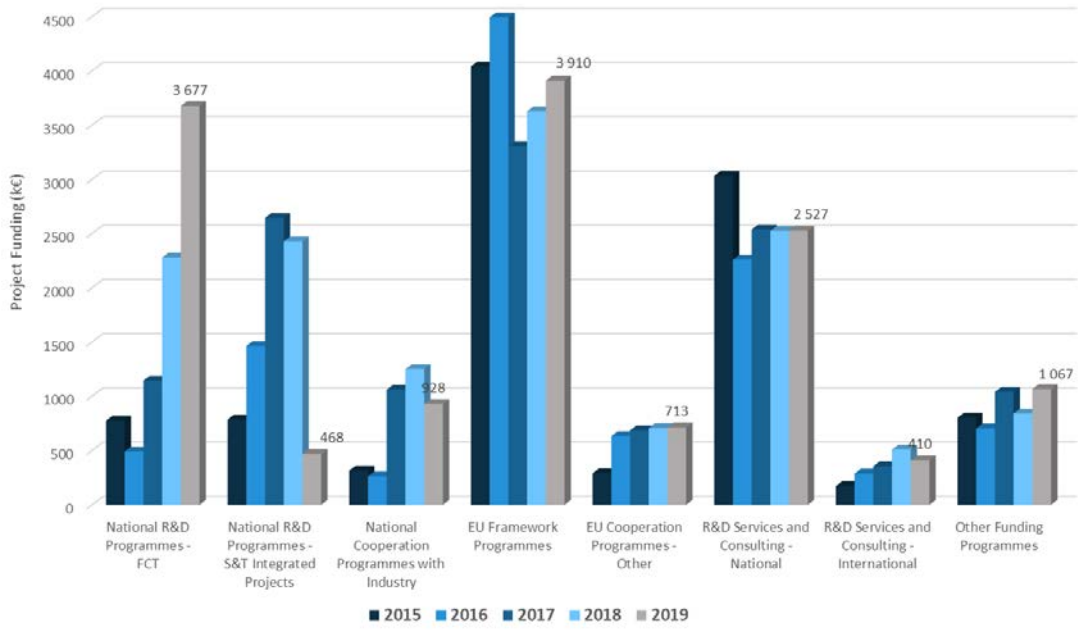

Figure 3.3.1 - Evolution of project funding by source (k€)

Figure 3.3.2 shows the project funding distribution by source, in comparison with the previous year.

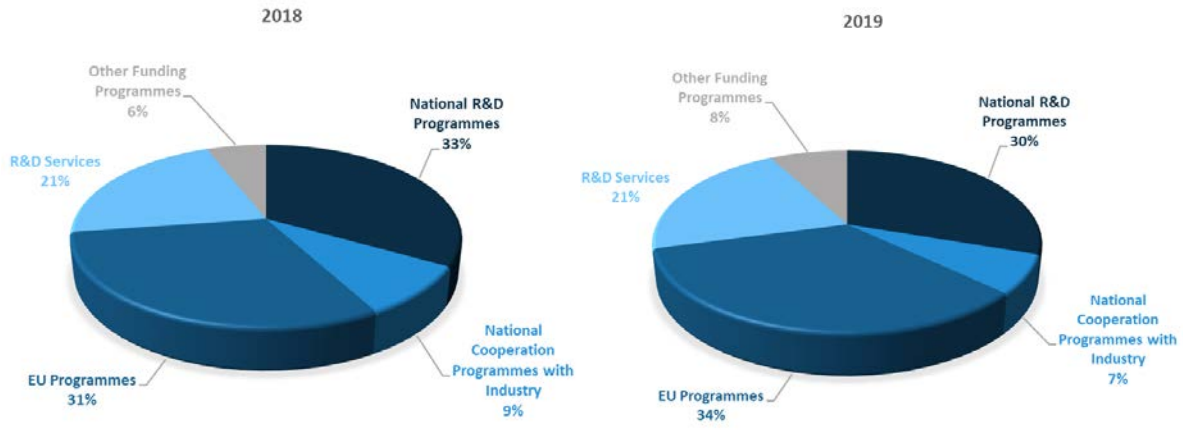

Figure 3.3.2 - Distribution of project funding by source – 2018 and 2019

The number of active projects and the average funding per project by source are also of interest, and are shown in Table 3.3.2.

Table 3.3.2 - Number of active projects and average funding by source

Type of Project		Number of Active Projects					Δ (%)	Average Funding (k€)	
		2015	2016	2017	2018	2019	2018-19	2018	2019
PN-FCT	National R&D Programmes - FCT	41	32	33	73	74	1%	31	50
PN-PICT	National R&D Programmes - S&T Integrated Projects	6	10	10	8	10	25%	303	47
PN-COOP	National Cooperation Programmes with Industry	11	13	22	17	21	24%	74	44
PUE-FP	EU Framework Programmes	26	35	31	22	48	118%	165	81
PUE-DIV	EU Cooperation Programmes - Other	4	9	18	18	20	11%	39	36
SERV-NAC	R&D Services and Consulting - National	71	72	60	48	121	152%	53	21
SERV-INT	R&D Services and Consulting - International	8	6	9	8	13	63%	64	32
OP	Other Funding Programmes	11	13	24	21	31	48%	40	34
	Total	**178**	**190**	**207**	**215**	**338**	**123**	**66**	**41**

The main conclusions that can be drawn from the global indicators summarized in the previous tables and graphs are the following:

- INESC TEC maintained a diversified and sustainable activity according to its funding model, with a turnover of about 18 M€, 338 R&D projects, and 28% of project funding from international sources. 2019 was, mostly, a year of consolidation of INESC TEC's activity, with an increase in activity of about 3%, consolidating growth observed in previous years of 26% in 2015, 6% in 2016, 16% in 2017 and 6% in 2018;
- A balance between the different funding sources was successfully maintained, with an increase in the level of funding of European projects, mainly justified by the institution's strategic efforts towards this type of projects, as well as FCT projects, and by maintaining the level of contract research and consulting activities;
- The gradual completion of the NORTE 2020 National S&T Integrated Projects between 2018 and 2019 has been offset with new FCT projects, ensuring that a significant level of national financing is maintained for lower TRL activities;

- The base funding for technology transfer activities – "CIT" – is a new and very important funding source received since 2019 to strengthen technology transfer capabilities, representing 5% of the total revenue;
- The support from the National Strategic Programme - "Pluriannual" - is a critical source of funding due to its flexibility and stability. As a relatively small proportion of the total funding sources (12.8%), it is greatly multiplied by the institution in its activity;
- EU Framework Projects are naturally the largest projects in terms of funding volume. At the opposite end, R&D and Consulting Services are often short duration projects and therefore below average funding per project.

3.3.2 Clusters Indicators

This section presents in Table 3.3.3 and Figure 3.3.3 the funding by source and Cluster, providing an overview of their relative size and results in 2019.

Table 3.3.3 - Activity (k€) in projects by Cluster and funding source

Funding Source			Clusters			
			NIS	PE	ISE	CS
Active Projects	PN-FCT	National R&D Programmes - FCT	1 541	488	759	888
	PN-PICT	National R&D Programmes - S&T Integrated Projects	241	4	64	159
	PN-COOP	National Cooperation Programmes with Industry	395	21	442	70
	PUE-FP	EU Framework Programmes	543	977	1 234	988
	PUE-DIV	EU Cooperation Programmes - Other	272	88	289	65
	SERV-NAC	R&D Services and Consulting - National	412	796	773	535
	SERV-INT	R&D Services and Consulting - International	222	12	48	129
	OP	Other Funding Programmes	29	155	38	361
		Total Active Projects	3 654	2 541	3 646	3 195
		Total Closed Projects	93	42	19	31
		Total Funding	**3 747**	**2 583**	**3 665**	**3 226**

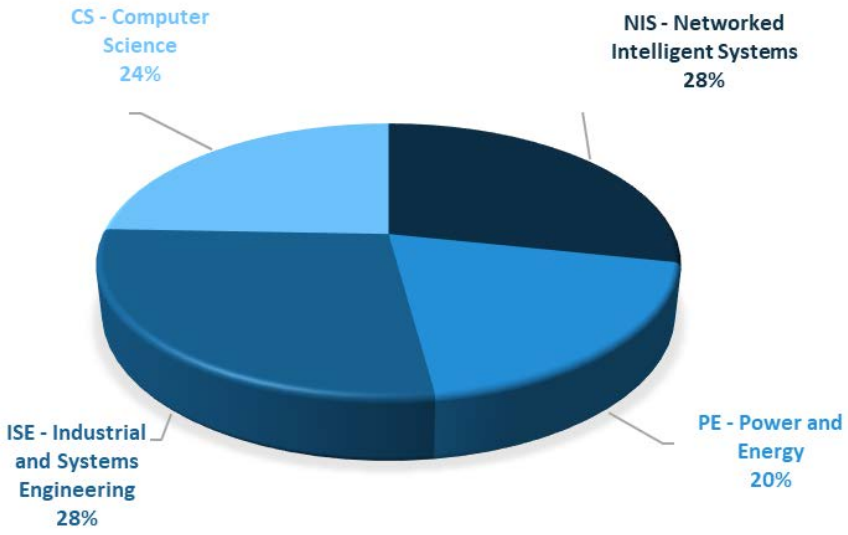

Figure 3.3.3 - Project Funding by Cluster

3.3.3 R&D Centres Indicators

A detailed view of the total funding by source per R&D Centre is given in Table 3.3.4 and Figure 3.3.4.

Table 3.3.4 - Project Funding (k€) per R&D Centre

	Funding Source	Total (k€)	R&D Centre												
			CTM	CAP	CRAS	CBER	CPES	CESE	CRIIS	CEGI	CITE	CSIG	LIAAD	CRACS	HASLAB
Active Projects	PN-FCT	**3 677**	474	370	482	215	488	231	202	310	16	366	229	65	228
	PN-PICT	**468**	95	81	13	52	4	17	8	35	4	48	51	25	34
	PN-COOP	**928**	248	0	147	0	21	330	78	34	0	68	0	0	2
	PUE-FP	**3 910**	245	22	276	0	977	576	505	95	57	371	95	70	452
	PUE-DIV	**713**	0	70	201	0	88	38	170	0	81	49	0	15	0
	SERV-NAC	**2 527**	302	46	61	3	796	487	145	104	37	273	141	49	72
	SERV-INT	**410**	89	0	132	0	12	43	5	0	0	16	0	0	113
	OP	**1 067**	23	0	7	0	155	0	32	4	2	110	2	0	249
	Total Active Projects	**13 699**	**1 476**	**589**	**1 320**	**270**	**2 541**	**1 722**	**1 145**	**581**	**198**	**1 301**	**518**	**225**	**1 151**
	Total Closed Projects	**185**	**11**	**19**	**60**	**2**	**42**	**-1**	**2**	**0**	**18**	**13**	**8**	**4**	**6**
	Total Funding	**13 884**	**1 487**	**608**	**1 380**	**272**	**2 583**	**1 720**	**1 147**	**581**	**216**	**1 314**	**526**	**229**	**1 158**

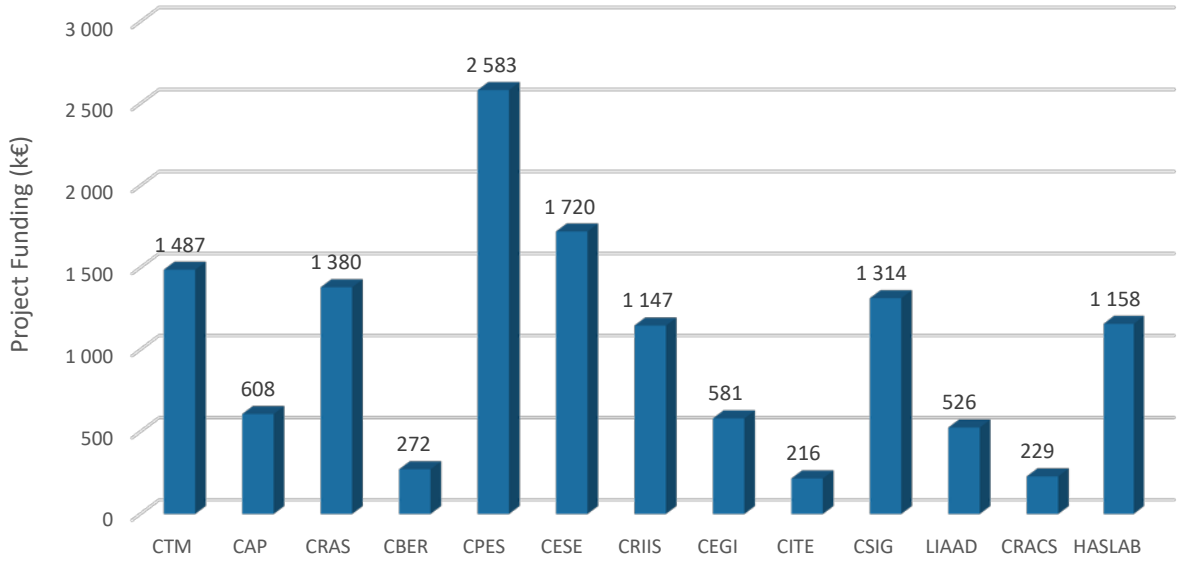

Figure 3.3.4 - Total Project Funding per R&D Centre (k€)

3.4 Publications

3.4.1 Global Indicators

Table 3.4.1 and Figure 3.4.1 show the number of INESC TEC publications and their evolution between 2016 and 2019.

The number of publications was obtained from different indexing sources (ISI and SCOPUS) gathered by the Authenticus platform, and from CORE (Computing Research and Education Association of Australasia). Publications with authors from different Centres are counted individually in each author's Centre, but the institution total removes repetitions, whenever they occur.

It is important to highlight a significant increase in the number of publications in indexed journals, INESC TEC's main overall publication priority. The number of publications in indexed conferences decreased 17%, mostly due to the transition in the funding of earlier stage research from the large-scale integrated projects to FCT projects. The total number of indexed publications decreased slightly in 2019 (4%), due to the reduction of publications in indexed conferences.

Table 3.4.1 - Number of Publications

Publication Type	2016	2017	2018	2019
Indexed Journals	311	318	312	369
Indexed Conferences	476	492	494	410
Books	1	1	7	4
Book Chapters	37	27	40	29
Concluded PhD Theses - Members	38	34	38	19
Concluded PhD Theses - Supervised	56	56	56	33

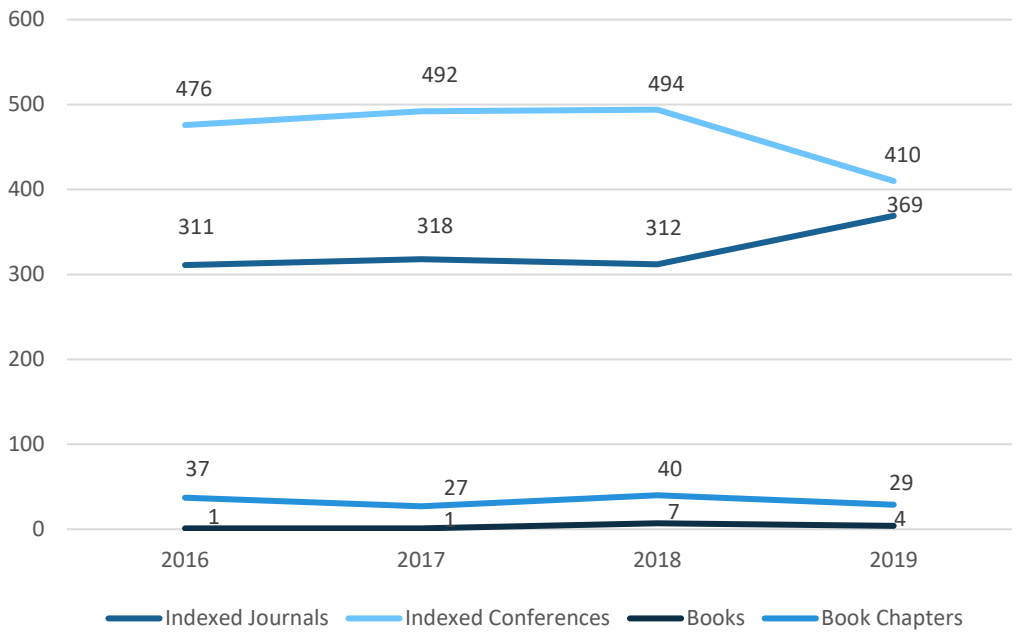

Figure 3.4.1 - Evolution of Publications

The evolution of publications per capita followed the trend of the absolute values, namely with the number of articles in indexed journals per capita featuring a significant increase, as presented in Figure 3.4.2.

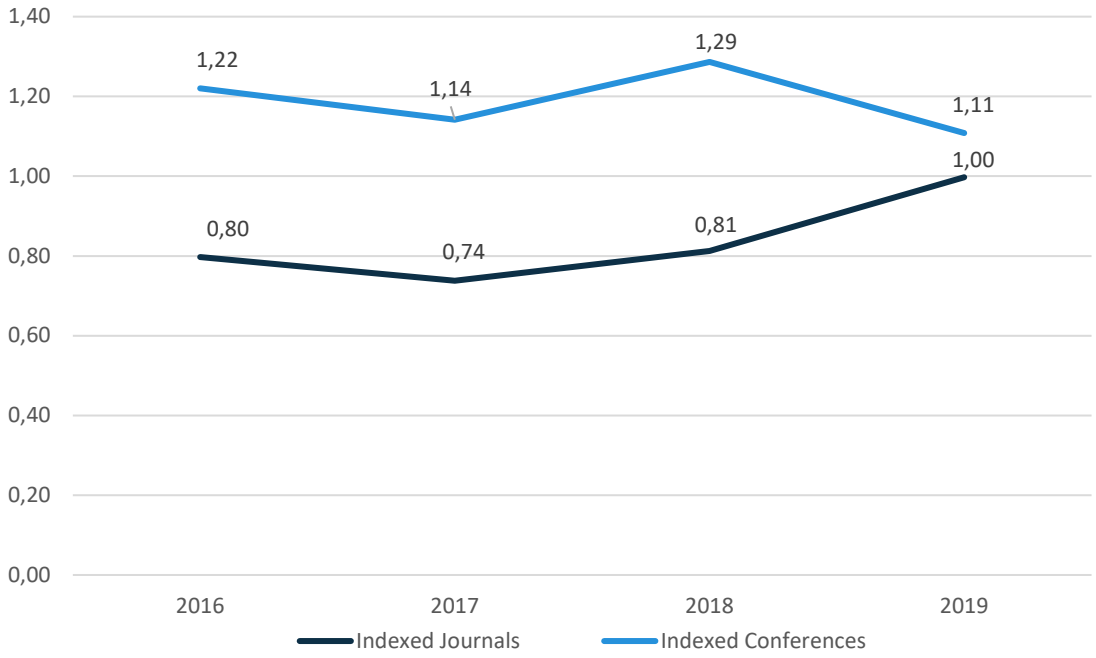

Figure 3.4.2 - Evolution of Publications per Core PhD

For the publications in journals indexed by Scopus, the Figure 3.4.3Figure 3.4.3 shows its distribution per impact factor quartile. In 2019, the publication effort was mainly channelled to indexed journals. When comparing with the previous year, although in terms of percentage, there was a diminution in the number of publications in the First Quartile (71% to 62%), in absolute terms, there was an increase in publications in this Quartile, from 189 articles in 2018 to 195 articles in 2019.

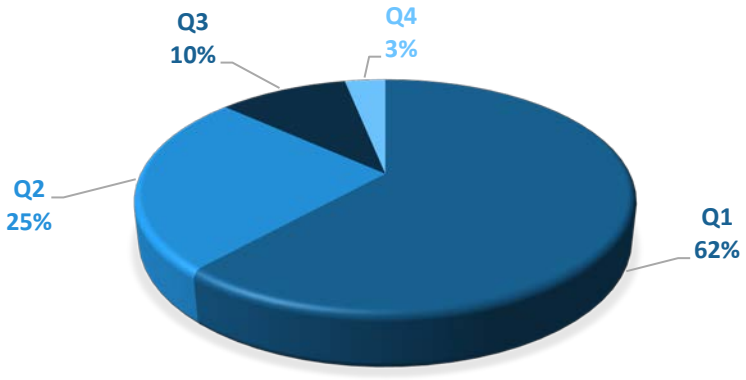

Figure 3.4.3 - Journal impact factor Quartile distribution (Scopus)

3.4.2 R&D Clusters Indicators

This section presents the Clusters main publication indicators (Table 3.4.2 and Figure 3.4.4).

Table 3.4.2 - Publications by Cluster and publication type

Publication Type	Clusters			
	NIS	PE	ISE	CS
Indexed Journals	96	95	87	114
Indexed Conferences	114	65	83	163
Books	0	0	2	2
Book Chapters	10	5	6	9
Concluded PhD Theses - Members	4	1	9	5
Concluded PhD Theses - Supervised	9	2	15	8

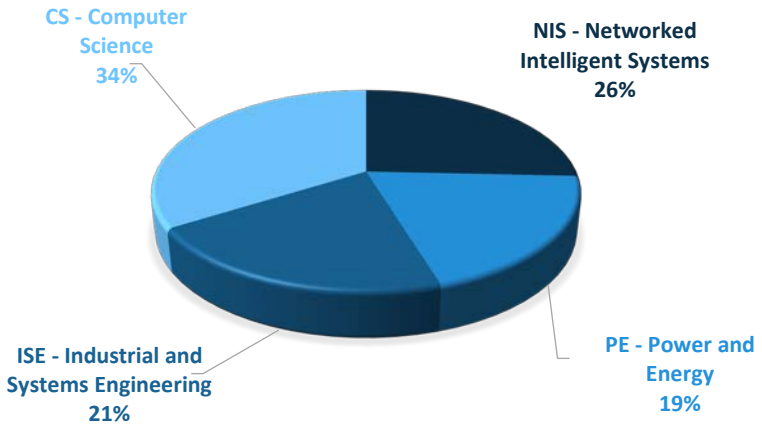

Figure 3.4.4 - Indexed publications by Cluster

3.4.3 R&D Centres Indicators

Figure 3.4.5 presents the number of indexed publications in journals and conferences per R&D Centre. The figures and their evolution are presented in greater detail in Annex I.

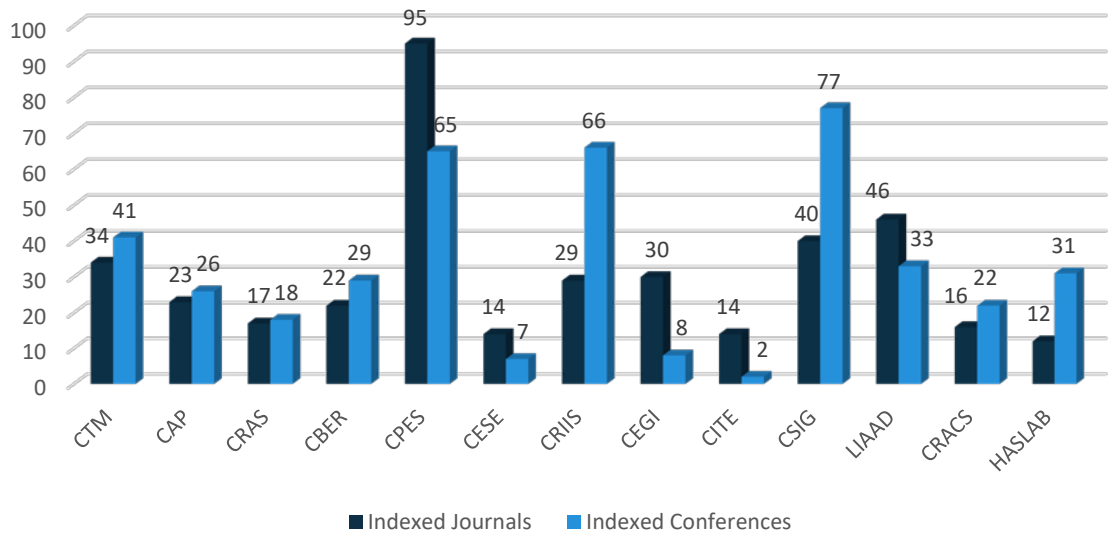

Figure 3.4.5 - Indexed Publications in Journals and Conferences by Centre

3.5 IP Protection, Exploitation and Technology Transfer

In 2019, the number of invention disclosures and patent first priority filings was significantly lower than in the previous year (Table 3.5.1), mostly as the result of an effort to accelerate filings in 2018 so they could be reported within the scope of the NORTE 2020 National S&T Integrated Projects. Spin-off activity in 2019 was again considerable, with two new spinoffs established and three in development.

Table 3.5.1 - Results related with IP Protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	8	15	9
Software copyright registrations	0	3	2
Patent first priority filings (New inventions)	6	11	2
Patent applications (Internationalisation)	26	22	26
Granted patents	1	6	4
Licence agreements	2	1	1

3.5.1 Technological entrepreneurship

INESC TEC supports the launch of technology-based spin-offs, expressly established to further develop and exploit IP created by INESC TEC. The table below provides an overview of INESC TEC's most recent spin offs, established and in development since 2014, and their main developments in 2019.

Table 3.5.2 - Overview on INESC TEC's most recent spin-offs

Established Spin-offs				
Name and description	**Year of incorporation**	**Sector**	**Employees (FTE)**	**Main developments in 2019**
Keyruptive Technologies Mobile app solution for secure cloud storage and management of digital assets such as crypto currency, using patent pending technology that enables the distribution of trust among multiple entities.	2019	Software security / Fintech	< 5	Spin-off launch, development of first functional version of the first product for market entry. Financial support from INESC TEC.
Insignals Neurotech Wearable wireless devices to precisely measure wrist rigidity, helping surgeons place brain implants more accurately during surgery on patients with Parkinson's, epilepsy, and other neural conditions.	2019	Medtech	< 5	Spin-off launch, in partnership with Frontier IP Group, additional technology development and preparation of clinical trials. The company won the second place in the EIT Health Germany – Startups Meet Pharma Programme.

Established Spin-offs				
Name and description	**Year of incorporation**	**Sector**	**Employees (FTE)**	**Main developments in 2019**
Ubirider Develop solutions to make urban mobility smarter and to improve travellers' overall experience. Pick is a universal app which integrates any mobility service for multimodal trip planning and mobile payment of fares.	2018	Digital mobility	10-20	Conversion from private limited company to public limited company, in a round of funding with new investors. Initial customer deployments.
MITMYNID Marketplace to search and compare transport and logistics services with simple or multimodal door-to-door solutions. Intelligent Routing System to search and combine logistics services (air, rail, road, sea) to provide optimized solutions.	2015	IT for transport and logistics	5-10	Customer acquisition and additional technology development.
LTPlabs Advanced analytics and business consultancy in Marketing, Sales, Operations and Supply Chain, based on digital platforms.	2014	Business consultancy	20-50	In September 2019, INESC TEC sold its equity share to LTPlabs, according to predefined exit conditions in the shareholders' agreement, successfully concluding its participation in the company.
Spin-offs in Development				
Name and description	**Year of incorporation**	**Sector**	**Employees (FTE)**	**Main developments in 2019**
iLoF Leverage machine learning to drastically reduce the cost and time of drug discovery, using a patented photonics and Artificial Intelligence system to identify unique features of various gold-standard biomarkers, capturing their signature on a cloud-based library.	2019	Medtech, Digital health	5-10	The team won the EIT Health's Wildcard award, raising an initial funding round of 2.0 M€.
UNEXMIN Georobotics Underwater mine exploration robotic system for commercial mine surveying, exploration and geoscientific purposes.	2018	Geological consulting	< 5	First legal steps, agreement on equity distribution among founders, and final version of the business plan.
WeSENSS Corporate solutions for security and quantified occupational health approaches to promote worker wellbeing and improve performance, based on a wearable & IoT platform for hazardous professionals' vitals and work environment monitoring.	N/A	Medtech	N/A	Search for non-dilutive initial funding.

3.6 Dissemination Activities

Table 3.6.1 and Table 3.6.2 illustrate the expressive activity of INESC TEC members and R&D Centres in a variety of categories of dissemination activities.

Table 3.6.1 - Results related with dissemination activity

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	75
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	75
International events in which INESC TEC members participate in the program committees	330
Participation in events such as fairs, exhibitions or similar	66

Table 3.6.2 - Dissemination activities organized by the R&D Centres

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the R&D Centres	54
Participants in the conferences, workshops and scientific sessions organised by the R&D Centres	4 549
Advanced training courses organised by the R&D Centres	19

3.7 R&D Clusters Activity Overview

Finally, Figure 3.7.1 presents an integrated overview of the activity of the four R&D Clusters, with the axes representing each Cluster's proportion of INESC TEC's total funding, indexed publications and human resources.

The activity in 2019 was quite balanced across the three dimensions for all Clusters, with the variations resulting mostly from the Clusters' specific activity patterns, as well as from cyclical fluctuations in publication productivity, in competitive grants and research contracts.

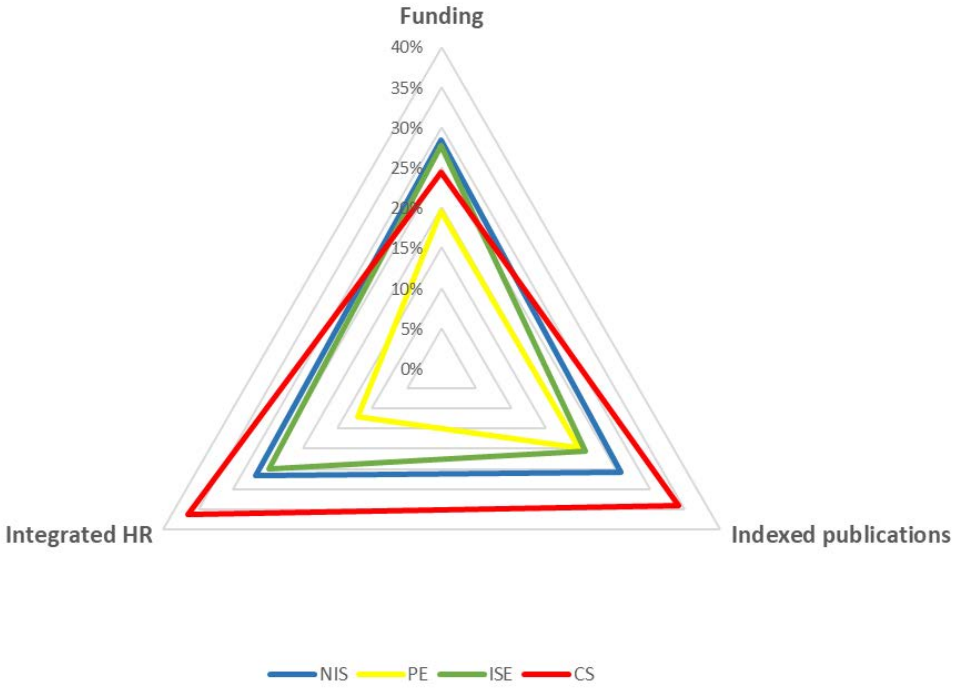

Figure 3.7.1 - Overview of the R&D Clusters' dimension and activity

4 INESC TEC CLUSTERS

The research at INESC TEC is structured in four Clusters: Networked Intelligent Systems (NIS); Power and Energy (PE); Industrial and Systems Engineering (ISE), formerly known as Industry and Innovation; and Computer Science (CS). The next sections present these clusters including their objectives and results obtained during 2019.

4.1 NETWORKED INTELLIGENT SYSTEMS

Coordinator: Manuel Ricardo
Assistant to the Cluster Coordinator: Andry Pinto
Centres: *CAP, C-BER, CRAS and CTM.*

4.1.1 Presentation of the Cluster

The Cluster on Networked Intelligent Systems (NIS) envisions to work "*towards autonomous networked intelligent hybrid systems enabled by ubiquitous sensing and processing of information*". This Cluster is formed by research Centres working in complementary scientific domains: CAP addresses optical sensing, optical imaging, and microfabrication of devices; C-BER addresses bio-instrumentation, biomedical imaging, and neuro-engineering; CRAS addresses robotics and autonomous systems operating in complex environments for data gathering, mapping, inspection, surveillance, and intervention; CTM addresses electronics, radio and optical communications, communications networks, multimedia technologies, computer vision, and intelligent information processing.

The Cluster NIS has 4 main Research Lines (RLs): Sensing, Communications, Computer Vision, and Autonomous Systems. Together, these RLs combine 160 researchers (66 of them having a PhD) in projects focused in developing algorithms, statistics, simulation and machine learning to address problems related to both fundamental theory and systems implementation. Activities for the next 5 years will be fostered by intelligent and collaborative agents, smaller and long endurance systems, convergence of deep learning and communications, and ubiquity of Computer Vision.

The Cluster NIS Council is composed by the following members: Manuel Ricardo, Andry Pinto, Aníbal Matos, Aurélio Campilho, Carlos Pinho, Duarte Dias, Eduardo Silva, Filipe Ribeiro, Hélder Oliveira, Ireneu Dias, Jaime Cardoso, João Paulo Cunha, Luís Pessoa, Paula Viana, Paulo Marques, and Rui Campos.

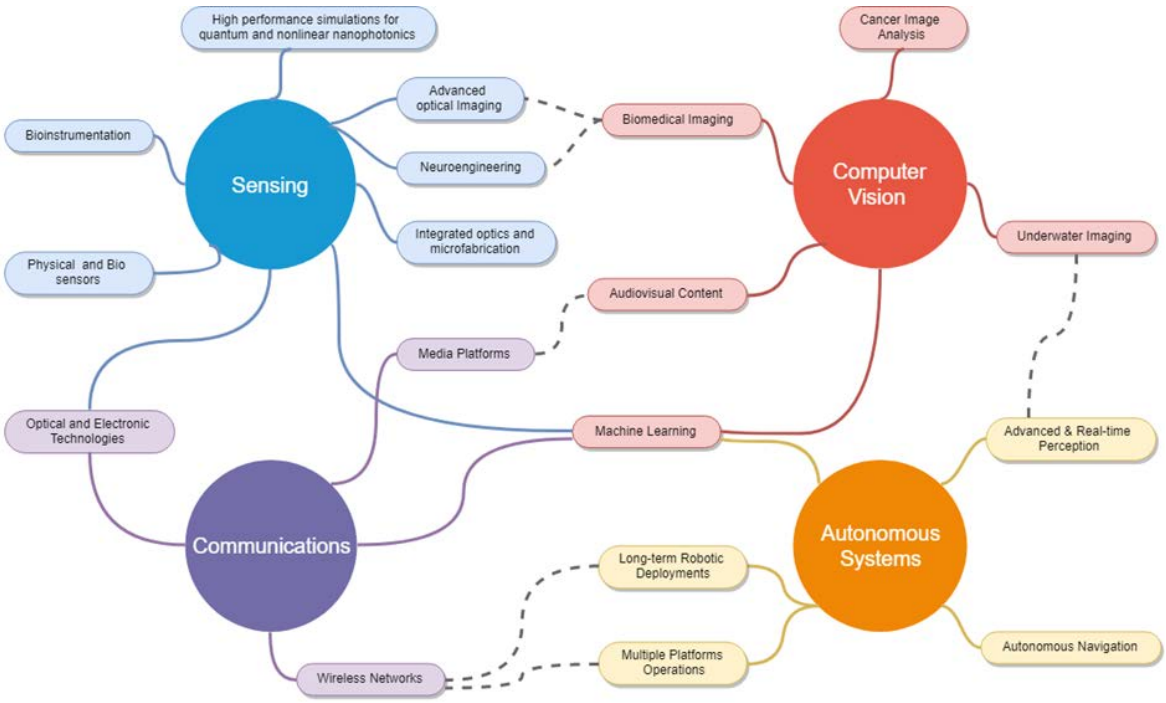

Figure 4.1.1 – Interaction between research topics and lines in Cluster NIS

4.1.2 Scientific Outcomes in 2019

RL1 - Sensing

The Sensing RL aims to design multi-parameter sensing systems for capturing relevant information. By the end of 2019 this RL consisted of 56 Core Researchers including 24 PhDs. During 2019 this RL published 28 articles in indexed journals (17 of them classified by Scopus as first quartile) and had 9 PhD theses ongoing (2 of them concluded). The 4 main scientific outcomes produced during 2019 were the following:

- **New label free method for medical analysis**. This outcome consists of a new method and corresponding sensing system, for direct analysis of biological entities in complex solutions. It deals with AI analysis of backscattered signals from optically trapped cells or biomolecules and has a very strong potential for medical and environment applications;
- **Broadband optical waveguides by laser direct writing**. This outcome consists of high quality broadband (from the visible to infrared) waveguides in fused silica substrates by femtosecond laser direct writing. These results are of outmost importance for the demonstration of integrated sensors, based in plasmonics for instance;
- **Raman endoscopy**. This outcome consists of the development and application of Raman fiber endoscopy based on new fibers such as hollow core PCFs and plastic fibers. The fiber endoscope is intended to detect cancer tumors by Raman spectroscopy, complementing existing characterization methods;
- **Model of the optical response of nanostructured metal-dielectric media**. This outcome consists of a model to explain the optical response of nanostructured metal-dielectric media based on the quantization of the localized plasmon modes, their coupling, and collective excitation. This outcome will be of utmost importance to new design sensors to sense multiple physical parameters and in particular, provide direct optical sensing of electrostatic fields.

RL2 - Computer Vision

The Computer Vision RL aims to empower the next generation of intelligent systems with the capability of reasoning from visual data, approaching or even surpassing the human vision. The RL addresses both fundamental and applied problems in computer vision, image processing, machine learning, and decision support systems anchored in the automatic analysis of visual data. The focus is on the fields of health, multimedia and robotics.

By the end of 2019 this RL consisted of 48 Core Researchers including 18 PhDs. During 2019 this RL published 32 articles in indexed journals (23 of them classified by Scopus as first quartile) and had 23 PhD theses ongoing (1 of them concluded). The 4 main scientific outcomes produced during 2019 were the following:

- **Sparse Multi-Bending Snakes**. We proposed a novel parametric active contour model which can divide the contour into a set of contiguous regions with different bending properties. We derived a new energy function that induces such behaviour and present a group optimization strategy to find the optimal bending resistance parameter for each point of the contour;
- **Region identification in images and video frames.** Flexible strategies combining computer vision techniques and deep machine learning models for processing images and videos, while seeking to minimise required training data and favouring online training;
- **Uncertainty-aware deep learning-based approach for computer-aided diagnosis and grading.** We proposed a CAD grading system that supports the clinical decision and the assigned pathology grades by providing a medically interpretable explanation. This methodology was successively tested in grading Diabetic Retinopathy;
- **Tools to explore, map and gather information from flooded caves across Europe using optical and sonar data integrated in the UNEXMIN robot.** We developed models for 3D mapping that were successfully tested in different flooded mines in Portugal, UK and Hungary.

RL3 - Autonomous Systems

The Autonomous Systems RL addresses the development of innovative robotics solutions for operation in complex environments; relevant examples are underwater environments, and particularly deep-sea water. This research line also includes activities related to the development of key components of field going robotic platform, addressing topics such as persistent operations, underwater robotic data and energy mules, operations in non-segregated space, and collaborative mapping and learning.

By the end of 2019 this RL consisted of 26 Core Researchers including 8 PhDs. During 2019 this RL published 11 articles in indexed journals (5 of them classified by Scopus as first quartile), and had 6 PhD theses ongoing. The 4 main scientific outcomes produced during 2019 were the following:

- **Underwater Mine Explorer Robot**. Validation in real experiments of an autonomous robot for exploration of flooded mines. This robot is endowed with multiple sensors for extendend perception of the environment allowing for its autonomous operation inside flooded galleries;
- **IS-ABS - In situ autonomous biosampler**. The IS-ABS automates the process of collecting environmental DNA, and is suitable for integration in water observation systems, which will contribute to substantially increase biological surveillances;
- **Multiple AUV tracker**. The proposed approach is based on a Probability Hypothesis Density Filter, thus overcoming the data association problem which is crucial in multiple AUV tracker. Our tracker is able not only to successfully estimate the positions of the vehicles, but also their velocities;
- **Target detection in hyperspectral imaging.** A novel 3-D convolutional neural network approach and compared against two implementations of other state-of-the-art methods: spectral angle mapper and hyperspectral derivative anomaly detection.

RL4 - Communications

The Communications RL aims to create self-learning communications systems that can support different types of services and data in Immersive and Extreme Environments, taking advantage of state of the art heuristics including artificial intelligence and machine learning. The focus is on solutions for the communications systems of the future, from the physical layer to the networking layer to the application layer, considering both terrestrial and maritime environments.

By the end of 2019 this RL consisted of 30 Core Researchers including 16 PhDs. During 2019 this RL published 19 articles in indexed journals (13 of them classified by Scopus as first quartile), and had 17 PhD theses ongoing (5 of them concluded). The 4 main scientific outcomes produced during 2019 were the following:

- **Positioning and routing algorithms for aerial networks.** Position control and routing algorithms for aerial networks that enable significant performance gains (higher throughput, lower delay) when compared to state of the art counterparts;
- **Content buffering approaches for interactive streaming**. Predictive stream buffering mechanisms based on Machine Learning techniques to optimize network resources and reduce view switching latency on multi-view content when transitioning from distinct views;
- **Impulse-radio integration-and-fire transceiver**. Ultra-low power, transceiver architecture based on impulse-radio ultra-wide band communications that avoids the need for conventional A/D conversion and outperforms competing state-of-the-art solutions;
- **Optical modulation of 79GHz resonant tunneling diode**. First reported experimental demonstration of a resonant tunneling diode-photodetector oscillator in the mmWave frequency range, establishing RTD-PD oscillators as solid candidates to be used as optical transceivers in the interface between optical communication networks and mmWave/THz terminals.

4.2 POWER AND ENERGY

Coordinator: Luís Seca
Assistant to the Cluster Coordinator: David Rua

4.2.1 Presentation of the Cluster

The Cluster is focused on traditional and emergent areas of power and energy systems, for planning and operation purposes, with an emphasis on renewable energy sources (RES) integration, electric vehicles (EV) deployment, distributed energy resources (DER) management, demand response (DR), smart grids and energy analytics, through steady-state and dynamic network analysis, reliability models and tools, optimization, soft computing and data science.

CPES is the core Centre of the Cluster, as it is clearly where the sector critical mass is concentrated, but the evolution of the energy system, particularly the electrical power system, has supported the involvement of other competences, held by associated Centres, due to the multidisciplinary nature of the problems and opportunities to address. There are already examples of this collaboration and joint projects, in the areas of information and communication technologies (CTM), data science (LIAAD), data platforms and hubs (HASLab), asset management (CEGI) and combined energy and process optimization in industry (CESE). More than sharing projects, the goal is to foster a multidisciplinary approach to support current applied research and technology transfer, but most of all, to design the scientific strategy for this particular domain, distributed among the different Centres of the Cluster, that will guarantee the creation of new knowledge to support the future challenges of a digital and decarbonized energy system.

The Cluster coordination changed in 2019, being the main focus of work the definition of the overall strategy and the strategic Research lines. The objective of the new coordination is to invite in 2020 a new team, including representatives from other Centres to foster a truly multidisciplinary approach to the topic. To support the Cluster activity, David Rua (PhD from CPES) was invited to assist the coordinator.

In the following figure, one can observe the different Reasearch lines of the Cluster for 2019, being currently under revision. The smaller boxes represent the scientific domains of the different Centres of INESC TEC that can leverage a significant development in the different RL.

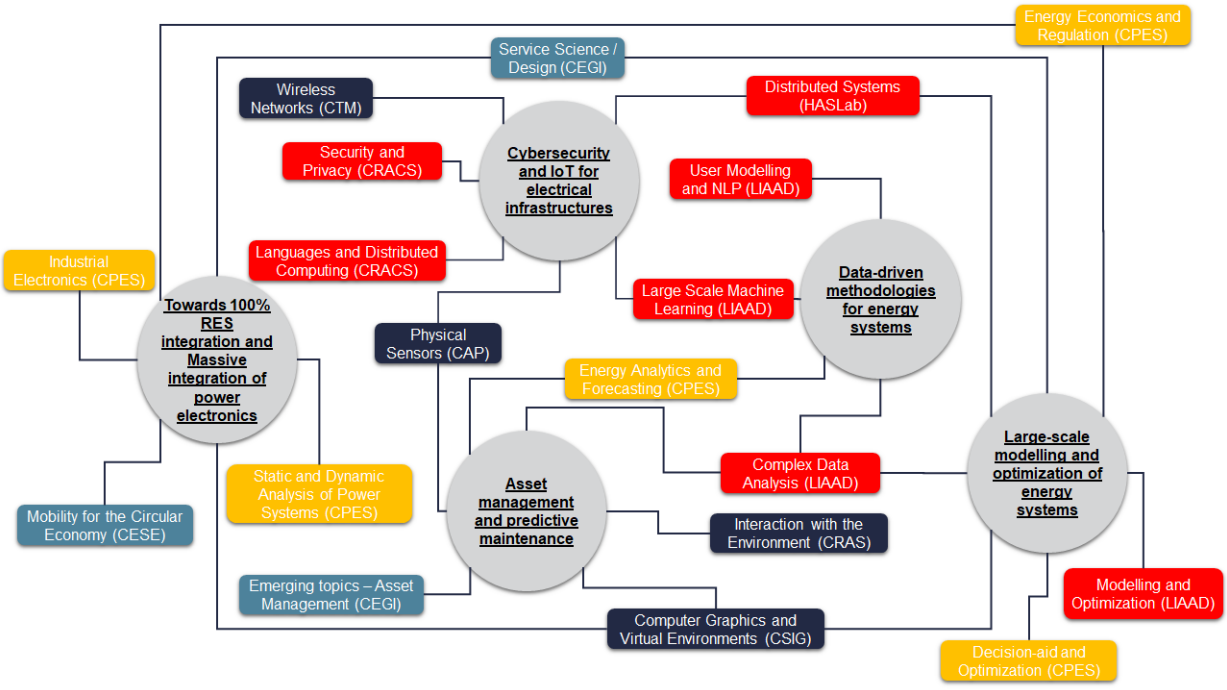

Figure 4.2.1 - Interaction between research topics and lines in Cluster PE

4.2.2 Scientific Outcomes in 2019

RL1 - Towards 100% RES integration and massive integration of power electronic-based interfaces

Identification and development of innovative contributions within the scope of the future grid scenario of up to 100% share of RES, where the active contribution of distributed power electronics inverter-based generation, connected at different voltage levels, is necessary for increasing grid resiliency and stability.

In 2019, the main scientific achievements were:

- Novel grid-forming self-adaptive control parameters solution that improves the isolated power system transient stability, considering large shares of RES;
- Innovative control strategies for hybrid AC/DC microgrids supplied by Smart Transformers involving advanced functionalities (e.g., frequency-support to the AC grid, islanded mode);
- Grey-box approach for identifying an aggregated dynamic model for active distribution grids;
- Hierarchical optimisation for the energy dispatch and volt/var control of a photovoltaic-battery microgrid cluster;
- Development of a methodology and an experimental prototype that enables the balancing of battery cells and hybridization with supercapacitors (best paper award in 2019 IEEE Vehicle Power and Propulsion Conference);
- Prototype of a smart inverter with full integration of PV modules and batteries and remote monitoring functions.

RL2 - Large-scale modelling and optimization of energy systems

This RL is focused in real-time monitoring, large-scale modelling and optimization of multi-energy systems considering different time horizons (from day- to years-ahead). A fundamental requirement is to design computationally efficient algorithms that integrate different sources of uncertainty.

In 2019, the main scientific achievements were:

- Two-stage stochastic optimization model to support an aggregator in the definition of bids for the day-ahead energy and secondary reserve markets;
- Cluster-based optimization approach to support an aggregator in the definition of demand and supply bids for the day-ahead energy market;
- Genetic and cross-entropy algorithms for energy optimization in a home energy management system with low computation platform;
- Cost-benefit analysis regarding the changes proposed by ERSE to be introduced in the Portuguese tariff code;
- Estimation of the Levelized Cost of Electricity for wind and PV units, taking into account the need to limit the ramping values;
- Estimation of domestic consumers' elasticity in response to dynamic tariffs.

RL3 - Data-driven methodologies for energy systems

The digitalization of the energy sector requires novel data-driven methodologies for forecasting, optimization and prescriptive analysis, which enables the creation of new services for end-users. Improvement of RES, load and market prices forecasting skill by developing distributed and privacy-preserving statistical learning algorithms that explore geographically distributed time series data.

In 2019, the main scientific achievements were:

- New contributions to RES forecasting, such as privacy-preserving collaborative forecasting and data markets;

- Conceptualization, development and integration of an end-to-end forecasting platform for load and solar resources for Elergone Energias;
- GPU-based implementation for the adequacy assessment of generating systems via sequential Monte Carlo simulation.

RL4 - Asset management and predictive maintenance

Utilities are facing the need to improve asset management policies, in order to increase their availability and reduce CAPEX and OPEX. The combination of data-driven and engineering-based methods for the descriptive and predictive analysis of asset condition, and studies to evaluate the impact of maintenance actions in assets' failure rate and degradation curveswere developed. The software developed by CPES for long-term adequacy and reserves evaluation was enhanced with the reliability models and maintenance policies developed by CEGI for each individual asset.

In 2019, the main scientific achievements were:

- New models to assess the integrated effects of investments and maintenance in the quality of service, as well as to estimate the impact of RES on distribution network losses;
- Data-driven energy optimization method for wastewater pumping stations (patent submitted).

4.3 INDUSTRIAL AND SYSTEMS ENGINEERING

Coordinator: Bernardo Almada Lobo
Assistant to the Cluster Coordinator: Alexandra Marques

Centres: *CEGI, CESE, CITE and CRIIS.*

4.3.1 Presentation of the Cluster

The Cluster on Industrial and Systems Engineering (C_ISE) aims to research and innovate in systems and services applied to the management of value streams. C_ISE envisions to lead complex decision-making in end-to-end, customer-centric, agile supply chains across different industries (e.g., manufacturing, process industries, retail, health and mobility).

In order to improve business performance and foster productivity, as well as to contribute to environmental and social sustainability, C_ISE intervention ranges from local optimization of individual organizations to complex system optimization of networks and chains. Its activities cover the design, implementation and improvement of systems for decision support, operations automation, management and intelligence, as well as the provision of innovation management & technology transfer consultancy services.

Clearly, the Cluster helps companies to fully embrace the fourth industrial revolution by leveraging digital transformation, advanced analytics and the integration of advanced manufacturing technologies and new business models. Customer-centric and real-time supply chain optimisation, as well the decentralized decision-making, will only be possible with highly flexible, realocable, adaptable and intelligent automation, control and robotics.

The Cluster ISE has five strategic research lines that are cross-fertilized to extend the space of its solutions, namely: Operations Management, Operations Research and Management Science, ICT for Digitization, Human-Robot Collaborative workstations and Technology enabled-Innovation.

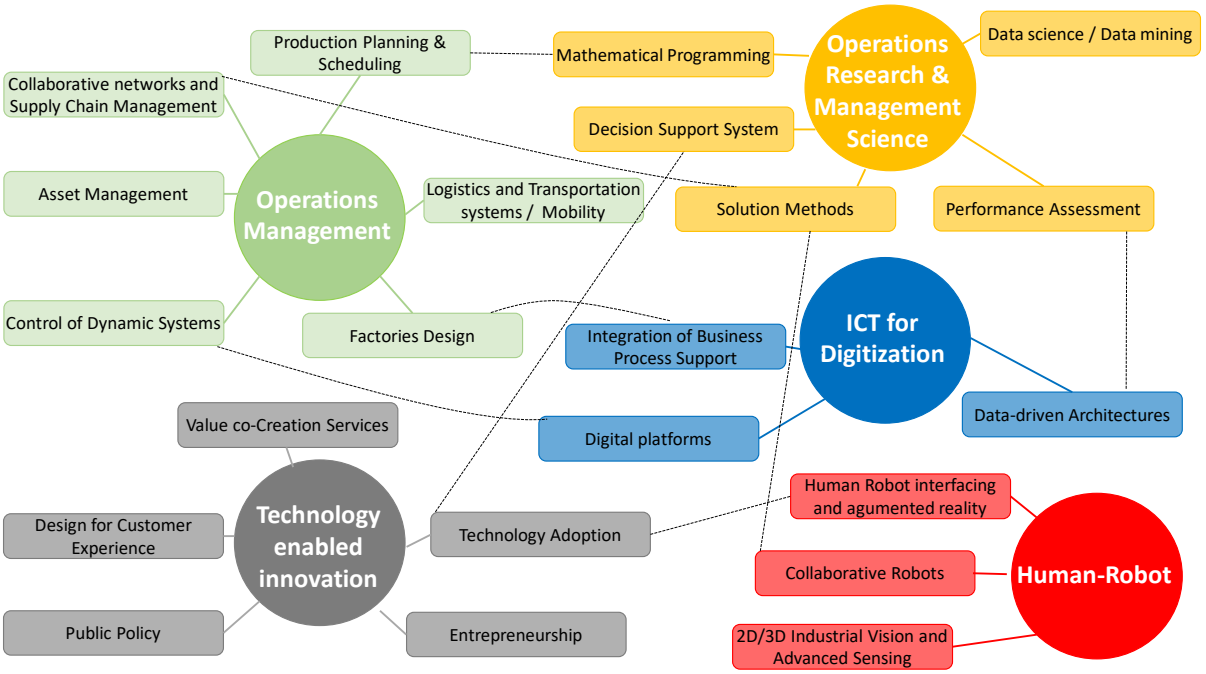

Figure 4.3.1 Interaction between research topics and lines in Cluster ISE

4.3.2 Scientific Outcomes in 2019

RL1 - Operations Management (in manufacturing and services) for responsive, sustainable and resilient operations

With a holistic and integrated view of operations, this RL is focused on the design, management, and improvement of all value adding processes in an organisation that lead to some form of output, whether it be a product or a service. It studies innovative or traditional processes for the design, procurement, production, delivery, and recovery of goods and services. Research interests range from quantitative modeling to empirical studies using tools from operations research, mathematical programming, applied stochastic processes, simulation, artificial intelligence, statistics, econometrics and economics, social sciences and exploratory research.

The four main scientific outcomes produced during 2019 were the following:

- **Production Planning and Scheduling**. Assessment of the impact of performance determinants in complex MTO/ETO supply chains through an extended hybrid modelling approach;
- **Asset Management**. Predictive and Presctiptive models for asset management and reliability engineering to control the health status across the whole life cycle of the asset (e.g. a health index for the hydropower system to monitor the effects of the newly designed flexible power services);
- **Logistics and Supply Chain Management**. Multiple vehicle synchronisation in a full truck-load pickup within the biomass supply chain; and new ways of exploring the marketing-operations interface on the delivery service model in grocery retail; we pushed mobile robots systems closer to industrial production lines;
- **Factories design**. A new prescriptive dynamic multiobjective model for designing machine layouts.

RL2 - Operations Research and Management Science: decision support in a digitised industry

This research line contributes to the methodology of operational research and to the practice of decision-making, leveraging the science of optimal decision-making under uncertainty. Modelling techniques or creative algorithms drawn from the fields of mathematical optimization, statistics, simulation and computer science are proposed for specific applications. In addition, integrated and innovative forms of Optimisation / Decision Support Systems (DSS) are also researched, that complement quantitative methods and algorithms with an active “participation” of human decision-makers.

The three main scientific outcomes produced during 2019 were the following:

- **Mathematical Programming-based heuristics**. New insights were obtained on how to deal with uncertainty and hybridize heuristics and mathematical programming (matheuristics). These approaches have been applied on emerging topics related to car-sharing;
- **Data Visualization**. Within this emerging topic in data science, C_ISE brought to light new ways of exposing and exploring data by means of contextual family trees;
- **Machine Learning meets Optimization**. New results were to improve well established research in Optimization by coupling it with Machine Learning techniques.

RL3 - Operational and strategic architectures for a data-driven industry

This RL conducts research on digital architectures and operational elements for industrial applications addressing the design and use of new (ICT) architectural concepts at the strategic and operational levels. The motivation comes from the changing context of manufacturing and of the increasing adoption of data-driven manufacturing, which requires new design knowledge to inform the development of management systems as well as execution systems. This poses demands for architectural concepts involving the so-called cyber-physical systems and the industrial internet of things.

The three main scientific outcomes produced during 2019 on **Digital Platforms, Data-driven architectures** and **Integration of Business Process Support** were as following:

- Digital Platform Architecture to Support Multi-dimensional Surplus Capacity Sharing;

- IoT-based architecture for decision support in the aeronautic industry;
- New linkages between the Internet of Things and Planning and Control Systems in Industrial Applications, as well as a novel method to test the vertical and cyber-physical integration of cognitive robots in manufacturing (including the architectural development of the Task Manager for Skill based robotic system orchestration).

RL4 - Human Robot Collaborative workstations

This RL line addresses new challenges for Manufacturing and Smart Production Systems. It is focused on developing cognitive, sensitive, collaborative and safe robotic-based workstations. These advanced automation technologies for manufacturing applications will support agile production, digital transformation and smart sensing related with Human-Machine interaction.

The main scientific outcomes produced during 2019 were the following:

- **Human-Robot interfacing and Augmented Reality**. New breakthroughs on (i) the advanced use of spatial augmented reality for assembly tasks through Building information modelling; (ii) the collaborative assembly workbench with visual guidance and increased operator comfort by making robot movements explicit;
- **Collaborative Robots**. Integration of augmented reality in collaborative robotics systems in the structural steel sector, and an overview of the use of collaborative robots in industry 4.0 regarding the human role and safety;
- **2D/3D Industrial Vision and advanced Sensing**. The extension of a modular and highly reconfigurable 3D Robot Perception framework for estimating both the 6 DoF (degrees of freedom) and for grasping poses of rigid and semi-rigid objects. The visual perception systems were also improved in 2019 to work under all-weather (illuminations) conditions, to feed localization and mapping procedures with high-level visual features positioning.

RL5 - Technology Management and Policy, and enabled Service Design and Innovation

This RL focuses on concepts, theories and methods for service design and innovation in technology enabled contexts. Furthermore, the factors that influence the decision to adopt a technology, the assessment of the social impacts of technology adoption, the planning and management of its adoption and implementation process, and its considering aspects related to human well-being, are systematically explored within this RL. This research line also studies how technology enabled service innovation leads to organizational change and how public policy can promote systemic transformation.

The main scientific outcomes produced during 2019 were the following:

- **Technology management and adoption**. Research outputs on: (i) the drivers impacting Cobots Adoption in Manufacturing Context; (ii) the environmental factors influencing the adoption of digitalization technologies in automotive supply chains; (iii) Scaling-up innovation capacities through the design and engineering of cognitive systems;
- **Advancing the theory of service design**. Service design research has been advanced with the design science research, and we have demonstrated how service design can be leveraged as a multidisciplinary approach to service innovation.

4.4 COMPUTER SCIENCE

Coordinator: Rui Oliveira
Assistant to the Cluster Coordinator: Ana Alonso

Centres: CRACS, CSIG, HASLab and LIAAD

4.4.1 Presentation of the Cluster

The mission of the Computer Science Cluster is to achieve international excellence in both fundamental and applied research, with strong contribution to technological innovation and transfer that benefits society at large.

Computing became fully decentralized, mobile, increasingly autonomous, and ubiquitous reaching all appliances, devices and living beings. As a result, current information and communications systems present many hard and intricate challenges associated to scalability, security and criticality. The ever-increasing amounts of generated data embody a wealth of information that needs to be properly and timely mined and analysed. This challenges our capacity to filter, curate, store, process, query and visualise unprecedented volumes of data from diverse sources and formats. In addition, the economic value of the data, trade and state secrets, and individual rights require data manipulation to comply with demanding levels of privacy. Smarter and autonomous systems in critical realms such as utilities, health care, transportation and finance require dealing with new, and often unanticipated, sorts of risks that challenge the best practices of software engineering, network and information security and human-computer interaction.

Our commitment encompasses many core areas from programming languages and rigorous software development to complex information systems, from data processing to large scale computing, from embedded systems to virtual environments, and from security to quantum computing, with the goal of bringing better intelligence into everything.

Through each of its Centres, the Cluster addresses diversified, heterogeneous and yet complementary research topics such as Artificial Intelligence, Cybersecurity, Computer Graphics and Virtual Environments, Information Management and Systems, Decision Support Methods, Parallel and Distributed Systems, and Software Engineering.

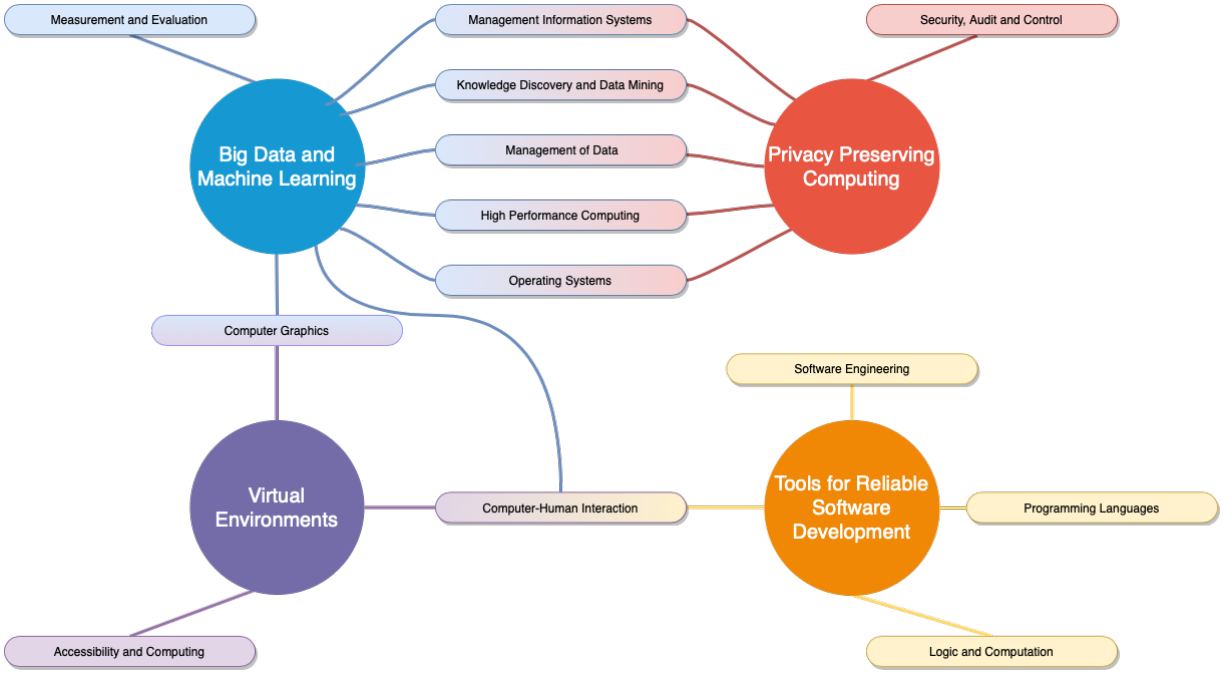

Figure 4.4.1 - Interaction between research topics and lines in Cluster CS

For 2019, the Computer Science Cluster singled out four research lines with considerable critical mass and deemed strategic with regards to social and economic impact. These are:

- Big Data and Machine Learning;
- Privacy Preserving Computing;
- Tools for Reliable Software Development;
- Virtual Environments.

The interaction between of these research topics and lines is pictured in the Figure above. The Cluster is also strongly involved in Technology Transfer activities, either as Advanced ICT Consulting or Innovative Systems Development, in areas such as Agriculture, Electronic Government, Energy, Healthcare, Earth and Ocean Observation, Industry, and Telecommunications.

4.4.2 Scientific Outcomes in 2019

An overarching objective of the Cluster for 2019 was to increase the international visibility and notoriety of INESC TEC's computer science research. This has been pursued in several ways that, on each own, acknowledged our scientific competences and seniority.

INESC TEC has organized the 3rd World Congress on Formal Methods (CORE A) that received more than 600 researchers, Eurovis 2019 (CORE B) with about 300 attendees, and, with the University of Porto, the 43rd International Collegiate Programming Contest Finals with 1500 participants.

The two appointed Portuguese representatives for the EuroHPC Joint Undertaking and AI High-Level Digitising Industry EU initiatives were INESC TEC computer scientists.

A major strategic goal of INESC TEC for 2019 was to integrate one of the European Networks of Excellence on Artificial Intelligence. From the two submitted proposals, the H2020 flagship Project Humane AI has been selected. Of similar relevance, INESC TEC promoted and created the Research Data Alliance Portugal (RDA-pt) node, a participant of RDA Europe 4.0.

Of particular international relevance was the outcome of the consultancy contract with Amazon to assess the security of one of their critical services used throughout Amazon Web Services. The conclusions have been published on the ACM Conference on Computer and Communications Security (a CORE A* conference in the area of cryptography and information security).

A continued effort of INESC TEC has been to improve the average publication impact while increasingly target the very best venues. To the computer science Cluster this means focusing on CORE A and A* conferences and Q1 journals. To this end, during 2019 the Cluster researchers produced 46 Q1 journal papers, and 9 CORE A and 4 CORE A* conference papers. While on the same level, these figures were below 2018's. As a whole, in 2019 the Cluster researchers published 114 papers in indexed journals and 163 papers in indexed conferences.

On the specific topics of the Cluster research lines, we highlight the following outcomes. These were either published or made available to the community as software packages.

RL1 - Big Data and Machine Learning

Regarding the management of big data, two contributions were made for the replication of large databases; one on the efficient synchronization of state-based Conflict-free Replicated Data Types (IEEE International Conference on Data Engineering) and the other a full-featured prototype of high-available large scale convergent databases (transactional and analytical) in the context of the H2020 CloudDBAppliance project.

On the thriving research on "fake news" identification contributions have been made (eg. Journal of Web Engineering) on the recognition of sets of emotions as a "signature" and on the creation of reputation metrics to help measuring the impact of the dissemination of false information.

Three important results on the topic of Natural Language Processing have been published. One on the ACL conference, the number one forum for NLP, the second on Narrative Extraction from Text as a special issue of the "Information Processing and Management" journal (Q1) and the last on ECIR 2019, the top European Information Retrieval Conference which deserved the Best Demo Paper Award.

A special mention is due to the computer science Cluster leadership on the creation of INESC TEC's Data Science Hub. The hub has promoted several scientific initiatives together with the other Clusters such as project proposals, a workshop with Imperial College's Data Science Institute, advanced training and a first iteration of INESC TEC's data science toolbox.

RL2 - Privacy-Preserving Computing

Besides the aforementioned AWS paper results, the Cluster had two other ACM CCS publications on machine-checked proofs co-authored by researchers from the Max Planck Institute for Security and Privacy and the Stanford Research Institute, and two publications on IEEE Symposium on Reliable Distributed Systems contributing to the state-of-the-art of multi-party computation practical systems (d'Artagnan) and of computation over encrypted data (BISEN).

RL3 - Tools for Reliable Software Development

The recently consolidated research line encompassing topics such as software engineering, programming languages, logic and computation, and computer-human interaction was granted the Most Influential Paper award at the IEEE Symposium on Visual Language and Human-Centric Computing and the research on automatic generation of FPGA-based hardware accelerators was published on ACM Computing Surveys, the computer science journal with the highest impact factor, and on IEEE Transactions on Very Large Scale Integration Systems.

Logtalk, a declarative object-oriented logic programming language created in 1998 and mantained by INESC TEC researchers has seen improved debugging support, static binding optimizations, testing tools, goal-expansion mechanism, a reorganized library and new test suites and libraries among many other additions. Logtalk has an average of 500 downloads per month.

Related with agile methods and tools, a new research topic was coined (LiveSD) as the result of one PhD. and several MSc. theses. LiveSD catalyzes interdisciplinary research with Artificial Intelligence (AI), Programming Languages (PL), Human-computer Interaction (HCI), and User Experience (UX).

The book "A Scrum Book: the Spirit of the Game" has been published and gathers several person-centuries of combined experience of the authors observing Scrum Teams worldwide (Japan, the Nordics, the U.K., Portugal, Canada, U.S., Netherlands, and Australia), including its creator, Jeff Sutherland—both their successes and failures, and distills this collective experience into proven solutions called patterns that make it work: *how* Scrum works, *why* it works, and *how* best to apply it in daily practice.

RL4 - Virtual Environments

The CG&VE area achieved scientific outcomes in the use of gamification and games-based learning, at H2020 projects Feedback and BEACONING awarded with the Gamification award of 2019.

Three IEEE Access and IEEE Transaction on Visualization and Computer Graphics publication are noteworthy results of the Cluster work on Virtual Environments.

5 TEC4 INITIATIVES

5.1 Overview

A TEC4 ("TEChnologies FOR …") is a new organizational approach aiming at structuring the market-pull innovation process, as opposed to the science-push that occurs naturally in the Research Centres. This supports the establishment of the adequate balance between the two complementary motivations and supports the full knowledge-to-value chain.

Each TEC4 targets a specific market and induces cross-Cluster multidisciplinary projects, promoting collaboration with business and producing solutions to be transferred to companies.

The performance of each TEC4 is measured by the volume of direct contracts and collaborative projects with companies and other relevant stakeholders and the number of inter-Centre projects generated. The TEC4 are not involved in project development: once an opportunity is detected, negotiations occur with the relevant Research Centres and it is under these that the project is then managed and completed.

The TEC4 initiatives address regional, national or international challenges by mapping the short and medium-term domain needs with INESC TEC scientific roadmaps. Typically, each TEC4 encompasses:

- A concrete market domain, represented by businesses and associations;
- A multidisciplinary scientific community dedicated to the challenges of that market domain;
- A technological R&D infrastructure that supports the scientific, innovation, education and training activities and provides added value services to businesses that cannot be found in the market.

Each TEC4 defines its own strategic agenda, according to the respective market domain requirements, addressing three pillars: the stakeholder's perspective, the technological roadmap and the R&D infrastructure evolution - to keep up with the state-of-the-art and support the roadmap. Each TEC4 monitors results in the range TRL 1-9 and focuses on applied research leading to products, processes and services (TRL 5-9) that can be transferred to the market.

The short-term objectives of the TEC4 initiatives are the creation of innovative solutions and services with high export potential, based on internationally competitive research and innovation capabilities, contributing to the resilience and growth of the Portuguese economy. Their long-term objectives comprise the identification of scientific and technical challenges, embracing multiple specialities, involving and exploiting the full potential of INESC TEC in application domains that are easily understood and incorporated by businesses. Creating and maintaining these virtuous innovation cycles within each TEC4 is the main medium to long-term challenge.

Sections 5.2 to 5.7 present a short description of the scope and objectives of the current TEC4 initiatives.

5.2 Initiatives in 2019

In 2019, INESC TEC reformulated its strategy and also the TEC4 organisation to impulse the impact effect on society and economy, as briefly described in the following section. During this reporting period, the global TEC4s organisation was composed by:

- TEC4ENERGY: energy related activities and economy;
- TEC4HEALTH: health and well-being related activities and economy;
- TEC4INDUSTRY: production technologies, manufacturing, distribution, logistics and retail;
- TEC4MEDIA: solutions for the creative industry economy;
- TEC4SEA: sea activities and economy;
- TEC4AGRO-FOOD: agro-food and forestry.

The application areas addressed by the TEC4s are aligned with European, national and regional priority domains, developing and consolidating internal R&D competencies around socio-economic pillars. Furthermore, the attraction of international partners to the TEC4 initiatives, supports INESC TEC internationalisation strategy,

facilitates the national companies an easy access to international partners and enables the attraction of foreign direct investment to the region and to the country.

5.3 Action Plan for 2020

As a result of the INESC TEC strategic meeting held in September 2018, the Board of Directors reformulated the strategy towards the market during 2019 and decided to:

- Strengthen the intervention capacity of TEC4, calling for a coordinating function assigned to a Senior Researcher and a Business Development function assigned, preferably, to an element with experience in the business world;
- Create a TECPARTNERSHIPS dedicated to address and support the other market areas/segments where INESC TEC has an intervention and to explore new market segments and incubate new potential TEC4's until they reach a qualified maturity level;

TEC4s are dynamic organisation models that need to be periodically evaluated and adapted to the economic landscape. For this reason, it was also decided the following:

- TEC4MEDIA: to refocus its activities on market segments that are more promising and dynamic than the traditional media sector. Consequently, this TEC4 will be put on standby to give rise to a new TEC4 whose framework will be studied and validated;
- TEC4HEALTH: is a TEC4 with a very broad field of activities, which leads to a loss of efficiency and impact on society. Consequently, it was decided to select and focus its activities on a few market segments.

Although some steps of this change were already given in the last months of 2019, the full implementation of this plan only started in 2020.

5.4 TEC4ENERGY

Coordinator: João Peças Lopes

5.4.1 TEC4ENERGY Presentation

TEC4ENERGY benefits from a strong recognized INESC TEC expertise in Power Systems, with more than 20 years transferring research results to manufacturers, software vendors, electric utilities and large energy users in Portugal, Europe and Brazil. This adds credibility to a broader effort, extended also to the fossil fuel sector, and encompassing from industry to transportation, buildings and energy efficiency.

The main driver of TEC4ENERGY initiative is the need to respond to decarbonisation of the society and economy. Within this framework TEC4ENERGY initiative responds to the Societal Challenges and Innovation Strategies for Smart Specialization defined by EU policies: the energy sector will be heavily digitalized, decentralized, under a user centric and market based approach, involving a large scale integration of renewable power sources, requiring the conceptualization and development of disruptive solutions.

TEC4ENERGY offers several innovation services to the energy ecosystem as:

- **DMS/EMS and network automation**: specification, development and integration of advanced computational tools for network management systems for all voltage levels (transmission, distribution and island systems) and of new solutions for network automation, protection and control of distribution networks;
- **System planning and reliability**: tools and models within this area aim at supporting not only the operational planning but also the expansion of power systems. Naturally, this activity appeals to advanced optimization techniques and new stochastic models for the representation of the overall system behaviour;
- **RES & DER integration**: RES integration studies, identification of system support functions/ancillary services from RES and the exploitation of new technologies for increasing the controllability and flexibility of transmission and distribution grids (transmission and distribution FACTS, energy storage and associated power converters, HVDC). This involves also the development of simulation studies, both in terms steady state and dynamic behaviour analysis, oriented towards the evaluation of impact analysis from the integration of renewable power sources. Part of these activities are supported by the laboratorial infrastructure of CPES (SGEVL);
- **Asset Management and preventive maintenance**: implementation of a risk-based maintenance strategy software for the distribution grids by analysing failure modes, consequences and decision maker's risk attitudes; estimation of power transformers condition and remaining useful life (RUL) by combining expert knowledge, engineering models and data analytics; fibre optic sensors to measure vibration and magnetic field for HV lines, and corrosion monitoring in off shore wind parks; drone with rotary wings to monitor electrical assets, such as, for example, medium and high voltage support, substations and wind turbines. This solution is innovative because it operates autonomously, making it possible to reduce risks and to optimise the inspection process.

The R&D Centres that have a closer involvement with TEC4ENERGY are:

- CPES - Power and Energy Systems
- CAP - Applied Photonics
- CTM - Telecommunications and Multimedia
- CRAS - Robotics and Autonomous Systems
- CEGI - Management and Industrial Engineering
- LIAAD - Artificial Intelligence and Decision Support

- CESE - Enterprise Systems Engineering
- HASLab - High Assurance Software

5.4.2 Main Achievements in 2019

TEC4ENERGY aimed to identify new potential projects with the industry and the society, through a multidisciplinary scientific-based approach to overcome the limitations that stakeholders found in the existing market solutions, conveying these projects for further development to the Centres closer to the technological requirements. TEC4ENERGY therefore intended to impact INESC TEC activity by fostering the generation of new contract programs and projects joining in this response different Centres of the institution.

Taking into consideration the main TEC4ENERGY achievements, 2019 was a great year in respect to new projects, in which Interconnect represents the flagship project, being the largest European project led by a Portuguese entity. Interconnect project has 51 partner institutions from 11 European countries, with a 4-year operational framework, the project is divided into eight major areas: electricity, big data, cybersecurity, standardization, ontology, digital platforms, cloud and IoT.

There were several important TEC4ENERGY active projects in 2019, with an accumulated revenue of 12,8 M€, of which we can highlight InteGrid, POCITYF, XFLEX, ESGRIDS, EU-SysFlex, Smart4RES, FEEdBACk and TDX-ASSIST.

TEC4ENERGY demonstrates a great balance in its innovation activities, not only considering the number of projects per theme, but also the aggregated revenue per theme. Concerning the number of partner's distribution, it clearly demonstrates a greater concentration of partners on the themes (User-Centric Solutions and RES&DER Integration) being developed in European projects, in which many partners collaborate.

Briefly, the main 2019 numbers regarding TEC4ENERGY active projects are:

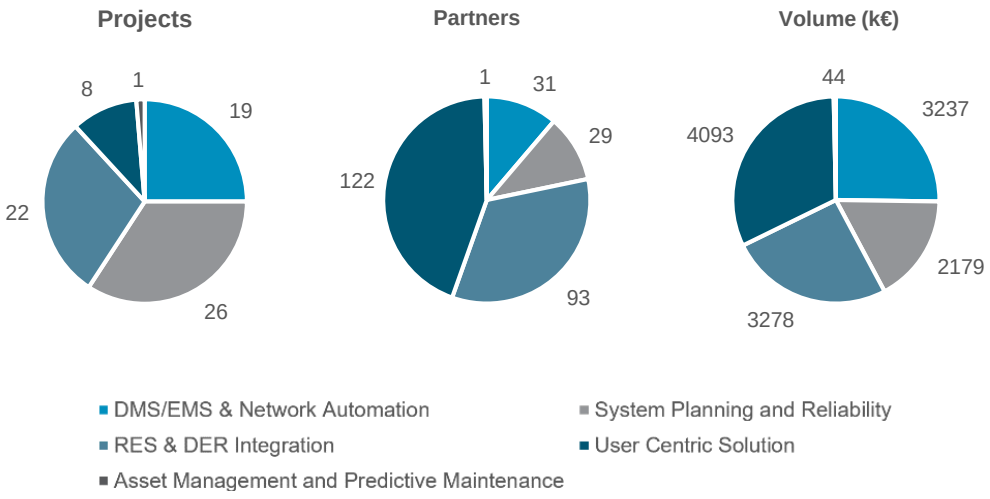

Figure 5.4.1 -TEC4ENERGY results in numbers

5.5 TEC4INDUSTRY

Coordinator: José Nina de Andrade

5.5.1 TEC4INDUSTRY Presentation

The MISSION of TEC4INDUSTRY is to foster transformation for an innovative, collaborative, human-centred and sustainable industry.

TEC4INDUSTRY is the INESC TEC initiative to induce a market pull drive into R&D and generate a convergence of knowledge and competences into producing solutions for the Retail and Manufacturing Industry, covering end-to-end supply chain actors anchored in a history of successes and impact in technology transfer to companies.

TEC4INDUSTRY, covering all the value chain actors and processes, is committed to bringing unique knowledge and solutions to logistics, manufacturing industry, distribution, and retail.

The following innovation services are provided by INESC TEC in the scope of this TEC4:

- **Factory Design and Operational Planning**. The work addressed simulation and optimization of the production lines through mathematical and simulation models to design facilities and to plan and operate operations;
- **Industrial Robotics and Collaborative Robotics**. Industrial robotics will move from a robot centred perspective of a robotics work cell, to an integrated approach that involves perception, multiple sources of information, close collaboration with humans and continuous process learning;
- **Logistics and Retail**. Development of intra and inter-organisational logistics systems. Services to enable companies to integrate IoT components and orchestrate manufacturing modules, such as planning, scheduling. New models and algorithms for optimising the delivery of products purchased by online customers;
- **Predictive Maintenance and Consumer Forecasting**. Prediction of anomalous events and machine learning techniques to increase maintenance optimization and consumer forecast.

The Centres involved in TEC4INDUSTRY are the following:

- CESE - Enterprise Systems Engineering
- CEGI - Management and Industrial Engineering
- CRIIS - Industrial Robotics and Intelligent Systems
- CITE - Innovation, Technology and Entrepreneurship
- LIAAD - Artificial Intelligence and Decision Support
- HASLab - High Assurance Laboratory
- CSIG - Information Systems and Computer Graphics
- CTM - Telecommunications and Multimedia
- CAP - Applied Photonics

5.5.2 Main Achievements in 2019

INESC TEC continues participating in national and international projects addressing solutions covering all value chain areas of TEC4INDUSTRY. Most of the new projects address the challenges related with digitalization activity of the enterprises in the context of INDUSTRY 4.0 framework.

INESC TEC maintained active participation in national and international network forums and initiatives, such as iMAN Norte DIH and EIT Manufacturing. EIT Manufacturing intends to stimulate the European innovation ecosystem in this area and to promote a transformation of the European industry, in line with Industry 4.0, making it more competitive and sustainable in economic, environmental and social terms.

INESC TEC was also involved in EIT Digital, which promotes innovation and the consequent digital transformation in Europe, particularly through research, training and entrepreneurship.

In order to be active in the main national industry areas, INESC TEC participated in the proposals of new mobilizing projects in the textile, shoes, production and automotive areas.

The main objectives for 2019 were accomplished. The following can be highlighted:

- **iiLab.** (May, INESC TEC) In the context of ANI's technological demonstrator, the Industry and Innovation Laboratory – iiLab, was inaugurated. In this laboratory are presented production technologies and cyber-physical systems. Besides the demonstration of the different technologies, the laboratory will also offers a training component;
- **360TECHINDUSTRY.** (May, EXPONOR) In this fair, INESC TEC presented technologies that help companies in digital transformation, namely through the digital twin technique, which allows the design and optimization of plants and production systems. A mobile manipulator that acts in scalable production systems and an intelligent autonomous vehicle for internal logistics applications were also presented. Furthermore, INESC TEC contributed with five presentations: "Implementing Digital transformation in Mature SMEs – practices and strategies, "Immersive environments for training and certification in Industry 4.0", "Exploring the value of analytics for the improvement of decisions in the asset management", "Predictive maintenance as a support for the Diagnosis and Prognosis based on Machine Learning" and "IManNorteHub: Access point to the digitalisation of companies";
- **Industria 4.0**. (April, University of Minho – Guimarães) Within the scope of the Industria 4.0 initiative, promoted by the Portuguese Ministry of Economy, INESC TEC was present at the launch of the second phase of the Program, which took place at the University of Minho. INESC TEC participated in a joint space with the company TALUS, in which it demonstrated a prototype developed for the transport and reorientation of boxes, combining technologies of a different nature for this purpose;
- **Digital Transformation Maturity and Roadmap**. In this context, INESC TEC developed an industrial oriented maturity model, covering different dimentions, in order to quantify the maturity level of targeted organizations. Furthermore, INESC TEC settled a digital transformation roadmap model to support the digital transformation journey, to be explored and implemented by induatrial companies. As an example, we can identify the work done in Galp refinery context;
- **Digital Twin and simulation.** Exploitation of advanced simulation technologies, linked with optimization platforms, to support decision making and analysis in complex manufacturing environments. In this context, the impact of introducing new products in the production system and layout design was addressed.

The main 2019 numbers regarding TEC4INDUSTRY active projects are:

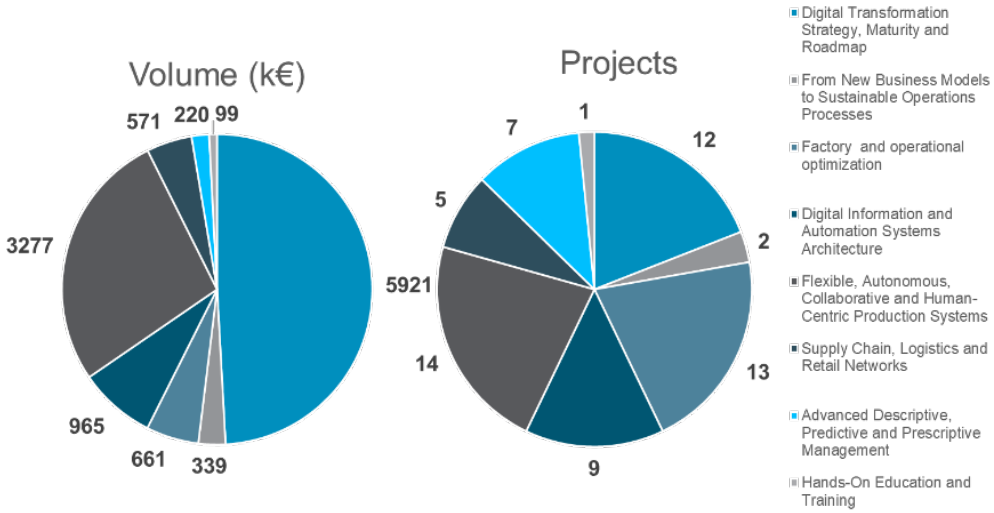

Figure 5.5.1 – TEC4INDUSTRY results in numbers

5.6 TEC4AGRO-FOOD

Coordinator: André Sá

5.6.1 TEC4AGRO-FOOD Presentation

The mission of TEC4AGRO-FOOD is co-shaping the digital (r)evolution in Agro-Food and Forestry to tackle the productivity and sustainability societal challenges towards an effective bioeconomy.

TEC4AGRO-FOOD acts through Research and Technological Development (RTD) in all phases of the Smart Precision Agriculture and Forestry, from Variability Measurement to Action with Variable Rate Technologies (VRT), encompassing Data Analysis and Decision and Prescription Map, as well as in what concerns Food Security and Bioeconomy.

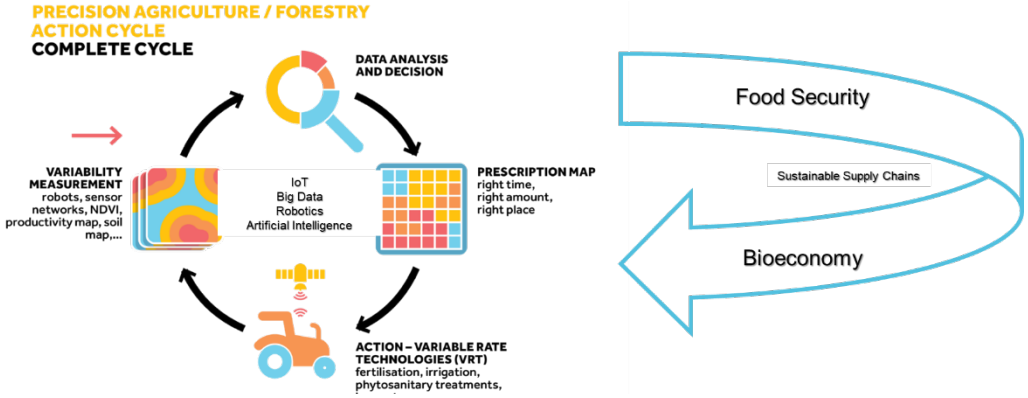

Figure 5.6.1 – Precision Agriculture/Forestry Action Cycle

In the scope of TEC4AGRO-FOOD, INESC TEC provides innovation services of consultancy and research and technological development, in the following application areas:

- Smart Precision Agriculture and Forestry. This innovation service comprises all phases of the Smart (IoT, Big Data, Robotics and Artificial Intelligence) Precision (right time, right amount, right place) Agriculture and Forestry: Variability Measurement, Data Analysis and Decision, Prescription Map and Action with Variable Rate Technologies (VRT);
- Food Security. This innovation service deals with Food Security issues along the Agriculture and Forestry supply chains;
- Bioeconomy. This innovation service deals with Bioeconomy issues along the Agriculture and Forestry supply chains.

The 13 R&D Centres of INESC TEC are involved in TEC4AGRO-FOOD with different levels.

5.6.2 Main Achievements in 2019

Following the strategy of full implementation of portfolio projects and redoubling efforts with companies and at international level, in 2019, TEC4AGRO-FOOD has continued its consolidation as the main RTD Portuguese partner in the scope of ICT&E and Robotics for Agro-Food and Forestry. At the same time, at European level, TEC4AGRO-FOOD was entering in a sustainable manner the “champions league” of H2020.

TEC4AGRO-FOOD’s main achievements in 2019 are presented below in chronological order:

- Organisation of Workshop BIOTECFOR - Forestry Machinery and Implements;
- Participation in the 1st Meeting Research Centers of Heroic Viticulture (CERVIM);

- Signature of a Collaboration Protocol with CITAB - Centre for the Research and Technology of Agro-Environmental and Biological Sciences;
- Presentation "Forest 4.0 - Smart Precision Forestry" at AgroIN 2019;
- INESCT TEC and CoLAB ForestWISE presentation in EUBCE 2019 - 27th European Biomass Conference and Exhibition;
- Participation in ADVID Technical Visit to Germany - Steep Slope Viticulture Mechanization;
- Approval of CoLAB FEEDINOV - Association for Research and Innovation in Nutrition and Animal Feed;
- FDCONTROLO - Smart Traps for Flavescence Dorée project presentation at Agro Inovação 2019 - Agriculture Innovation Regional Workshops (Operational Groups PDR2020);
- Participation in "Agroenvironmental Systems and Food" Smart Specialization Regional Platform (CCDR-N);
- Organization of EPIA 2019 - 19th EPIA Conference on Artificial Intelligence;
- H2020 large-scale project DEMETER - Building an Interoperable, Data-Driven, Innovative and Sustainable European Agri-Food Sector Kick Off Meeting;
- Signature of the Constitution Protocol of the National Competence Centre for Climate Change of the Agroforestry Sector;
- Participation in InVivo Quest Challenge Jury Boards;
- H2020 Digital Innovation Hubs project agROBOfood Kick Off Meeting;
- Active participation in the organisation of 5th INESC TEC Autumn Forum "Digital (R)evolution in Agro-Food and Forestry";
- Signature of Collaboration Protocols with Instituto Superior de Agronomia (ISA), School of Agriculture and INOVISA and GreenUPorto - Research Centre on Sustainable Agri-food Production;
- Organisation of Workshop "Research and Technology at the Service of Forestry Value Chains Sustainability";
- Co-organisation of Workshop ROMOVI - Mechanization and Automation in Steep Slope Viticulture;
- Co-organisation of International Congress "Digital Agro-food & Forestry (r)evolution";
- Approval of PT2020 Individual R&D Project ROBOCARE - Robotic Platforms for Smart Precision Protected Cultivation;
- Award of Direct Contracts PIVOTBOT - Robotized Pivot for Agricultural Operations and SIFOREST - Shared Information Systems in the Scope of Organizational and Forestry Management;
- VIDA RURAL "Digital Revolution" Series of Articles about INESC TEC projects.

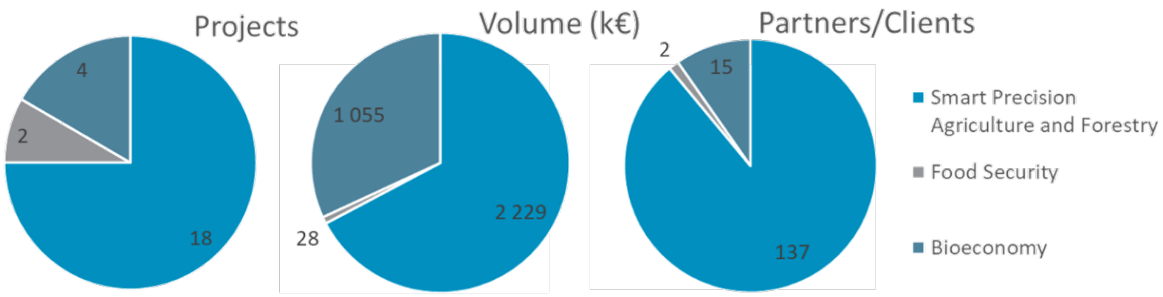

Figure 5.6.2 - TEC4AGRO-FOOD results in numbers

5.7 TEC4SEA

Coordinator: Carlos Pinho

5.7.1 TEC4SEA Presentation

The MISSION of TEC4SEA is to induce a market pull drive into R&D activities targeting sea and deep-sea challenges towards a sustainable Sea Economy.

Supported by core Centres such as Robotics and Autonomous Systems (CRAS), Telecommunications and Multimedia (CTM), Applied Photonics (CAP), Information Systems and Computer Graphics (CSIG) and Power and Energy Systems (CPES), TEC4SEA is able to offer value-added innovation services related with 3D mapping and data fusion in unstructured environments, optical and bio-sensors, broadband communications solutions for marine environments, software solutions for data collection, processing and management, among others. The multidisciplinary competencies within the TEC4SEA facilitate the development of solutions for a wide range of industries, such as: aquaculture, marine and seabed mining, management of marine protected areas, deep-sea observation, ocean renewable energy (including offshore wind energy), maritime safety and surveillance.

5.7.2 Main Achievements in 2019

Concerning the TEC4SEA initiative, the main focus during 2019 were: i) the infrastructure and ii) to make INESC TEC competencies in the Sea domain known in international forums.

During 2019, the following achievements were reached:

Promotion and dissemination activities:

- **European Maritime Day (May, Lisbon):** the TEC4SEA Research Infrastructure ambition, prototypes and solutions developed within the TEC4SEA context were exposed to national and international entities present in this international event, where entrepreneurship, innovation and investment were its main focus;
- **Oceans (June, Marseille):** the TEC4SEA initiative was showcased at the OCEANS´19 Marseille exhibition to international entities present in this event. The theme of the conference “Let’s sea our future together” reflects our concern to understand the future of our oceans in terms of the preservation of marine, animal or plant life, as well as the exploitation of new energies;
- **Business2Sea (November, Porto)**: several R&D results, prototypes and solutions developed within the TEC4SEA context were showed to national and international entities. The TEC4SEA Research Infrastructure and its services were the main focus of the stand.

Other relevant initiatives:

- **Sea OpenDay (June, Porto)**: the event under the name “Waving the Future” focused in the R&D competencies and technological capabilities of Robotic and Autonomous Systems. The event counted with the presence of representatives of multiple companies as well as R&D partners. The TEC4SEA Research Infrastructure and its future services was also presented;
- **Shell Ocean Discovery Xprize Screening Panel (February, Monaco):** the event aimed at aligning and disseminating the competencies of the finalist teams within Shell Group, who might be interested in developing technology and pursuing future commercial agreements;
- **NESSIE:** this 3-years project involving national stakeholders aims at developing innovative technologies and solutions to address several issues related with offshore infrastructures inspection and maintenance;
- **DeepField:** this 3-years project that started in the last quarter of 2019 aims at consolidating the knowledge on Deep Learning within the robotics domain, as well as promote and strengthen the networking with other European Institutions experienced in this domain;

- **SIMBED+**: this 2-years project that started in mid-2019, funded under the H2020 Fed4FIRE+ Open Call 5, will focus on the replication of wireless networking experiments using ns-3 with real data assimilation, including above and underwater environments.

Structural initiatives:

- **INTHEBLACK 2019 (June, Porto):** «In the Black – Exploration, Extraction and Construction Opportunities for Underwater Technology» was the name of the workshop organized by INESC TEC for the third consecutive year in coordination with the EIT Raw Materials. The workshop had several relevant worldwide representatives interested in this theme;
- **REP (MUS)10 (September, Sesimbra and Troia Peninsula)**: large-scale demonstration, experimentation and cooperation exercises involving academia, industry and the naval operational community across the NATO alliance;
- **TEC4SEA Infrastructure:** INESC TEC pursued its ambition to install an infrastructure dedicated to support research, development, and test of marine robotics, telecommunications, and sensing technologies for monitoring and operating in the ocean environment. The investments in this infrastructure continued during 2019.

The main 2019 numbers regarding TEC4SEA active projects are:

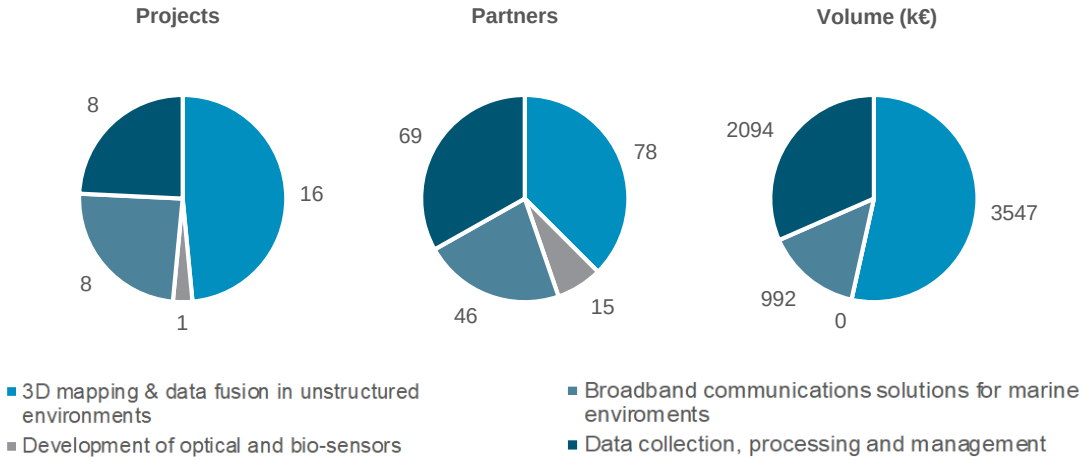

Figure 5.7.1 - TEC4SEA results in numbers

5.8 TEC4HEALTH

Coordinator:
Cristina Machado Guimarães, 1st semestre of 2019.
Miguel Tavares Coimbra, 2nd semestre of 2019.

5.8.1 TEC4HEALTH Presentation

The Mission of TEC4HEALTH is to induce a market pull human centered systems engineering R&D targeting healthcare and personal wellbeing challenges towards personalized medicine, healthier life style and better health systems management.

TEC4HEALTH is the INESC TEC initiative to induce a market pull drive into R&D and generate a convergence of knowledge and competences into producing solutions for the Health Economy.

INESC TEC is already a relevant producer of research targeting the Health sector, leading to products, processes and services that can be transferred in 3 broad areas of application: healthcare providers (primary, secondary and long-term care); patient monitoring (medical devices, e-health, m-health); pharmaceutical industry.

From a technology transfer perspective, health technologies have already been quite successful within INESC TEC (3 recent spin-offs, ~50% of INESC TEC's patent portfolio). Mapping the past experience of INESC TEC with current worldwide health challenges led to the identification of three key TEC4HEALTH challenges to address in the next 5 years: cancer, neurological diseases and disease screening.

The following innovation services are provided by INESC TEC in the scope of TEC4HEALTH:

- Artificial Intelligence Enhanced Healthcare;
- Predictive Analytics;
- TeleHealth and Information Systems;
- Healthcare Sensing and Monitoring.

The Centres more related with TEC4HEALTH are the following:

- CAP - Applied Photonics
- CITE - Innovation, Technology and Entrepreneurship
- CTM - Telecommunications and Multimedia
- C-BER - Biomedical Engineering Research
- CEGI - Management and Industrial Engineering
- LIAAD - Artificial Intelligence and Decision Support
- CSIG - Information Systems and Computer Graphics

5.8.2 Main Achievements in 2019

In the first semester, a consolidation of the presence in thematic international and national networks related with TEC4HEALTH was realized, such as:

- EIP_AHA, acting as co-coordinator of the C.2 Working Group and working with D.4 group in international initiatives;
- Participating in EIT Health initiatives through PORTO4AGEING reference site consortium.

In the second semester, the following actions have been achieved:

- Reception of committees from the University of Pecs and international EIT Health resulting from the interaction with the EIT Health RIS HUB of the University of Porto;

- Establishing informal relationships with doctors from IPO Porto and Santo António Hospital to start more research projects;
- Establishment of a consortium with Glintt for participation in UAQT2019013 (Consulting Services in Artificial Intelligence to SPMS);
- Integration WG Health Technologies (INESC Brussels HUB initiative);
- Creation of inter-Centre meetings to discuss research overlaps, advices and research projects related to a TEC4Health innovation services.

The main 2019 numbers regarding TEC4HEALTH active projects are:

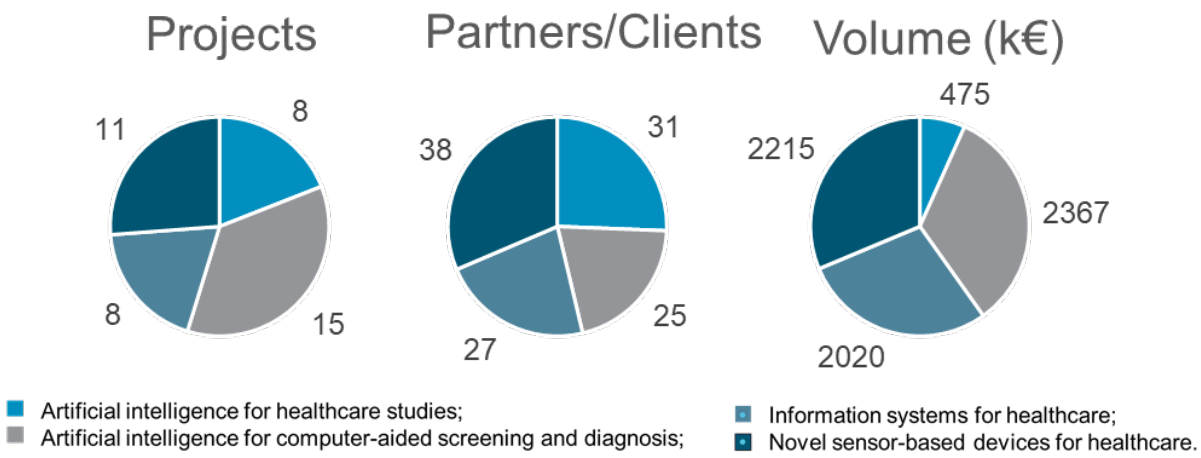

Figure 5.8.1 – TEC4HEALTH results in numbers

6 RESEARCH AND DEVELOPMENT CENTRES

6.1 CTM - CENTRE FOR TELECOMMUNICATIONS AND MULTIMEDIA

Coordinators: Jaime Cardoso and Filipe Ribeiro

6.1.1 Presentation of the Centre

The Centre for Telecommunications and Multimedia (CTM) consists of more than 100 researchers addressing scientific and technological challenges related with the fields of telecommunications and multimedia. CTM is fully committed and aligned with the vision and mission of INESC TEC and specializes them as follows:

- Vision: A lively and sustainable world where networked intelligence enables ubiquitous interaction with sensory-rich content;
- Mission: Research and development of advanced systems and technologies enabling high capacity, efficient communications, media knowledge extraction, and immersive ubiquitous multimedia applications.

CTM accomplishes its mission, within the Cluster NIS, by directing its activities towards 4 main areas of research: Optical and Electronic Technologies (OET); Wireless Networks (WiN); Multimedia and Communications Technologies (MCT); Information Processing and Pattern Recognition (IPPR). CTM contributes to the research in new sensors, low power or nanoscale, to enable the envisioned “electrosphere of sensors”. CTM has also focused its activities on wireless communications for dynamic and challenging scenarios, well aligned to the NIS vision. The CTM’s expertise in machine learning and audiovisual data interpretation and management provides the means to make sense of the acquired data; the semantic knowledge built from the integration of the network of sensors will allow acting over the environment as well as over the content.

6.1.2 Research Outcomes in 2019

The main broad research achievements obtained by **CTM in 2019** were the following:

- More than 30 articles published in relevant scientific journals, the majority of them in journals classified by SCOPUS as “1st Quartile” and “2nd Quartile”;
- Eight awards to CTM Researchers in the 2019 FCT Individual Call for PhD Scholarships;
- Five successfully concluded PhD theses and more than 40 successfully concluded MSc theses.

The main achievements obtained by the **OET Area in 2019** were the following:

- **Impulse-radio integration-and-fire transceiver.** Novel, ultra-low power, transceiver architecture based on impulse-radio ultra-wide band communications that avoids the need for traditional A/D;
- **Packaged compact antenna for Bluetooth communications.** Experimental validation of a design methodology for packaged electrically small antennas, demonstrated through a miniaturized inductively loaded meander-line monopole antenna, for a Bluetooth Low Energy (BLE) application;
- **Optical modulation of 79GHz resonant-tunneling diode.** First experimental demonstration of a resonant-tunneling diode-photodetector oscillator in the mm-wave frequency range.

The main research achievements obtained by the **WiN Area in 2019** were the following:

- **Position control and routing algorithms for aerial networks** that enable significant performance gains (higher throughput, lower delay) when compared to state-of-the-art counterparts;
- **New trace-driven ns-3 simulation models** enabling the replication of experiments by using information on physical data rates and wireless channel occupancy observed in the real-world.

The main research achievements obtained by the **MCT Area in 2019** were the following:

- **Region identification in images and video frames.** Strategies for combining computer vision techniques and deep machine learning models for processing images and videos, while seeking to minimise required training data and favouring online training;

- **Content buffering approaches for interactive streaming**. Predictive stream buffering mechanisms based on Machine Learning techniques to optimize network resources and reduce view switching latency on multi-view content when transitioning from distinct views.

The main research achievements obtained by the **IPPR Area in 2019** were the following:

- **Sparse Multi-Bending Snakes**. We proposed a novel parametric active contour model which divides the contour into a set of contiguous regions with different bending properties. We derived a new energy function and presented a group optimization strategy to find the optimal solution;
- **Deep Signer-Invariant Representations for Sign Language Recognition**. A novel model that learns latent representations and discards signer-specific traits that are irrelevant for recognition.

6.1.3 Innovation Outcomes in 2019

The main broad innovation achievements obtained by **CTM in 2019** were the following:

- CTM researchers organized two advanced training courses; the events took place in Porto;
- The CTM Open week in 18-21 March. Students from neighbour universities visited CTM and participated in activities conducted by CTM researchers;
- The CTM Summer internships, to provide students the opportunity of conducting a short-term R&D project framed around a research team of CTM.

The innovation achievements obtained by the **OET Area in 2019** were the following:

- **Scalable sub-THz horn antenna**. Scalable empirical model of a horn antenna having a split-block diagonal spline profile, which is scalable in length and aperture to control the frequency and gain. This innovation resulted in a patent filling and a software copyright registration;
- **Microwave assisted vegetation water stress measurement technology**. Method capable of mapping the water distribution within plants in a precise and non-invasive way, through the production of 2D or 3D images. This innovation resulted in an EPO and a PCT patent filling and was among the three finalists of the “Entrepreneurship and Innovation” award from Crédito Agrícola.

The main innovation achievements obtained by the **WiN Area in 2019** were the following:

- **Remote monitoring of underwater hoses using wireless communications**, in partnership with multinational company for remote monitoring of flow leakages in underwater hoses, using innovative wireless induction and energy-efficient multi-hop communications techniques;
- **Low-power narrowband wireless communications for utilities**. Study developed in partnership with an electric utility for assessing the suitability of the NB-IoT technology for supporting smart metering and related applications within the operational scenarios of an electric utility.

The main innovation achievements obtained by the **MCT Area in 2019** were the following:

- **Computer Vision applied to sports in low cost equipment.** A solution for object detection and tracking applied to sports operating in low cost mobile devices, with statistical analysis of the game;
- **Content Annotation Framework for fashion objects.** A framework combining machine learning approaches and crowd sourcing for object and region of interest detection.

The main innovation achievements obtained by the **IPPR Area in 2019** were the following:

- **Computer aided detection of deep inferior epigastric perforators (DIEAP) in computed tomography angiography scans,** reducing the time and subjectivity inherent to the manual annotation of perforators vessels and facilitating the pre-operative planning of DIEAP flaps;
- **Particle Tracking in Microrheology Images.** We proposed a framework exploring particle tracking techniques that would be robust enough to cover a variety of video types in Microrheology studies.

6.1.4 Activity Overview

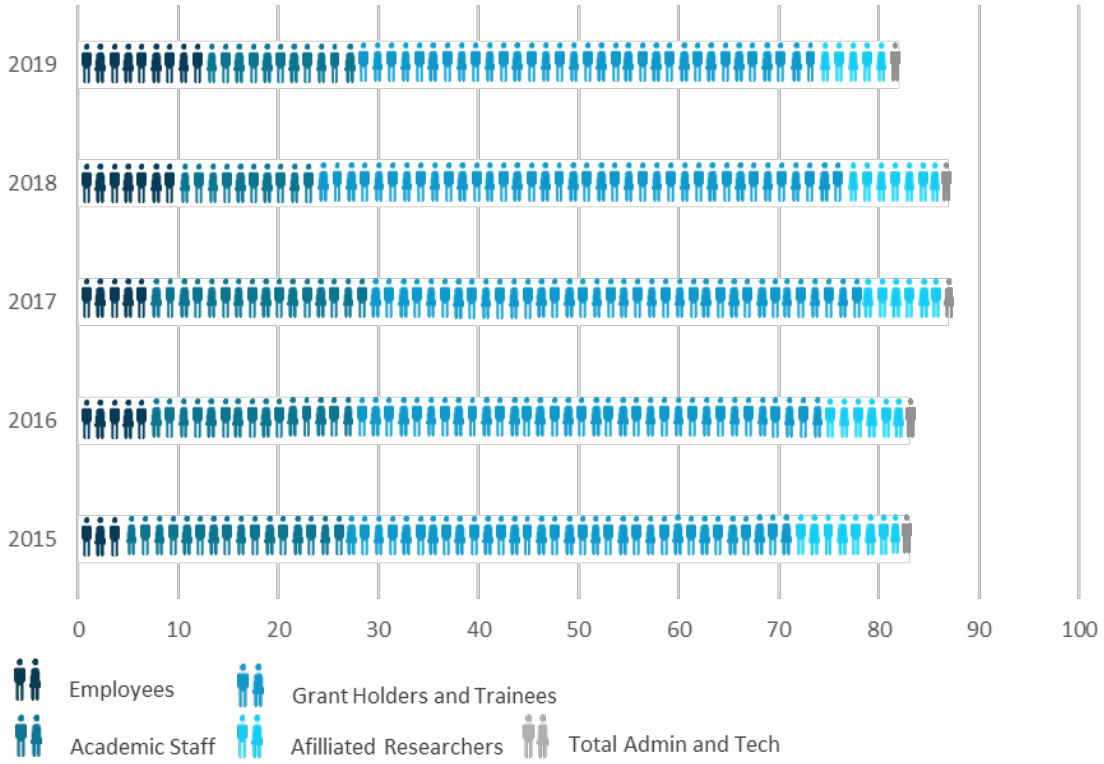

Figure 6.1.1 - CTM - Research team evolution

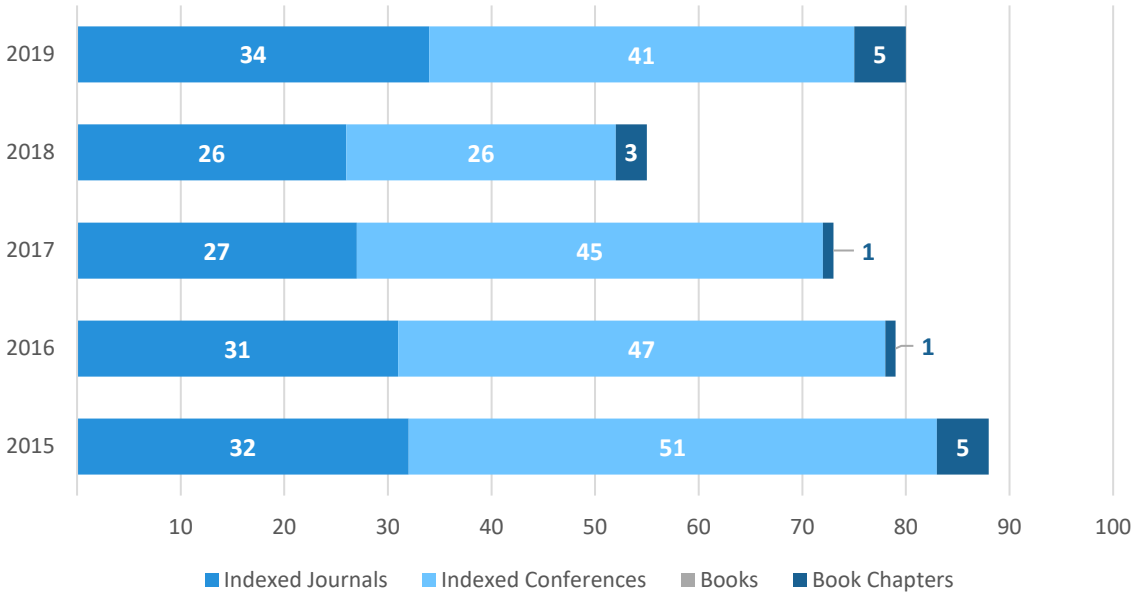

Figure 6.1.2 - CTM - Evolution of publications by members of the Centre

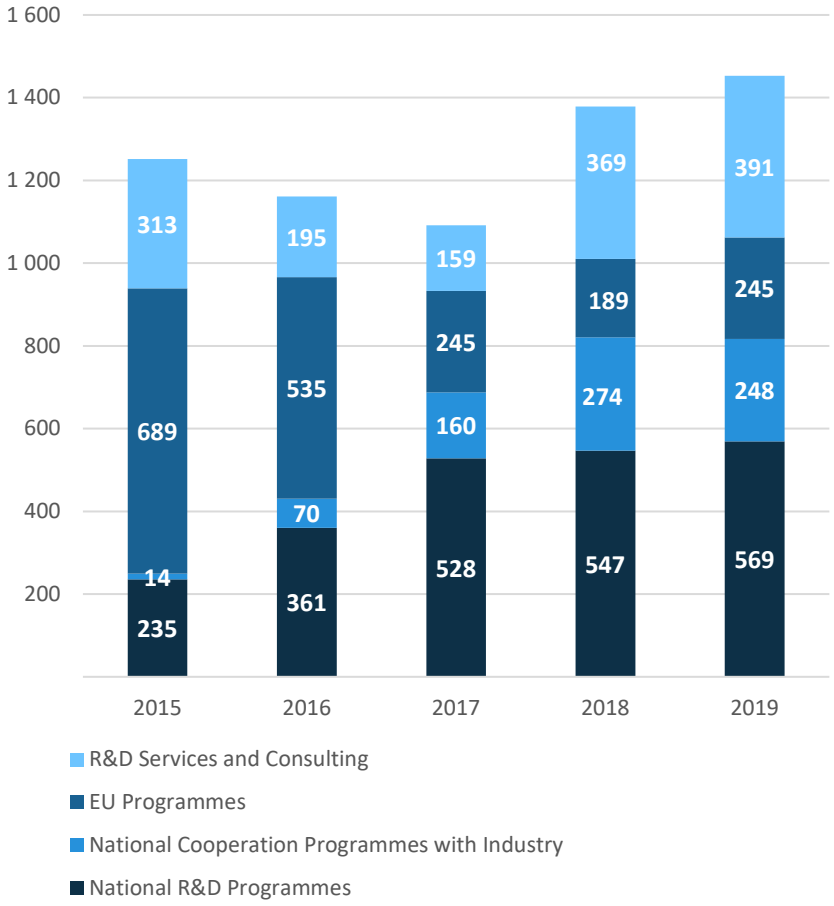

Figure 6.1.3 - CTM - Project funding evolution (k€)

6.2 CAP - CENTRE FOR APPLIED PHOTONICS

Coordinators: Paulo Marques and Ireneu Dias

6.2.1 Presentation of the Centre

CAP accomplishes its mission within the Cluster NIS by directing its activities towards 4 main areas of research: integrated optics and microfabrication, advanced optical imaging, optical sensors, comprising chemical/biosensors and physical sensors, and high-performance simulations for nanophotonics. This organization is non-hermetic and the development of solutions implies multidisciplinarity and cooperative work from the different fields of the available expertise.

A good example is Microfabrication which explores traditional top-down microfabrication techniques and non-traditional based on laser direct writing processes to support the activities of other areas. For example, microfluidics chips will be produced to implement biosensors and micro and nanostructures; Bragg gratings will be made by laser direct writing to implement new sensing heads that will lead to the development of better and more reliable sensing heads. Of particular importance is the insertion of the Centre and its dissemination activities within the universe of the DFA (Department of Physics and Astronomy of the Faculty of Sciences of the University of Porto) that hosts the Research Centre. In particular, CAP set up a lab, which provides advanced optics experiments available to both CAP researchers and also for advanced laboratory lectures of MSc and PhD teaching programs. These activities lead to better prepared students in these topics and an enhancement and widespread interest on many related subjects.

CAP develops its activity along the following strategic research lines: Integrated optics and microfabrication; Advanced optical imaging; Physical sensors; Biosensors; High performance simulations for quantum and nonlinear photonics.

6.2.2 Research Outcomes in 2019

INTEGRATED OPTICS AND MICROFABRICATION. The main outcomes in this line were the following:

- **Optical magnetic field sensors**. The developed sensor consists of an optofluidic device that combines optical waveguides integrated with a microfluidic channel, all fabricated by femtosecond laser direct writing. The microfluidic channel is filled with the magnetic fluid and the refractive index of the media on the light path changes, depending on the applied external field;
- **Broadband optical waveguides by laser direct writing**. Femtosecond laser direct writing is a recent fabrication technique but is well established for production of high-quality waveguides in fused silica substrates. However, the results available concern mainly transmission at around 1550 nm. We demonstrated the fabrication of very wideband waveguides, working with low attenuation from the visible to infrared. These are of outmost importance for the demonstration of integrated sensors, based in plasmonics for instance, in planar substrates.

ADVANCED OPTICAL IMAGING. In this research line, the work centered on **compressive sensing** techniques with hyperspectral imaging systems, dedicated to remote detection of marine litter. Basic R&D exploratory work in **digital holography and turbid lens** imaging principles, to be combined later with hybrid microfabricated devices and small size optical devices, was developed.

PHYSICAL SENSORS. Concerning **Raman endoscopy**, a first version of the fiber endoscope was designed and a new plastic fiber is being manufactured at the polish partner, according to our specifications and design. Related to **graphene applications**, the graphene deposition technique by chemical processes and its application as a thin film in coated fibers were studied and its application to the design highly sensitive sensor in the area of ultrasound and its application in antennas in the GHz region were carried out. The review of the state of the art on **high power lasers** as source of electrical power delivery, by optical-electrical conversion, to a CubeSat and in wireless power distribution network was done in order to design a new optical fiber laser configuration.

BIOSENSORS. The main achievements in this research line were the following:

- **Spectroscopy for nutrient detection.** This outcome consists of a modular optoelectronic system, coupled with Artificial intelligence for signal analysis, which enables the detection of nutrients (NPK) in aquaponic systems, by direct UV_VIS spectroscopy with a simple and compact configuration;
- **New label free method for medical analysis.** This outcome consists of a new method and corresponding sensing system, for direct analysis of biological entities in complex solutions. It deals with AI analysis of backscattered signals from optiallly trapped cells or biomolecules and has a very strong potential for medical and environment applications;
- **LIBS applications**. Modular LIBS and UV-vis hardware/firmware configurations were designed and evaluated. The goal is to to develop modular sub-systems, to operate in the Lab and the field that will be adapted to various operational situations. A robust data base for reference spectra for LIBS for mineral and soil samples, coupled with information of reference techniques such as XRF or ICP-MS, was designed and developed, and went in production phase.

HIGH PERFORMANCE SIMULATIONS FOR QUANTUM AND NONLINEAR NANOPHOTONICS. This research line reached multiple achievements, some of them in the framework of the Advanced Computing Training Program of the Austin-Portugal initiative, which include the following:

- **Novel model to explain the optical response of nanostructured metal-dielectric media** based on the quantization of the localized plasmon modes, their coupling, and collective excitation, to be applied to develop and model several proposals of optical sensors able to sense multiple physical parameters and in particular, provide direct optical sensing of electrostatic fields;
- **Development of optical functional metamaterials for sensing**, namely a self-calibrating metamaterial that allows to not only detect atmospheric hydrogen above the explosion limit but more importantly its concentration.

CAP's team is becoming more experienced and lacking new PhD students, that is strongly correlated with output indicators, namely papers. Quite a few research topics were new to us and consequently an appreciate percentage has been ground breaking work that often does not result in fast publication, but these topics are of utmost importance for the years to come and are the seeds for the medium and long-term activities. Dissemination activities specially oriented to get more PhD students are going to be increased.

6.2.3 Innovation Outcomes in 2019

A novel **dCO2 optical sensor** prototype, consisting of a modular optical system capable of measuring dissolved CO2 in harsh aquaculture environments, with 1 ppm resolution was designed, tested and validated, in order to be adapted to different operational conditions.

CAP has an assymetric funding mix, with small and few contract services to industry, that is a weakness that is being addressed by "internal selling" to other INESC TEC Centres, mainly within NIS Cluster.

6.2.4 Activity Overview

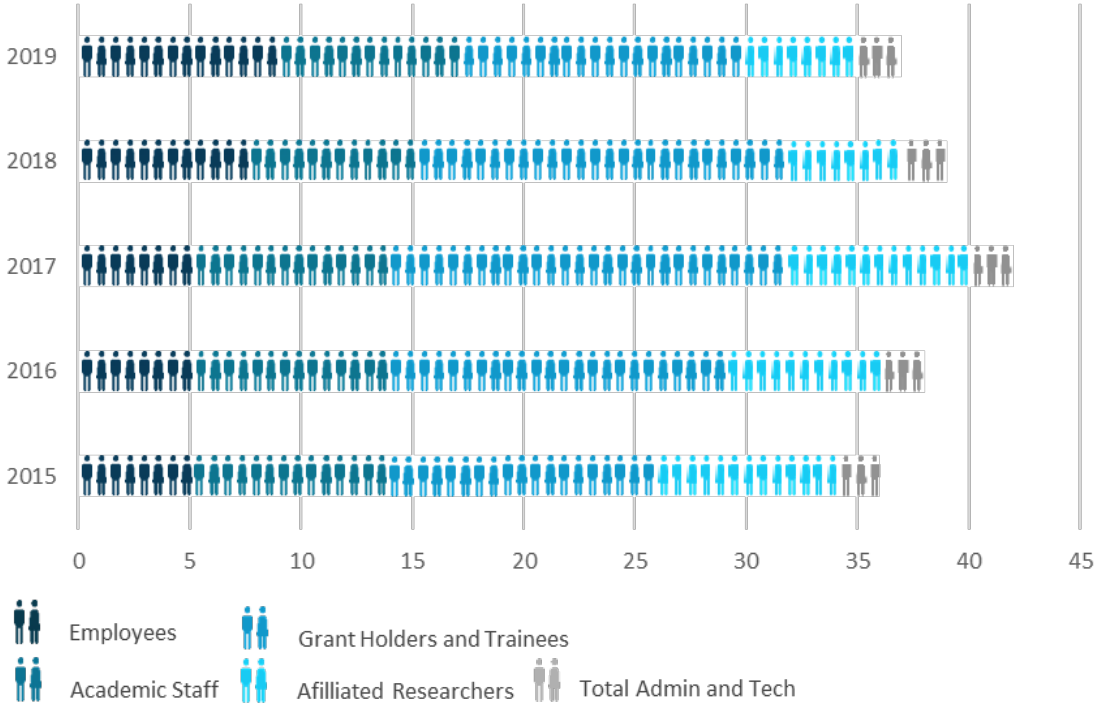

Figure 6.2.1 - CAP - Research team evolution

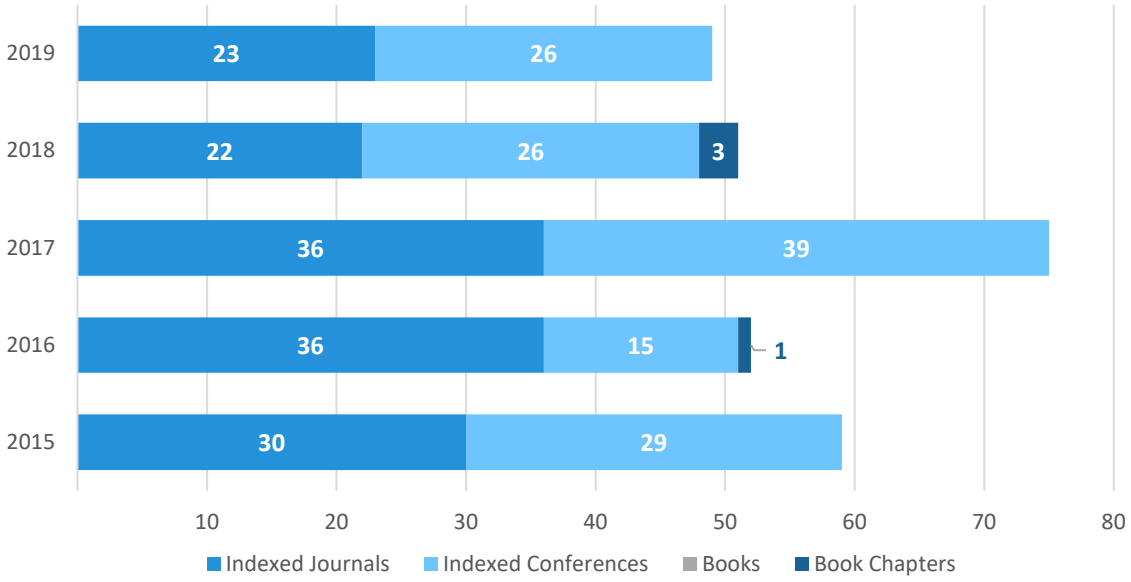

Figure 6.2.2 - CAP - Evolution of publications by members of the Centre

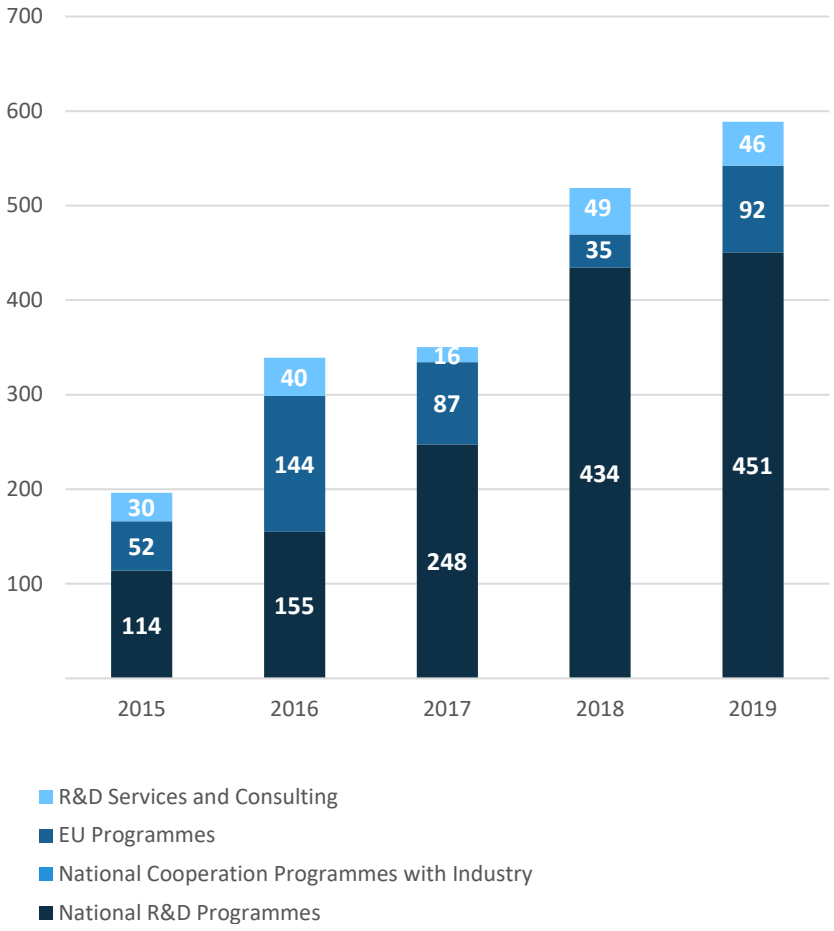

Figure 6.2.3 - CAP - Project funding evolution (k€)

6.3 CRAS - CENTRE FOR ROBOTICS AND AUTONOMOUS SYSTEMS

Coordinators: Eduardo Silva and Aníbal Matos
Co-coordinator: Carlos Pinho

6.3.1 Presentation of the Centre

The Centre for Robotics and Autonomous Systems (CRAS) aggregates more than 40 researchers addressing scientific and technological topics associated to field robotics and autonomous systems. CRAS aims at becoming a worldwide reference in field robotics and autonomous systems and is already internationally recognised for its innovative robotics solutions for operation in complex environments – relevant examples are underwater environments, and particularly deep-sea water.

CRAS has a special scientific focus in the multi-sensor perception, navigation, positioning, and sensor fusion competences. Within the Cluster NIS - Networked Intelligent Systems, CRAS accomplishes its mission, by directing its activities towards 4 main areas of research: autonomous navigation and exploration; long term deployments and autonomy; sensing, mapping, and intervention; multiple platform operations.

CRAS activities are mainly positioned within RL levels 5-8, associated with design, development and integration of robotic platforms with increasing degrees of autonomy. These activities have contributed to the deployment of innovative solutions in multiple application domains, such as safety security and defence, underwater mining, deep sea exploration and infrastructure inspection.

6.3.2 Research Outcomes in 2019

In 2019, CRAS researchers published 17 papers in recognized scientific journals, the majority of them in 1st or 2nd quartile journals. Three Individual PhD Scholarships were awarded to CRAS researchers in the 2019 FCT Call for PhD Scholarships. The main research achievements during 2019 were the following:

- **Underwater Mine Explorer Robot**. Validation in real experiments of an autonomous robot for exploration of flooded mines. This robot is endowed with multiple sensors for extended perception of the environment allowing for its autonomous operation inside flooded galleries;
- **IS-ABS - In situ autonomous biosampler**. The IS-ABS automates the process of collecting environmental DNA, and is suitable for integration in water observation systems, what will contribute to substantially increase biological surveillances;
- **Multiple AUV tracker**. The proposed approach is based on a Probability Hypothesis Density Filter, thus overcoming the data association problem which is crucial in multiple AUV tracker. Our tracker is able not only to successfully estimate the positions of the vehicles, but also their velocities;
- **Target detection in hyperspectral imaging.** A novel 3-D convolutional neural network approach and compared against two implementations of other state-of-the-art methods: spectral angle mapper and hyperspectral derivative anomaly detection;
- **ROLAMOS.** A mosaicking method for underwater robotic applications based on an efficient frame-to-frame motion estimation with outlier removal and consistency checking that maps large visual areas in high resolution.

6.3.3 Innovation Outcomes in 2019

In 2019, CRAS organized the following events:

- “Waving the Future”, the internal annual event of CRAS. It is a one-day event for presentation of research, development and innovation results, and discussion of future plans;

- The 2019 edition of IN THE BLACK. This edition focused on Exploration, Extraction and Construction Opportunities for Underwater Technology and is expected to generate renewed momentum to the EIT Raw Materials Community;
- CRAS Open Day. Entrepreneurs and stakeholders were invited to visit CRAS. During the morning, robotic assets were exhibited in the Laboratory of Autonomous Systems at ISEP and after lunch the coordinators presented the results of past and ongoing projects, the business strategies and the TEC4SEA infrastructure.

CRAS also co-organized a workshop on Blue Economy Financing in Business2Sea event. This workshop was organized in the framework of the ProtoAtlantic Project and brought together different stakeholders in the Startup and SME financing systems in the Maritime area in order to identify available financing instruments, discuss the main difficulties and identify measures to be promoted to facilitate access to finance. CRAS was also present in several events with prototype exhibition. The most relevant ones were Business2Sea (Porto), European Maritime Days (Lisboa), and European Utility Week (Paris). During 2019 CRAS had a strong field activity, demonstrating results of research projects. The most important events were the following:

- Participation in “Recognized Environmental Picture Atlantic” Exercise - REP. This year’s edition was held under the NATO’s Maritime Unmanned Systems Initiative and brought the exercise to new levels of participation, institutional support, and complexity. CRAS participated with TURTLE (robotic autonomous lander) and MARES (autonomous underwater vehicle);
- SIDENAV project final demonstration at Sesimbra. Researchers from the CRAS, together with the rest of the partners, tested with success if a group of submerged landers (TURTLE) were able to localize an AUV (EVA) that was moving above;
- UNEXMIN trials at the Molnar Janos cave team (Budapest, Hungary). The aim of this trial was to map the flooded cave, at the same time as the team improved the operability of the surveying process;
- UNEXMIN trials at the Ecton mine (UK). The aim of this trial was to map the most important flooded sections of the underground mine, at the same time as the team improves the operability of the surveying process. The data obtained through the exploration of the three main shafts of Ecton mine will now be processed to later be used by Ecton Mine Education Trust for education and cultural purposes in archeology and mining related activities;
- UNEXMIN trials at the Urgeiriça mine (Portugal). Robots UX-1a and UX-1b were tested to explore and map the galleries and tunnels of the flooded underground mine, at different times with positive results;
- Field tests of the MyTag project on the Douro River. Flounders were tagged and successfully tracked with a developed acoustic system;
- Spilless Project final demonstrations. The UAV and ASV were tested at Douro River (Medas, Portugal) and the three vehicles UAV, ASV and ROV were tested together in a cooperative exercise, simulating their response towards a real-life oil mitigation process one week later in the Atlantic Ocean (Coruña, Spain).

6.3.4 Activity Overview

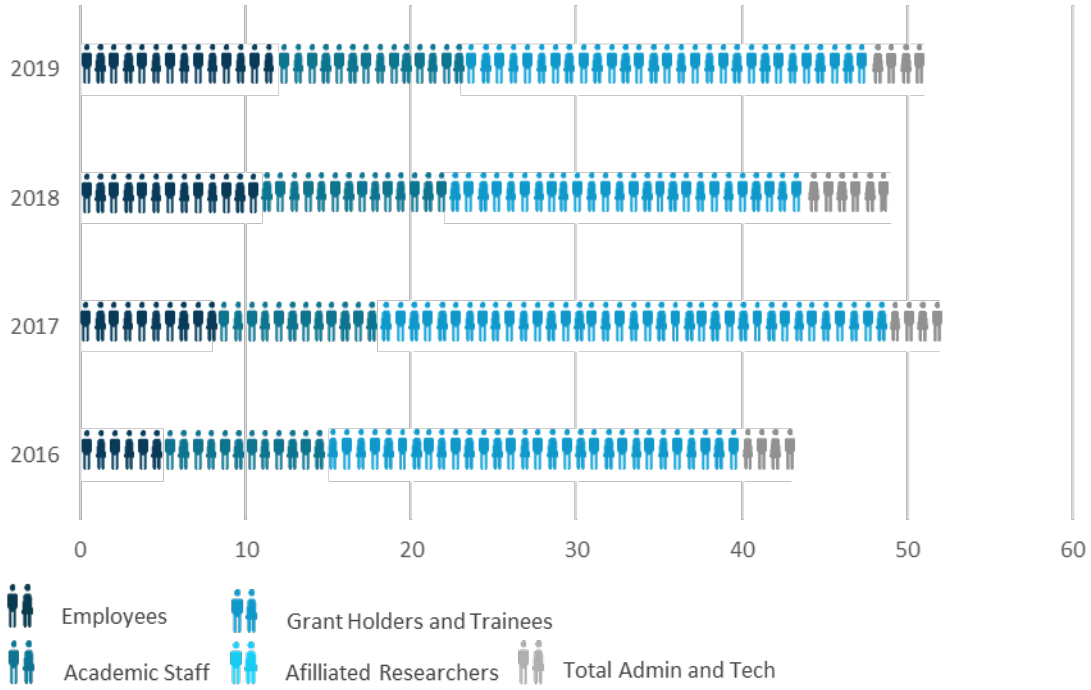

Figure 6.3.1 - CRAS - Research team evolution

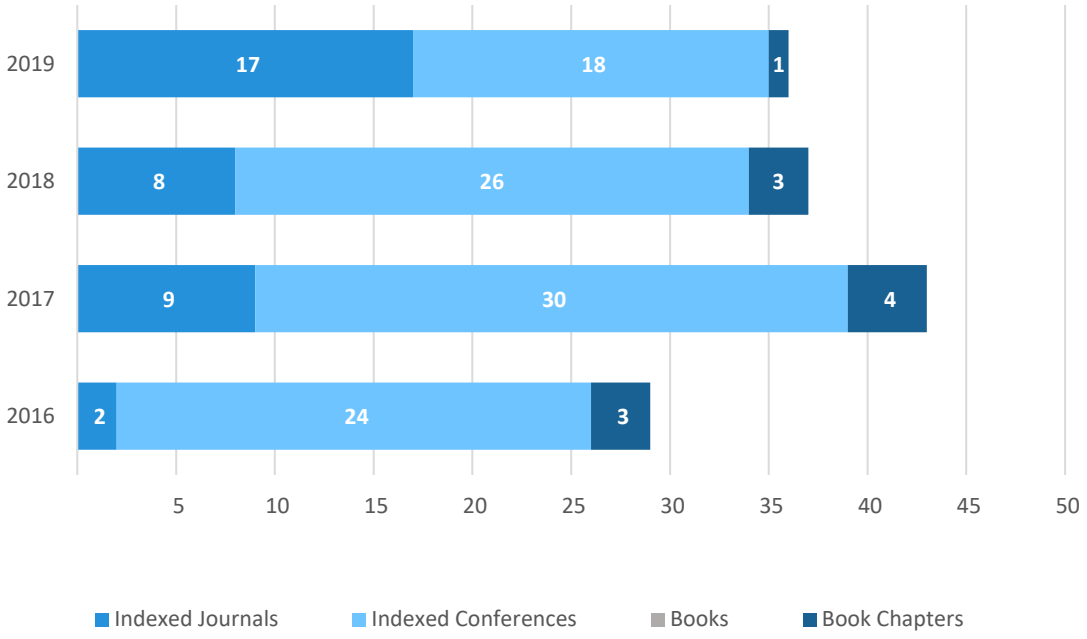

Figure 6.3.2 - CRAS - Evolution of publications by members of the Centre

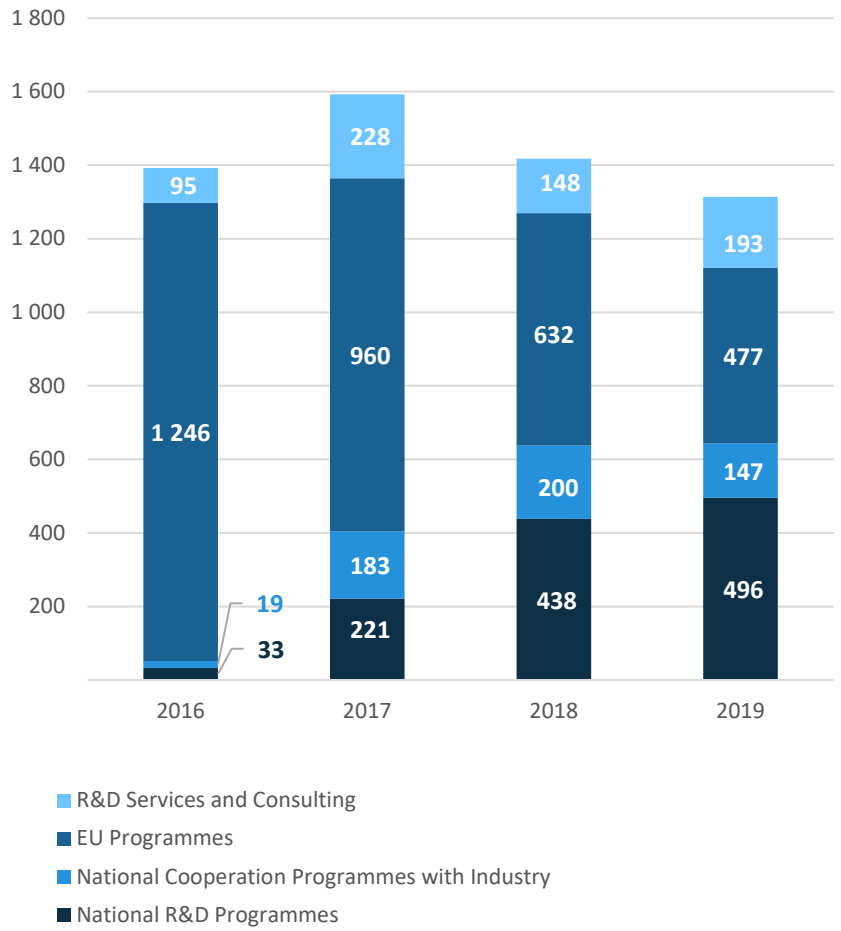

Figure 6.3.3 - CRAS - Project funding evolution (k€)

6.4 C-BER - CENTRE FOR BIOMEDICAL ENGINEERING RESEARCH

Coordinators: Aurélio Campilho and João Paulo Cunha

6.4.1 Presentation of the Centre

The mission of C-BER – Centre for Biomedical Engineering Research is "to promote scientific knowledge excellence through fundamental and applied research, advanced training and innovation in Biomedical Engineering". C-BER activities are aligned with the vision of the Cluster on Networked Intelligent Systems (NIS). To accomplish its mission, C-BER is organized in three Labs (Biomedical Imaging Lab, BioInstrumentation Lab and NeuroEngineering Lab), and is guided by the following goals:

- To create interdisciplinary knowledge enabling the innovation and technology transfer with economic impact;
- To develop bioengineering methods, products and tools for the prevention, early detection and diagnosis of different types of diseases, aging-related impairments, or for human rehabilitation, physiotherapy or functional assessment;
- To contribute to the development of advanced neuro-technologies at the frontier of engineering and neuroscience;
- To promote strategic partnerships with other Centres of INESC TEC, clinical partners, research institutes and foster international cooperation.

6.4.2 Research Outcomes in 2019

C-BER increased scientific publications in 2019 as planned, mainly in the first quartile. We achieved in 2019 a 2.2 indexed international jornal publication per core PhD, from a 1.5 ratio in 2018.

Furthermore, the Centre has achieved other high-impact outcomes such as:

- **New label free method for Bio-nano-sensing.** This outcome consists of a new method and corresponding sensing system, for direct analysis of biological nonometer particles in complex solutions. It deals with AI analysis of laser backscattered signals from optically trapped cells or bio-particles (we had results up to 100 nm) and has a very strong potential for biomedical and environment applications. This outcome is patent pending and generated one of our spin-off startups (see below);
- **Uncertainty-aware deep learning-based approach for computer-aided diagnosis and grading.** We proposed a CAD grading system that supports the clinical decision and the assigned pathology grades by providing a medically interpretable explanation. This approach was tested with success for grading diabetic retinopathy;
- **Minimalistic interactive lesion segmentation deep network**. We conceived a deep learning model that allows for both automatic and interactive segmentation of lesions in computed tomography images. This approach was tested with success for the segmentation of lung nodules;
- **Online Active Deep Learning for Medical Image Analysis.** We introduced a novel Online Active Deep Learning method for Medical Image Analysis. This new online active learning model requires significantly less labelings, is more accurate, and is more robust to class imbalances than existing methods. It was successfully tested for Diabetic Retinopathy detection;
- **Relationships between imaging phenotypes and lung cancer-related mutations.** We studied the relationships between imaging phenotypes and lung cancer-related mutation status. We developed classifiers, and analysed the results for EGFR and KRAS biological markers according to different combinations of input features. We show that EGFR mutation status might be correlated to CT scans imaging phenotypes;
- **Best Practical Paper Award**. EyeWeS: Weakly Supervised Pre-Trained Convolutional Neural Networks for Diabetic Retinopathy Detection" is the title of the scientific article that earned the Best Practical

Paper Award at the MVA 2019 (International Conference on Machine Vision Applications) held in Tokyo, Japan;

- **Smart garments and mobile applications** for product development in the garment and textile industry under research and development in the TexBoost project. A patent request will be submited in the early 2020 as a result of this work. A master dissertation was also concluded on Bioengineering related to this project.

6.4.3 Innovation Outcomes in 2019

2019 was the best year ever for C-BER innovations. As planned, we were able to create the first C-BER spin-off company – inSignals Neurotech - in February. This startup won the "I3S / Hovione Capital Prize" and received a small funding and additional mentoring services. We went further and also created a second spin-off startup in August – iLoF-Intelligent Lab-on-Fiber, in cooperation with CAP. This startup was the winner of the largest Medtech EU funding entrepreneurship challenge – EIT Health "Wildcard" – a 2,000,000 € funding for the startup. Furthermore, this startup has also won the "Altice International Innovation Award" and the ANI "Born from Knowledge" prizes.

Following the previous concessions in 2018, in USA, South-Korea, Japan, and EU, the patent entitled "Control module for multiple mixed-signal resources management" was also approved and granted in China on 12/13/2019. Funding from the University of Porto initiative BIPProof was granted to develop a demonstrator prototype to promote commercial licensing of this technology. Together with SAL, C-BER is preparing the filing of a patent on the detection of diabetic retinopathy.

Overall, in 2019 we have submitted 2 more patent applications, had 2 other granted and entered the international track of 8 of our previous patents. This track record of patents and spin-offs shows the vitality of the innovation spirit at C-BER.

6.4.4 Activity Overview

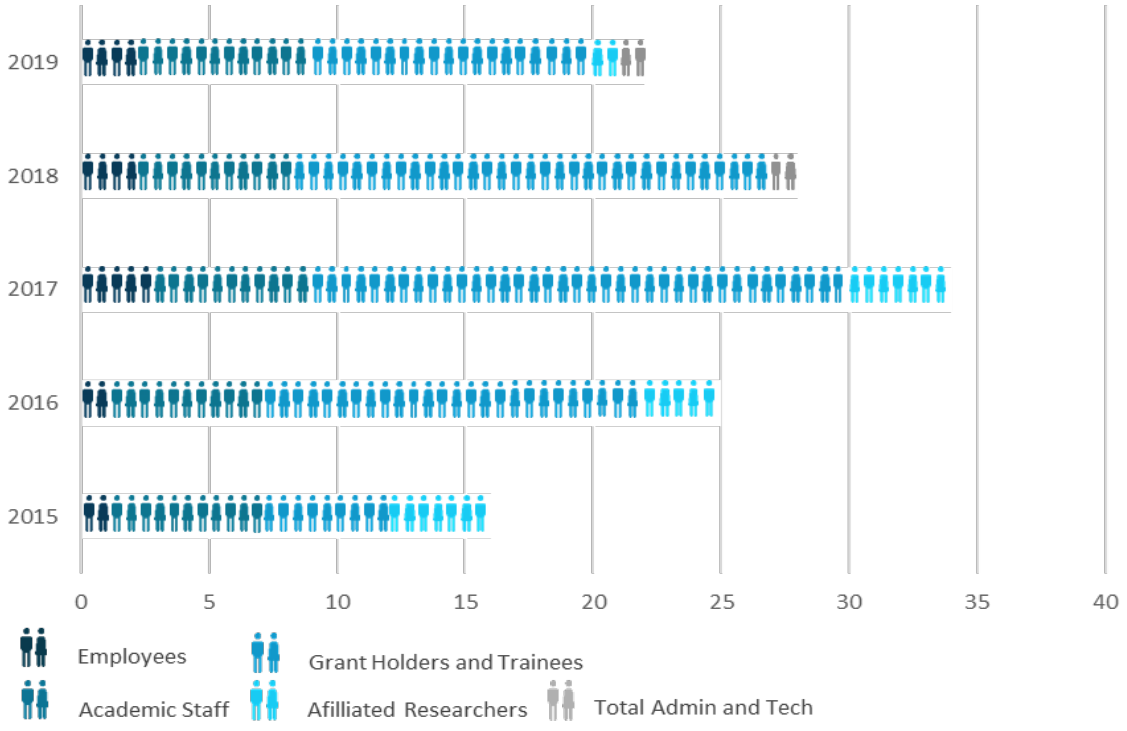

Figure 6.4.1 - C-BER - Research team evolution

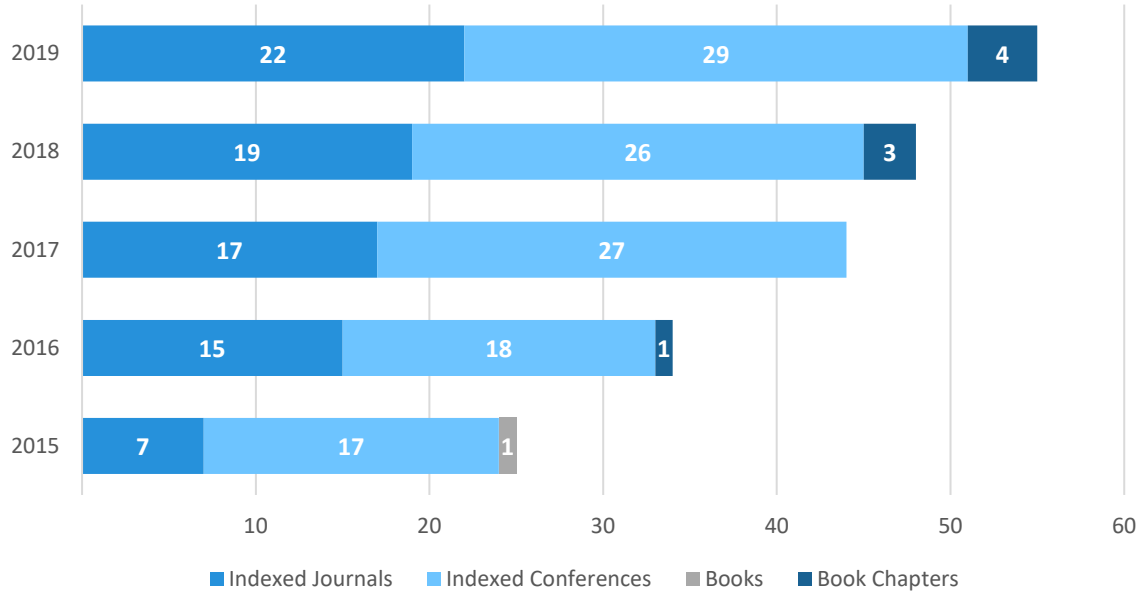

Figure 6.4.2 - C-BER - Evolution of publications by members of the Centre

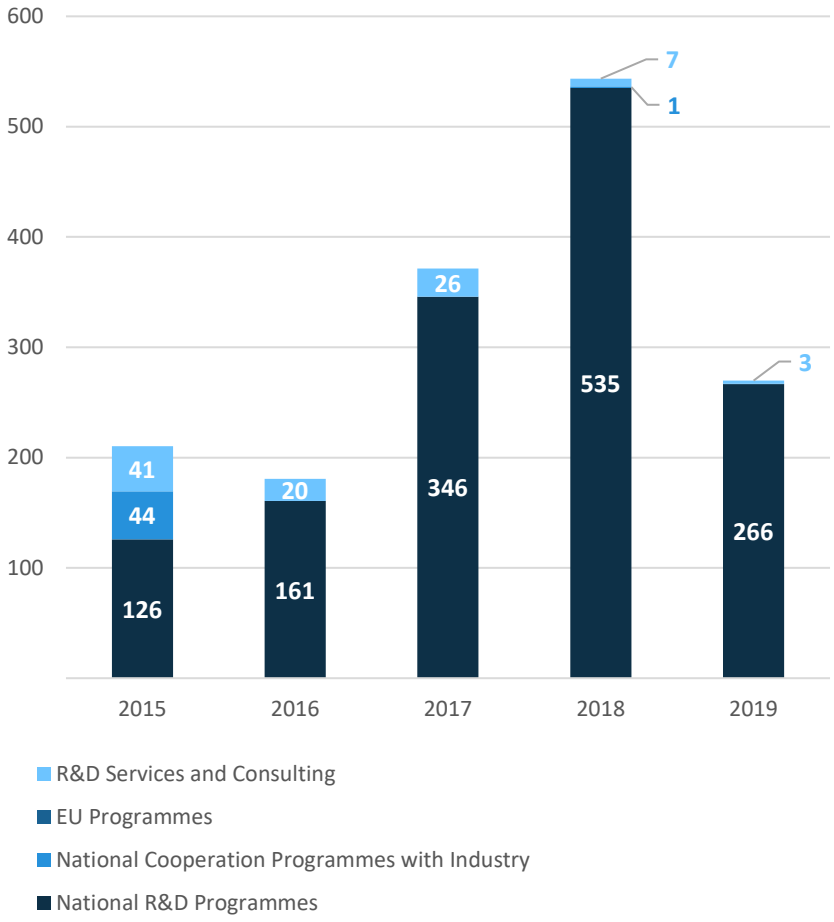

Figure 6.4.3 - C-BER - Project funding evolution (k€)

6.5 CPES - CENTRE FOR POWER AND ENERGY SYSTEMS

Coordinators: Manuel Matos and Ricardo Bessa

6.5.1 Presentation of the Centre

The Centre for Power and Energy Systems (CPES) is the core Centre of the Cluster Power and Energy. Within this Cluster, CPES holds specific expertise in power systems analysis (steady-state and dynamic), probabilistic and fuzzy modelling, reliability, optimisation and decision-aid, computational intelligence, energy analytics and forecasting, with special focus on large scale integration of Renewable Energy Sources (RES), Distributed Energy Resources (DER) operation, Electric Vehicles (EV) deployment and Energy and Flexibility management, under the Smart Grid paradigm.

CPES activity is organised in six research areas: 1. DMS/EMS and network automation; 2. System planning and reliability; 3. RES & DER integration; 4. Electricity markets; 5. X-energy management systems; 6. Multi-energy networks.

The research results produced by CPES cover a large range in the technology readiness level (TRL), ranging from level 2, where fundamental research is carried out, to level 8, where prototyping and demonstration of technology is performed. Part of the activity of the group is developed in its Laboratory of Smart Grids and Electric Vehicles (SGEV) that supports real environment, testing and validation of major developments.

The Centre is a world reference in large scale integration of RES and DER. CPES has two IEEE Fellows (one in the IEEE Distinguished Lecturer Program) and is a strong player in EU H2020 (in 2019, it coordinated two European projects) and direct contracts with national and international companies, with a robust track record in technology transfer and consulting. One researcher received the IEEE PES Renewable Energy Excellence Award 2013. Another received a recognition award 2013 from CIGRE. Yet other researchers won the 2014, 2017 and 2018 IEEE PES competitions in meta-heuristics applications to difficult power systems problems. Several post-graduate students won the Portugal best MSc thesis prizes attributed by: the Portuguese TSO (REN) in 2014-17; the Portuguese association of renewable GENCO (APREN), including the best PhD thesis bi-annual prize in 2015, 2016 and 2019 and by Portuguese pattern recognition association (APRP) in 2017. Because of this expertise, INESC TEC won the recognition of best innovation partner of EDP in 2016 (the major player in the Portuguese wholesale and retail markets, besides being the Electrical Distribution System Operator).

6.5.2 Research Outcomes in 2019

CPES is organised in five scientific domains that produce results in low TRL, which are further exploited in combination with the technology transfer areas to produce innovative outcomes (section 6.5.3).

Static and dynamic analysis of power systems: a) Novel grid-forming self-adaptive control parameters solution that improves the isolated power system transient stability, considering large shares of RES; b) Innovative control strategies for hybrid AC/DC microgrids supplied by Smart Transformers involving advanced functionalities (e.g., frequency-support to the AC grid, islanded mode; c) Grey-box approach for identifying an aggregated dynamic model for active distribution grids; d) Hierarchical optimisation for the energy dispatch and volt/var control of a photovoltaic-battery microgrid cluster.

Decision-aid and optimization: a) Data-driven energy optimization method for wastewater pumping stations (patent submitted); b) Two-stage stochastic optimization model to support an aggregator in the definition of bids for the day-ahead energy and secondary reserve markets; c) Cluster-based optimization approach to support an aggregator in the definition of demand and supply bids for the day-ahead energy market; d) Genetic and cross-entropy algorithms for energy optimization in a home energy management system with low computation platform.

Energy analytics and forecasting: a) New contributions to RES forecasting, such as privacy-preserving collaborative forecasting and data markets; b) Conceptualization, development and integration of an end-to-end forecasting platform for load and solar resources for Elergone Energias; c) New models to assess the integrated effects of investments and maintenance in the quality of service, as well as to estimate the impact of RES on distribution network losses; d) GPU-based implementation for the adequacy assessment of generating systems via sequential Monte Carlo simulation.

Energy economics and regulation: a) Cost-benefit analysis regarding the changes proposed by ERSE to be introduced in the Portuguese tariff code; b) Estimation of the Levelized Cost of Electricity for wind and PV units, taking into account the need to limit the ramping values; c) Estimation of domestic consumers' elasticity in response to dynamic tariffs.

Industrial electronics: a) Development of a methodology and an experimental prototype that enables the balancing of battery cells and hybridization with supercapacitors (best paper award in 2019 IEEE Vehicle Power and Propulsion Conference); b) prototype of a smart inverter with full integration of PV modules and batteries and remote monitoring functions.

6.5.3 Innovation Outcomes in 2019

DMS/EMS and network automation: a) Integration of advanced MV grid management tools in two pilot sites, Portugal and Slovenia (InteGrid EU project). Finalization of the software integration for low voltage control and state estimation. These tools were integrated with commercial General Electric Advanced Distribution Management System; b) Analysis of the adequacy of HV/MV substations automation functions regarding the expected technology evolution (contract w/EDP); c) Identification of roadmap for the evolution of distribution network control and automation architectures and functionalities; d) Development and demonstration of advanced observability and control algorithms for future smart MV/LV substations (P2020 NEXTSTEP project); e) Operational planning tools for enabling the provision of reactive power services by the DSO to the TSO, tested in the field (TDX-ASSIST EU project).

System planning and reliability: a) Data-driven methods for the assessment of the condition and the remaining useful life of distribution network equipment (contract w/EDP); b) Analysis of the voltage stability and behavior of the Portuguese power system, in planning scenarios, without the existing large coal-fired power plants and with considerable RES integration (contract w/EDP); c) Novel tools for distribution network expansion planning with battery energy storage systems (contract w/EDP).

RES & DER integration: a) Development of battery storage energy management solution (contract with EFACEC); b) Specification of the connection requirements for the solar photovoltaic power plants to be connected in the Portuguese power system (contract with DGEG); c) Sizing and technical specification of the connection requirements of a battery storage system in Azores (contract w/EDA); d) Development of simulation studies regarding the assessment of the dynamic performance of the Graciosa power system considering an hybrid solution (RES+storage) installed in the field (contract w/Graciolica); e) Drafting the technical document defining the Madeira island RES connection requirements.

Electricity markets: a) Prototype of a local reactive power market to provide reactive power flexibility to the TSO from resources located at the distribution grid (EU SysFlex project); b) Prototype of an active power TSO-DSO coordination mechanism (traffic light concept) to allow DER to participate in reserves markets (EU SysFlex project); c) Assess local energy market business models with flexibility and network constraints (ESGRIDS FCT project).

X-energy management systems: a) Development, testing and implementation of HW and SW modules for the HEMS system implemented in the InteGrid project; field testing and deployment; b) Definition of the methodologies for Energy Performance Contracts for energy services provisioning of buildings in the scope of demand response (AmBIENCe EU project).

Multi-energy networks: a) Strategies to optimise multi-energy aggregators participation in day-ahead electricity markets, considering gas and CO2 markets' prices; b) Network-constrained method to optimise the operating point of multi-energy resources in real-time; c) Business models for nearly-zero multi-energy districts, considering wasted cold and heat (EMB3Rs EU project).

6.5.4 Activity Overview

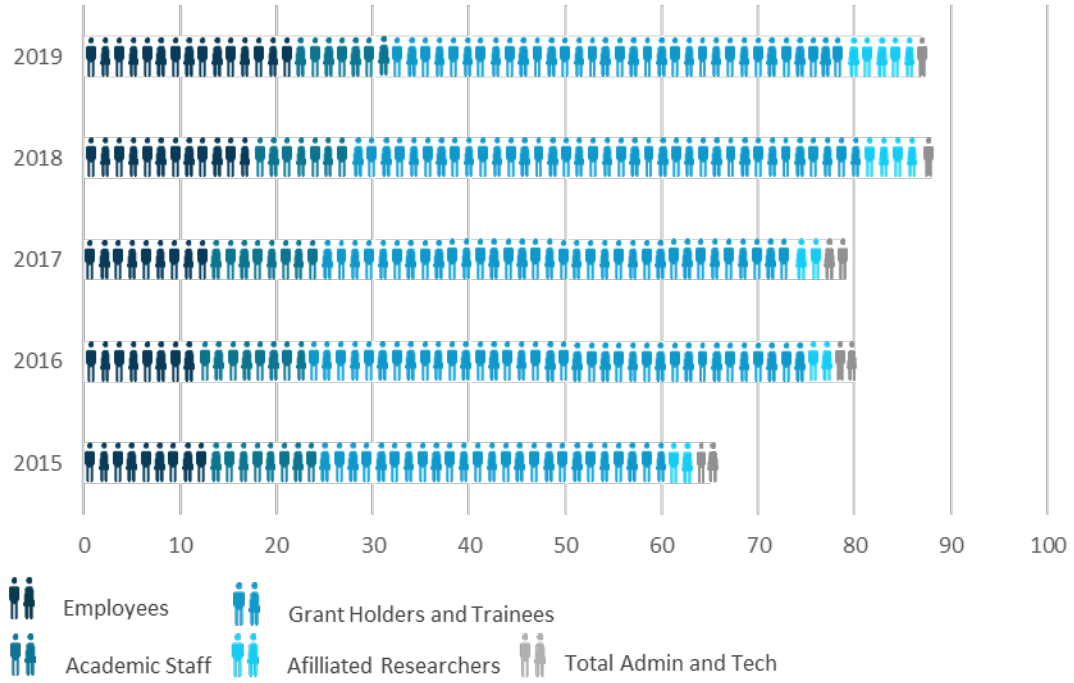

Figure 6.5.1 - CPES - Research team evolution

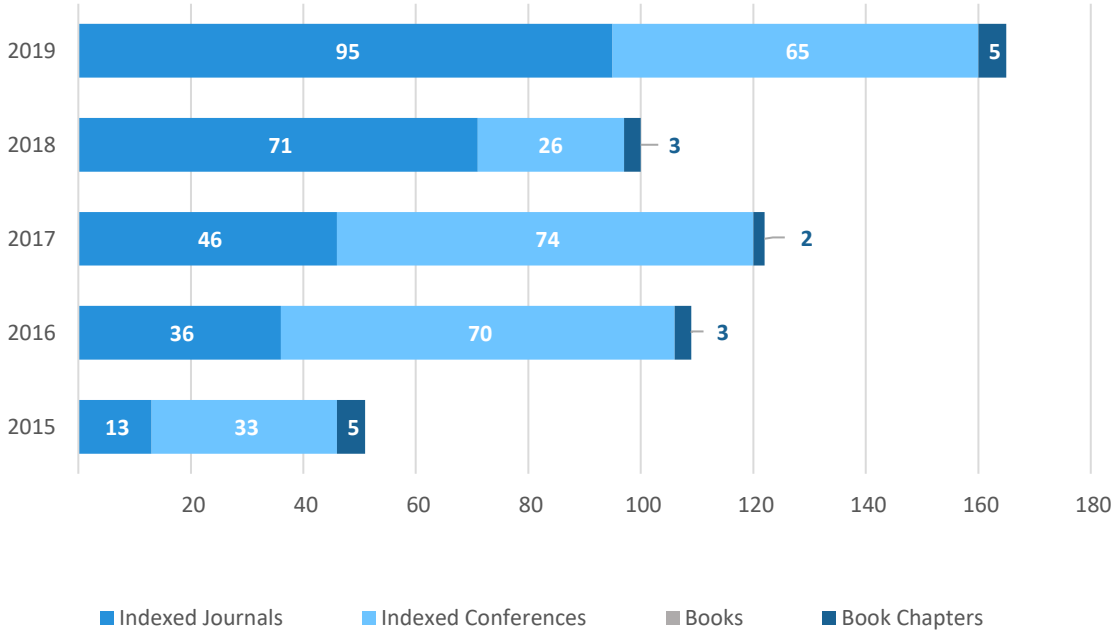

Figure 6.5.2 - CPES - Evolution of publications by members of the Centre

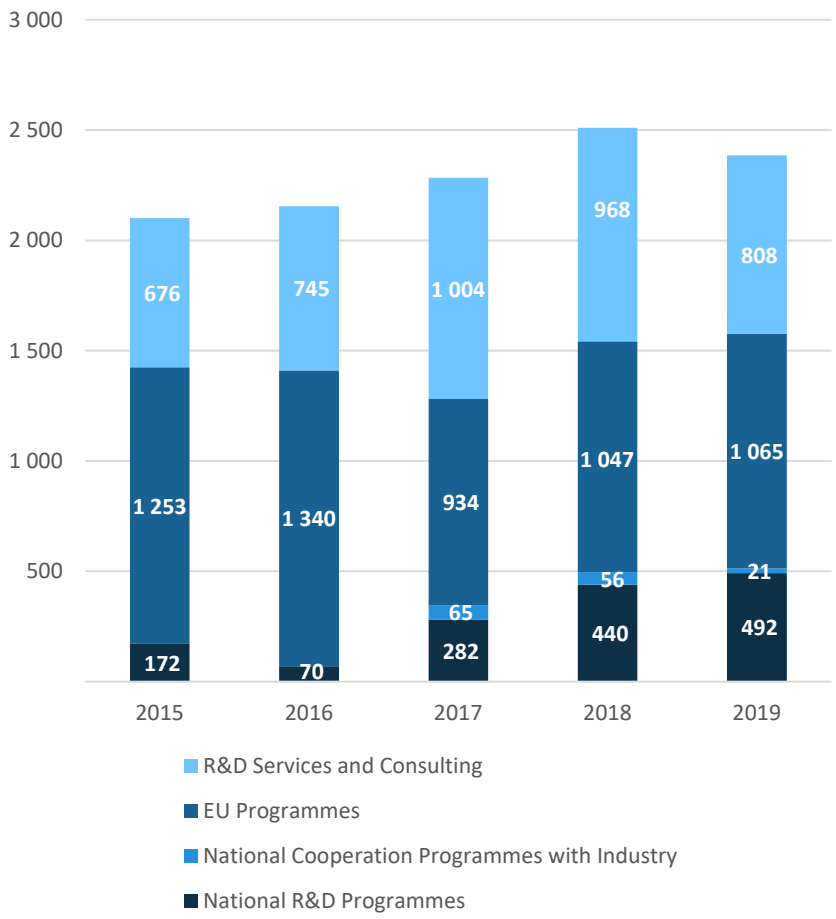

Figure 6.5.3 - CPES - Project funding evolution (k€)

6.6 CESE - CENTRE FOR ENTERPRISE SYSTEMS ENGINEERING

Coordinators: Américo Lopes Azevedo and António Lucas Soares

6.6.1 Presentation of the Centre

CESE mission is to advance the scientific knowledge in enterprise systems engineering, providing unique expertise targeting complex industrial organisation challenges that foster high impact management and ICT systems and generate innovative services for industrial organisations. CESE wants to be positioned as a leading research Centre focused on connected, sustainable and customizable production systems through the engineering of innovative enterprise systems and as a first choice in helping industrial organisations to improve competitiveness and sustainability of their supply chains and achieve high-performance levels of their inner business processes.

CESE accomplishes its mission, within the Cluster ISE – Industrial and Systems Engineering, by undertaking multi-disciplinary, system-oriented research and technology development for the strategic and operational management of industrial enterprises and networks. Research at CESE is organized along the following lines: responsive, sustainable and resilient manufacturing systems, collaborative networks and digital value chains as socio-technical systems, digital architectures for data-driven manufacturing, decision support in a digital manufacturing context, mobility for the circular economy, and technology adoption and management for inclusive manufacturing.

It uses the knowledge generated in research to provide high value-added and innovative niche services to the industrial enterprises in areas such as Production Systems Management, Logistics Systems, Digital platforms for networks and supply chain, and Digitalisation and Industry 4.0 roadmapping.

6.6.2 Research Outcomes in 2019

RL1. Responsive, sustainable and resilient manufacturing systems

Research outcomes along this research line included (i) the assessment of the impact of performance determinants in complex MTO/ETO supply chains through an extended hybrid modelling approach, (ii) and a systematic literature review on the assessment and optimization of sustainable forest wood supply chains. These contributed to the RL1 goal of researching and developing novel optimization-simulation approaches to address uncertainty in production scheduling and planning.

RL2. Collaborative networks and digital value chains as socio-technical systems

The EU project Manu-Square continued and an intermediate outcome was the design of a Digital Platform Architecture to Support Multi-dimensional Surplus Capacity Sharing. Furthermore, a conceptual study of the strategic fit between innovation strategies and supply chain strategies emerged from a PhD work along this line. Both outputs contributed to the RL2 goals, namely, to develop design methods and tools for the transformation of existing networks into collaborative networks, and to develop methodologies for the selection of practices for supply chain management towards increasing resource-efficiency and resilience.

RL3. Digital architectures for data-driven manufacturing

Research outcomes along this research line contributing to the goal of developing methodologies for analysis and selection of methods and software tools aiming to model cyber-physical systems included (i) a method to test the vertical and cyber-physical integration of cognitive robots in manufacturing, (ii) an IIoT-based architecture for decision support in the aeronautic industry and (iii) the study of the Linkages Between the Internet of Things and Planning and Control Systems in Industrial Applications. A further outcome regarding a data mining-based framework to assess solution quality for the rectangular 2D strip-packing problem was also achieved.

RL4. Decision support in a digital manufacturing context

The general goal for this RL for 2019 was to improve Decision-support sytems dealing with growing uncertainty levels and risks, in strongly dynamic environments. Aiming at this, several research outcomes in this year are

highlight: (i) a characterization of Challenges in Decision-Making Modelling for New Product Development in the Pharmaceutical Industry; (ii) a Case Study in the biomass supply chain for multiple vehicle synchronisation in a full truck-load pickup; (iii) a delivery and a dynamic multiobjective model for designing machine layouts. Within the scope of DSS based in data analytics and machine learning, three outcomes deserve to be mentioned: (i) a method based on robust cepstral-based features for anomaly detection in ball bearings; (ii) a method to discover Relevant Patterns in Chatbot Dialogues; (iii) the assessment of the Performance of Hierarchical Forecasting Methods on the Retail Sector.

RL5. Managing Transport, Logistics and Mobility for the Circular Economy

The main goal of this research line for 2019 was to develop advanced optimisation and simulation models, along with data and knowledge management procedures. A study on the comparison of models for the Prediction of Journey Destination for Travelers of Urban Public Transport was one of the outcomes contibuting to this goal. Another one, was the review of the vehicle routing problem with backhauls towards a sustainability perspective.

RL6. Technology adoption and management for inclusive manufacturing

The main goal was to complete the research on the factors influencing the adoption of collaborative robots in manufacturing organisations, which was achieved and resulted in: a brief overview of the use of collaborative robots in industry 4.0 regarding the human role and safety; a qualitative study on the Drivers Impacting Cobots Adoption in Manufacturing Context; and the characterization of the Environmental Factors Influencing the Adoption of Digitalization Technologies in Automotive Supply Chains. Further outcomes in this SRL include Lessons for Industrial Development Policies to Join Global Aerospace Value Networks, a multi-case study on the implementation of RAMI4.0 in Production and the design of a maturity assessment model of industry 4.0 applied to a manufacturing company.

6.6.3 Innovation Outcomes in 2019

Advanced consulting and licensing have been the most successful techniques for transferring technology and specialized knowledge to industry.

INOV1. & INOV2. Production Systems Management and Logistics Sytems

Production planning and scheduling resulted in new implementations at DECATHLON and Amorim Irmãos. The challenges required innovative approaches that were combined with research results on optimization algorithms under uncertainty, considering multipled scenarios for the production of articles in complex distribution networks.

The Design of Advanced Factories was another successful result with examples in several industrial areas during 2019. IKEA Industry has continued to rely on CESE to optimize their layouts, and new customers came along. At ENERGI, advanced simulation techniques were applied to a complex production system where all the production dynamics and supply chain were modelled.

INOV3. Digital platforms for networks and supply chains

Digital platforms for networks and supply chains were implemented at Amorim's Group, integrating equipment from production units located in several countries in two continents according to the concept of Industry 4.0. This advanced and innovative service brought together CESE and CTM competences in terms of industrial processes, Production Systems Management and Communications.

INOV4. Digitalisation and Industry 4.0 roadmapping

An innovative roadmap for industry 4.0, specified in 2018, was implemented in 2019, with several proofs of concept, some of them having already originated rollouts. Innovation was achieved with methodologies that combine multidisciplinary profiles and different areas of research. In this project, CESE involved other Centres (CRIIS and C-BER) expanding its areas of intervention and fulfilling the mission of INESC TEC.

6.6.4 Activity Overview

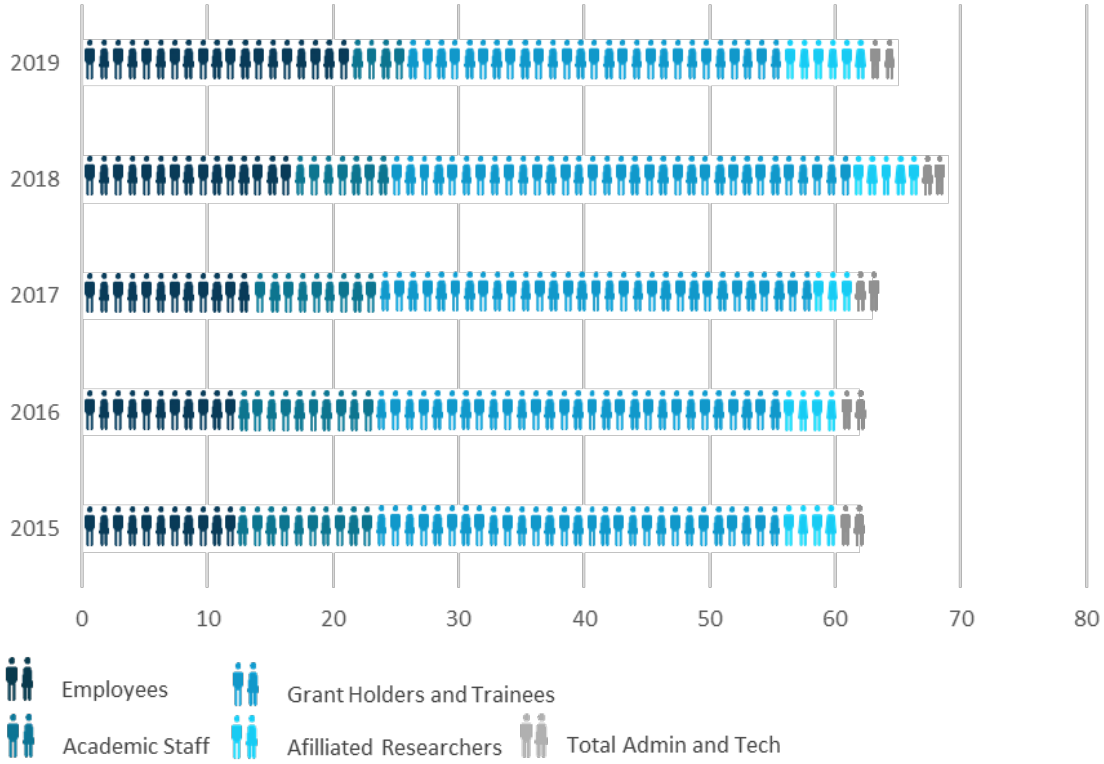

Figure 6.6.1 - CESE - Research team evolution

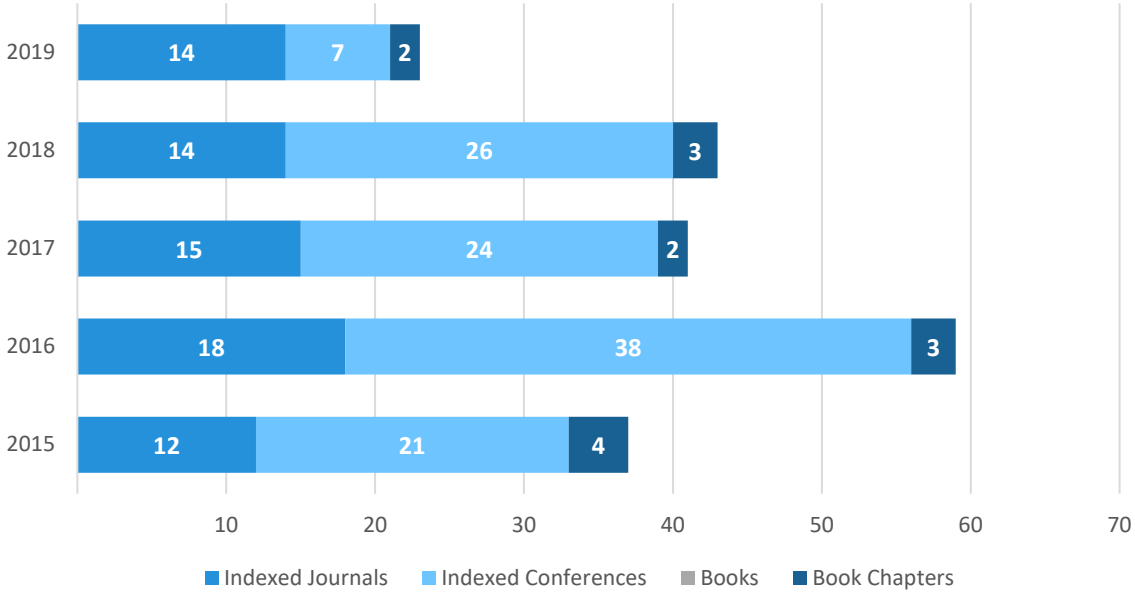

Figure 6.6.2 - CESE - Evolution of publications by members of the Centre

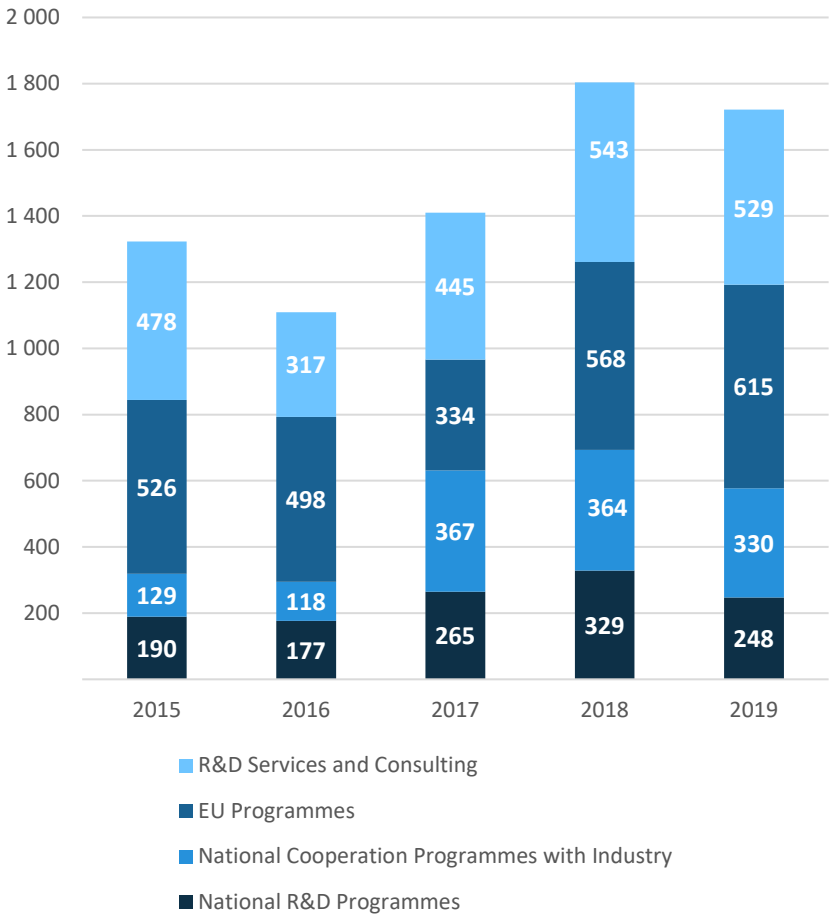

Figure 6.6.3 - CESE - Project funding evolution (k€)

6.7 CRIIS - CENTRE FOR ROBOTICS IN INDUSTRY AND INTELLIGENT SYSTEMS

Coordinators: António Paulo Moreira and Germano Veiga

6.7.1 Presentation of the Centre

The Robotics and Intelligent Systems Centre designs and implements innovative solutions within the areas of industrial robotics and intelligent systems. The Centre works in close cooperation with Companies, other INESC-TEC Centres and other Institutes and Universities, following the lemma from Research and Development to Innovation, passing through Design, Prototyping and Implementation.

6.7.2 Research Outcomes in 2019

The main research outcomes are provided along the main research lines.

RL1. Navigation, Localization and Coordination of Mobile Robots

In the context of Navigation, Localization and Coordination of Mobile Robots, during 2019, CRIIS was involved in eight projects with industrial companies. As a result of this intense activity, we pushed mobile robots systems closer to industrial production lines, either through the development of basic technologies, but also the development of higher TRL projects. In terms of scientific results, in this area, we had five articles in international journals and four in international conferences. Examples of such projects are DM4Manufacturing (FCT-PAC), TEC4Growth - Pervasive Intelligence, Enhancers and Proofs of Concept with Industrial Impact, Research Line: iMAN Intelligence for advanced Manufacturing systems (Norte2020), PRODUTECH (P2020), FAMEST P2020, PROJETO RDH (under contract), ColRobot (H2020), ScalABLE 4.0 (H2020).

RL2. Intelligent Sensors and Control of Dynamical Systems

During 2019 we developed several intelligent sensors and control algorithms for robotics systems and other industrial systems, namely based on image processing, kalman filters, auto-calibration methods, etc. These developments have been applied in the following projects: DM4Manufacturing (FCT-PAC), TEC4Growth Line: iMAN (Norte2020), PRODUTECH – SIF (P2020), ColRobot - (H2020), COBOTIS (FCT) and AGRINUPES (H2020). The scientific results have been published in 3 articles in international journals and 1 article in an international conference.

RL3. 2D/3D Industrial Vision and Advanced Sensing

In the 2D/3D Industrial Vision Systems and Advanced Sensing, the most significant developments were related to: (1) the consolidation of a modular and highly reconfigurable 3D Robot Perception framework for industrial use. It is a generic point cloud matching processing pipeline, endowed with an iterative multi-hypothesis grasping planner that receives as input the object's 3D model (or primitive description) and the robotic gripper. It was initially developed for 3D mobile robot self-localization and mapping and, during 2019, was extended for estimating both the 6 DoF and grasping poses of rigid and semi-rigid objects. (2) in Agricultural and Forestry Robotics, the visual perception systems were significantly improved to work under all-weather (illuminations) conditions, to feed localization and mapping procedures with high-level visual features (semantic features, such as vine trunks, fruits...) positioning, and to be faster by employing the use of dedicated parallelization hardware. Big real data-sets acquired in real steep slope vineyards and forests were segmented and classified for further deep learning network development, training, and benchmarking. In this area, four papers were presented in international conferences, and one paper in an International Journal.

RL4. Human Robot Interfacing and Augmented Reality

In the human robot interfacing the most significant developments in 2019 were related to: (i) the advanced use of spatial augmented reality for assembly tasks, namely through the use of BIM (Building information modelling) for the collaborative assembly of steel construction elements; (ii) the collaborative assembly workbench with visual guidance and increased operator comfort by making robot movements explicit. In this area, one paper was published in an International conference and one paper in an International Journal.

RL5. Future Industrial Robotics and Collaborative Robots

In the research line regarding collaborative robots the most significant achievements were two main publications in reference international journals: the first targets the use of collaborative robots in SME's, in the outcome of the large International Project SMErobotics (IEEE Robotics and Automation Magazine), and the results from the previous works on the integration of augmented reality in collaborative robotics systems in the structural steel sector (Elsevier Automation in Construction).

RL6. Vertical Integration, IoT, Industry 4.0

In 2019 the RL main achievements were related with the architectural development of the Task Manager for Skill based robotic system orchestration and the static analysis of ROS code for a large scale robotic system. In this RL two scientific publications were presented in international conferences. In the vertical integration and IoT domain, the main innovation achievements relate to the Open Scalable Production system (OSPS) jointly developed with CESE and CEGI and applied in industrial demonstrators on the scope of EU-funded initiatives coordinated by INESC TEC, namely: H2020 ScalABLE4.0 and H2020 FASTEN. These took place in Europe (PSA Peugeot Citröen, Embraer, Simoldes Plásticos), but also in South America (ThyssenKrupp Brazil), leveraged by INESC Brasil researchers, which further attests to the usability and maturity of this innovation area.

6.7.3 Innovation Outcomes in 2019

The main innovation activities in 2019 were targeted as follows:

INOV1. Internal Logistics

In mobile robotics the main innovation achievements related with licensing of the existing assets to national and international companies. In particular, it is worth of note the international contract for navigation and localization software for a robot manufacturer in Singapore, and the national contract for the demonstration of the use of mobile robotics in refineries.

INOV2. Robotics for Agriculture and Forestry

In the agriculture application, two outcomes must be emphasized: (i) the international contract with an American association for the development of a prunning tool for aerial robots; (ii) the development under contract of smart fertilizing systems.

INOV3. Flexible Production using Robotics

The main innovation activities were the development and commissioning in real shopfloor of robotic systems for the collaborative assembly of structural steel components and finally the part handling in multiproduct production line in the plastic parts injection sector.

INOV4. Inspection, Control and Embedded Systems

The main innovation activities regarding inspection and control, were the development of a cork stoppers inspection system, and the development under contract of the embedded system for the control of large scale textile printer.

INOV5. New challenges in Robotics

Concerning new challenges in Robotics, INESC TEC main innovation achievement was the development and deployment of a mobile manipulator for screwing operations for the Automotive Industry, as a final shop-floor collaborative robotic solution. It was based on a traditional industrial robot supplemented with a safety certified machine vision system provided by pilz (https://youtu.be/MWhkrRbPB_o).

6.7.4 Activity Overview

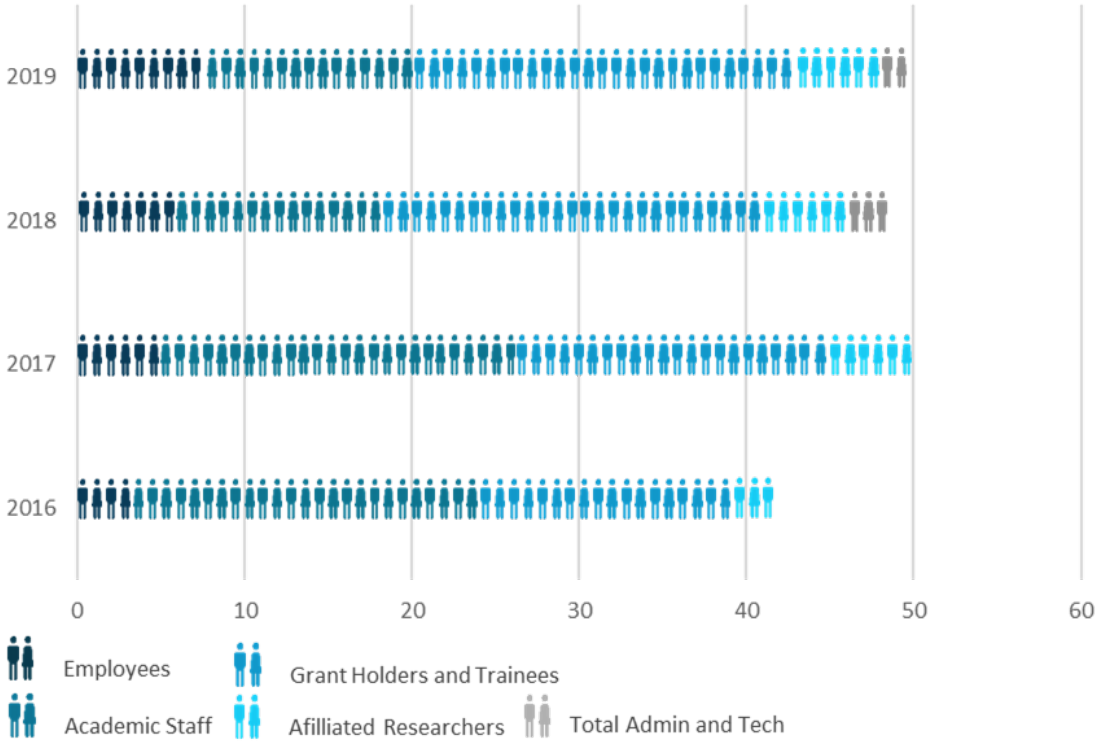

Figure 6.7.1 - CRIIS - Research team evolution

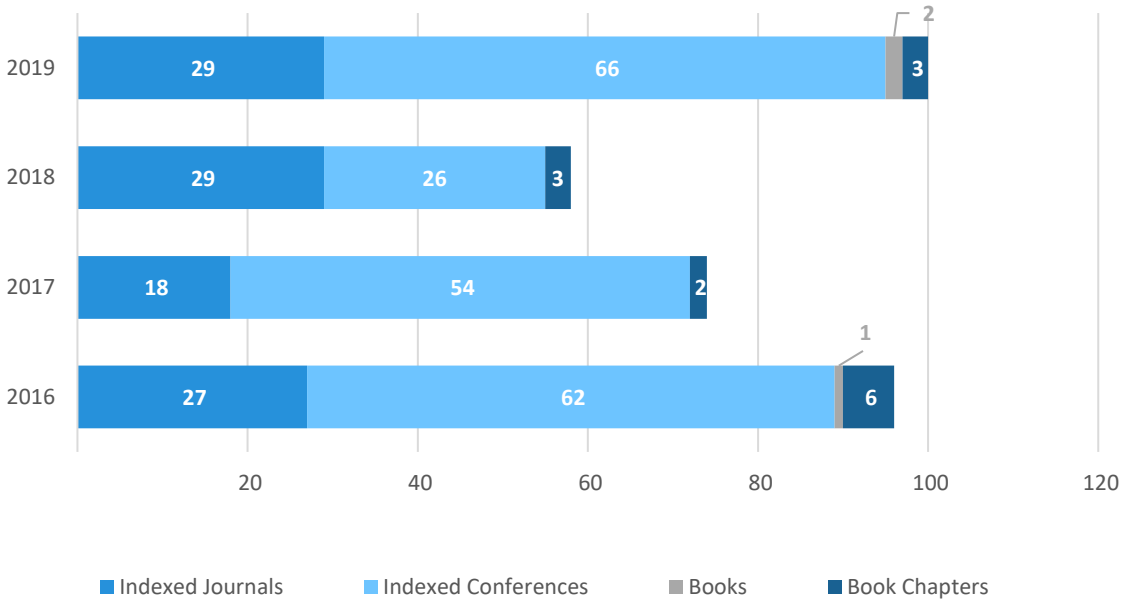

Figure 6.7.2 - CRIIS - Evolution of publications by members of the Centre

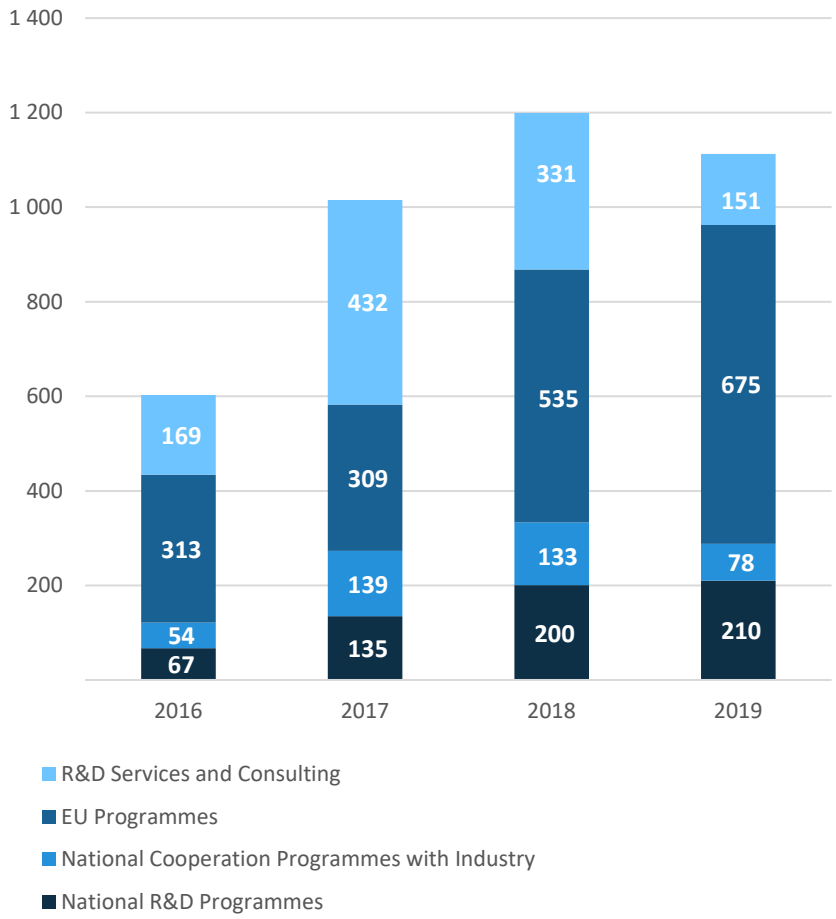

Figure 6.7.3 - CRIIS - Project funding evolution (k€)

6.8 CEGI – CENTRE FOR INDUSTRIAL ENGINEERING AND MANAGEMENT

Coordinators: Ana Viana and Pedro Amorim

6.8.1 Presentation of the Centre

CEGI integrates the Industrial and Systems Engineering Cluster (ISE). This Research Group (RG) is an international reference in business analytics through decision support systems for service and operations management, contributing also in data science, service science, and other emerging topics (e.g., blockchain and asset management).

Within the domain of business analytics, the goal of the RG is to extract knowledge from data that can be leveraged to increase, for example, revenues of a business. The focus of the RG is on prescriptive analytics, particularly in addressing challenges related to dynamic optimization under uncertainty.

In the service science area, the RG helps to shape the worldwide research priorities in this field with its cross-disciplinary approach that had put in contact several research teams (e.g., by leading a Marie-Curie EU project).

Core areas of application/innovation of CEGI include Retail/Industry, Mobility and Healthcare, with significant contributions also in the Energy Sector.

6.8.2 Research Outcomes in 2019

RL1. Operations Research / Management Science

The RG publishes research in established areas of Operations Research/Management Science such as inventory management, production and distribution planning, service operations, supply chain management, workforce staffing and performance assessment. The RG seeks to promote research on emerging topics such as e-commerce, emerging country operations, and the shared economy.

In 2019, the RG continued to advance the state of the art in terms of methods and models of operations research/management science in its several domains of interest (e.g., health, retail, and industry). New insights were obtained on how to deal with uncertainty and hybridize heuristics and mathematical programming (matheuristics). These approaches have been applied on emerging topics related to car-sharing (Oliveira, B.B., et al., EJOR (2019)) and integrated planning (Moreira, F., et al. Omega, 2019).

RL2. Data Science / Data Mining

The RG performs research in the various domains of the vast research field of data science, data mining and visualization, mainly with an application perspective. This includes individual methods and techniques in knowledge acquisition and representation, and their application in the construction of recommendation systems.

In 2019, the RG had outcomes on its two main streams of research: visualization and data mining. In terms of visualization, an emerging topic in data science, we brought to light new means to expose and explore data by means of a contextual family tree (Borges, J., Information Visualization (2019)). Regarding data mining, the RG kept exploring business problems from multiple perspectives. For instance, neural networks have been used instrumentally to analyze discounts in the retail sector (Miguéis, V. L. et al., Expert Systems (2019)).

RL3. Service Science / Design

The RG fosters novel and relevant ideas about service design and/or service innovation, in B2C, B2B, as well as nonprofit services (education, and government). Illustrative topics include service strategy (focus, competitive capabilities and competencies, business models).

In 2019, the RG worked mainly in advancing the theory of service design and two important research outputs were generated. Firstly, the RG advanced service design research with design science research (cf. Teixeira, J.G. et al., Journal of Service Management (2019)). Secondly, the RG demonstrated how service design can be leveraged as a multidisciplinary approach to service innovation (Joly, M.P. et al., Journal of Service Management (2019)).

RL4. Emerging topics (Blockchain, Asset Management, Machine Learning and Optimisation)

In 2019, the RG performed several research activities related to blockchain and asset management, through the participation in European and consultancy projects. Regarding the hybridization of Machine Learning and Optimization, the main goal of this topic is to improve well established research of the Centre in Optimization by coupling it with Machine Learning techniques.

This last research topic has already resulted in a concrete output for a problem that is, traditionally, in the domain of operations research: Júnior, A. N., Silva, E., Gomes, A. M., Soares, C., & Oliveira, J. F. (2019). Data mining based framework to assess solution quality for the rectangular 2D strip-packing problem. Expert Systems with Applications, 118, 365-380.

In 2020, due to the several research efforts in these emerging topics, more research outcomes should follow, particularly in the blockchain and asset management domains.

6.8.3 Innovation Outcomes in 2019

Techonology transfer of the Centre has been mainly directed to three areas of activity: Energy, Retail/Industry and the Healthcare sector.

INOV1. ENERGY

The energy application area is a core area for CEGI in terms of technology transfer. Both asset management, decision support and prescriptive analytics have been used to significantly improve processes in this industry.

In 2019, the Centre started to participate in several European projects within this domain (XFLEX, INTEGRID, and POCITYF). In XFLEX, INESC TEC team is responsible to create a health index for the hydropower system to monitor the effects of the newly designed flexible power services. This will be integrated in a smart control to leverage enhanced variable- and fixed-speed turbine systems, as well as a battery-turbine hybrid. In the Integrid project the INESC TEC team is in charge of creating a condition prognosis tool to make individual and status dependent maintenance possible for dry transformers in medium/low voltage substations.

INOV2. RETAIL AND INDUSTRY

Over the last years, there was a set of PhDs focused on developing empirical and analytical methods for better decision making in both offline and online retail settings. This research has resulted in the possibility of advising retail companies on how to better present and explore their services (e.g., subscription services). Hopefully, this innovation outcome can be spread out to retailers outside the pilot setting of 2019.
Within the Industry 4.0 related concepts, in 2019, a software module to support cutting and packing activities in the logistics industry; and a minimum viable product was built to support transactions over a decentralized platform that leverages blockchain technology and smart contracts. The first innovation outcome is related to research activities carried on during the CrossLog project (P2020) and the second one is related to the DoubleChain project (CMU-Portugal).

INOV3. HEALTHCARE

The healthcare area has evolved due to the close collaboration between CEGI and several entities of the public sector, namely hospitals and central regulatory entities. Both Service Design and Operations Research/Management Science have contributed with best practices to this sector.

In 2019, CEGI developed inventory management policies that were readily implemented in practice (OCP project) and has started a large project with IPO to leverage the sheer amount of data present in this oncology hospital.

6.8.4 Activity Overview

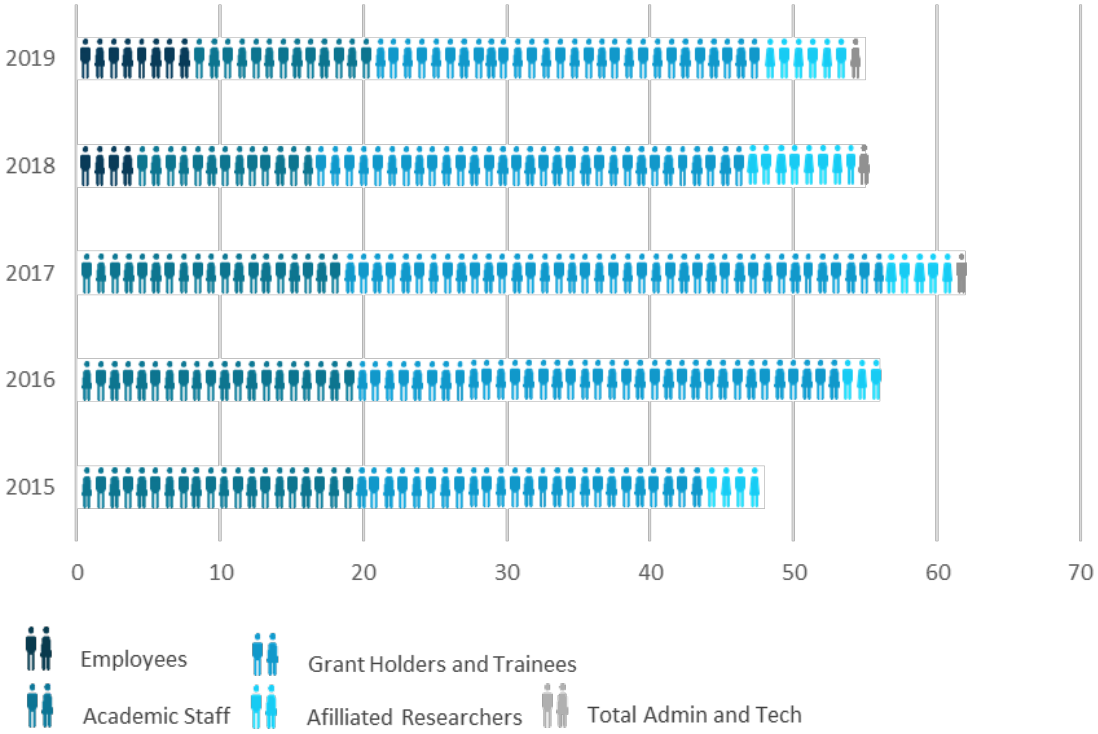

Figure 6.8.1 - CEGI - Research team evolution

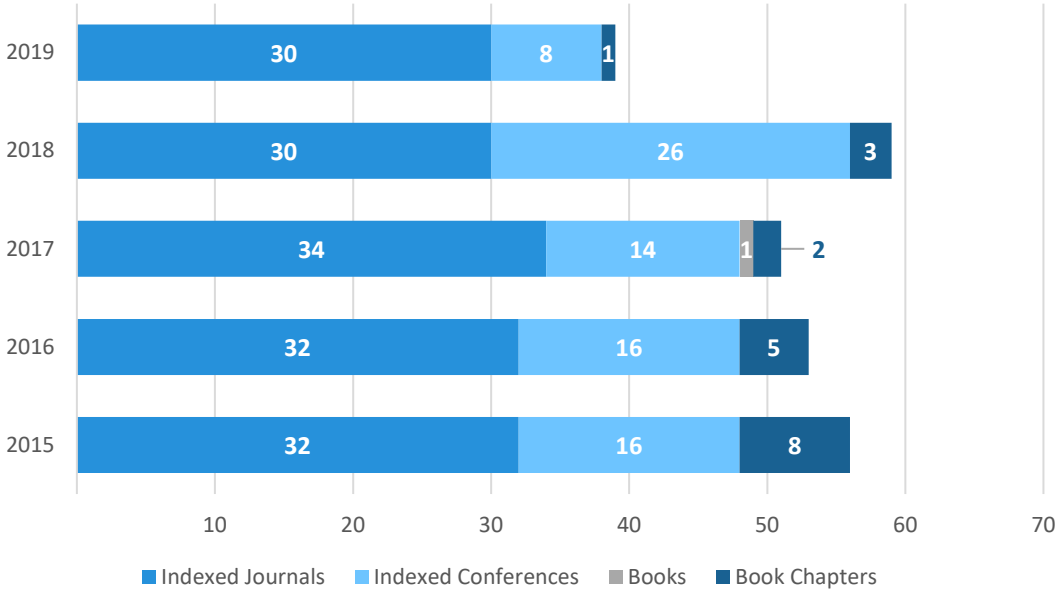

Figure 6.8.2 - CEGI - Evolution of publications by members of the Centre

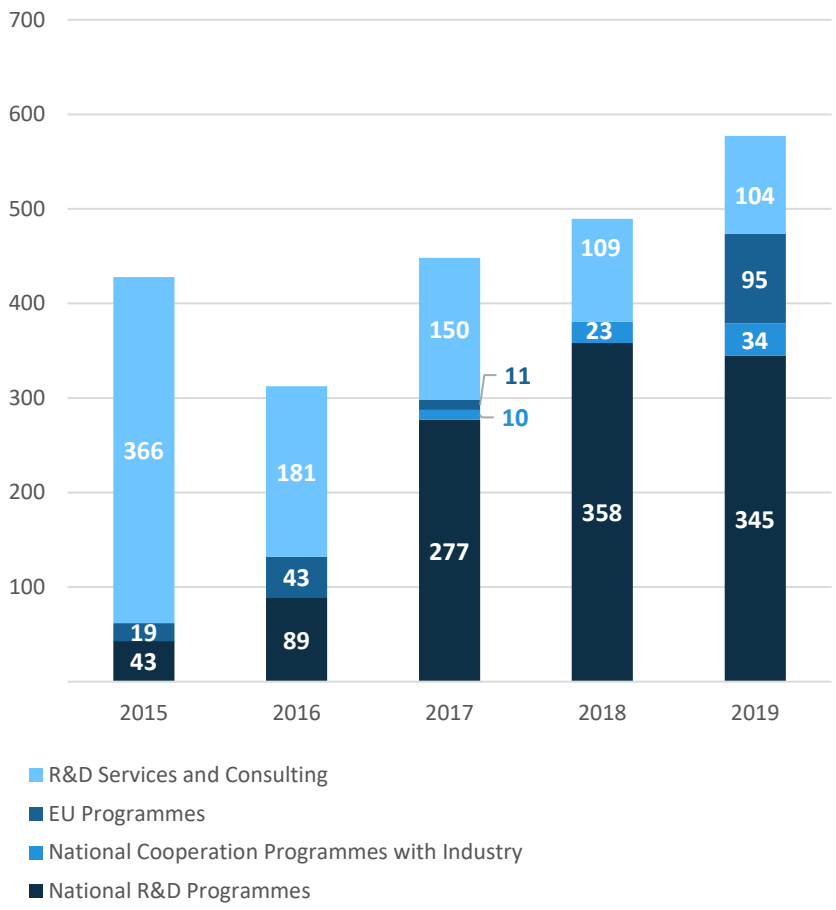

Figure 6.8.3 - CEGI - Project funding evolution (k€)

6.9 CITE – CENTRE FOR INNOVATION, TECHNOLOGY AND ENTREPRENEURSHIP

Coordinator: Alexandra Lobo Xavier

6.9.1 Presentation of the Centre

CITE accomplishes its mission, by carrying out R&D, advanced consulting and executive education bringing together expertise in Innovation & Technology Management and Technology Entrepreneurship fostering a cross-cutting approach to all INESC TEC's Clusters, and for Private and Public organizations.

CITE aims at contributing for a better innovation and technology management with a sustainable and circular perspective of the entire knowledge value chain. CITE R&D activities provide novel methods, frameworks, methodologies, tools and resources to support the design, development, adoption and to maximize the value realized by responsible technological innovations (products & services, new business functions and new business models).

Formed by a multidisciplinary team from humanities, engineering and business management CITE researches and develops new approaches in innovation and technology strategic management at all type of organizations, as well as in all stages of technological maturity development. From early stage, through multi-business unit technology strategy to end-of-life, CITE gives comprehensive support for organizations to put emerging technologies in the center of the strategic innovation decisions, within a systemic and sustainable thinking and mindset in the approach of technology innovation.

CITE operates the LET-in (Laboratory for Technological Entrepreneurship of INESC TEC). LET-In is a service promoted by CITE that offers mentoring, coaching, technological and business consultancy, supporting the development of technology-based entrepreneurial projects related to the institution's core technological areas.

6.9.2 Research Outcomes in 2019

RL1. Innovation Management

CITE reinforced its active participation as a national expert in the ISO TC 279 – Innovation Management, WG 4 – Innovation Management Assessment. In 2019 the ISO/TR 56004:2019 Innovation Management Assessement Guidelines have been published. A senior researcher of CITE kept as one of the principal editors and took part of the board of the Journal of Innovation Management. The Journal is indexed by ProQuest as Scholarly Journal at ABI/Inform, under the Subject Business and Economics (Pub ID: 2046363).

RL2. Technology Management and Policy

CITE presented several communications in international conferences in the topics of Innovation and Technology Management, such as:

- "Co-creating our Future: Scaling-up Innovation Capacities through the Design and Engineering of Immersive, Collaborative, Empathic and Cognitive Systems", at the 25th International Conference on Engineering, Technology and Innovation – ICE/ITMC 2019, Sophia Antipolis, France, 17-19 June 2019;
- Workshop "Preparing for the Future Supply Chain", within the scope of the European project H2020: "Next generation Technologies for networked Europe - NEXT-NET, Project ID: 768884", on July 11, 2019 INESC TEC, Porto.

RL3. Technology Entrepreneurship

CITE organized, hosted and participated in the Committee of CEC – The International Conference on Entrepreneurship Education 2019.

6.9.3 Innovation Outcomes in 2019

INOV1. LET in, the umbrella project for Technology Entrepreneurship

ForestWISE subcontracted INESC TEC to incubate the CoLAB throughout 2019. CITE was part of this team. The results included: (i) the leadership in the development of the R&D&I Agenda; (ii) the definition of the governance policy; (iii) the development of communication tools; (iv) the submission of several proposals, including for the CoLAB human resources funding; (v) and the organization of several meetings and workshops, between ForestWISE associates members, and with ForestWISE stakeholders.

INOV2. Innovation Management dissemination

CITE was present in European Networks as EIP_AHA, by co-coordinating the working group C2: Independent living solutions and participating in working group D4: Age-friendly environments, working on collaborative projects (with submissions to Active and Assisted Living Programme-AAL, as an example) for technology adoption and new business models for the silver economy. CITE also participated in the Thematic Network on Smart Healthy Age-Friendly Environments' activities and its mirror-national thematic network "Rede Portuguesa Ambientes Saudáveis, Inteligentes e Amigáveis" in new business model creation.

INOV3. Consulting and Innovation Labs

CITE was envolved during 2019 in 3 main consultancy projects: Monitoring CIR 2019 (Monitoring the Portuguese rural fire campaign 2019); NMP-REG (Regional agenda for the promotion of the NMP in the North of Portugal); Final report of project in Dec 2019; and Implementation of an Innovation Management System in Bondalti Company.

INOV4. EEN Portugal, EEN Innovation Journey and Diva Project

In 2019, INESC TEC was placed as a national provider of a range of services, on behalf of the EASME, to support innovative SMEs, including start-ups, going abroad through tailored innovation advisory, partnering and coaching services. INESC TEC was a host organization of the Network in 3 co-funded projects during 2019: EEN-Portugal, EEN-INNOVATE PLUS PT, and TouriSMEshare. In 2019, INESC TEC directly supported, through specialized services, 69 Portuguese companies (as an illustrative example 4 of these SMEs gained EU funding and support for breakthrough innovation projects – the SME instrument phase 1 and 2– DIDIMO, ECOFOOT, PRIBERAM and ADDVOLT). This active role in the Network, leveraged INESC TEC's reputation as an interface organization, working closely with companies, including start-ups and scale up companies, and on former successful enterprise-based network/enterprise-oriented projects. The "TouriSMEshare" is dedicated to supporting organizations that explore business models based on the Economy of Sharing. In 2019, INESC TEC provided advisory service and training programme to improve the capacity building of 15 Portuguese organisations. In 2019, the team was invited by Airbnb to present the topic "How to Become an Entrepreneur in the Tourism Sector" in the Porto Anniversary Summit 2019 event; and also to present a methodology developed by CITE researchers: "Sharing Economy Business Model Innovation Canvas for Tourism" at the Enterprise Europe Network Annual Conference, in Helsinki.

The "DIVA" Project launched, in 2019, the first edition of the programme. There were 147 applications received, 66 of them were awarded vouchers worth a total of EUR 1.320 million (21 Portuguese SMEs). In cooperation with CESE and CRIIS, CITE organised and developed two European events and offered several online webinars to foster the development of innovative technical solutions applied to the agricultural and forestry sector.

General Comments:

The Centre had a major change in the team. One of the most senior members of the team left the Centre and all of her responsibilities were atributed to new members, having forced a significant effort in internal training, monitoring and coordination. At the same time, the Centre incorporated a new senior researcher, who strengthened CITE link to other Centres and also reinforced the transversal characteristics of CITE regarding the innovation and technology management.

6.9.4 Activity Overview

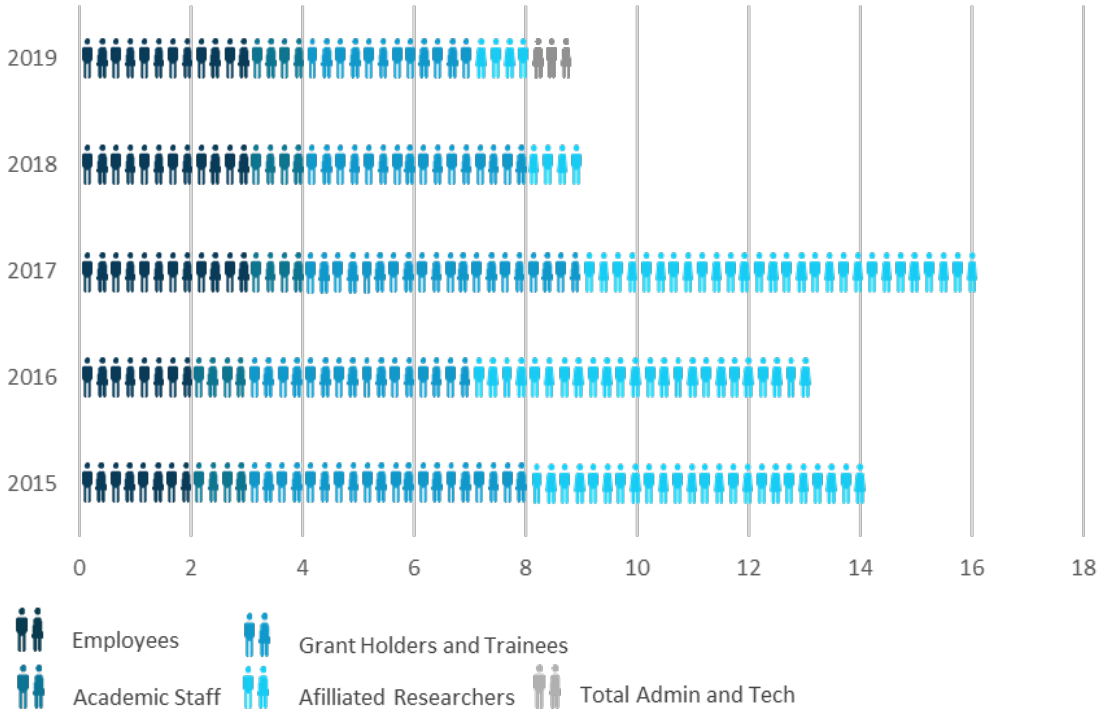

Figure 6.9.1 - CITE - Research team evolution

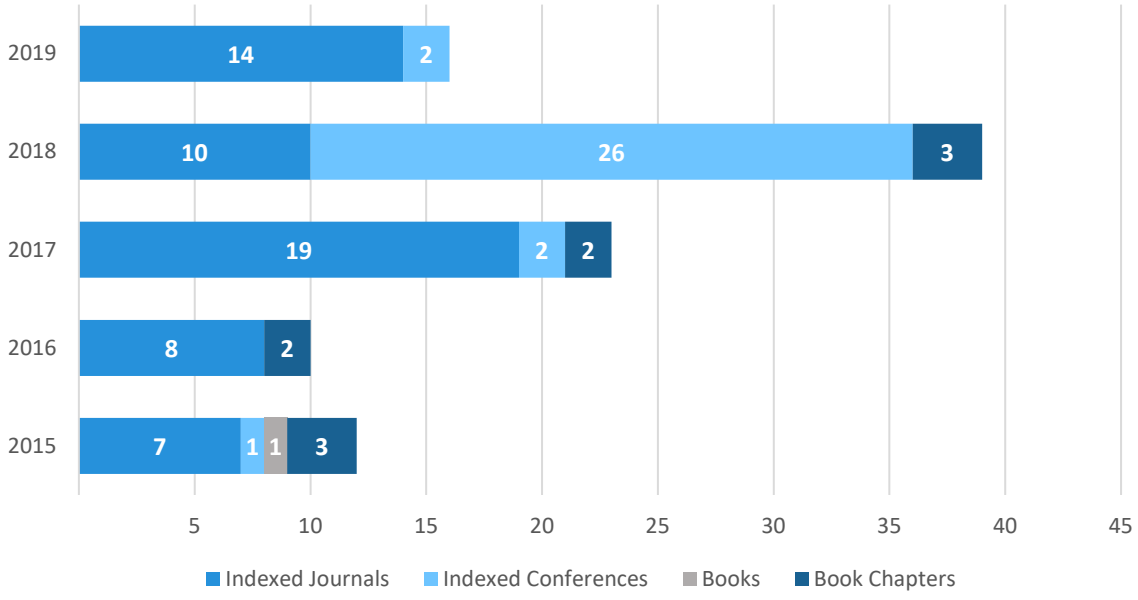

Figure 6.9.2 - CITE - Evolution of publications by members of the Centre

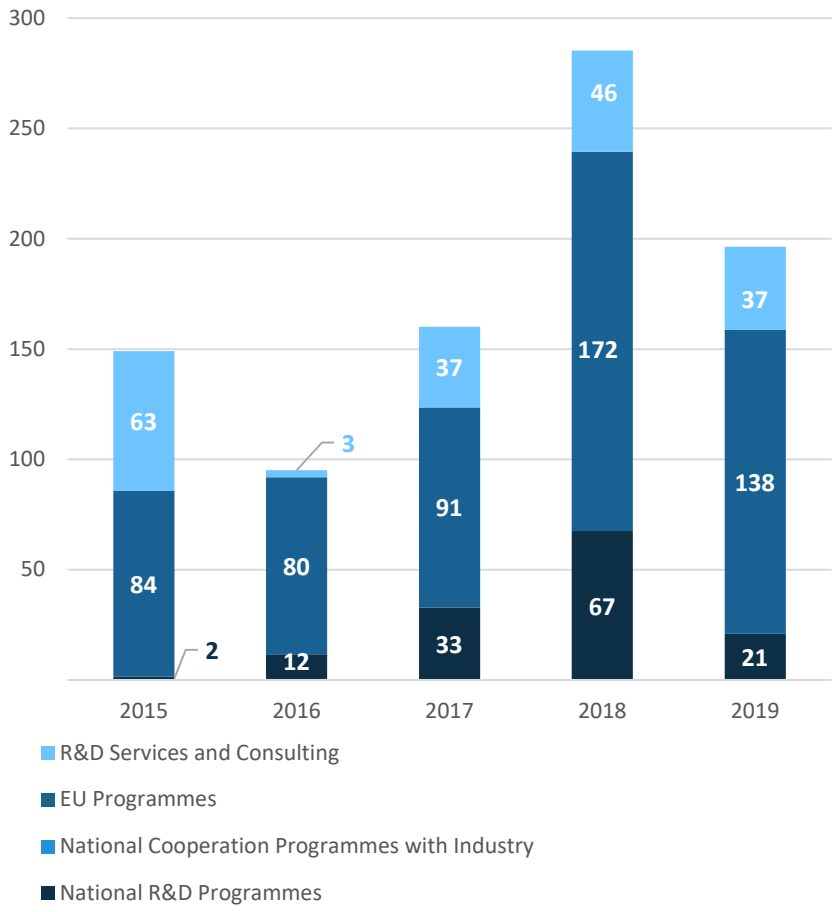

Figure 6.9.3 - CITE - Project funding evolution (k€)

6.10 CSIG – CENTRE FOR INFORMATION SYSTEMS AND COMPUTER GRAPHICS

Coordinators: António Gaspar and Ângelo Martins

6.10.1 Presentation of the Centre

The CSIG Centre is integrated in the Computer Science Cluster. Its mission is to pursue high quality research strongly linked to industrial partnerships, consultancy and technology transfer, in five main areas: Computer Graphics and Virtual Environments, Information Management and Information Systems, Software Engineering, Accessibility and Assistive Technologies and Embedded/Special Purpose Computing Systems. The Centre is particularly well positioned to address complex and difficult engineering problems faced by industry, organized in four transversal application areas: Platforms and Methods for Earth and Ocean Observation Science, Platforms and Methods for Personalized Health Research, Public Administration Business Area, and Mobility and Transport Business Area. The Centre is also committed to the training of young researchers and professionals, regularly graduating more than 10 hosted PhD students per year. CSIG researchers originate from University of Porto, Polytechnic of Porto, University of Trás-os-Montes e Alto Douro, Universidade Aberta and University of Minho.

6.10.2 Research Outcomes in 2019

Software Engineering

The area improved testing mobile apps and mutation testing. A new crawler able to exercise mobile apps was proposed and the research work was awarded in QUATIC-2019 conference with a best paper award. We developed new operators for mutation testing of mobile specific characteristics, and developed also distributed scenario-based testing approach for IoT ecosystems. In the field of Agile, it was released the “A Scrum Book”, co-authored with the creator of Scrum, and advanced work on Live Software Development, with first publications and environments using VR/AR, and keynotes in conferences.

Special Purpose Computing Systems/Embedded Systems

The research outcomes of the Special-Purpose Computing Systems (SPeCS) group include energy efficient embedded computing in the context of prototyping human-activity recognition (HAR) systems in mobile devices; automatic generation of application-specific architectures from software code and targeting FPGA-based accelerators; compiler optimizations and code transformations for performance improvement (including energy consumption); and runtime adaptivity techniques. The research on automatic generation of FPGA-based hardware accelerators resulted in publications on ACM Computing Surveys and on IEEE Transactions on Very Large Scale Integration (VLSI) Systems.

Accessibility and Assistive Technologies

The validation of the supervised exercise prescription ecosystem for peripheral arterial disease patients was carried out under the NanoStima RL2. The study of the influence of co-creation and collaborative participation in crowd computing environments for semantic annotation by expert users was one of the main results of eCSAAP and will be published in 2020.

Platforms and Methods for Personalized Health Research (PM4PHR)

This area had 3 large active H2020 projects. The RECAP Preterm released a network of federated nodes, constituting a privacy-preserving health research environment, abiding by the FAIR principles, including 20 European cohorts with duly curated data of children and adults born preterm. The novel harmonization methods, as well as the non-disclosive distributed analysis, is under testing on 3 on-going multi-center research studies. INESC TEC organized a training workshop for all partners’ data managers. EUCAN-Connect created and made available to other on-going H2020 projects a new distribution of this research environment (CORAL), along with training materials. iReceptor Plus presented a proof of concept of a layered security framework for a federated research environment for immunogenetics.

Platforms and Methods for Earth and Ocean Observation Science (PM4EOOS)

Under H2020 MELOA, it was prototyped and tested a software ecosystem for the real time processing of geospatial data streams, and tools and methods for the assisted curation and exploratory analysis of large scientific datasets. In the MarRISK project, a platform incorporating the semantic interoperability of data from IoT platforms was extended and the extraction of climate change indicators prototyped. The activity in the National Research Infrastructure C4G and in the respective European Research Infrastructure EPO led to a new H2020 project (EPOS Sustainability Phase) starting in February 2020.

Information Management and Information Systems

The group developed the linked data model, the design and evaluation of infrastructure solutions, and the initial exploration of user interface designs. The outcomes also include the creation of the Research Data Alliance Portugal (RDA-pt), participant of RDA Europe 4.0.

6.10.3 Innovation Outcomes in 2019

Computer Graphics and Virtual Environments

The CG&VE area has achieved innovative outcomes in the use of gamification and games-based learning, at H2020 projects Feedback and BEACONING awarded with the Gamification award of 2019. INESC TEC has been also been leading research at the ILRN network and has concluded a relevant project in immersive medical training. Industry 4.0 is also a lead research line in immersive environments.

Special Purpose Computing Systems/Embedded Systems

Members of SPeCS continued the research on the new approach to generate more efficient FPGA-based hardware using high-level synthesis tools as backend. The approach has been published in an international symposium (ARC'2019) and a patent application was filled (PCT/EP2019/071491). Regarding the exploration of compiler optimizations, SPeCS proposed a framework to support design-space exploration of compiler flags and phase selection and ordering (published in a SoftwareX paper).

Public Administration

The research focus was on the application of the Open Geospatial Consortium standards (OGC), particularly the Sensor Web Enablement (SWE) standard, for viticulture. We investigated the use of information services based on Earth observation by satellite and data in situ, offered by the EU's Earth observation program (COPERNICUS). INESC TEC joined two Research Infrastructures: the iRSlab (Remote Sensing Laboratory), and the Laboratory of Robotics and IoT for smart precision agriculture and forest. At the national event "Workshop on Innovation in Agriculture", it was presented the innovative concept of Smart Trap developed at INESC TEC, for remote monitoring of the presence of pests in the vineyards.

Platforms and Methods for Personalized Health Research (PM4PHR)

DIFFER – Digital Framework for E-health Research, an adaptive health research support platform for healthcare interventions, resulting from previous European Health Research projects, was formally constituted as a consortium between INESC TEC and the Vrije Universiteit Amsterdam, and others. The platform is currently used to support RCT in research projects in the mental health domain such as the FCT project iCare4Depression, H2020 project ImpleMentAll and Interreg project eMEN.

Accessibility and Assistive Technologies

Sports teams' big data visualization and analysis – Swish, developed in cooperation with CIDESD/UTAD and in a process of technology transfer.

6.10.4 Activity Overview

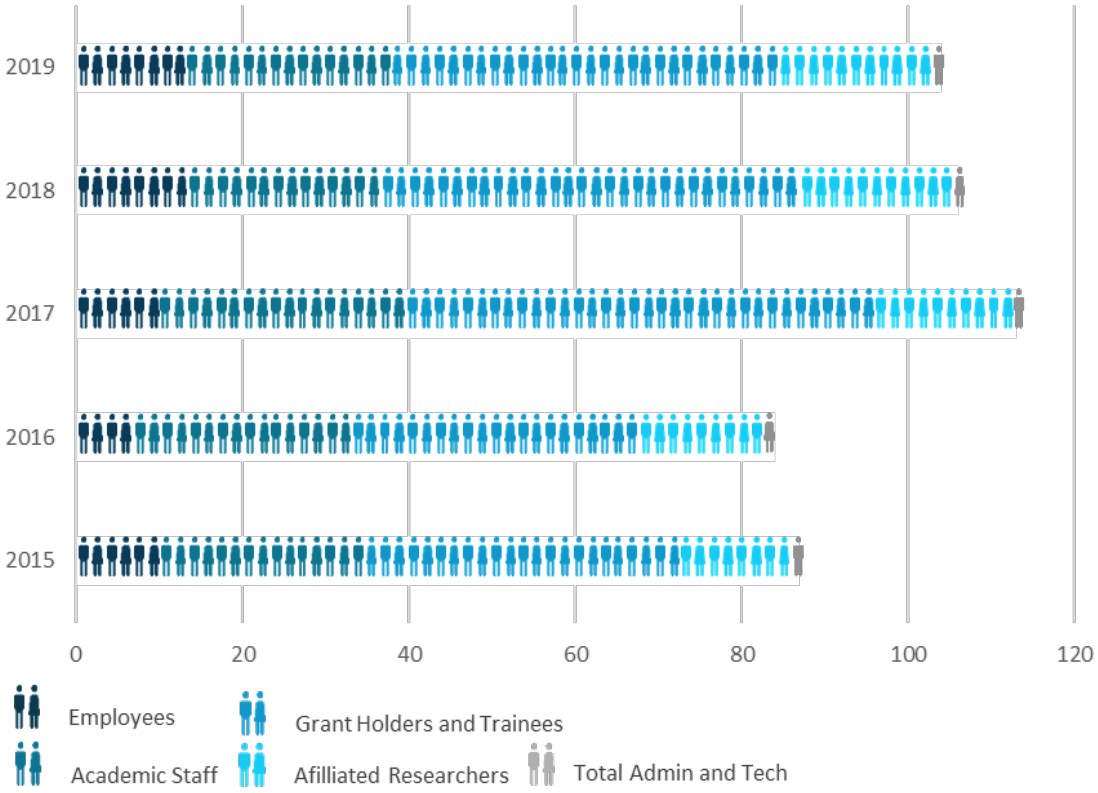

Figure 6.10.1 - CSIG - Research team evolution

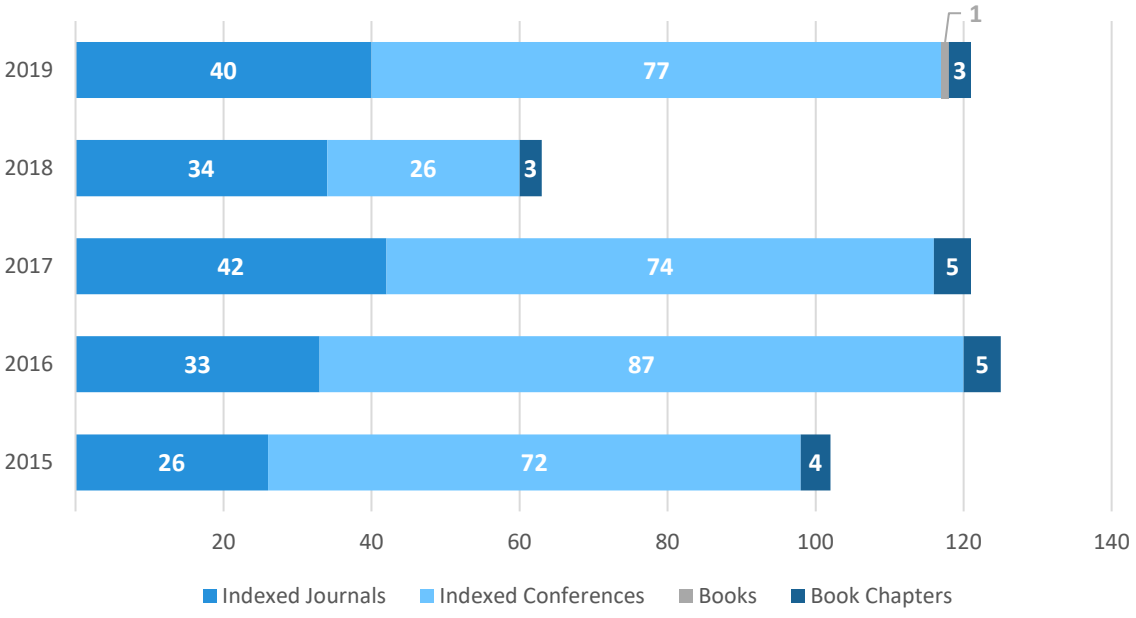

Figure 6.10.2 - CSIG - Evolution of publications by members of the Centre

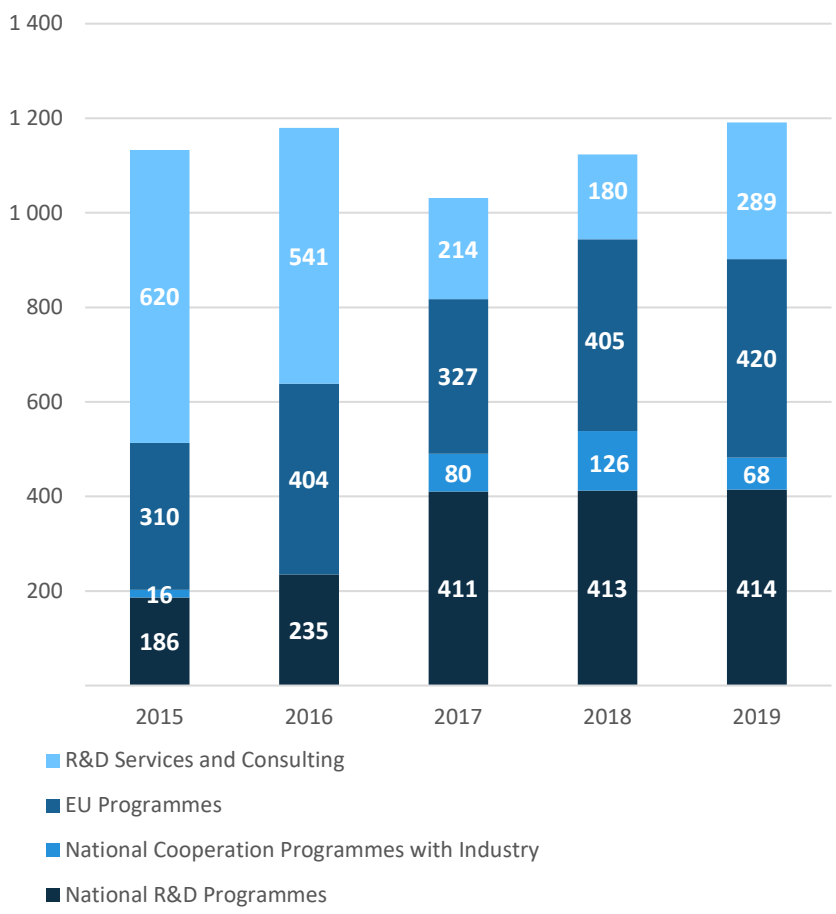

Figure 6.10.3 - CSIG - Project funding evolution (k€)

6.11 LIAAD – ARTIFICIAL INTELLIGENCE AND DECISION SUPPORT LABORATORY

Coordinator: Alípio Jorge

6.11.1 Presentation of the Centre

LIAAD accomplishes its mission within the Computer Science Cluster focusing on Intelligent and Adaptive Systems and Mathematical Modeling in Decision Support.

LIAAD aims to produce high quality cutting-edge research in the international forefront of our research areas and promoting transfer of knowledge and technology. This Centre has been working in the area of Machine Learning and Data Science since 1991. The huge amounts of collected data (Big Data) and the ubiquity of devices with sensors and/or processing power offer opportunities and challenges to scientists and engineers. On the other hand, the demand for complex models for objective decision support is spreading in business, health, science and e-government, motivating our investment in different approaches to modeling. Currently, the growing awareness of the impact of Artificial Intelligence (and in particular of Machine Learning) in our lives demands a finer attention to bringing the human to the AI loop. Our overall strategy is to take advantage of the data flood and data diversification and invest in research lines that will help shorten the gap between collected data and useful data, offering diverse modeling solutions, as well as bringing more transparency and meaning to Artificial Intelligence.

The scientific foundations of LIAAD are machine learning, statistics, optimisation and mathematics. By the end of 2019, LIAAD had a total of 125 members, with 52 core researchers (29 Core PhD) and 27 grant holders and trainees. 22 of the researchers were Academic staff mostly from the University of Porto.

6.11.2 Research Outcomes in 2019

The most active area of research is Machine Learning (ML), which includes the lines of **Large Scale ML**, **Auto ML** and **User Modeling and Natural Language Processing**. These lines accounted for 27 of the 59 journal papers published. Other strong areas are **Modeling and Optimization** (16 papers) and **Mathematical Modeling** (11 papers).

LIAAD participated in the H2020 flagship **Project Humane AI**, which has prepared a proposal for European **Network of Excellence on Artificial Intelligence**, meanwhile accepted early 2020.

The FCT project "Text2Story: Narrative Extraction from Text" was started, bringing together a team of researchers on **Natural Language Processing**. We had one important **publication at the ACL conference**, the number one forum for NLP. We published a **special issue** on Narrative Extraction from Text at the Q1 journal "Information Processing and Management". At ECIR 2019, the top European Information Retrieval Conference, we had the Best Demo Paper Award. Ricardo Campos was keynote speaker at SoMePeAs@ECIR2019. In **User Modeling**, we lead the organization of the ORSUM workshop at RecSys (Online Recommender Systems and User Modeling).

In **Large Scale ML**, researchers from LIAAD were distinguished with **invited talks** (João Gama at IEEE RIVF and Big Data Coruña) and **excellence recognition** award (João Moreira by FEUP). Alípio Jorge was the head figure in the preparation of the **Portuguese AI strategy**.

The line of **Mathematical modeling** kept the good level of activity. Alberto Pinto co-edited a **special issue** of the journal Mathematical Biosciences and Engineering.

In **Complex Data Analysis**, Paula Brito was **invited speaker** at the "Why R?" Conference in Poland. The **European project** Fin-Tech took Data Analysis and Machine Learning to the financial regulators (CMVM in Portugal).

Scientific objectives for 2019 that were largely achieved:

- Top-notch publications, increasing our worldwide impact;
- Organization of international events;
- Active in the organization of scientific societies;

- To promote interaction with the scientific community through the dissemination of demos, software packages, datasets and other resources;
- Attract high level BSc and MSc candidates in local programmes;

The following objective was achieved in the areas of industry4.0, health and ocean exploration:

- To develop frontier research initiatives within the cluster and with other clusters.

The following objectives were partly achieved:

- To attract high level PhD and post-doc fellows;
- To attract international visitors, short to long term, for research internships in our group.

6.11.3 Innovation Outcomes in 2019

LIAAD had a first knowledge transfer project in the Financial area with the **Natixis** bank on risk sensis causality analysis - finding the causes of outliers in the vega sensis. The project ML-ABA with **WeDo** Technologies was completed and a **software for fraud detection** using stream learning was deployed. The project Pelikan with company **SeedStars** applied ML to credit scoring. The insurance software company **RandTech** developed with LIAAD and CSIG a pipeline for automatic generation of software testing from GUI interaction logs. These projects show a growing presence in the area of **finance**.

Project PROMESSA with **Strongstep** and Fraunhofer AICOS (started 2019, finishes in 2022) focusses on intelligent tasks for project management software on prediction of projects duration, risk analysis and optimal human resources allocation to the tasks of the project.

With respect to collaborations with the **public sector**, we won the FCT project FailStopper with Metro do Porto in the area of predictive maintenance, and two contracts started in 2019 (Mine4Health and Terralva) and the basis for more collaborations have been launched.

In the line of **User Modeling**, Nuno Moniz and Arian Pasquali won the 10000 Euros **Arquivo.pt award** (http://www.meuparlamento.pt). This was the second consecutive Arquivo award for LIAAD. They have been selected as one of the 5 finalists in their category for the **World Summit Awards for digital innovation**.

LIAAD made available the API, package, mobile app and demo for **Yake!** the automatic keyword extraction algorithm.

- http://yake.inesctec.pt/demo/user;

Yake! was the basis for the **Conta-me Histórias** API, also released.

- https://github.com/LIAAD/TemporalSummarizationFramework;

The following objectives have been largely achieved:

- To increase the volume of projects with companies;
- To increase the number of collaborations with the public sector.

The following objective has been worked in two different fronts (ML and NLP) but the platform is not yet operational:

- To establish a platform for efficient deployment of Data Science and AI services for companies and organizations.

6.11.4 Activity Overview

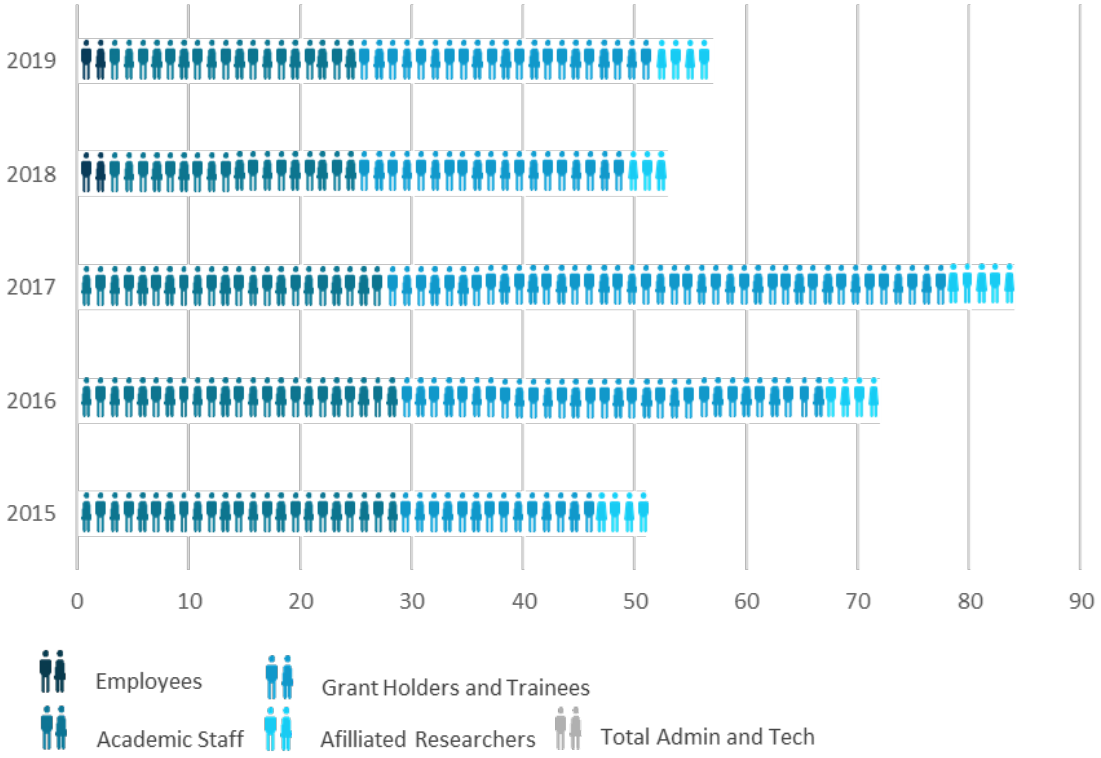

Figure 6.11.1 – LIAAD - Research team evolution

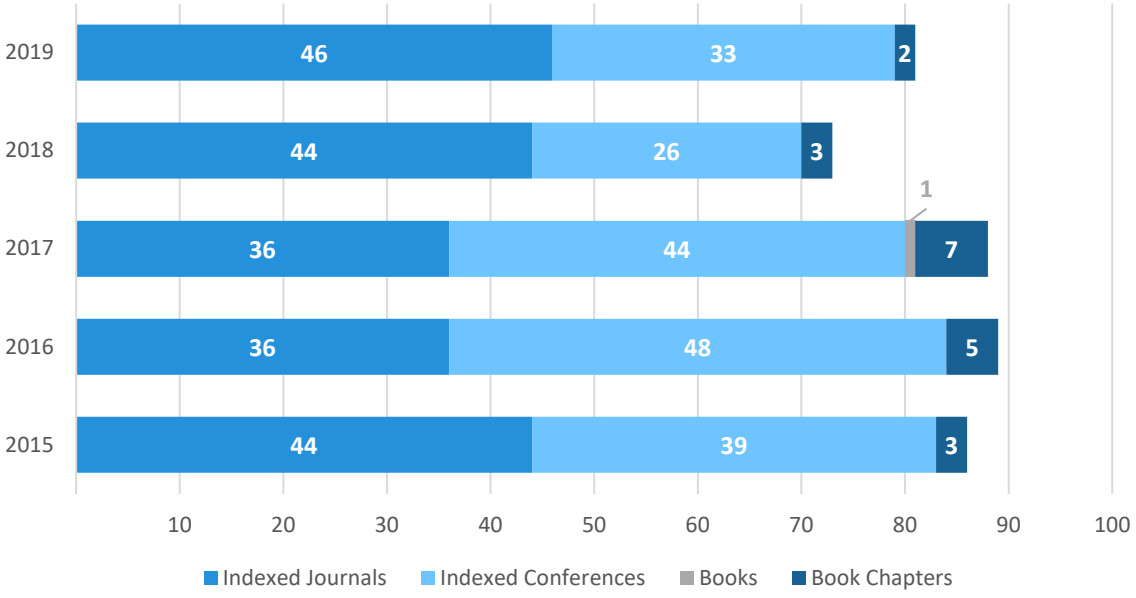

Figure 6.11.2 - LIAAD - Evolution of publications by members of the Centre

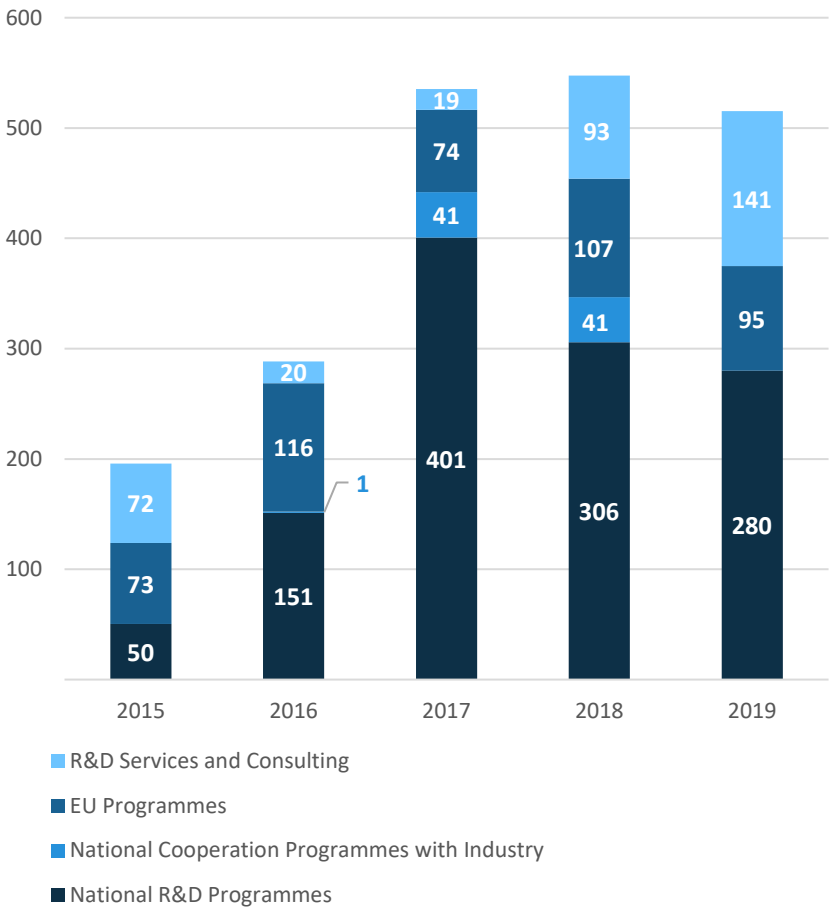

Figure 6.11.3 - LIAAD - Project funding evolution (k€)

6.12 CRACS – CENTRE FOR RESEARCH IN ADVANCED COMPUTING SYSTEMS

Coordinators: Luís Antunes and Ricardo Rocha

6.12.1 Presentation of the Centre

CRACS integrates the Computer Science Cluster with the mission of pursuing scientific excellence in the areas of programming languages, parallel and distributed computing, information mining, security and privacy, with a focus on scalable software systems for challenging multidisciplinary applications in Engineering, Life Sciences, Social Networks and the Internet of Things. The core research team is composed mainly of faculty members at the CS department at FCUP. The research environment is enriched with talented junior researchers that together with senior researchers build the necessary critical mass and scientific competences to fulfill our mission.

CRACS has a world leading role on the design and implementation of logic systems supporting large-scale parallelism, probabilities, negation and tabling towards Data Science and Big Data applications. Considerable progress was made in these areas, with work on large datasets for author identification, semantic relatedness, sentiment discovery, motifs discovery and medical diagnosis, by developing methods, systems and applications that better understand the process of transforming raw data into useful knowledge as a competitive advantage. Significant research is also carried out on mobile edge computing and sensor networks towards IoT, where we contribute in the development of DSLs, VMs and middleware to harness the combined resources of large networks of mobile devices and sensors, focusing on new policies and mechanisms at application and services level that ensure an adequate level of privacy protection and user empowerment.

6.12.2 Research Outcomes in 2019

A key goal for 2019 was to consolidate CRACS's international visibility, notoriety and publication output. In fact, there was a significant decrease in the number of indexed publications, from 52 in 2018 to 38 in 2019, mainly due to a proportional reduction in the number of core researchers, from 52 in 2018 to 37 in 2019. Despite this fact, there was an increase in the number of international events in which CRACS members participated in program committees, from 27 in 2018 to 32 in 2019. CRACS members were also strongly involved in the organization of the International Collegiate Programming Contest finals, held in Porto with around 1500 participants. Another key goal was to continue developing CRACS' research lines proposed as strategic, particularly for the Computer Science Cluster, namely mobile edge computing, big data, security and privacy. CRACS' main research achievements in 2019 were:

- Lock-freedom: (i) first known design of a generic scheme for an efficient lock-free best-fit coalescing-capable mechanism for memory management that supports lock-free splitting and coalescing of blocks with arbitrary sizes and is able of satisfying memory allocation requests with desirable low fragmentation characteristics; (ii) new memory reclamation method for lock-free hash map data structures based on the concept of hazard pairs defining small and well-defined regions of memory to be protected from reclamation, while providing lower synchronization overheads with low and well-defined memory bounds;

- Logtalk: improved debugging support including a new debugging tool, improved static binding optimizations, new and expanded test suites, improved testing tool including updated QuickCheck support, significantly improved linter, improved goal-expansion mechanism, port of the Metagol ILP system, improved documenting and diagrams tools, reorganized library and new and improved libraries, support for declaring object aliases, expanded support for parameter variables in directives, Windows installer build per commit, improved support for compiling Prolog modules as objects, improved embedding support, improved make support, and portability fixes and improvements. Logtalk has around 500 downloads per month;

- SafeCities: (i) development of a hybrid system for indoor positioning that uses the capabilities of mobile devices, namely WiFi and Bluetooth receivers/transmitters coupled to an infrastructure of Bluetooth beacons to pinpoint the position of users. The system also grabs video frames with the device's builtin camera(s) and uses a TFLite model, generated offline with convolutional neural networks, to recognize the location based on photograms; (ii) development of a crowd-sourcing applications that takes advantage of convolutional neural networks to allow users to photograph animals, plants and fungi and

get immediate feedback on their genus or species. The applications aim at gathering large datasets observations of different taxa to monitor biodiversity, preservation and restauration projects; (iii) development of a modular and extensible platform for mobile devices, cloudlets, and clouds that can manage computational tasks spawned by devices and make informed decisions about offloading to neighboring devices, cloudlets, or traditional clouds;

- Graph mining: (i) a novel and accurate method for alignining temporal networks; (ii) a new centrality metric for ranking nodes based on dominance; (iii) improvements on a state-of-the-art methodology for forecasting tensors; (iv) improvements on a state-of-the-art method for counting subgraphs;
- Fake news: (i) recognition of sets of emotions as a "signature" for the identification of fake news; (ii) creation of reputation metrics to help measure the impact of the dissemination of false information;
- Quantitative type systems: definition of new type systems based on non-idempotent intersection types that allows for the extraction of upper-bounds and exact measures for pattern-based languages and languages with bounded-iteration;
- Event processing: following the definition of a general typed term-based language for events, we developed a higher-order typed language that can be used to deal with obligations in the context of access control models but also as a general mechanism to deal with event classification and event processing agents in the area of complex event processing;
- Computational complexity: prove of new results regarding the computational complexity of compositions f o g, showing that the communication complexity of computing f o g, is at least the decision-tree complexity of computing f, times the communication complexity of g.

6.12.3 Innovation Outcomes in 2019

For the second consecutive year, CRACS shows IP protection, exploitation and technology transfer outputs, namely 2 patent applications (compared to 1 in 2018 and none in 2016 and 2017) and 1 invention disclosure (compared to 1 in 2018 and none in 2016 and 2017). Other important innovation outcomes were:

- SafeCities with BOSCH: proof of concept prototype and scenario using the Hyrax middleware for RAMBLE, an application that allows geo-referenced content sharing in environments that have limited infrastructural communications;
- Câmara Municipal de Gaia (Parque Biológico de Gaia): a citizen science platform for monitoring the spread and control of the invasive species Cortaderia selloana;
- Câmara Municipal de Gaia (Parque Biológico de Gaia): a citizen science platform for monitoring the biodiversity and the health of ecosystems in the Vila Nova de Gaia region;
- Museu de História Natural e da Ciência da Universidade do Porto (Galeria da Biodiversidade): an indoor positioning system and a museum app that allows for an improved visiting experience (contents dynamically adjusted to age, learned and expressed interests, augmented reality, gamification) and the gathering analytics;
- Automated assessment (Erasmus+ project): an interoperability specification for gamified exercises and authoring system for that specification. The target group are programming instructors and students learning programming (also self-teaching).

6.12.4 Activity Overview

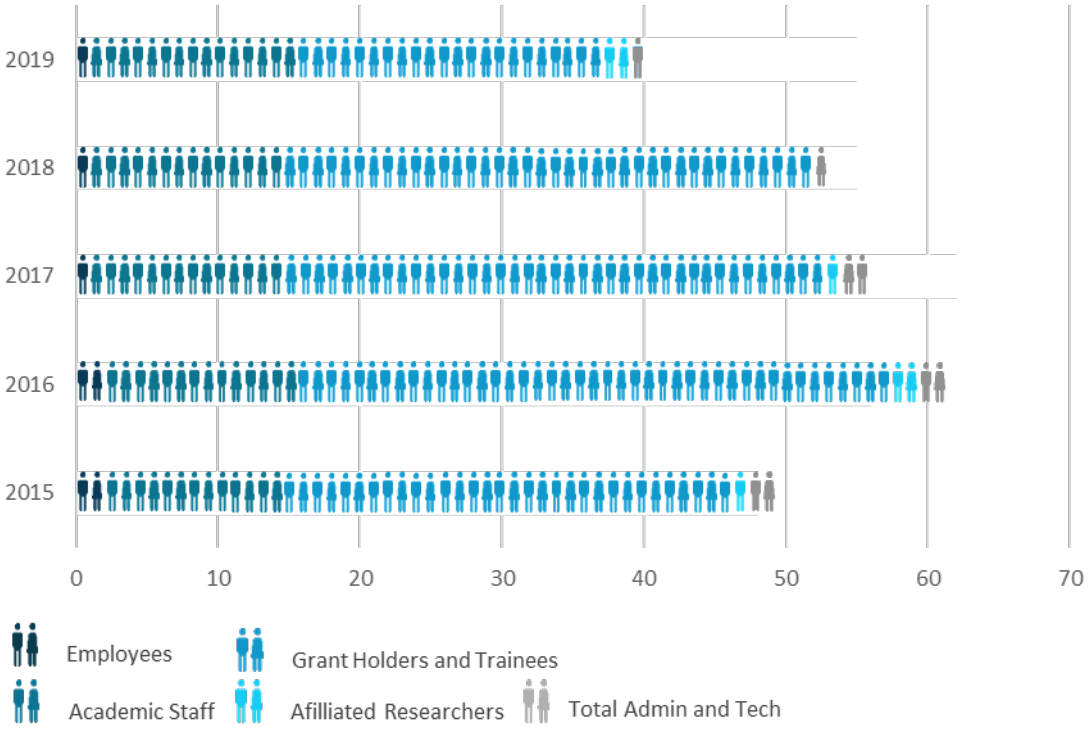

Figure 6.12.1 - CRACS - Research team evolution

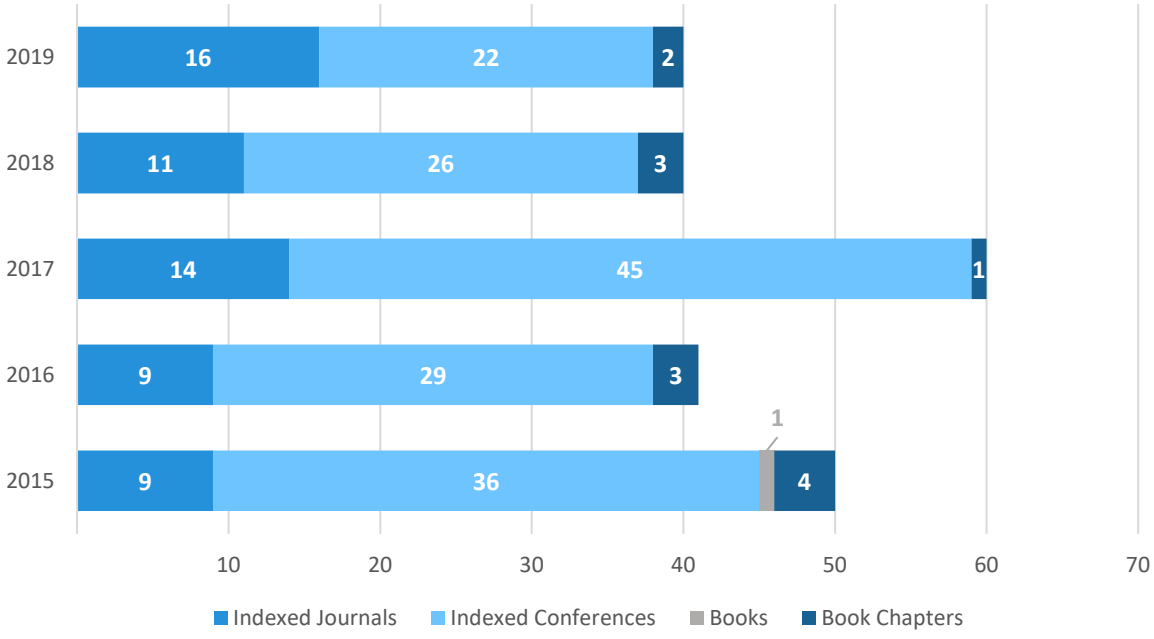

Figure 6.12.2 – CRACS - Evolution of publications by members of the Centre

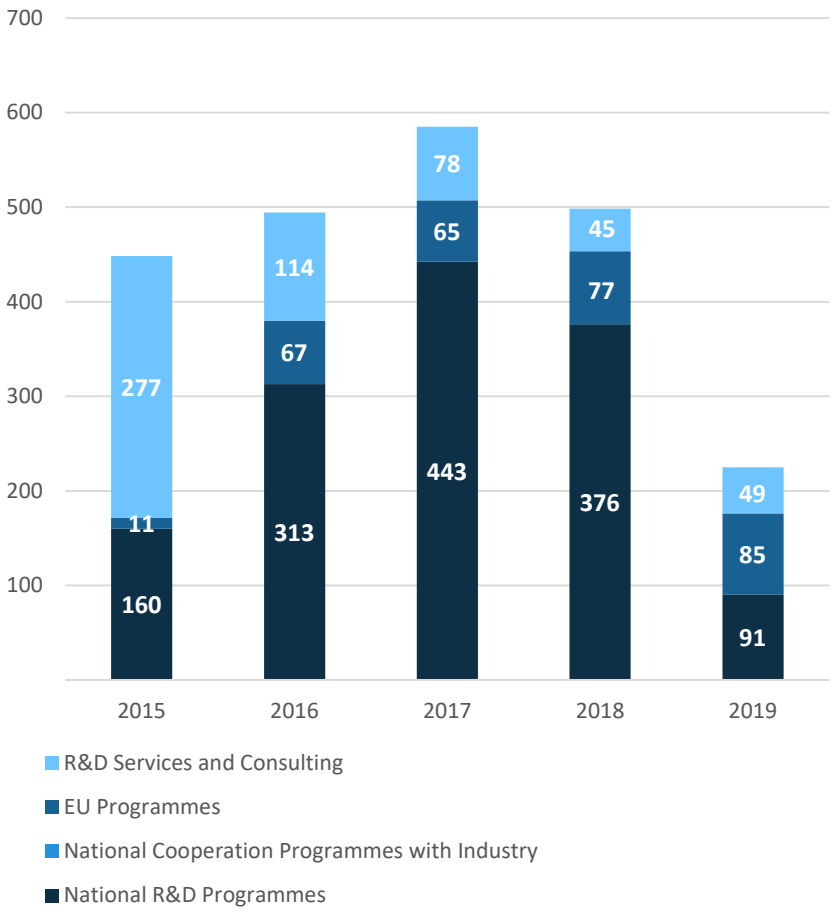

Figure 6.12.3 - CRACS - Project funding evolution (k€)

6.13 HASLAB – HIGH-ASSURANCE SOFTWARE LABORATORY

Coordinators: Alcino Cunha and António Luís Sousa

6.13.1 Presentation of the Centre

HASLab is focused on the design and implementation of high-assurance software systems: software that is correct by design and resilient to environment faults and malicious attacks. HASLab accomplishes its mission within the Computer Science Cluster, anchoring its research on a rigorous approach to three areas of Computer Science: Software Engineering, Distributed Systems, and Cryptography and Information Security.

The contributions of HASLab to these areas range from fundamental research on formal methods and algorithms, to applied research on developing tools and middleware that address real-world demands stemming from long-term collaborations with industry.

6.13.2 Research Outcomes in 2019

One of the main goals for 2019 was to increase the international visibility of the Centre. Among the actions planned towards this goal was the organization of one major international conference. This action was successfully accomplished - HASLab organized the 3rd World Congress on Formal Methods in Porto on October 7th-11th. This event, chaired by José Nuno Oliveira from HASLab, included 9 conferences, 16 workshops, more than 30 volunteers in the organization, and was attended by more than 600 researchers. It was a resounding success and a major highlight of HASLab's activity in 2019.

HASLab continued to produce fundamental and applied research that met the quality requirements of top-rated international journals and conferences. In particular, the Centre published 3 papers at CORE A* conferences, and 3 papers at Q1 journals. Among these, we highlight a paper published in the 2019 ACM SIGSAC Conference on Computer and Communications Security, entitled "A Machine-Checked Proof of Security for AWS Key Management Service", that presents a machine-checked proof of security for the domain management protocol of Amazon Web Services's Key Management Service, a critical security service used throughout AWS and by AWS customers. This paper resulted from a consultancy project with Amazon, where several researchers from HASLab were involved. Another publication highlight was the paper "Efficient Synchronization of State-based CRDTs", published at the IEEE International Conference on Data Engineering, that describes another outcome of the internationally recognised research conducted by the Centre on the topic of Conflict-free Replicated Data Types.

Concerning prizes, the paper "Automatically Inferring ClassSheet Models from Spreadsheets", co-written by João Saraiva from HASLab, received the Most Influential Paper award at the VL/HCC 2019 international conference. This award distinguishes the most influential paper published in the conference edition that occurred 10 years earlier and is usually the top prize awarded nowadays by a conference.

The EU project CloudDBAppliance developed a European Cloud Database Appliance composed of software and hardware, in order to provide storage capacity for large volumes of data and hybrid and/or analytical cloud processing (as a service). This platform contributes to high availability and predictable performance, permitting the same measurable quality of service, even in the presence of specific failures. HASLab was responsible for the development of the mechanisms for high availability i.e. the process that ensures the use of data regardless of the occurrence of service failures - caused by server or network problems, or even natural disasters that result in a loss of connection between data centres. The project started in 2016 under the H2020 programme and had 12 partners from 8 different countries.

The EU project LightKone, that started in 2017 and had 10 partners from 6 different countries, developed new programming models and algorithms that were later tested in industrial environments and evaluated in large-scale systems. Research was focused on finding solid principled approaches to support distributed and collaborative computing at the edge of the networks, providing both offline-first and low latency capabilities. Some of the applications included new database models (AntidoteDB https://www.antidotedb.eu) and direct data synchronisation among standard web browsers (Legion https://legion.di.fct.unl.pt).

6.13.3 Innovation Outcomes in 2019

In terms of consultancy projects, in 2019 the Centre continued its efforts to establish new services and consultancy projects with key national and international companies. This effort resulted in four new consultancy projects, including an international one with Oracle. This project is another contribution towards the ongoing goal of establishing stable long-term technology transfer collaborations with international giants in ICT.

In terms of innovation, another goal for 2019 was to identify some tools being developed at the Centre with potential for widespread adoption and promote their development from prototype-level to production-level open-source tools, with the goal of attracting a significant user-base and high-profile real-world applications. In this respect, it is worthy to mention HAROS (https://github.com/git-afsantos/haros), a framework for static analysis of robotic software developed with the Robot Operating System, a tool that is now reaching a mature level, including a reasonable user base, including some key international players in the area, such as Fraunhofer IPA.

Regarding EU projects, in CloudDBAppliance it was the expert's opinion after the final review that the project exceeded the objectives and produced an unusual amount of Innovation/IP as tangible results, ranging from subsystems, integrated appliances, and business solutions. The experts also highlighted that these products and solutions already integrate academic research. In InteGrid, the “Grid and Market Hub”, a TRL 7 prototype builds a neutral data sharing hub for the electrical grid ecosystem, allowing several stakeholders to share and consume data under a set of common interfaces for grid management and advanced consumer services. According to the project's Advisory Board experts the innovation impact is high and follows the EU’s DG ENER objectives, on the creation of a common ICT interface for the Distribution System Operator (DSO), but also, bringing the GDPR as a key design concern, ultimately empowering consumers to decide where their data is used. The prototype is deployed at a public cloud infraestructure and supports two medium size pilots in Slovenia and Portugal.

The consultancy project with the company Nau21 focused on the use of Distributed Ledger Technologies (DLT) (e.g., blockchain) as part of their software stack for the insurance industry. The study highlighted the capabilities for storing arbitrary large objects within the DTL and provided a prototype for routing the storage of such objects “on-chain” or “off-chain” according to the semantic reasoning established on the DLT’s smart agents. Together, these outcomes are in-line with the needs for data processing over DLTs for several industries as reported by the European Commission’s “Blockchain for industrial transformation” bulletin.

6.13.4 Activity Overview

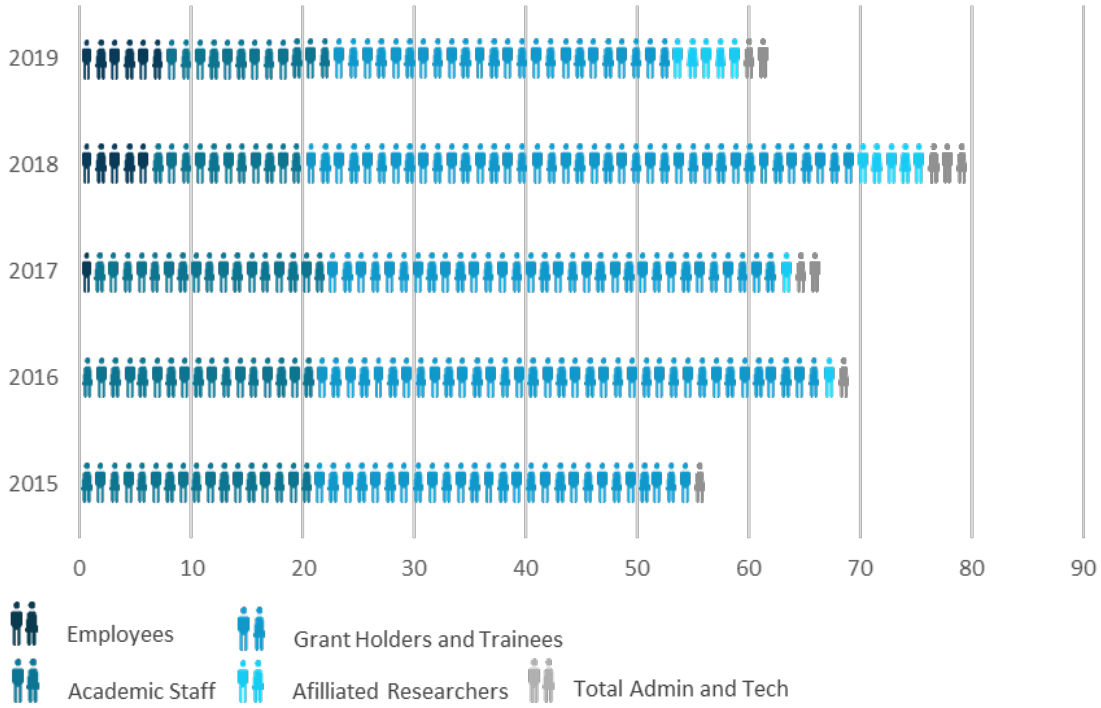

Figure 6.13.1 - HASLab - Research team evolution

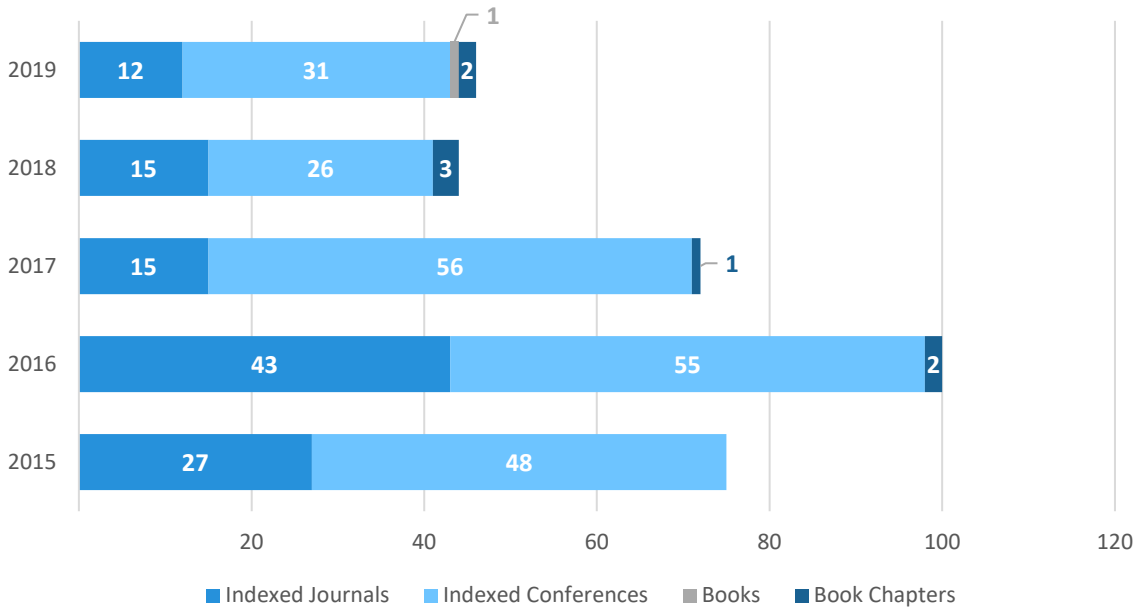

Figure 6.13.2 - HASLab - Evolution of publications by members of the Centre

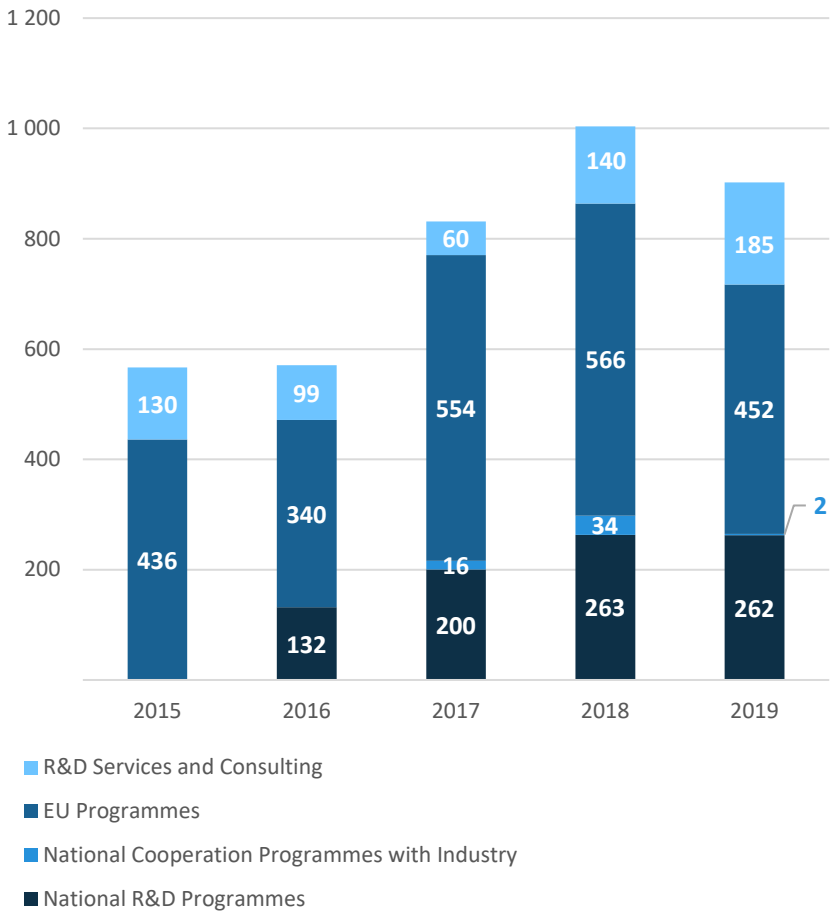

Figure 6.13.3 - HASLab - Project funding evolution (k€)

7 RESEARCH INFRASTRUCTURES

7.1 TEChnologies for the Sea (TEC4SEA)

7.1.1 Mission and Positioning

The TEChnology for Sea infrastructure (TEC4SEA; www.tec4sea.com), currently under implementation, is a platform designed to support multidisciplinary research, development, and test of marine robotics, telecommunications, and sensing technologies for operation in oceanic environments. It is open to both the R&D community and the industrial sector, thus providing the equipment, expertise, and logistics needed to support those communities in developing, evaluating, and validating technological solutions designed for maritime environments, thus fostering and advancing the blue economy.

TEC4SEA has three main objectives: supporting the R&D community, supporting the industrial sector, and pushing the technological envelope in developing technology for maritime environments, by making available facilities, resources, and know-how to economic agents and researchers.

TEC4SEA is a vertically integrated infrastructure; its expertise and resources range from pure conceptual research to field deployment missions, with strong industrial and logistic competences in prototype production and an eclectic set of laboratories, testbeds, equipment, and support facilities for experiments in controlled and real environments. It can thus support researchers in all phases of technology development, from conception and theoretical analysis to prototype development, field deployment, and technology validation. It is therefore an invaluable asset in producing, disseminating, and applying knowledge, and in addressing the challenges and opportunities that the oceans represent to Portugal and to mankind in general.

Its geographic location (allowing fast access to deep sea), multidisciplinary nature, and vertically integrated structure are vital assets in supporting the development, evaluation, and validation of technological solutions designed for the ocean environment, allowing researchers to evolve from simulation/lab experiment to deployment and field trials. Its focus on ocean technology development–not on the ocean itself–and structural characteristics define it as a unique research infrastructure in Europe.

TEC4SEA has poles in Porto and Faro, two major coastal cities in Portugal. Its implementation phase is coordinated by Paulo Mónica as Principal Investigator. The implementation management team also includes Eduardo Silva, António Silva, Aníbal Matos, Olivier Pellegrin, Carlos Pinho, Diana Viegas, Luís Pessoa, Bruno Ferreira, Maria Graça Barbosa, and Marta Barbas.

7.1.2 Main Achievements in 2019

During 2019, the implementation works have proceeded as planned in general terms, albeit with the need for some timing readjustments, and the need to implement some risk mitigation measures. With many of the smaller investments already finished at the start of 2019, the major procurement activity during this period has been the specification and tender procedure concerning the larger vessel to be acquired, which will provide the infrastructure with the capability to autonomously support deep-sea missions of up to four days and 12 researchers. This vessel is now under construction at Nautiber's shipyard, in Vila Real de Santo António, and will be delivered at the latest stages of the currently ongoing project.

As mentioned before, some risk mitigation was performed during 2019, to minimize the risk associated with objectives whose successful completion depends on external entities and, as such, are partially out of control of the project team. In particular, given the existence of a considerable delay in the negotiation process with the Administração dos Portos do Douro, Leixões e Viana do Castelo leading to the creation of support facilities in the Leixões harbor, the specifications of the mentioned deep-sea-capable research vessel were revised, so that the vessel, when in harbor, may provide the same set of core services envisaged for the desired harbor facilities. The mentioned negotiation process is now proceeding speedily, and the objective of creating the desired harbor facilities is well within reach in the original intended terms.

From the point of view of capacity building at the end of 2019 the project was at approximately 75% of completion, even though with some differences between different components:

In what concerns the update of back-office labs, the update of both the Sensor Lab and Telecommunications Labs has been basically finished; in contrast, the update of the Ocean Engineering Lab has been postponed to 2020, while the Acoustics and Robotics labs were, at the end of 2019, at approximately 50% completion. The vital component of land-to-sea deployment has been much advanced during 2019, and is now also almost finished, even though still waiting for some minor acquisitions to reach full operational capability. The sea-going capability of TEC4SEA has also been much focused during 2019. The RIB (rigid inflatable boat) vessel that was acquired is now fully operational, and provides the capability of autonomous access to epipelagic depths, while the bigger vessel is well under construction; the ability for autonomous access to deep sea will thus be arriving during 2020. Finally, the mobile robotic platforms that are a part of the envisaged underwater infrastructure have also been advanced during 2019, with the inclusion of atomic clocks, better acoustic localization systems, and new, improved coding schemes.

From the point of view of scientific production, at the end of 2019 almost all the scientific-impact objectives envisaged for the presently on-going infrastructure financing project had already been achieved or surpassed, even though still months away from the end of the project. In particular, items such as the number of published articles, supported PhD and MSc theses, and developed prototypes were already presenting ratios between the achieved and established goals in the 1.22–7.33 range.

It should also be mentioned that the year of 2019 has shown that, even though while still in its implementation phase, the existence of the TEC4SEA infrastructure is already constituting an important factor in attracting new international projects, financing sources, and research partners. Additionally, during this year, we have seen a growth in the number of entities potentially interested in adhering to the infrastructure, which indicates that a healthy and diverse ecosystem will certainly appear around this infrastructure, from which many synergies and technological advances should be expected.

7.2 European Multidisciplinary Seafloor Observatory – Portugal (EMSO-PT)

7.2.1 Mission and Positioning

EMSO-PT is a research infrastructure lead by IPMA (Instituto Português do Mar e da Atmosfera) and involving 15 other research institutions working on ocean science or technology, including INESC TEC.

The ultimate goal of EMSO-PT is to organise the Portuguese contribution to the EMSO-ERIC network, a large-scale European Research Infrastructure, networking fixed point, deep sea multidisciplinary observatories, with the scientific objective of real-time, long-term monitoring of environmental processes related to the interaction between the geo-sphere, biosphere, and hydrosphere. It is a geographically distributed infrastructure at key sites in European waters, spanning the Arctic, the Atlantic, and the Mediterranean, up to the Black Sea. It will be in place by the end of the decade.

EMSO identifies eight main scientific questions where advances are foreseen: 1) Dynamics of tectonic plates and magmatic systems; 2) Climate and greenhouse gas cycling; 3) Ocean productivity and ocean dynamics; 4) Marine mammal and fish stocks; 5) Non-renewable marine resources; 6) Episodes, events and catastrophes; 7) Origins and limits of life; 8) Marine ecosystems dynamics. All these topics are dependent on long-term, continuous observations, able to capture significant episodes as they occur.

So far, the Portuguese participation in EMSO has been focused on the Azores and Cadiz nodes, in cooperation with France (Azores) and Italy (Cadiz) using two of the few available technological solutions for long term seafloor monitoring (ASSEM and GEOSTAR). Within the scope of EMSO-PT two sites will be considered close to the mainland: a deep water one, located in the Gulf of Cadiz, and another shallow water, located off North Portugal. The later one will also be a test bench for emerging monitoring strategies.

EMSO-PT observatories will merge “off-the-shelf” technology, which will ensure that they will meet the international standards, with novel approaches (based on networked, autonomous observation platforms) that will contribute to more sustainable monitoring operations and will create the basis for the development of new marine products and services, creating value and qualified jobs.

INESC TEC involvement in EMSO-PT addresses the establishment of long-term non-fixed observatories. Such work is organised along two complementary lines: relocatable nodes and long-endurance mobile platforms. In the first case, INESC TEC is building an EGIM (EMSO Generic Instrument Module) for integration and use in a Turtle relocatable node. In the second one, INESC TEC is implementing a network of underwater gliders for collection of oceanographic data.

While the goal of the EMSO-PT infrastructure is the implementation of a network of ocean observatories for data gathering, the underlying activities are aligned with CRAS research line associated with long term deployments.

7.2.2 Main Achievements in 2019

The main achievements of this research infrastructure during 2019 were:

- Detailed design of the EGIM module according to specifications, acquisition of sensors and beginning of assembly;
- Upgrade of a Slocum glider according to the requirements previously established (rechargeable batteries, variable floatation module for dives up to 1000m deep, payload sensors: conductivity, temperature, dissolved oxygen, and optical back-scatter).

7.3 Smart Grids and Electric Vehicles Laboratory (SGEVL)

7.3.1 Mission and Positioning

The Smart Grid and Electric Vehicle Laboratory (SGEVL) constitutes a physical space integrating systems and equipment designed to support the development and testing of solutions and pre-industrial prototypes, promoting active and intelligent management of electric grids in scenarios with a progressive integration of microgeneration together with other distributed energy resources including Electric Vehicles (EV). Proof-of-concept and experimental validation, which includes pre-prototyping processes for physical devices and/or software and equipment modules, are performed to support functional/technical specification of solutions for microgeneration, active demand response solutions and EV integration in distribution grids. It allows individual and integrated test of control concepts, communication solutions in normal and emergency modes of operation.

This RI has a unique integrated capacity to simulate, prototype and test the electrical system of the future, providing support and services to the scientific and industrial ecosystem, generating revenue through those direct services or indirectly by supporting R&D funded initiatives.

The main benefit of this RI, in comparison with other infrastructures with commercial purposes, is the fact of being neutral in terms of commercial interest, which is also an opportunity. Other main advantage of SGEVL is the staff, which has a professional behavior as it can be expected from certification laboratories, but at the same time is very active in research activities which brings an updated and scientific approach to these works. This can be particularly interesting to companies needing a support in the initial stage of development and not only for advanced prototypes that require testing for pre-certification. It can be also useful to offload some development and research which is not possible to perform in house due to time and human resource limitations.

The laboratory facility has a significant flexibility that is easily configured to a specific project, to provide quick and reliable results. Most of the test laboratories have a very rigid infrastructure which requires for the equipment under test to be adapted to the laboratory, which we believe is a major weakness. Finally, and of great relevance, we can give a detailed analysis and feedback reporting, considering not also the results of the tests, but going deep into the technological solution.

Research areas

- Directly associated: DMS/EMS and Network Automation, Industrial Electronics, Static and Dynamic Analysis of Power Systems, X-Energy Management Systems, RES & DER Integration;
- Other areas: Multi-Energy Systems, Energy Analytics and Forecasting.

The SGEVL is intended to support research and validation activities for the scientific community and companies that develop products in the energy sector, supporting top-level research and innovation in their respective fields.

Having in mind the range of activities in the referred domains, the infrastructure intends to provide professional support to the research activities, taking also advantage of INESC TEC expertise in these domains. But more than that, these developments are usually supported and supervised by academic staff, namely Professors, which are not fully dedicated to these activities. In SGEVL, a new researcher is quickly integrated in an active R&D environment where he can work side-by-side with senior researchers with solid experience on the same topics, which has proven to motivate the new researchers and accelerates the development considerably. This acceleration allows then to go deeper in the topics within the same time frame.

The RI has a professional management team (since November 2018, it is an area of CPES, coordinated by Luis Miguel Miranda), with competences in innovation and research funding management, that guarantees the implementation of an action plan and the accomplishment of the specific aims defined, with an efficient and transparent internal management of resources. This management structure is also responsible for the implementation of specific procedures to grant access to national and international researchers that are external to the infrastructure.

7.3.2 Main Achievements in 2019

The main achievements of the RI for 2019 were:

- Conclusion of the development and integration of the home energy management system (HEMS) developed in the European Project InteGrid, tested in laboratorial environment and with the start of functional testing in an external laboratory. This involved the collaboration between CPES and CSIG to test an in-house solution for energy management, including mobile apps, firmware, energy management algorithms, and hardware;
- Conclusion of the development and integration of the electric vehicle charger (EVSE) developed in the European Project InteGrid, tested in laboratorial environment and with the start of functional testing in external laboratory. First steps on the certification of electric safety of INESCTEC electric vehicle chargers and inverters, in collaboration with EDP Labelec;
- Conclusion of the development and integration of the smart hybrid inverters (SHI) developed in the European Project InteGrid, tested in laboratorial environment and with the start of functional testing in external laboratory;
- Initiation of the development of a new generation of electric vehicle chargers compliant with the ISO 15118 standard for vehicle-to-grid communication interface for bi-directional charging/discharging of electric vehicles;
- Specification, electrical installation design and elaboration of the international tender for the 100 kVA power-hardware-in-the-loop (PHIL) amplifier. Currently, this PHIL platform is used for research and testing purposes and the upgrade of the power capacity (from 15kW to 100kW) can be interesting for attracting companies to use our laboratory since it can connect higher power equipment (e.g., grid storage) and simulate larger electrical grids;
- Join of effort with TEC4ENERGY to produce dissemination contents to widen market opportunities for technologies and solutions developed in SGEVL;
- Acquisition of a climatic chamber to allow the testing of prototypes in distinct environmental conditions and assess the impact in performance and behavior. Testing of batteries and other storage elements in a wide temperature range.

8 SPECIAL PROJECTS

8.1 UT AUSTIN PORTUGAL PROGRAM

Coordinators: José Manuel Mendonça and Rui Oliveira

The UT Austin Portugal Program is a partnership between the Portuguese Science and Technology Foundation (FCT) and the University of Texas at Austin (UT Austin), in conjunction with several national universities and laboratories.

It was launched in 2006, as part of a strategy to promote Portuguese scientific institutions at an international level, through a series of main structured areas of research and education organized in the form of a Co-Laboratory for Emerging Technologies (CoLab). Additionally, the CoLab included a series of entrepreneurial projects and new technology-based business initiatives developed through a network of "Technology Transfer Offices" in Portugal and at UT Austin which became known as the "University Technology Enterprise Network" or "UTEN."

After a decade setting up joint projects and building unique scientific, technology transfer and entrepreneurship capabilities, the transatlantic partnership moved into a new phase in 2018 towards 2030, determined to ensure its actions would go on shaping research agendas and delivering transformative results.

UT Austin Portugal offers an integrated and consistent approach to the knowledge-to-value chain thanks to its three types of instruments - Research, Education and Innovation.

8.1.1 Main Achievements in 2019

2019 was an important year in the Program's alignment towards 2030 as significant progress was made since the start of the partnership's third phase, back in 2018. 2019 was, first and foremost, a year for sowing the seeds of transformative collaborations that should come to fruition over the next coming years.

On an operational level, the Program was able to undertake several research and education activities and connect with relevant actors, both at national and international levels, acting in scientific or application domains related to the Program's core areas of knowledge. This is something to be valued, in particular in the new areas that had been added up to the Program's portfolio (Space-Earth Interactions and Medical Physics). Indeed, these areas claimed for additional networking efforts with a view to raising awareness about them in the frame of the Program and getting the right people and institutions on board for collaboration.

At the end of 2019, the following achievements must be highlighted:

- Setting up of the Minho Advanced Computing Center (MACC), the most advanced research-based computational infrastructure in Portugal thanks to the supercomputer BOB, brought all the way from TACC (the Texas Advanced Computing Center) under the international partnership;
- Implementation of an advanced training scheme in partnership with TACC;
- Launch of two competitive calls, managed by Portuguese funding agencies, for collaborative projects oriented towards pre-defined research and innovation agendas;
    - For the first time ever, the Program supported the engagement of researchers both from Portugal and UT Austin with Portuguese companies, through a dedicated call for three-year industry-driven R&D projects (sponsors: Compete2020 & FCT). Additionally, the Program supported a call to fund high-risk and high-impact collaborative one-year research projects. Performance in both calls largely exceeded the Program and sponsors' best expectations.
- Increased visibility of the Program, through enhanced communication outreach - as the partnership gathered pace, its community of stakeholders grew significantly and the Program reached beyond its conventional geographic scope (e.g.: Japan; Germany; Norway);
- Organization of several training and networking activities in practically all areas of the Program in partnership or with the support and involvement of relevant stakeholders (e.g.: Portugal Space; AIR Centre; Faculty of Medicine of the University of Coimbra; NASA; AICIB; QuantaLab), fostering discussion and knowledge sharing and opening up new partnering opportunities for attendees and speakers.

8.2 DIGITAL COMPETENCE INITIATIVE

Coordinator: Pedro Guedes de Oliveira

The Digital Competence Initiative constituted INESC TEC role in the coordination of the National Initiative for Digital Competences, e.2030 (INCoDe.2030) for which Pedro Guedes de Oliveira (PGO) was nominated General Coordinator in 2017. On the 20 of August 2019 the coordination was transferred to Nuno F. Rodrigues (NFR), member of the Board of FCT, having ceased the responsibilities of INESC TEC.

The coordination team also included as Associate Coordinators Sofia Marques da Silva (SMS) and Nuno F. Rodrigues (NFR). The group activities were supported by FCT that for this purpose signed a protocol with INESC TEC. The team could also count with the cooperation of Francisco Vaz (FV) for some special tasks and, until the end of February the secretarial and administrative support of Lucília Fernandes (LF) and since March to August of Sandra Oliveira (SO). Finally, João Neves (JN) was also involved in a special group dedicated to planning an Integrated Network for Public Communication Services.

As reported previously, INCoDe.2030 is structured in 5 Action Lines (AL): AL 1, INCLUSION; AL 2, EDUCATION; AL 3, QUALIFICATION; AL 4, SPECIALISATION; and AL 5, RESEARCH.

8.2.1 Main Achievements in 2019

Global actions

- Organisation of set of meetings, one for each Action Line (with the exception of AL4), to assess the results obtained so far and to programme the actions for the near future as well as for the medium term. The meetings took place in May and the objectives were fully accomplished having mobilised most of the relevant actors in each domain;
- Contract with INOVA RIA to develop a programme to bring together tech companies and basic and secondary school students to promote ICT studies. More than 1200 students from Aveiro region were involved but, although the report shows a considerable impact on the students approach to the subject, difficulties with the school schedules didn't allow a full development of the programme;
- Discussion of the 2018 report concerning the Integrated Network for Public Communication Services (RISPC), with the Directory General of Education and the Directory General of Statistics of Education and Science as well as with the Secretary of State of Local Constituencies, which has led to a budgetary plan for RISPC;
- Implementation of the platform to manage the INCoDe Seal, as well as participation in a vast number of public events to promote the programme;
- Organisation of the visit of the members of the International High Level Group, both prior and during their stay in Portugal, creating the conditions for the submission of a (very favourable) preliminary assessment report of INCoDe.2030.

Main achievements in each Action Line

- AL 1 - In cooperation with CIENCIA VIVA, the coordination team supported the submission of applications to the POISE programme that involved 6 different consortia to carry out 110 CCID to reach 47 thousand people, with a global value of more than 10M€. Although it was considered a particularly relevant proposal, the application was not successful due to bureaucratic difficulties; An intense cooperation was developed with DNS.pt and MUDA, as well as with the Directory General of Reinsertion and Prisons, in order to integrate the Digital Campus EducOnline@Pris within the concept of CCID;
- AL 2 - Creation of the e-Computation Association to promote Computational Thinking in basic and secondary studies, having accomplished the first steps towards the development of the curricula for each year;
- AL3 - Continuation of the programme SWitCH with PortoTechHub and ISEP;

- AL4 - Contract with the University of Aveiro (ESTG of Águeda) to carry out a quantitave assessment of the 7 CTeSP developed under a Project Based Approach, which led to important conclusions to new implementations of this methodology;
- AL5 - Development of strategic plans for Advanced Computing and for Artificial Intelligence (this one, led by Alípio Jorge, Portuguese Sherpa for the European AI Initiative) which involved an intense mobilization of the interested communities, both from companies and academia.

9 SUPPORT SERVICES

9.1 LEGAL SUPPORT SERVICE

Manager: Maria da Graça Barbosa

Figure 9.1.1 - AJ - Team composition and evolution

9.1.1 Presentation of the Service

The Legal Support service provides legal advice and appropriate action on most legal matters emerging within the scope of INESC TEC's activity, namely in the areas of human resources, institutional relations, project contracts, public procurement of goods, services and works, intellectual property and personal data protection. The service is committed to always defend the institution's best interests, not only preventively, to ensure its compliance with national, European or other applicable legal frameworks, but also to repair any damage or minimize costs.

9.1.2 Highlights in 2019

- Continued participation in the multidisciplinary Data Protection Team, appointed to support and monitor the implementation and compliance with the European General Data Protection Regulation (Regulation EU 2016/679) and complementary national legislation, namely through:
    - direct involvement in the implementation of several actions and tasks assigned to the Data Protection Team, e.g., meetings with staff and researchers, awareness initiatives, seminars on data protection and research, and early identification and monitoring of research projects with potential privacy and data protection implications;
    - contribution to the preparation and design of data protection management plans, data protection policies for contract templates, and other data protection related documentation, as well as participation in the negotiation and drafting of data sharing and data processing agreements;
    - general legal counselling related to data protection matters and permanent legal support to the activity of the appointed Data Protection Officer (DPO).
- Definition and update of the internal procedures for application of the Public Procurement Code and complementary or special legislation for R&D activities ("excluded public procurement contracts") as well as launching of procedures and open tenders for acquisition of several services and goods.

Reporting of all the public procurement procedures observed in several acquisitions, to ensure accountability to the funding entities;

- Study and support to the application of several important legal diplomas that have been approved, with direct impact on INESC TEC organisation and activities, namely the new legal framework for R&D Institutions; the alterations to the Grant Holder Statute and the new legal framework for the assignment of the Associated Laboratory Statute. Drafting of the new Research Grant Holder Regulation of INESC TEC;
- Close collaboration with HR service in several matters, such as employment contracts and related issues, in particular the scientific employment of PhD; grant holder statute; foreign citizens' entry and stay procedures; foreign academic degrees' recognition process; legal support to the interaction with the Workers' Committee;
- Legal support to the formalization of operations related to INESC TEC's participation in associations and companies, including several Collaborative Laboratories and spin-off companies, as well as the design and implementation of the licensing models associated to such operations, in close collaboration with SAL;
- Legal support to the negotiation and drafting of contracts, including consortium agreements in the context of funded National and European projects, service contracts and licensing deals, in close collaboration with SAL;
- Organization of awareness and information internal sessions, addressed to different audiences, on legal subjects with relevant or high impact on INESC TEC, such as Recruitment of foreign nationals (entry and stay procedures; academic degrees recognition process);
- Preparation of templates, available on the intranet, for the most frequent types of contracts and other frequently requested documents; participation in the revision process of templates for R&D services and consulting contract proposals;
- Participation in the conclusion and implementation of the Intellectual Property Regulation, as well as the monitoring of its application in the context of the approval of a new Industrial Property Code and new EU Directives on Copyright and trade secrets; participation in follow-up negotiations with INESC TEC Associates, further to the approval of the IP Regulation;
- Participation in the workgroup on Gender equality/parity;
- Participation in the workgroup on Ethics responsible for the drafting of a Code of Ethics and related instruments.

9.2 ACCOUNTING AND FINANCE SERVICE

Manager: Paula Faria

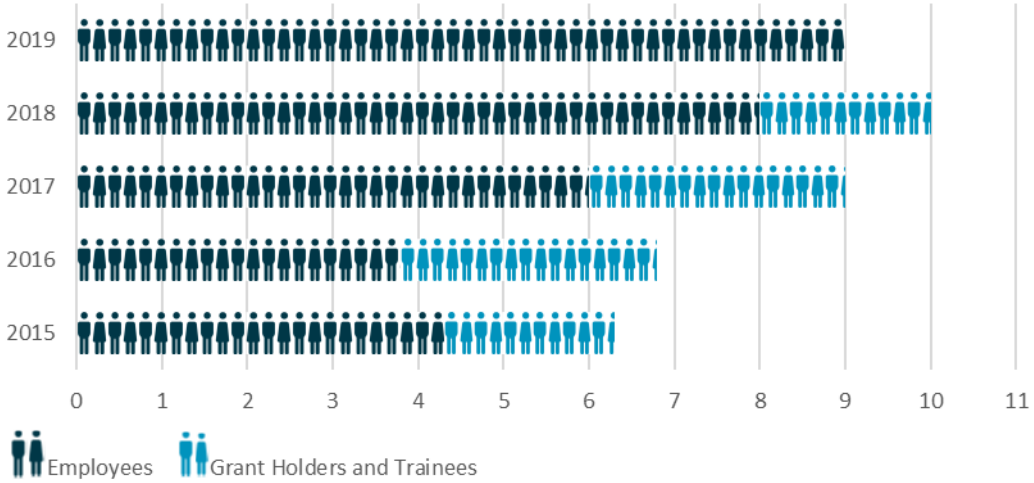

Figure 9.2.1 - CF - Team composition and evolution

9.2.1 Presentation of the Service

The Accounting and Finance service is responsible for coordinating and executing the accounting activities, for fulfilling all fiscal obligations and for managing INESC TEC´s cash flow and ensure the availability of enough funds to meet the payments due. In this context, the service acts as a mediator between the institute and external parties, according to the guidelines provided by the Board. From an administrative perspective, it is also responsible for the purchasing and travel processes and for managing the institute insurances and fixed assets.

9.2.2 Highlights in 2019

According with the main actions planned for 2019 and the Accounting and Finance service goals, the most important highlights are:

- A skill matrix and task allocation tables were developed for the Accounting and Finance team;
- Accounting processes and procedures handbooks were developed to reduce training period, ensure common practices and save time;
- Internal processes were upgraded to accommodate purchase orders' growth;
- The implementation of Electronic billing was initiated;
- Introduction of a contract manager in the purchase order work-flow;
- Awareness and implementation of new practices and technological solutions towards a paper-free office;
- The debt collection process was improved, towards greater efficiency and effectiveness;
- Better fit of fiscal control reports have been implemented.

9.3 MANAGEMENT CONTROL SERVICE

Manager: Marta Barbas
Assistant Manager: Vanda Ferreira

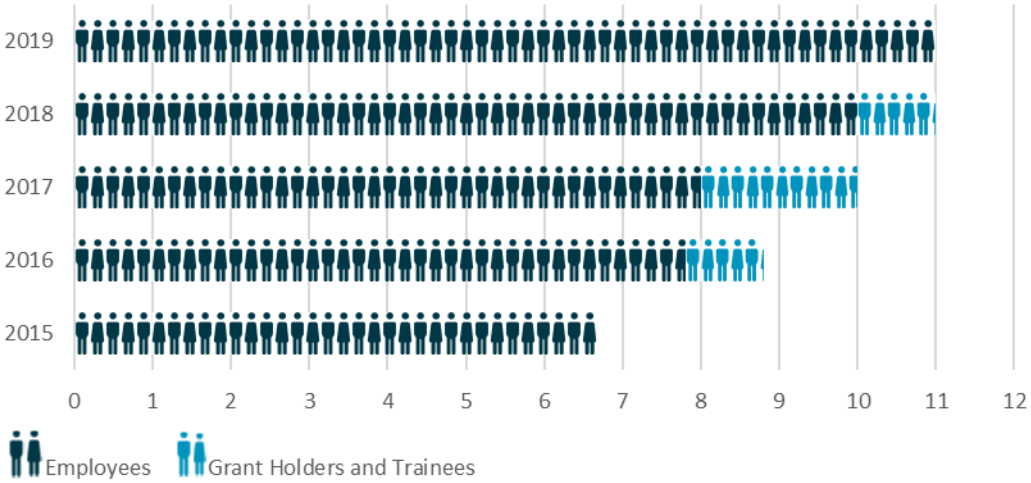

Figure 9.3.1 - CG - Team composition and evolution

9.3.1 Presentation of the Service

The Management Control service aims to ensure that the institution's resources are used effectively and efficiently in the accomplishment of their objectives, setting standards, measuring actual performance and taking corrective action. It stands for internal controls to promote efficiency, reduce risk of asset loss, and help ensure the reliability of financial statements and compliance with laws and regulations, but also with internal standards. On the other side, the service has the role of reporting to funding agencies all the financial reports with the reimbursement of expenses, monitoring projects execution and its compliance with funding terms and conditions, working closely with project managers and providing training on good practises when needed.

9.3.2 Highlights in 2019

In 2019, the number of funded projects was 196, meaning those with obligations of reporting to funding agencies, which represents an increase of 16 projects when compared to 2018.

This year INESC TEC was awarded with the largest European collaborative research project coordinated by a Portuguese institution approved by Horizon 2020. The INTERCONNECT project, with a global budget of 30 million euros represents a challenge to the service, as it is a very large and ambitious project, performed by a consortium with 50 partners. In addition to this project, the service manages another 43 projects financed by H2020, of which five coordinated by INESC TEC. Furthermore, INESC TEC participates in European projects from other funding agencies, including five projects under European territorial cooperation Programme for cross-border cooperation between Spain and Portugal.

As to national projects, the service had 74 FCT projects to manage, 21 in cooperation with companies, funded by ANI, and the closure of the three big integrated projects from NORTE2020. We also had 15 other projects to fund patent applications.

In relation to internal control, we would like to highlight:

- The continuation of the work with SIG on improving all the intranet supporting tools;
- The aprovement of a new assets depreciation method by funding agencies, namely FCT.

9.4 HUMAN RESOURCES SERVICE

Manager: Maria da Graça Barbosa
Assistant Manager: Margarida Gonçalves
New model's working group: Bernardo Almada Lobo, Sara Brandão, Sandra Nunes, Rita Cardoso, Vera Pinto

Figure 9.4.1 - RH - Team composition and evolution

9.4.1 Presentation of the Service

The current Human Resources (HR) service coordinates and executes all activities pertaining to HR administrative management and to the implementation of HR related policies, according to the applicable law, internal regulations and guidelines provided by the Board. Moreover, some specific duties include follow-up and management of INESC TEC's insurances related to people, namely Personal and Work Accidents, health insurance and Safety and health at work.

In this report, in addition to the highlights of the service in 2019, the result of the work related with the strategic mission on the Definition of a New Human Resources Management Model is presented.

9.4.2 Highlights in 2019

- Improvement of intranet HR-related processes, in order to reduce workload, processing time and nonconformities, namely with the creation of automatic: (i) messages to notify the absence of plans and grant reports; (ii) lists to the secretariat and coordinators to notify processes whose date has already ended or exceeded; (iii)"Movimento de Ligação"(ML); (iv) lists to Workers Committee, communicating the beginning and the ending of employment contracts subject to certain or uncertain terms;
- Generation of the most frequently needed reports and lists based on the historical record implementation in order to help HR management at global and Centre level and definition and report of strategic HR indicators organised by function besides legal status of the collaborators;
- Other activities included: update of job descriptions, so as to reflect the organization evolution; revisit of nomination categories and appointed positions (new tables); recruitment improvement process: higher participation in job fairs and social media publications; internal sessions addressed to the Secretariat or other attendees, to inform of changes occurred in HR processes and new requirements; continuous revision of all processes involving personal data treatment, in order to comply with the requirements of the General Data Protection Regulation; clarification on foreign degrees, recognition and instruction of the procedures for foreign researchers to apply for research visas; Transition and monitoring of the activity of the new service provider for Safety and Health at Work;

- Approval of a new INESC TEC Research Grants Regulation due to the changes on the Research Grant Holder which triggered: (i) dissemination of several calls for applications under the previous regulation; (ii) revision of the INESC TEC's HR documents available on intranet;
- Adjustment of the monthly Welcome Sessions made to new collaborators, in order to include key messages and presence of support staff;
- Profound change in the assessment process to the renewal of contracts for hired staff; Implementation of employee exit interviews in order to understand the reasons for leaving and to improve attractiveness of the institution.

9.4.3 Definition of a New Human Resources Management Model

The following procedures were developed to define the new HR management model:

1. **Assessment of the current Human Resources management model, based on the practices of the *Evidence-based Management Model:***
   - Identifying the **best available scientific evidence**, gathering information of practices that could better be applied to INESC TEC complex institutional model;
   - Collecting **stakeholder values and concerns**, conducting over 80 interviews, to assess top-priority needs, suggestions and improvement points, and running a INESC TEC Climate Survey, to measure the perception all collaborators have of INESC TEC, its work environment and conditions, and interpersonal relations with leaders and co-workers; this first survey was conducted in June 2019;
   - Seeking **professional expertise**, by (i) creating a network and getting experience from more than 40 professional experts, that meet regularly to share information of the latest HR practices, by (ii) providing appropriate training to the RH team and by (ii9) conducting some benchmarking in renowned companies and institutions;
   - Gathering **internal organizational data** to better understand how the institution works, its legal, administrative and governing model and its strategic objectives and main concerns by: (i) assessing the current state of each RH process, making the diagnosis of the AS IS of the *main seven HR processes*, namely *recruitment and selection*, *performance management*, *training and development*, *career development*, *compensation*, *communication and coordination* and *work environment*; (ii) identifying improvement opportunities and delineating action lines across the institution; (iii) collecting analytical data to revision and monitoring the model, setting specific goals that can be measured; (iv) discussing alternative approaches both on functional and strategic HR activities to reconceive and reconfigure the human resources management strategy, policy and practice.
2. **Creation of an assessment framework that helped gathering all the information collected**
   The scope of each main HR processes was defined, the employee's perception, the needs, suggestions and mains objectives of the stakeholders, and the current state of the process. This framework allowed the **identification of the main improvement action lines**.
3. **Characterization of the current management model**
   The need for a transformational change has been identified, to move from a highly reactive and administrative model, poorly integrated with the current HR service, to a more proactive model capable to manage the HR processes in advance: (i) implementing new HR Best Practices, (ii) having more efficient HR processes and information systems, (iii) implementing a more agile communication mechanism, (iv) approaching the HR service to the strategic decision, (v) operating as an agent of change, and (vi) giving employees a voice.
4. **Define and propose a new Human Resources Management Model with 3 dimensions:**
   - **OPERATIONAL**: executing efficiently all the HR processes on a daily basis and integrating all initiatives that are scattered throughout the organization; adequate tools need to be provided to allow the team to become more efficient and administrative specialists;

- **COLLABORATOR'S LIFE CYCLE**: introducing HR Business partners working together with the line managers in (i) i**dentifying and attracting** the best candidates, defining well the *Employee's Value Proposition* while using an adequate *Employer Branding*, also helping in the **selection process** , and make sure we are capable to **retain good talent**; (ii) **developing career paths**, training and promoting development, and creating *Individual Development Plans*; (iii) helping **managing performance** of each individual with a clear definition of goals and evaluation of expected results, creating a *Matrix of Potential vs. Performance Assessment* for each individual; (iv) **engage, recognize and compensate**, allowing to choose between a mix of benefits, from the classical *Tangible Benefits* (salary, bonuses, health insurance) to more *Intangible Benefits* (flexitime, teleworking) and also more *Career-focused Benefits* (specialized training, functional upgrades), to name a few; (v) **managing employee leave**, ensuring **the knowledge transfer** is secured and making **exit interviews**; make sure **succession plans** are prepared in a timely manner; manage the **former employees as an asset** of the organization;

- **STRATEGIC:** developing strategic initiatives**, to influence change** and provide specialized training to make change happen**, to train leaders** to be HR leaders, while bringing the **interests** of the organization and its people **closer together**. Two additional support groups will be created: an "**HR Advisory Body"** that would meet regularly to provide advice and assistance; and **"HR Centres of Excellence"**, that are working groups specifically brought together to help developing practices, policies or frameworks of specific strategic matters (e.g. talent attraction, careers progression…).

IMPLEMENTATION OF THE NEW HR MODEL

Considering the complexity of the operation and the sophistication of the organization itself, an implementation committee will be created in 2020 to put into action the transformational change that is required. This committee will work together as a team to guarantee the day-to-day operations while the new management model starts to take place.

9.5 MANAGEMENT SUPPORT SERVICE

Manager: Isabel Macedo

Figure 9.5.1 - AG - Team composition and evolution

9.5.1 Presentation of the Service

The Management Support Service facilitates effective decision-making in the following governing bodies of INESC TEC: General Council, Board of Directors, Executive Board and Council of R&D Centres.

In addition to its operational focus, it also assists the Board of Directors and the Executive Board in streamlining internal strategic initiatives. With a cross-cutting perspective, it ensures institution-wide coordinated information management, and seeks to improve current processes and procedures, namely by developing data-driven recommendations and solutions.

9.5.2 Highlights in 2019

Decision-making process

- Dematerialisation of the decision-making process at the Board of Directors, Executive Board and Council of R&D Centres' levels, as of September 2019 (with the exception of public procurement processes due to administrative obligations).

Direct support to Management

- Direct assistance to the closure of the 1st call of Internal Seed Projects and support to the launch and follow-up of the 2nd call;
- Conclusion of the Board of Directors' initiative to review professional categories and positions of appointment, which took effect in January 2019;
- Support to INESC TEC's participation in other entities and companies, namely the new participation in the associations APGEI, CERVIM, EPIC, EARTO, EIT MANUFACTURING, EIT DIGITAL and the CoLABs B2E, VORTEX, Smart Energy Lab, BUILT and Vasco da Gama, and in the companies Keyruptive, Insignals Neurotech, UBIRIDER, and in the sale of the share in LTPLabs.

Information Management:

- Reorganisation of INESC TEC's intranet from a user's perspective;

- Full deployment of INESC TEC's documental Repository, namely through its interoperability with the new Intranet and INESC TEC Research Information System (IRIS); the migration and review of institutional documentation; and by ensuring e-mail notices for each contract release;
- Implementation of procedures for quality control of the institutional strategic performance indicators, combined with a systematic review of publication indicators, and the operationalisation of quarterly assessments;
- Broad study of copyright policies of INESC TEC scientific publications and evaluation of the institutional Repository in the context of Open Access, as ground to an Open Access policy to be deployed in 2020.

Continuous improvement

- Start of business processes analysis' periodical routines for continuous improvement, in a multidisciplinary collaboration with other Services;
- Participation and contributions to the Social Responsibility and Data Protection Work Groups.

9.6 SECRETARIAL COORDINATION

Manager: Grasiela Almeida

9.6.1 Presentation of the Service

The Manager coordinates and supervises the team of Administrative Assistants (Centres and Services), providing feedback to the Board on performance and anticipating any needed intervention and also coordinates the communication and training of new procedures and institutional norms closely with every Assistant at INESC TEC, whether it supports a Centre, Service or the Board. This function was performed cumulatively with the support to other research Centres and Services. This may be verified in the table presented on the Highlights in 2019 and an estimate of the percentage of time invested in each development area is also available close to the description of each one.

9.6.2 Highlights in 2019

As Secretarial Coordination Manager, the following activities were developed:

1. **Team Management** and self-improvement **(50% time estimate)**, trough:
    a. Internal training and coaching:
        i. 3 team meetings/coaching sessions regarding the update of rules and processes (namely the new "Projects" Process, Foreign Degree Recognition, Engagement on Welcome Sessions, the implementation of the new International Relations Service and the presentation of the new Intranet) but also pursuing engagement towards a more efficient, productive and fulfilled team;
        ii. 1 remote training session with the new service provider company: UberforBusiness and also a training session with CG regarding Project Budgeting (postponed to 2020).
    b. Performance evaluation on the team regarding 2018, overseeing the process closely with direct managers and also with a similar process with the main services that the teams interact (HR, CG and CF);
    c. Performance evaluation on the Secretarial Coordinator from the team, providing me with constructive feedback to anticipate the team's needs;
    d. Enhancement of the team's morale and engagement through several initiatives, such as the Assistant Day, a full day workshop that aims to work on personal/professional skills, develop teamwork, increase internal recognition of the vitality of the function and increase the team's motivation. The initiative was designed in 2019 but the first edition will only be held in February 2020, the month in which we celebrate the National Assistant Day in Portugal.
2. **Focus on Continuous Improvement (25% time estimate)** within the scope of a team effort with the "Organization and Management" and "Technical Support" services, a new Intranet version was released in order to produce a faster, cleaner and more user-friendly tool;
3. **Supplier Relationship Management** of the institution's suppliers directly related to secretariat's activity **(20% time estimate)**, trough the management of contract and service relations with fidelity suppliers INESC TEC cooperated in 2019: maintenance of the contract with travel agency and also of the service relations with 1 rental car company, 2 private transport companies and more than 100 hotels (27 in Oporto, 3 in Braga, 53 in Lisbon, amongst others in Portuguese cities). This resulted in better service solutions and conditions for the team and institution to work with;
4. **Information Management (5% time estimate)**, trough the convey of information and organized Directory feed in Secr-Drive, including the creation and sharing of several useful templates for our activity.

The team of Assistants is now composed by 17 members, as presented bellow. This was a year of consolidation in terms of growth, information organization and process instruction.

The Performance evaluation process collected in 2019 (regarding 2018) presented us with a better quality service evaluation, when compared to the last analysed period. This is obviously a reflection of the effort and motivation of each member of the team, but also of the coordination's efforts to provide the team with better information and tools, a more transparent and accurate evaluation process and better communication environment in general.

Assistant	Supports
Ana Isabel Oliveira	**Personal Assistant:** José Manuel Mendonça, Gabriel David, João Claro, Luís Carneiro, José Carlos Príncipe, José Fortes. **Organizational Structure:** General Council, Fiscal Council, Infrastructures Maintenance Service, Scientific Advisory Board, Business Advisory Board, Workers Committee. **Intervention Areas/Projects:** Board of Directors Budget, Infrastructure Management, Communications, Continuous Improvement, CoLAB ForestWISE, KIC Manufacturing.
Lídia Vilas Boas	**Personal Assistant:** João Peças Lopes, Luís Seca, Manuel Ricardo, Mário Jorge Leitão. **Organizational Structures:** Infrastructures Maintenance Service, Human Resources. **Intervention Areas /Projects:** GC Plan and Report, FCT Report, Conference organization.
Sandra Nunes	**Personal Assistant:** Bernardo Almada Lobo, José Carlos Caldeira, Rui Oliveira, Vladimiro Miranda, Pedro Guedes de Oliveira, José C. Marques Santos. **Organizational Structure:** Conflict of Interest Management Commission, International Relations Office – India. **Intervention Areas/Projects**: Conflict of Interest Process Management, Projeto INCoDE, Projeto INFUSE, Manufacturing Vanguard Initiative
Ana Paula Silva	**Organizational Structures:** Information Systems Computer Graphics
Catarina Fernandes	**Organizational Structures:** High-Assurance Software
Cláudia Almeida	**Organizational Structures:** Robotics Autonomous Systems (CRAS) @ISEP LSA
Flávia Ferreira	**Organizational Structures:** Robotics Industry Intelligent Systems
Grasiela Almeida	**Organizational Structures:** Enterprise Systems Engineering (CESE), Innovation, Technology Entrepreneurship (CITE), International Relations Office – Brazil, Networks Communications Service. **Intervention Areas/Projects:** Secretarial Coordination Manager, Steering Committee for Social Responsibility
Helena Silva	**Organizational Structures:** Industrial Engineering Management, Communication Service, Organization Management Services, Funding Opportunities Office
Joana Dumas	**Organizational Structures:** Artificial Intelligence Decision Support, Advanced Computing Systems
Luísa Mendonça	**Organizational Structures:** Applied Photonics
Marta Oliveira	**Organizational Structures:** Enterprise Systems Engineering (CESE), Innovation, Technology Entrepreneurship (CITE), Systems Administration Service, Management Information Systems Service
Paula Castro	**Organizational Structures:** Power and Energy Systems
Renata Rodrigues	**Organizational Structures:** Telecommunications and Multimedia
Rute Ferreira	**Organizational Structures:** Biomedical Engineering Research, Industry Partnership Service, Technology Licensing Office
Sílvia Pina	**Organizational Structures:** Robotics Autonomous Systems (CRAS) @FEUP
Vera Pinto	**Organizational Structures:** International Partnership Office

9.7 FUNDING OPPORTUNITIES OFFICE

Manager: Marta Barbas

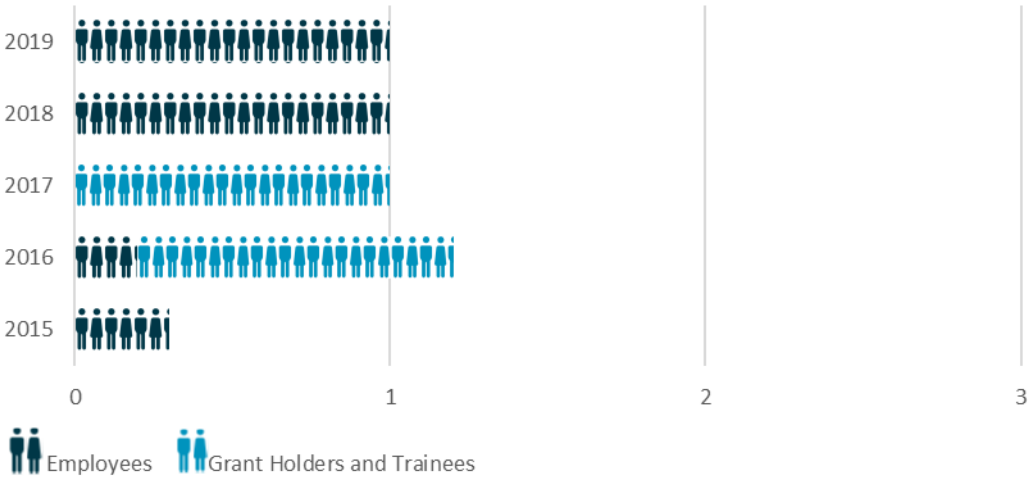

Figure 9.7.1 - SAAF - Team composition and evolution

9.7.1 Presentation of the Service

The Funding Opportunities Office aims at identifying the relevant funding opportunities to support INESC TEC Research, Development and Innovation activities, always aligned with the mission and objectives of the Institute. This service will also support and supervise the development and submission of proposals to different funding programmes, always in collaboration with the R&D Centres and with the other Business Development Services.

9.7.2 Highlights in 2019

In 2019, the service started to evaluate the success of the institution in the different types of financing programmes, in order to support the development of a new strategy that will foster a set of training sessions for researchers, in order to increase the success of researchers and consequently the institution.

The analysis developed highlighted the need to invest in reinforcing the capacity of the service for H2020 projects, a high quality financing programme for the institution. For this purpose, a position was open for an extra team member, focused on supporting H2020 applications.

From all the activities developed we shall highlight that the service was responsible for the submission of a proposal for hiring highly qualified human resources, with 20 hired staff positions for 3 years in a total amount of 1.898.983,43€. This proposal was totally developed by the service, based on the Activity Plan for 2020 of INESC TEC, including descriptive memory and budget.

Some facts and figures related to relevant proposals submitted:

- 1st call for research projets between Portugal and Israel (2019-2021): 2 proposals;
- 2nd edition of the call for health research projectst Fundação ‘la Caixa’: 5 proposals;
- FCT Forest Fire Prevention research projects: 13 proposals;
- FCT Data Science and Artificial Intelligence in Public Administration research projects: 6 proposals;
- FCT V Centenary circumnavigation research projects: 13 proposals;
- FCT call n.º 04/SI/2019 for R&D international cooperation projects MIT-Portugal, UTA-Portugal e CMU-Portugal: 8 proposals;

- FCT call for exploratory international cooperation projects Carnegie Mellon Portugal – 2019: 4 proposals;
- FCT call for exploratory international cooperation projects - MIT Portugal – 2019: 3 proposals;
- HORIZON 2020: 63 proposals were submitted in 31 different calls but we shall highlight 2 successful proposals which submission were strongly supported by the service: ATLANTIS submitted to the call ICT-09-2019-2020 in March and AI REGIO submitted to the call DT-ICT-03-2020 in November.

9.8 INDUSTRY PARTNERSHIP SERVICE

Manager: Augustin Olivier

Figure 9.8.1 - SAPE - Team composition and evolution

9.8.1 Presentation of the Service

The Industry Partnership Service aims at strengthening INESC TEC's approach to the market and achieve higher industry contract revenues. The service is responsible for building strong relationships with partners, identifying business opportunities, negotiate and close industry contracts for innovative projects based on INESC TEC R&D competencies and maintain an extensive knowledge of market trends and conditions. Furthermore, SAPE should plan different strategies and marketing contents highlighting INESC TEC added value and differentiation, prospect for new industry partners, organise and set up business meetings and increase INESC TEC business network.

9.8.2 Highlights in 2019

Activity 1: Organisation based on a multidisciplinary approach

In 2019, INESC TEC continued to present its competencies on the market based on its multidisciplinary approach organized in innovation areas, called TEC4 ("TEChnology FOR ...").

During 2019, all TEC4 areas were pushed forward in terms of structuring their activities and establishment of stronger relations with their stakeholders. TEC4SEA and TEC4ENERGY continued their efforts in implementing their R&D infrastructure; TEC4INDUSTRY strengthened its relations with the main stakeholders; TEC4AGRO-FOOD asserted as a preferential partner for the national agro-food and forestry digital (r)evolution. Only TEC4MEDIA needed to be reformulated.

During 2019, it started to explore a new sector related to finance (banking, capital markets, insurance and real state) as a follow up of SAB's (Scientific Advisory Board) suggestions and construction sector.

Activity 2: Networking and promotion activities for knowledge transfer

The main objectives of this activity were:

- to increase the networking activities with national and international partners as well as the efficiency of these networking activities;
- to extract more knowledge and value from the regular interactions with partners, supporting better targeting and, if possible, anticipating needs;

- to strengthen the INESC TEC positioning as an RTD partner of businesses, by increasing the number of national and international projects.

During 2019, those global objectives were reached by the following tasks:

- Networking and promotion activities - participation in exhibition fairs/events. Aligned with the TEC4, INESC TEC has participated in Business2Sea (Ocean Forum), European Maritime Day, Oceans, 360TECHINDUSTRY, and Agro iN;
- National networking and promotion activities – Seminars organization, aligned with the smart specialization thematic areas and/or societal challenges identified in Horizon 2020;
- International networking and promotion activities: events such as infodays, international fairs, participation in interest groups (e.g. AgGateway, CEMA and CERVIM), reference site member of the EIP on Active & Healthy Ageing as Porto4Ageing), member of thematic networks (SHAFE- Smart Healthy Age Friendly Environments, international and national) to enable the identification of high-level challenges that remain to be solved and facilitate the entrance in international consortiums;
- Networking and promotion activities through Business Clusters. The establishment of strong links with the Business Clusters, strategically aligned with the TEC4, is a means to access people with power to decide, influence and/or provide valuable feedbacks. The National Business Clusters aligned with the previously presented TEC4, are: Forum Oceano, Portugal Mineral Resources, Produtech, Smartwaste, Mobinov, HEALTH CLUSTER Portugal, ADVID, AIFF, Portuguese AgroFood Cluster and TICE.PT. New organisations will be followed, like Associação Portuguesa de Blockchain e Criptomoedas and Aliança Portuguesa Blockchain. The International Network Organisations are: Manufuture, EFFRA, euRobotics, EIT RawMaterials, EIT Manufacturing, ROS-Industrial, AEF and NEM;
- Networking and promotion activities through Collaborative Labs (CoLABs). The establishment of strong links with the CoLABs, strategically aligned with the TEC4, is a means to access people with power to decide, influence and/or provide valuable feedbacks. Highlighted the participation in BUILT Colab.

Activity 3: New technologies and knowledge dissemination for business

Communicating and disseminating the new thematic organization, supported by the TEC4.

In 2020, SAPE functions and structure will be integrated in the new TEC4 model.

9.9 TECHNOLOGY LICENSING OFFICE

Manager: Catarina Maia

Figure 9.9.1 - SAL - Team composition and evolution

9.9.1 Presentation of the Service

The mission of the Technology Licensing Office is to protect and license technology developed at INESC TEC. To carry out its mission, the office works in close collaboration with the Legal Support Service and the Industrial Partnerships Service. The office's responsibilities consist of establishing and managing INESC TEC's processes related to: internal scouting and dissemination of research results that can be protected by Intellectual Property (IP) rights; market and state of the art assessment; definition of IP strategy; technology licensing; negotiation and monitoring of licensing contracts.

9.9.2 Highlights in 2019

Following its mission and goals, SAL developed numerous activities during 2019. There was a strong focus on scouting in order to fulfil the integrated programs' KPIs, supporting 12 new patent applications of which 2 were priority filing (new patent families) and 3 were European Patent applications. The office also filed 16 national applications in geographies such as the USA, Canada, Japan, China, South Korea, and Australia. In addition to the notourious internationalization of INESC TEC's patent portfolio, 4 patents were granted to INESC TEC in 2019 – 1 in the U.S., 1 in Japan, 1 in China, and 1 in Europe. Moreover, 2 computer programs were protected by copyright. There was also a strong focus on securing competitive funding for patent internationalization (Aviso 1 - Sistema de Apoio à Investigação Científica e Tecnológica – Propriedade Intelectual SAICT – PI).

In 2019, SAL also supported the setting up and beginning of operations of INESC TEC's spin-off companies Insignals Neurotech, Lda. and Keyruptive. The office supported the iLoF team in securing EIT Health's Wildcard award and Insignals Neurotech team in EIT Health Germany – Startups Meet Pharma Programme (2nd Place).

SAL continued to support internal technology scouting activities, both for patenting and copyright (open or closed source licensing). New activities in this area include the support to InterConnect project, in which the team is deeply involved. The office has also been involved in background identification and drafting exploitation plans in the context of European Projects.

The office continued to support the European Entreprise Network through the EU IP Helpdesk Ambassador, Catarina Maia. SAL also represented INESC TEC at the Annual Meeting of the TTO Circle, in Dublin.

9.10 INTERNATIONAL RELATIONS OFFICE

Manager: Vladimiro Miranda

Figure 9.10.1 - GRI - Team composition and evolution

9.10.1 Presentation of the Service

The International Relations Office (GRI) was established under the dependency of the Board to systematically and regularly organise the internationalisation of activities in selected countries. The Office focuses specifically on identifying opportunities, concentrating knowledge on research and industrial foreign markets, promoting the attraction of foreign researchers to INESC TEC and acting, in general, as a facilitator of contacts and relations between research groups at INESC TEC and overseas institutions.

The GRI is a structure constituted presently by two Offices: the Brazil Office and the India Office. These Offices act as mediators, facilitators or cooperation brokers. In 2019, a reorganization of the internal activities supporting International Relations began taking place with a view to setting up an International Relations Service that would replace GRI. Since the official starting date of this service was set to January 2020, the activity of GRI throughout 2019 had to be adapted to such time horizon.

9.10.2 Highlights in 2019

In the course of 2019, the service remained highly focused on two geographic areas of interest: Brazil and India. Nevertheless, the office established and further contacts with prospective partners and champions in African countries, most notably with PALOPs Angola, Mozambique and Cabo Verde.

Brazil Office: main actions in 2019

The Brazil Office kept a routine activity, following the profile adopted in previous years. The main activities undertaken by this office included 1) supporting INESC TEC in its supervisory duties towards INESC P&D Brasil (IB), as one of its staff members serves as President of IB's Fiscal Council; 2) assisting INESC TEC's R&D Centres in their relationship with IB and 3) assisting in the identification and negotiation of new collaborative proposals as well as in the wall-to-wall implementation of ongoing R&D contracts and projects with Brazilian partners.

INESC TEC's operations in the Brazilian market benefit, to a great extent, from the relationship with IB and the sustained growth and expansion of its network of partners. It is worth noting that IB kept growing and consolidating its organization throughout 2019 at different levels, thereby drawing the interest of new associates seeking to join the institution in a juridical association and not only as members of a cooperation network.

In 2019, a first-hand evidence of the wealth of cooperation opportunities opened up in Brazil by the relationship with IB was the signing of a cooperation agreement between INESC TEC, the Brazilian institute and the Brazilian State of Espírito Santo in the fields of scientific development, technological innovation and entrepreneurship.

In the domestic realm, the office went on assisting visitors, candidates and newly arrived researchers from Brazil to INESC TEC. Brazilian is by far the largest foreign community in INESC TEC and the office has been committed to providing a sense of community and belonging to all Brazilian researchers at INESC TEC through a series of cultural, networking and knowledge sharing events known as “Café com pão de queijo”.

India Office: main actions in 2019

The activity towards India was intensive and produced clear advancement, leading to a result never before achieved by INESC TEC: visibility among top science and technology Indian institutions.

The policy followed had two important landmark results: the organization of two workshops, in September 2019, in Chennai and in Goa, joining INESC TEC with Indian institutions. The Portuguese delegation included researchers of six INESC TEC’s Centres pertaining to Clusters NIS and PES.

1. MEET - Marine Exploration and Energy Technologies - this workshop developed in Chennai, brought together a mission of 10 INESC TEC researchers with tens of researchers from IIT Madras, the no.1 university of engineering in India. This workshop led to the identification of 16 potential joint projects, to be submitted to funding with a further developed description;
2. BEST - Blue Economy, Science and Technology - this workshop developed in Goa, joined together a mission of 10 INESC TEC researchers with tens of researchers of five institutions in Goa: CSIR-NIO, NCOPOR, IIT Goa, NIT Goa and TERI. This workshop led to the identification of 22 potential joint projects, to be submitted to funding with a further developed description;

   Furthermore, this workshop was funded by two industrial companies - Goa Shipyard Ltd and ONGC - and led to the concept of establishing an alliance denoted CEMENT - Cooperation for Excellence in Marine Exploration and Navigation Technologies. Almost all the institutions mentioned above, with headquarters or activity in Goa, prepared MoUs to be signed with INESC TEC and Letters of Intent for joining CEMENT, which signature date was set for the time of the visit of the President of Portugal to India, in February 2020.

Finally, the India Office also provided support to the increase of joint projects of INESC TEC with Indian partners, either within the EU-India cooperation framework or directly supported by the India Government, which in 2017 was still non-existing.

9.11 COMMUNICATION SERVICE

Manager: Sandra Pinto

Figure 9.11.1 – SCOM - Team composition and evolution

9.11.1 Presentation of the Service

The Communication Service collaborates with the Board in order to define the institution's communication strategies and image. The main activities are planning, implementing, organising and coordinating both internal and external communication, according to the regulations and procedures established, thus promoting the status and notability of the institution.

9.11.2 Highlights in 2019

9.11.2.1 New Communication Achievements

- A **new version of BIP, "BIP INESC TEC Magazine"**, was published in September 2019, with a new layout, novel or renovated sections and a more dynamic format, constantly updated;
- A **new version of the Annual Report INESC TEC** was created in 2019, representing a qualitative improvement in the public presentation of INESC TEC results;
- It's also important to point out the creation and implementation of the **image of a new INESC TEC laboratory, iilab**;
- In the context of the initiative "Ciência Viva nos Laboratórios - Ocupação Científica de Jovens nas Férias", a **new studentship in AI** was created by SCOM with the support of LIAAD, CTM, CRIIS, HASLab and CITE. INESC TEC was **selected to host the kick-off event of this nationwide initiative** – with the presence of the Minister of Science, Technology and Higher Education.

9.11.2.2 External Communication

- The efforts made to achieve a greater visibility in the media have led to a **more sustained presence of INESC TEC in the main Portuguese media outlets**. A clipping service hired for this purpose identified 1183 news pieces in 2019, similarly to the previous year (Δ+8). The Automatic Advertising Value (AAV) return was 9.5M€, 3.2M€ more than in 2018. SCOM also had set out the goal of promoting the mediatisation of the least active Centres, with the results exceeding the expectations: CAP (63 news; Δ +61) and C-BER (93 news; Δ +88);

- Concerning the international press office, the team created an **institutional account in the Medium platform**, for the publication of four articles in 2019. INESC TEC collaborated in two news pieces for “El País” and “Marine Technology Reporter”;
- With regard to INESC TEC **Social Networks**, there were 2060 posts (posts and stories) in 2019, thus keeping a positive performance. Facebook continues to register the highest organic reach (average of 164.935 per semester) and the highest number of interactions. LinkedIn has the highest number of followers (9.699), with a significant increase over the year (Δ +44%). Twitter had the highest number of posts (623 over the year), while Instagram ranked second as the social network with the highest increase of followers (Δ +37%);
- The **“Fórum INESC TEC do Outono”** is an annual event organised by INESC TEC and open to the public. The 2019 edition focused on the theme "Digital Agro-food & Forestry (r)evolution”. This event, which featured SCOM in the organising team, had a tremendous impact and increased INESC TEC’s reputation through the quality of the presentations and debates, the number of executives and managers that were present (200 participants) and the opportunity to promote new business partnerships;
- INESC TEC also participated in **various events that promoted its status abroad**. SCOM ensured or supported the organisation of approximately 30 events, such as the inauguration of iilab and the closing event of integrated projects, as well as the participation in the European Utility Week (Paris), the Encontro Ciência 2019, the 360 Tech Industry, the European Maritime Day, the AED days, the Bussiness2Sea and the Marinetech;
- Concerning the **support to the R&D Centres**, SCOM increased its involvement in the design and execution of project dissemination activities, and supported the development of applications for new projects. In 2019, SCOM members ensured the dissemination work package of different European projects (InterConnect, FEEdBACk, GReSBAS, InteGrid, CloudDBAppliance and LightKone) and supported the communication actions of the Atlantis project, the EEN network and the CHIC project. SCOM also supported the applications (communication and dissemination sections) for 10 projects – five of them under the H2020. The team also designed the Communication Plan for iMAN Norte Hub;
- **The number of *in house* videos increased over 50%**, showing the SCOM focus on multimedia over the past years. In this sense, it’s worth mentioning the **production of 154 promotional videos** for events and exhibitions in 2019 (79 more than in 2018). The photographic coverage of events led to 73 albums in 2019;
- Regarding **communication material**, the focus was on the production of exhibition stands, outdoor screens, logos, flyers and roll-ups for different Centres, as well as templates, fact sheets, brochures, booklets, vinyl banners, stickers and merchandise.
- Equally important is the **dissemination of Science among younger generations**, with activities such as the institutional participation in the European Researchers’ Night, FEUP’s “Semana Profissão Engenheiro”, reception of the FEUP New Students and the Mostra of the U.Porto;
- The requests for sponsorship in **events organised by students** increased exponentially, with the SCOM evaluating 40 requests (20 in 2018). From the 21 sponsorships granted, SCOM was in charge of the operationalisation of the respective quid pro quo;
- SCOM was in charge of all the communication activities and strategy of the **UT Austin Portugal Program**. The Service also supported the communication instruments of the **CoLAB ForestWISE**.

9.11.2.3 Internal Communication

- A Team Building action called "**INESC TEC on the move**" was organised in 2019, with 90 participants. It aimed to provide cooperation and teamwork moments;
- The third edition of the annual **Strategic Meeting** brought together around 230 employees, in order to address and discuss fundamental topics for the Institution’s future;
- The **“INESC TEC on foot”** was organised and carried out in Lousã, with close to 50 participants. A second hike in Terras de Bouro was also organised, but it was cancelled due to bad weather;

- In 2019, in order to reinforce the internal cohesion, SCOM continued to **promote group activities for employees**, such as the photo contest, the Roasted Chestnuts party, the Multicultural Party and a solidarity campaign;
- In 2019, 13 **monthly sessions were organised in order to welcome 137 new employees**. These sessions were designed by SCOM, in liaison with the Human Resources Service;
- Considering that the Media are increasingly resorting to researchers for their interviews and news pieces, SCOM organised one **Media Training session** with 22 participants, in order to upgrade the communication skills of researchers, and the **Workshop "Techniques for effective presentations**" with 17 participants, in order to improve the ability to communicate in public events;
- All the **translation** and **proofreading** requests by the Centres and Services were carried out, according to SCOM's schedule.

9.12 NETWORKS AND COMMUNICATIONS SERVICE

Manager: Gil Coutinho

Figure 9.12.1 - SRC - Team composition and evolution

9.12.1 Presentation of the Service

The mission of the Networks and Communications Service (SRC) is to plan, manage and operate the communications infrastructures of INESC TEC. SRC runs INESC TEC's voice and data communication networks and is responsible for the implementation and maintenance of network-based services and for providing the respective support to end-users. Main areas of the team's activity are:

- Local Area Network (including cabled and wi-fi components);
- External connectivity (e.g. Internet);
- Voice communications (e.g. VoIP);
- Printing and scanning systems;
- Core mail system (e.g. Mail transfer agents, anti-virus, anti-spam);
- Remote access (e.g. VPN);
- Video-conference systems and solutions;
- Audio/Video streaming and broadcasting;
- Physical facility management (e.g. Datacenters);
- Support to events and remote facilities (including e.g. iiLab, INESC Brussels hub);
- User support.

9.12.2 Highlights in 2019

- A thorough reorganization of INESC TEC's local area network, including:
    - the upgrade of the switching infrastructure in order to provide access speeds of 1 Gigabit/s to workstations;
    - network virtualization in order to achieve path isolation, which in tandem with the local firewalls greatly improved the security of servers and workstations;

  - the provisioning of additional 10 gigabit/s interfaces and forwarding capacity, in order to fulfill the communication requirements of existing and new HPC clusters;

- Upgrade of the videoconferencing infrastructures, by the acquisition of 3 new room or portable solutions, with integration of legacy systems, WebEx, Zoom, etc.;
- The continuous improvement of monitoring and alarming platforms, with novelties like dashboards, centralized log search, mobile alarms;
- The implementation of the iiLab local area network and participation in the elaboration of the tender for its future facilities;
- The implementation of the communication infrastructure for the CCTV solution of building A;
- Support to locally organized events, held both within INESC TEC's facilities and otherwise, which included the mediation and validation of requirements in some cases but also the implementation and operation of infrastructures in others (e.g. streaming and VC solutions, sound systems, etc.);
- The planning, design and procurement of refurbishment works of the main datacenter of INESC TEC building A. The new solution offers more redundancy, better energy efficiency, better noise isolation and automatic fire detection and suppression. The refurbishment works will be concluded early 2020.

9.13 MANAGEMENT INFORMATION SYSTEMS SERVICE

Manager: José Carlos Sousa

Figure 9.13.1 - SIG - Team composition and evolution

9.13.1 Presentation of the Service

The Management Information Systems Service is in charge of the development and maintenance of INESC TEC's management information system.

The main systems under SIG supervision are the Human Resources system, the Intranet for the workflow processes, the IRIS database, the institutional repository and the website. SIG also supports the several Services in their interaction with the financial SAP system.

The team size in 2019 has been 3.5 FTE.

9.13.2 Highlights in 2019

The intranet has been extensively reorganized and focused on implementing the formal processes that are operating in the organization, along with its supporting documentation. Its infrastructure has been completely updated. The result is a significant improvement on usability and performance.

The IRIS – INESC TEC Research Information System continued to grow through the addition of a Projects module, which records the core information for projects and their teams, supporting documents and deliverables.

The production and dissemination of internal and external communication has been consolidated on a single platform, supporting the new BIP INESC TEC Magazine website and selectively feeding the news through several channels, including the website and the intranet.

Implementation of the ForestWISE website, a Collaborative Laboratory (CoLAB).

9.14 SYSTEM ADMINISTRATION SERVICE

Manager: Jaime Dias

Figure 9.14.1 - SAS - Team composition and evolution

9.14.1 Presentation of the Service

The System Administration Service is responsible for managing servers, computer systems and common applications, and for providing support to end-users, administrative staff as well as research and development teams. SAS is a member of the multidisciplinary Data Protection Team, appointed to support and monitor the implementation and compliance with the European General Data Protection Regulation. This Service is also responsible for managing the INESC TEC Living Lab, in collaboration with Research Centres and other Services, to enable INESC TEC's building and infrastructures as real life testbeds while promoting R&D results.

SAS has the responsability of administering and maintaining existing services/systems with minimal downtime and to continously improve them. Next are highlighted the main web-based services available to end-users that are administered by SAS:

- The Drive (drive.inesctec.pt), an on-premises file access and sharing service for Services and Centres. During 2019, its usage has grown from around 630 users to more than 1000;
- The Gitlab (gitlab.inesctec.pt), an on-premise Git repository service. The Gitlab service has seen an increment from around 500 to more than 720 active accounts, including 162 accounts from external users (INESC TEC partners) that rely on INESC TEC services to actively develop and store the code. The number of projects grew from around 1300 on 2018 to more than 1900 on 2019;
- The Chat (chat.inesctec.pt), an on-premises ChatOps service, grew from 40 teams with around 280 users on 2018 to 60 teams with around 1000 users on 2019;
- The RDM (rdm.inesctec.pt), the INESC TEC scientific dataset repository, has received 25 datasets from INESC TEC researchers until 2019;
- SAS hosted around 80 web sites during 2019, most of them are wordpress instances. SAS is responsible for the hosting and security monitoring of web framework instances.

The SAS Team manages aroung 200 PCs, more than 70 of Services and 140 of Centres. The management includes software and hardware maintenance.

Whenever required, SAS helps on assessing technical requirements of computer and software aquisitions and, when these are more complex, SAS also requests quotes.

The team size in 2019 has been 3.5 FTE.

9.14.2 Highlights in 2019

The computing cluster was extended with a new server, and the Network-Attached Storage (NAS) capacity was increased. The cluster hosted around 300 virtual machines, which includes the INESC TEC main services and Research & Development applications.

The Gitlab service was extended with resources to support Continuous Integration pipelines.

The institutional and data repositories were improved at the infrastructure level.

The organisation calendars on the Exchange servers were configured, enabling the publication of events to INESC TEC collaborators (e.g. “INESC TEC Events”) through their e-mail/calendaring applications.

Like in 2018, the tasks related with support to end-users and for Research and Development were those that took most of the time. Two thirds of the SAS team spent around 80% of their time on support requests. The SAS team handled and closed around 1400 support tickets. Like in 2018, these support tickets only account for around 60% of the support requests, which means that more than 2300 support requests were solved during 2019.

In 2019, SAS renegociated the Kasperky, Adobe, Matworks, and Microsoft software license agreements, including Office 365 licenses for all the INESC TEC users with no additional costs.

SAS contributed actively on the Data Protection Team to several actions and tasks, mainly on: system security audit actions, and security policy definition; technology, infraestructures and data handling procedures analysis; awareness initiatives, seminars on data protection and research; and assistance on the identification of research projects with potential privacy and data protection implications.

Under the INESC TEC Living Lab initiative, SAS contributed to the iiLab multimedia plataform definition and aquisition to help promoting and enabling the exploitation of INESC TEC R&D results on the iiLab.

9.15 INFRASTRUCTURE MANAGEMENT SERVICE

Manager: Jorge Couto

Figure 9.15.1 - SGI - Team composition and evolution

9.15.1 Presentation of the Service

The Infrastructure Management Service assures the support services necessary for the adequate management and maintenance of INESC TEC buildings infrastructures.

9.15.2 Highlights in 2019

In the service activity during 2019 the following achievements can be identified:

- Rationalization and optimization of the air conditioning system with the aim of improving comfort levels and reducing costs of operation;
- Actions to prevent and fight building fires were also implemented, namely the improvement of overall equipment installed at INESC TEC buildings to detect and fight building fires. All the technical verifications were made, and a fire drill took place to test the adequacy of equipment and procedures;
- Improve internal processes allowing better maintenance and support services with the existing resources;
- Maintenance actions in the buildings' electrical infrastructure were implemented on the main and partial LV switchboards;
- A sound system (including wirelesss microphones and speakers) to support videoconferences and large events was bought for the auditoriums A and B;
- Acquisition of a pulpit to support the presentations in the auditoriums;
- Advanced training in electrical installations and AVAC control systems;
- Overall improvement of building conditions, including painting and rearrangement of several offices to improve work condition.

10 ANNEX I

10.1 CTM – ACTIVITY RESULTS IN 2019

10.1.1 Activity indicators

The following tables present CTM research team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.1.1 - CTM - Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	7	10	13	3
		Academic Staff	22	14	15	1
		Grant Holders and Trainees	49	53	46	-7
		Total Core Researchers	**78**	**77**	**74**	**-3**
		Total Core PhD	**34**	**25**	**27**	**2**
	Affiliated Researchers		8	9	7	-2
	Administrative and Technical	Employees	1	1	1	0
		Grant Holders and Trainees	0	0	0	0
		Total Admin and Tech	**1**	**1**	**1**	**0**
		Total Integrated HR	**87**	**87**	**82**	**-5**
		Total Integrated PhD	**41**	**34**	**34**	**0**

Table 10.1.2 - CTM – Project funding

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes - FCT	31	257	474	217
PN-PICT	National R&D Programmes - S&T Integrated Projects	497	290	95	-195
PN-COOP	National Cooperation Programmes with Industry	160	274	248	-26
PUE-FP	EU Framework Programmes	223	189	245	56
PUE-DIV	EU Cooperation Programmes - Other	22			
SERV-NAC	R&D Services and Consulting - National	129	253	302	49
SERV-INT	R&D Services and Consulting - International	29	116	89	-26
OP	Other Funding Programmes	100	32	23	-10
Closed Projects		7	8	11	3
	Total Funding	**1 199**	**1 419**	**1 487**	**68**

Table 10.1.3 - CTM - Summary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	27	26	34
Indexed Conferences	45	43	41
Books			
Book Chapters	1		5
Concluded PhD Theses - Members	4	6	4
Concluded PhD Theses - Supervised	4	9	7

Table 10.1.4 - CTM - Summary of IP protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	1	1	3
Software copyright registrations	0	0	1
Patent first priority filings (New inventions)	3	1	1
Patent applications (Internationalization)	7	8	13
Granted patents	1	5	3
Licence agreements	1	0	0
Spin-offs established	0	0	0
Spin-offs in development	0	0	0

Table 10.1.5 - CTM - Summary of dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	3
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	5
International events in which INESC TEC members participate in the program committees	52
Participation in events such as fairs, exhibitions or similar	5

Table 10.1.6 - CTM - Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	5
Participants in the conferences, workshops and scientific sessions organised by the Centre	300
Advanced training courses organised by the Centre	10

Table 10.1.7 - CTM - List of projects

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
PN-FCT	WISE	Manuel Ricardo	01/06/2016	31/05/2019
PN-FCT	EVOXANT	André Marçal	15/06/2016	15/06/2020
PN-FCT	TEC4SEA-1	Rui Lopes Campos	01/09/2017	30/08/2020
PN-FCT	CompMash	Matthew Davies	01/10/2017	31/12/2019
PN-FCT	Blueenergy	Manuel Cândido Santos	01/10/2018	31/03/2020
PN-FCT	CLARE	Jaime Cardoso	01/07/2018	30/06/2021
PN-FCT	LUCAS	Hélder Filipe Oliveira	26/07/2018	25/07/2021
PN-FCT	ENDURANCE	Luís Manuel Pessoa	01/07/2018	29/06/2020
PN-FCT	PEPCC	João Canas Ferreira	01/10/2018	30/09/2021
PN-FCT	GROW	Rui Lopes Campos	01/10/2018	31/12/2020
PN-FCT	AUTOMOTIVE	Ana Maria Rebelo	01/10/2018	30/09/2021
PN-FCT	HEMOSwimmers	Hélder Filipe Oliveira	26/07/2018	25/07/2021
PN-FCT	S-MODE	Hélder Filipe Oliveira	01/07/2018	30/06/2021
PN-FCT	NeurOxide	Vítor Grade Tavares	01/10/2018	30/09/2021
PN-FCT	XPERIMUS	Rui Penha	26/11/2018	25/11/2021
PN-PICT	FOUREYES	Paula Viana	01/07/2015	30/06/2019
PN-PICT	SMILES-6	Manuel Ricardo	01/07/2015	30/06/2019
PN-PICT	CORAL-TOOLS-1	Rui Lopes Campos	01/01/2016	31/12/2018
PN-PICT	NanoStima-RL1-3	Henrique Salgado	01/07/2015	30/06/2019
PN-PICT	NanoStima-RL5	Jaime Cardoso	01/07/2015	30/06/2019
PN-COOP	BCCT.Plan	Hélder Filipe Oliveira	01/11/2016	31/10/2019
PN-COOP	Cloud-Setup	Pedro Miguel Carvalho	01/07/2016	31/01/2019
PN-COOP	ROMOVI-1	Manuel Cândido Santos	07/01/2017	30/11/2019
PN-COOP	5G	Manuel Ricardo	01/01/2018	31/12/2020
PN-COOP	CHIC	Paula Viana	01/10/2017	30/09/2020
PN-COOP	STRx	Luís Manuel Pessoa	01/10/2018	30/04/2022
PUE-FP	iBROW	Luís Manuel Pessoa	01/01/2015	2018-06-30
PUE-FP	STRONGMAR-1	Rui Lopes Campos	01/01/2016	31/12/2018
PUE-FP	TERAPOD	Luís Manuel Pessoa	01/09/2017	31/08/2020
PUE-FP	FotoInMotion	Maria Teresa Andrade	01/01/2018	31/12/2020
PUE-FP	RESPONDRONE	Rui Lopes Campos	01/05/2019	30/04/2022
PUE-FP	EuConNeCts4	Rui Lopes Campos	01/06/2019	01/12/2021
SERV-NAC	Where.is	Luís Manuel Pessoa	01/12/2017	29/02/2020
SERV-NAC	UGREEN	Rui Lopes Campos	01/10/2017	30/09/2019
SERV-NAC	ConnectedRefinery	Manuel Ricardo	01/01/2018	31/03/2019
SERV-NAC	TenisApp	Pedro Miguel Carvalho	01/09/2018	31/08/2019
SERV-NAC	NB-IoT	Filipe André Ribeiro	26/11/2018	25/05/2019
SERV-NAC	FollicleCounter	Hélder Filipe Oliveira	01/12/2018	31/03/2020
SERV-NAC	MetroRec	Filipe André Ribeiro	01/02/2019	15/02/2019
SERV-NAC	CLOUD4CANDY	Paula Viana	15/04/2019	15/05/2019
SERV-NAC	InterCork	Rui Lopes Campos	01/05/2019	01/08/2019
SERV-INT	SIMBED	Rui Lopes Campos	01/04/2018	31/03/2019
SERV-INT	NFCAD	Luís Manuel Pessoa	01/07/2019	30/09/2019
OP	Inphinit	Paula Viana	01/12/2019	01/12/2022
OP	Visum2019	Ana Maria Rebelo	01/01/2019	31/12/2020

Type of Project:

PN-FCT National R&D Programmes - FCT
PN-PICT National R&D Programmes - S&T Integrated Projects
PN-COOP National Cooperation Programmes with Industry
PUE-FP EU Framework Programme

PUE-DIV	EU Cooperation Programmes - Other
SERV-NAC	National R&D Services and Consulting
SERV-INT	International R&D Services and Consulting
OP	Other Funding Programmes

10.1.2 List of Publications

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4. Caetano, M, Zacharakis, A, Barbancho, I, Tarclon, LJ, "Leveraging diversity in computer-aided musical orchestration with an artificial immune system for multi-modal optimization", Swarm and Evolutionary Computation, 2019
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11. Fernandes, K, Cardoso, JS, "Hypothesis transfer learning based on structural model similarity", Neural Computing and Applications, pp.1-14, 2019
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7. Araújo, RJ, Cardoso, JS, Oliveira, HP, "Deep Vesselness Measure from Scale-Space Analysis of Hessian Matrix Eigenvalues", Pattern Recognition and Image Analysis - Lecture Notes in Computer Science, pp.473-484, 2019
8. Bernardes, G, Aly, L, Davies, MEP, "Seed: Resynthesizing environmental sounds from examples", SMC 2016 - 13th Sound and Music Computing Conference, Proceedings, pp.55-62, 2019
9. Bessa, S, Carvalho, PH, Oliveira, HP, "Registration of Breast Mri and 3d Scan Data Based on Surface Matching", 2019 IEEE 16th International Symposium on Biomedical Imaging (ISBI 2019), pp.1074-1077, 2019
10. Caridade, CMR, Marcal, ARS, "Automatic classification of coral images using colour and textures", CEUR Workshop Proceedings, vol.2380, 2019
11. Castro, E, Pereira, JC, Cardoso, JS, "Weight Rotation as a Regularization Strategy in Convolutional Neural Networks", 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), 2019
12. Castro, M, Araújo, RJ, Campo Deaño, L, Oliveira, HP, "Towards Automatic and Robust Particle Tracking in Microrheology Studies", Pattern Recognition and Image Analysis - Lecture Notes in Computer Science, pp.508-519, 2019
13. Coelho, A, Almeida, EN, Ruela, J, Campos, R, Ricardo, M, "A Routing Metric for Inter-flow Interference-aware Flying Multi-hop Networks", 2019 IEEE Symposium on Computers and Communications (ISCC), 2019
14. Cruz, R, Coelho, A, Campos, R, Ricardo, M, "A Theoretical Model for Planning NB-IoT Networks", 2019 International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob), 2019
15. Cruz, R, Costa, JFP, Cardoso, JS, "Averse Deep Semantic Segmentation", 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), 2019

16. Cruz, R, Pinto Costa, JF, Cardoso, JS, "Automatic Augmentation by Hill Climbing", Lecture Notes in Computer Science - Artificial Neural Networks and Machine Learning – ICANN 2019: Deep Learning, pp.115-124, 2019

17. Davies, MEP, Böck, S, "Temporal convolutional networks for musical audio beat tracking", 2019 27th European Signal Processing Conference (EUSIPCO), 2019

18. Fernandes Gomes, D, Luo, S, Teixeira, LF, "Garmnet: improving global with local perception for robotic laundry folding", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11650 LNAI, pp.49-61, 2019

19. Fernandes, R, Andrade, MT, "Adaptation execution cost definition for a multimedia adaptation decision engine using a neural network", AIP Conference Proceedings, vol.2116, 2019

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26. Marcal, ARS, Santos, EMDS, Tavares, F, "Image Based Estimation of Fruit Phytopathogenic Lesions Area", Pattern Recognition and Image Analysis - Lecture Notes in Computer Science, pp.285-295, 2019

27. Martins, ALR, Marcal, ARS, Pissarra, J, "Modified DBSCAN Algorithm for Microscopic Image Analysis of Wood", Pattern Recognition and Image Analysis - Lecture Notes in Computer Science, pp.257-269, 2019

28. Monteiro, JP, Zolfagharnasab, H, Oliveira, HP, "Geometry-based skin colour estimation for bare torso surface reconstruction", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11752 LNCS, pp.595-606, 2019

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32. Pinheiro, G, Coelho, P, Mourao, M, Salgado, M, Oliveira, HP, Cunha, A, "Small Bowel Mucosa Segmentation for Frame Characterization in Videos of Endoscopic Capsules", 2019 IEEE 16th International Symposium on Biomedical Imaging (ISBI 2019), 2019

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35. Rocha, CJ, Ribeiro, R, Cruz, PM, Viana, P, "Automatized Solution for Over-the-Air (OTA) Testing and Validation of Automotive Radar Sensors", Proceedings of the 2019 9th IEEE-APS Topical Conference on Antennas and Propagation in Wireless Communications, APWC 2019, pp.370-374, 2019
36. Silva, P, Almeida, NT, Campos, R, "Energy Consumption Management for Dense Wi-Fi Networks", IFIP Wireless Days, vol.2019-April, 2019
37. Silva, W, Castro, E, Cardoso, MJ, Fitzal, F, Cardoso, JS, "Deep Keypoint Detection for the Aesthetic Evaluation of Breast Cancer Surgery Outcomes", 2019 IEEE 16th International Symposium on Biomedical Imaging (ISBI 2019), pp.1082-1086, 2019
38. Silva, W, Fernandes, K, Cardoso, JS, "How to produce complementary explanations using an Ensemble Model", Proceedings of the International Joint Conference on Neural Networks, vol.2019-July, 2019
39. Simas Filho, EF, Prates, RM, Ramos, RP, Cardoso, JS, "Power distribution insulators classification using image hybrid deep learning", European Signal Processing Conference, vol.2019-September, 2019
40. Sousa, J, Rebelo, A, Cardoso, JS, "Automation of Waste Sorting with Deep Learning", Proceedings - 15th Workshop of Computer Vision, WVC 2019, pp.43-48, 2019
41. Teixeira, FB, Moreira, N, Campos, R, Ricardo, M, "Data Muling Approach for Long-Range Broadband Underwater Communications", International Conference on Wireless and Mobile Computing, Networking and Communications, vol.2019-October, 2019

Books

Blank

Chapters/Papers in Books

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2. Derogarian, F, Canas Ferreira, J, Grade Tavares, V, Machado da Silva, J, Velez, FJ, "A reliable wearable system for BAN applications with a high number of sensors and high data rate", Wearable Technologies and Wireless Body Sensor Networks for Healthcare, pp.53-87, 2019
3. Machado da Silva, J, Derogarian, F, Canas Ferreira, J, Grade Tavares, V, "Wearable sensor networks for human gait", Wearable Technologies and Wireless Body Sensor Networks for Healthcare, pp.321-360, 2019
4. S. Peixoto, P, Machado, A, P. Oliveira, H, A. Bordalo, A, A. Segundo, M, "Paper-Based Biosensors for Analysis of Water", Environmental Biosensors [Working Title], 2019
5. Silva, G, Monteiro, R, Ferreira, A, Carvalho, P, Corte-Real, L, "Face Detection in Thermal Images with YOLOv3", Advances in Visual Computing - Lecture Notes in Computer Science, pp.89-99, 2019

Publications (Editor)

Blank

Dissertations (PhD)

1. Aboderin, O., “Antenna Design for Underwater Applications”;
2. Ferreira, M., “Reconfigurable FPGA-Based Baseband Processor for Multi-mode Spectrum Aggregation”;

3. Fontes, H., “Improving the performance evaluation of wireless networks: towards a simulation-experimentation synergy using ns-3”;
4. Kianpour, I., “Design of a low power transmitter for UWB applications”.

10.2 CAP – ACTIVITY RESULTS IN 2019

10.2.1 Activity indicators

The following tables present CAP research team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.2.1 - CAP – Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	5	8	9	1
		Academic Staff	9	7	8	1
		Grant Holders and Trainees	18	17	13	-4
		Total Core Researchers	**32**	**32**	**30**	**-2**
		Total Core PhD	**16**	**15**	**15**	**0**
	Affiliated Researchers		8	5	5	0
	Administrative and Technical	Employees	2	2	2	0
		Grant Holders and Trainees	0	0	0	0
		Total Admin and Tech	**2**	**2**	**2**	**0**
		Total Integrated HR	**42**	**39**	**37**	**-2**
		Total Integrated PhD	**21**	**20**	**20**	**0**

Table 10.2.2 - CAP - Project funding

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes - FCT	9	214	370	156
PN-PICT	National R&D Programmes - S&T Integrated Projects	238	220	81	-139
PN-COOP	National Cooperation Programmes with Industry				
PUE-FP	EU Framework Programmes	80		22	22
PUE-DIV	EU Cooperation Programmes - Other	7	35	70	35
SERV-NAC	R&D Services and Consulting - National	16	34	46	12
SERV-INT	R&D Services and Consulting - International		15		-15
OP	Other Funding Programmes	3			
Closed Projects		24	22	19	-2
	Total Funding	**378**	**540**	**608**	**68**

Table 10.2.3 - CAP - Summary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	36	22	23
Indexed Conferences	39	12	26
Books			
Book Chapters			
Concluded PhD Theses - Members	3	4	
Concluded PhD Theses - Supervised	3	4	1

Table 10.2.4 - CAP - Summary of IP protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	1	3	1
Software copyright registrations	0	0	0
Patent first priority filings (New inventions)	1	3	0
Patent applications (Internationalization)	3	4	7
Granted patents	0	0	0
Licence agreements	0	0	0
Spin-offs established	0	0	0
Spin-offs in development	0	0	1

Table 10.2.5 - CAP - Summary of dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	5
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	1
International events in which INESC TEC members participate in the program committees	6
Participation in events such as fairs, exhibitions or similar	1

Table 10.2.6 - CAP - Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	8 (*)
Participants in the conferences, workshops and scientific sessions organised by the Centre	80 (*)
Advanced training courses organised by the Centre	0

* In co-organization with UP SPIE Student Chapter

Table 10.2.7 - CAP - List of projects

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
PN-FCT	TEC4SEA-2	Pedro Jorge	01/09/2017	30/08/2020
PN-FCT	FLAPSYS	Pedro Jorge	01/03/2018	28/02/2021
PN-FCT	SolSensors	Luís Carlos Coelho	01/05/2018	30/04/2021
PN-FCT	ENDOR	Orlando Frazão	01/06/2018	31/05/2021
PN-FCT	MetBots	Rui Costa Martins	26/07/2018	24/07/2020
PN-FCT	GreenNanoSensing	Ariel Guerreiro	01/07/2018	30/06/2021
PN-PICT	CORAL-SENSORS	Pedro Jorge	01/01/2016	31/12/2018
PN-PICT	CORAL-TOOLS-2	Pedro Jorge	01/01/2016	31/12/2018
PN-PICT	NanoStima-RL1-1	Carla Carmelo Rosa	01/07/2015	30/06/2019
PUE-DIV	AGRINUPES-1	Pedro Jorge	01/04/2017	31/03/2020
PUE-DIV	SAFEWATER	Pedro Jorge	03/04/2018	02/04/2021
PUE-FP	STRONGMAR-2	Ireneu Dias	01/01/2016	31/12/2018
PUE-FP	WiPTherm	Orlando Frazão	01/11/2019	31/10/2022
SERV-NAC	LED	Paulo Vicente Marques	19/12/2018	18/06/2020
SERV-NAC	MINDOG	Pedro Jorge	01/12/2017	01/12/2019
SERV-NAC	EFAR	Orlando Frazão	01/06/2019	01/01/2020
SERV-NAC	SmartEcotec	Ireneu Dias	01/12/2019	31/05/2020
SERV-NAC	FlexOPlan-1	Ireneu Dias	01/05/2019	01/11/2020

Type of Project:

PN-FCT	National R&D Programmes - FCT
PN-PICT	National R&D Programmes - S&T Integrated Projects
PN-COOP	National Cooperation Programmes with Industry
PUE-FP	EU Framework Programme
PUE-DIV	EU Cooperation Programmes - Other
SERV-NAC	National R&D Services and Consulting
SERV-INT	International R&D Services and Consulting
OP	Other Funding Programmes

10.2.2 List of Publications

International Journals with Scientific Referees

1. Amorim, VA, Maia, JM, Viveiros, D, Marques, PVS, "Loss Mechanisms of Optical Waveguides Inscribed in Fused Silica by Femtosecond Laser Direct Writing", Journal of Lightwave Technology, pp.1-1, 2019
2. Amorim, VA, Viveiros, D, Maia, JM, Marques, PVS, "Mass Producible Low-Loss Broadband Optical Waveguides in Eagle2000 by Femtosecond Laser Writing", IEEE Photonics Technology Letters, vol.31, pp.1658-1661, 2019
3. dos Santos, PSS, Jorge, PAS, de Almeida, JMMM, Coelho, L, "Low-cost interrogation system for long-period fiber gratings applied to remote sensing", Sensors (Switzerland), vol.19, pp.1500, 2019
4. Figueira, RB, Sousa, R, Coelho, L, Azenha, M, de Almeida, JM, Jorge, PAS, Silva, CJR, "Alkali-silica reaction in concrete: Mechanisms, mitigation and test methods", Construction and Building Materials, vol.222, pp.903-931, 2019
5. Fujiwara, E, Hayashi, JG, Delfino, TD, Jorge, PAS, de Barros Cordeiro, CMD, "Optical Fiber Anemometer Based on a Multi-FBG Curvature Sensor", IEEE Sensors Journal, vol.19, pp.8727-8732, 2019

6. Gangwar, RK, Amorim, VA, Marques, PVS, "High Performance Titanium oxide coated D-shaped Optical Fiber Plasmonic Sensor", IEEE Sensors Journal, pp.1-1, 2019
7. Gomes, AD, Becker, M, Dellith, J, Zibaii, MI, Latifi, H, Rothhardt, M, Bartelt, H, Frazao, O, "Multimode Fabry? Perot Interferometer Probe Based on Vernier Effect for Enhanced Temperature Sensing", Sensors (Basel, Switzerland), vol.19, pp.453, 2019
8. Gomes, AD, Kobelke, J, Bierlich, J, Schuster, K, Bartelt, H, Frazao, O, "Optical Fiber Probe Viscometer Based on Hollow Capillary Tube", Journal of Lightwave Technology, vol.37, pp.4456-4461, 2019
9. Guerreiro, A, Santos, DF, Baptista, JM, "New Trends in the Simulation of Nanosplasmonic Optical D-Type Fiber Sensors", Sensors, vol.19, pp.1772, 2019
10. Lobo Ribeiro, ABL, Silva, SFO, Frazao, O, Santos, JL, "Bi-core optical fiber for sensing o temperature, strain and torsion", Measurement Science and Technology, vol.30, MAR, 2019
11. Mendes, JP, Coelho, L, Kovacs, B, Almeida, JMMM, Pereira, CM, Jorge, PAS, Borges, MT, "Dissolved Carbon Dioxide Sensing Platform for Freshwater and Saline Water Applications: Characterization and Validation in Aquaculture Environments", Sensors (Basel, Switzerland), vol.19, pp.5513, 2019
12. Mendonca, JT, Guerreiro, A, Ali, S, "Photon Bubbles in a Self-gravitating Dust Gas: Collective Dust Interactions", Astrophysical Journal, vol.872, 2019
13. Monteiro Silva, F, Jorge, PAS, Martins, RC, "Optical Sensing of Nitrogen, Phosphorus and Potassium: A Spectrophotometrical Approach toward Smart Nutrient Deployment", Chemosensors, vol.7, DEC, 2019
14. Monteiro, CS, Kobelke, J, Schuster, K, Bierlich, J, Silva, SO, Frazao, O, "High sensitivity strain sensor based on twin hollow microspheres", Microwave and Optical Technology Letters, vol.61, pp.454-458, Feb, 2019
15. Moreira, MJ, Garcia Diez, J, de Almeida, JMMM, Saraiva, C, "Evaluation of food labelling usefulness for consumers", International Journal of Consumer Studies, 2019
16. Nascimento, M, Novais, S, Ding, MS, Ferreira, MS, Koch, S, Passerini, S, Pinto, JL, "Internal strain and temperature discrimination with optical fiber hybrid sensors in Li-ion batteries", Journal of Power Sources, vol.410, pp.1-9, 2019
17. Paiva, JS, Jorge, PAS, Ribeiro, RSR, Sampaio, P, Rosa, CC, Cunha, JPS, "Optical fiber-based sensing method for nanoparticle detection through supervised back-scattering analysis: a potential contributor for biomedicine", International Journal of Nanomedicine, vol. 14, pp.2349-2369, 2019
18. Robalinho, P, Frazao, O, "Fiber microsphere coupled in a taper for a large curvature range", Fibers, vol.7, 2019
19. Robalinho, P, Frazao, O, "Micro-cantilever displacement detection based in optical fiber tip", Sensors (Switzerland), vol.19, 2019
20. Santos, D, Guerreiro, A, Baptista, JM, "Evaluation of Nanoplasmonic Optical Fiber Sensors Based on D-Type and Suspended Core Fibers with Metallic Nanowires", Photonics, vol.6, pp.100, Sep, 2019
21. Soares Guedes Vasconcelos, HCASG, Marques Martins de Almeida, JMMM, Teixeira Saraiva, CMT, da Silva Jorge, PAD, Costa Coelho, LCC, "Mach-Zehnder Interferometers Based on Long Period Fiber Grating Coated with Titanium Dioxide for Refractive Index Sensing", Journal of Lightwave Technology, pp.1-1, 2019
22. Tehrani, MW, Huang, R, Guimaraes, D, Smieska, L, Woll, A, Parsons, PJ, "A study of lead uptake and distribution in horns from lead-dosed goats using synchrotron radiation-induced micro X-ray fluorescence elemental imaging", Journal of Trace Elements in Medicine and Biology, vol.55, pp.143-153, 2019
23. Vaz, A, Barroca, N, Ribeiro, M, Pereira, A, Frazao, O, "Optical Fiber Humidity Sensor Based on Polyvinylidene Fluoride Fabry-Perot", IEEE Photonics Technology Letters, vol.31, pp.549-552, 2019

International Conference Proceedings with Scientific Referees

1. Amorim, VA, Viveiros, D, Maia, JM, Marques, PVS, "Spectral characteristics of optical waveguides fabricated in glass by femtosecond laser direct writing", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
2. Ferreira, MFS, Guimarães, D, Jorge, PAS, Martins, RC, "Plasma control by pattern recognition in laser induced breakdown spectroscopy", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
3. Ferreira, TD, Silva, NA, Bertolami, O, Gomes, C, Guerreiro, A, "Simulating N-body systems for alternative theories of gravity using solvers from nonlocal optics", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
4. Ferreira, TD, Silva, NA, Guerreiro, A, "Developing tunable optical analogues using nematic liquid crystals", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
5. Ferreira, TD, Silva, NA, Guerreiro, A, "High-performance solver of the multidimensional generalized nonlinear Schrödinger equation with coupled fields", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
6. Gomes, AD, Becker, M, Dellith, J, Zibaii, MI, Latifi, H, Rothhardt, M, Bartelt, H, Frazaõ, O, "Enhanced temperature sensing with Vernier effect on fiber probe based on multimode Fabry-Perot interferometer", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
7. Gomes, AD, Frazao, O, "Microfiber Knot Resonators for Sensing Applications", Springer Series in Optical Sciences, vol.222, pp.145-163, 2019
8. Guerreiro, A, Apolinario, A, Lopes, A, Hierro Rodriguez, A, Aguilar, G, Baptista, JM, Silva, NA, Frazão, O, Quiterio, PV, Jorge, P, Rodrigues, P, Silveira Moraes, S, Silva, S, Ferreira, TD, Santos, JL, Araujo, JP, "Functional metamaterials for optical sensing of hydrogen", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
9. Guerreiro, A, Ferreira, TD, Silva, NA, "Quantum fluid equations for atomic gases", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
10. Guerreiro, A, Silva, NA, Costa, J, Gomes, M, Alves, R, Ferreira, TD, Madureira, IS, Almeida, AL, Pereira, AAM, "Hilight: A new simulation platform for advanced photonics", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
11. Guimarães, D, Ferreira, MFS, Ribeiro, R, Dias, C, Lima, A, Martins, RC, Jorge, PAS, "Application of a novel LIBS prototype as an analytical grade tool for Li quantification in pegmatite samples", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
12. Maia, JM, Amorim, VA, Alexandre, D, Marques, PVS, "Advances in Fs-Laser Micromachining Towards the Development of Optofluidic Devices", Springer Series in Optical Sciences, vol.222, pp.119-144, 2019
13. Maia, JM, Amorim, VA, Viveiros, D, Marques, PVS, "Femtosecond laser micromachining of Fabry-Pérot interferometers in fused silica for refractive index sensing", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
14. Martins, RC, Magalhães, S, Jorge, P, Barroso, T, Santos, F, "Metbots: Metabolomics Robots for Precision Viticulture", Progress in Artificial Intelligence - Lecture Notes in Computer Science, pp.156-166, 2019
15. Monteiro, CS, Raposo, M, Ribeiro, P, Silva, S, Frazaõ, O, "Graphene oxide as a tunable platform for microsphere-based optical fiber sensors", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
16. Monteiro, CS, Vaz, A, Viveiros, D, Linhares, C, Tavares, SMO, Mendes, H, Silva, SO, Marques, PVS, Frazao, O, "FBG two-dimensional vibration sensor for power transformers", Proceedings of SPIE - The International Society for Optical Engineering, vol.11199, 2019

17. Monteiro, CS, Viveiros, D, Linhares, C, Tavares, SMO, Mendes, H, Silva, SO, Marques, PVS, Frazaõ, O, "3D prototyping of a fiber Bragg grating vibration sensor for power transformers", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
18. Nóbrega Dos Santos, D, Guerreiro, A, Baptista, JM, "Enhancing nanoplasmonic sensing with metallic nanowires: From D-type to suspended core fibres", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
19. Novais, S, Ferreira, MS, Pinto, JL, "Humidity sensor based on optical fiber coated with agarose gel", Optical Sensors 2019, 2019
20. Novais, S, Silva, SO, Frazao, O, "Fabry-Perot cavity for curvature measurement in a medical needle", Proceedings of SPIE - The International Society for Optical Engineering, vol.11199, 2019
21. Paiva, JS, Ribeiro, RSR, Jorge, PAS, Rosa, CC, Sampaio, P, Cunha, JPS, "Optical fiber-based sensing method for nanoparticles detection through back-scattering signal analysis", Progress in Biomedical Optics and Imaging - Proceedings of SPIE, vol.10872, 2019
22. Perez Herrera, RA, Novais, S, Bravo, M, Leandro, D, Silva, SF, Frazao, O, Lopez Amo, M, "Multiplexing optical fiber Fabry-Perot interferometers based on air-microcavities", Proceedings of SPIE - The International Society for Optical Engineering, vol.11199, 2019
23. Silva, NA, Ferreira, TD, Guerreiro, A, "A hardware-independent solution for high-performance simulations of the Maxwell-Bloch system", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
24. Silva, NA, Ferreira, TD, Guerreiro, A, "Exploring dissipative optical solitons controlling gain and loss in atomic systems", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
25. Silva, NA, Ferreira, TD, Guerreiro, A, "Fluids of light in atomic systems: From superfluidity to quantum simulations", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019
26. Viveiros, D, Maia, J, Amorim, VA, Jorge, PAS, Marques, PVS, "Fabrication of periodic structures in optical fibers by femtosecond laser micromachining for sensing applications", Proceedings of SPIE - The International Society for Optical Engineering, vol.11207, 2019

Books

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Chapters/papers in Books

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Publications (Editor)

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Dissertations (PhD)

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10.3 CRAS – ACTIVITY RESULTS IN 2019

10.3.1 Activity indicators

The following tables present CRAS research team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.3.1 - CRAS - Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	8	11	12	1
		Academic Staff	10	11	11	0
		Grant Holders and Trainees	31	22	25	3
		Total Core Researchers	**49**	**44**	**48**	**4**
		Total Core PhD	**14**	**14**	**14**	**0**
	Affiliated Researchers		0	0	0	0
	Administrative and Technical	Employees	2	4	3	-1
		Grant Holders and Trainees	1	1	0	-1
		Total Admin and Tech	**3**	**5**	**3**	**-2**
		Total Integrated HR	**52**	**49**	**51**	**2**
		Total Integrated PhD	**14**	**14**	**14**	**0**

Table 10.3.2 - CRAS - Project funding

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes - FCT	94	337	482	146
PN-PICT	National R&D Programmes - S&T Integrated Projects	127	101	13	-87
PN-COOP	National Cooperation Programmes with Industry	183	200	147	-52
PUE-FP	EU Framework Programmes	845	530	276	-254
PUE-DIV	EU Cooperation Programmes - Other	115	102	201	100
SERV-NAC	R&D Services and Consulting - National	97	33	61	28
SERV-INT	R&D Services and Consulting - International	131	115	132	17
OP	Other Funding Programmes	11	94	7	-87
Closed Projects				60	60
	Total Funding	**1 603**	**1 511**	**1 380**	**-131**

Table 10.3.3 - CRAS - Summary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	9	8	17
Indexed Conferences	30	27	18
Books			
Book Chapters	4	1	1
Concluded PhD Theses - Members	1	1	
Concluded PhD Theses - Supervised	1	1	

Table 10.3.4 - CRAS - Summary of IP protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	1	1	1
Software copyright registrations	0	0	1
Patent first priority filings (New inventions)	0	2	0
Patent applications (Internationalization)	0	2	4
Granted patents	0	0	0
Licence agreements	0	0	0
Spin-offs established	0	0	0
Spin-offs in development	0	0	1

Table 10.3.5 - CRAS - Summary of dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	1
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	1
International events in which INESC TEC members participate in the program committees	5
Participation in events such as fairs, exhibitions or similar	4

Table 10.3.6 - CRAS - Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	4
Participants in the conferences, workshops and scientific sessions organised by the Centre	150
Advanced training courses organised by the Centre	0

Table 10.3.7 - CRAS - List of projects

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
PN-FCT	MyTag	Eduardo Silva	01/06/2016	31/05/2019
PN-FCT	TEC4SEA	Eduardo Silva	01/09/2017	30/08/2020
PN-FCT	ROSM	André Dias	01/10/2017	02/10/2019
PN-FCT	EMSO-PT	Aníbal Matos	01/07/2017	29/06/2021
PN-FCT	BIOREM	André Dias	01/06/2018	31/05/2021
PN-FCT	DIIUS	Andry Maykol Pinto	26/07/2018	25/07/2021
PN-FCT	ENDURANCE-1	Nuno Cruz	01/07/2018	29/06/2020
PN-FCT	GROW-1	Bruno Filipe Ferreira	01/10/2018	31/12/2020
PN-PICT	CORAL-SENSORS-1	Eduardo Silva	01/01/2016	31/12/2018
PN-PICT	CORAL-TOOLS	Eduardo Silva	01/01/2016	31/12/2018
PN-COOP	FEEDFIRST	Eduardo Silva	01/01/2018	31/12/2020
PN-COOP	HiperSea	Eduardo Silva	01/07/2018	30/06/2021
PN-COOP	NESSIE	Aníbal Matos	01/01/2019	31/12/2021
PUE-DIV	SpilLess	Eduardo Silva	01/02/2017	30/04/2019
PUE-DIV	PROTOATLANTIC	Eduardo Silva	01/11/2017	31/10/2020
PUE-DIV	INTENDU	Aníbal Matos	01/03/2018	28/02/2021
PUE-DIV	Prince	Hugo Miguel Silva	01/01/2019	31/12/2021
PUE-DIV	Nettag	Alfredo Martins	01/01/2019	31/12/2020
PUE-FP	VAMOS	Eduardo Silva	01/02/2015	31/01/2019
PUE-FP	STRONGMAR	Eduardo Silva	01/01/2016	31/12/2018
PUE-FP	UNEXMIN	Eduardo Silva	01/02/2016	31/10/2019
UE-FP	Mine_Heritage	Eduardo Silva	01/01/2019	31/12/2021
PUE-FP	SPRING	Aníbal Matos	01/08/2019	31/07/2022
PUE-FP	DEEPFIELD	Eduardo Silva	01/10/2019	30/09/2022
SERV-NAC	Modulmar	Eduardo Silva	01/01/2019	31/12/2020
SERV-NAC	SVManagement	Andry Maykol Pinto	01/02/2019	01/10/2019
SERV-NAC	MetroRec-1	Carlos Pinho	01/02/2019	15/02/2019
SERV-INT	AutoMon	Nuno Cruz	01/04/2017	31/08/2020
SERV-INT	SantoAntonio	Aníbal Matos	01/01/2019	31/07/2020
OP	INTHEBLACK2019	Eduardo Silva	03/04/2019	27/06/2019

Type of Project:

PN-FCT	National R&D Programmes - FCT
PN-PICT	National R&D Programmes - S&T Integrated Projects
PN-COOP	National Cooperation Programmes with Industry
PUE-FP	EU Framework Programme
PUE-DIV	EU Cooperation Programmes - Other
SERV-NAC	National R&D Services and Consulting
SERV-INT	International R&D Services and Consulting
OP	Other Funding Programmes

10.3.2 List of Publications

International Journals with Scientific Referees

1. Azevedo, F, Dias, A, Almeida, J, Oliveira, A, Ferreira, A, Santos, T, Martins, A, Silva, E, "LiDAR-Based Real-Time Detection and Modeling of Power Lines for Unmanned Aerial Vehicles", Sensors, vol.19, pp.1812, 2019
2. Carneiro, JF, Pinto, JB, Cruz, NA, de Almeida, FG, "Development of an Electrohydraulic Variable Buoyancy System", Information, vol.10, pp.396, DEC, 2019
3. Duarte, AJ, Malheiro, B, Arno, E, Perat, I, Silva, MF, Fuentes Dura, P, Guedes, P, Ferreira, P, "Engineering Education for Sustainable Development: The European Project Semester Approach", IEEE Transactions on Education, pp.1-10, 2019
4. Filho, EV, Dos Santos, PL, "A Dynamic Mode Decomposition Approach with Hankel Blocks to Forecast Multi-Channel Temporal Series", IEEE Control Systems Letters, vol.3, pp.739-744, 2019
5. Freitas, S, Silva, H, Almeida, JM, Silva, E, "Convolutional neural network target detection in hyperspectral imaging for maritime surveillance", International Journal of Advanced Robotic Systems, vol.16, pp.172988141984299, 2019
6. Leal, F, Malheiro, B, Burguillo, JC, "Analysis and prediction of hotel ratings from crowdsourced data", Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery, 2019
7. Leal, F, Veloso, BM, Malheiro, B, Gonzalez Velez, H, Carlos Burguillo, JC, "Scalable Modelling and Recommendation using Wiki-based Crowdsourced Repositories", Electronic Commerce Research and Applications, 2019
8. Malheiro, B, Guedes, P, Silva, ME, Ferreira, P, "Fostering Professional Competencies in Engineering Undergraduates with EPS@ISEP", Education Sciences, vol.9, pp.119, 2019
9. Malheiro, B, Silva, MF, Ferreira, P, Guedes, P, "Learning Engineering with EPS@ISEP: Developing Projects for Smart Sustainable Cities", International Journal of Engineering Pedagogy (iJEP), vol.9, pp.33, 2019
10. Melo, J, Matos, A, "A data-driven particle filter for terrain based navigation of sensor-limited autonomous underwater vehicles", Asian Journal of Control, 2019
11. Melo, J, Matos, AC, "Tracking multiple Autonomous Underwater Vehicles", Autonomous Robots, pp.1-20, 2019
12. Nunes, AP, Silva Gaspar, ARS, Pinto, AM, Matos, AC, "A mosaicking technique for object identification in underwater environments", Sensor Review, 2019
13. Ribeiro, H, Martins, A, Goncalves, M, Guedes, M, Tomasino, MP, Dias, N, Dias, A, Mucha, AP, Carvalho, MF, Almeida, CMR, Ramos, S, Almeida, JM, Silva, E, Magalhaes, C, "Development of an autonomous biosampler to capture in situ aquatic microbiomes", PLoS ONE, vol.14, pp.e0216882, 2019
14. Silva, MF, Friebe, A, Malheiro, B, Guedes, P, Ferreira, P, Waller, M, "Rigid wing sailboats: A state of the art survey", Ocean Engineering, vol.187, pp.106150, 2019
15. Sousa, P, Ferreira, A, Moreira, M, Santos, T, Martins, A, Dias, A, Almeida, J, Silva, E, "ISEP/INESC TEC Aerial Robotics Team for Search and Rescue Operations at the euRathlon 2015", Journal of Intelligent and Robotic Systems: Theory and Applications, pp.1-14, 2019
16. Suarez Fernandez, RAS, Grande, D, Martins, A, Bascetta, L, Dominguez, S, Rossi, C, "Modeling and Control of Underwater Mine Explorer Robot UX-1", IEEE Access, vol.7, pp.39432-39447, 2019
17. Veloso, BM, Leal, F, Malheiro, B, Carlos Burguillo, JC, "On-line guest profiling and hotel recommendation", Electronic Commerce Research and Applications, vol.34, pp.100832, 2019

International Conference Proceedings with Scientific Referees

1. Azevedo, F, Dias, A, Almeida, J, Oliveira, A, Ferreira, A, Santos, T, Martins, A, Silva, E, "Real- Time LiDAR-based Power Lines Detection for Unmanned Aerial Vehicles", 19th IEEE International Conference on Autonomous Robot Systems and Competitions, ICARSC 2019, 2019
2. Bleier, M, Almeida, C, Ferreira, A, Pereira, R, Matias, B, Almeida, J, Pidgeon, J, Van Der Lucht, J, Schilling, K, Martins, A, Silva, E, Nüchter, A, "3D Underwater Mine Modelling in the ¡vAMOS! PROJECT", ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, vol.42, pp.39-44, 2019
3. Colen, ME, Houard, H, Imenkamp, C, van Velthoven, G, Pajula, S, Malheiro, B, Ribeiro, C, Justo, J, Silva, MF, Ferreira, P, Guedes, P, "Water Intellibuoy—An EPS@ISEP 2018 Project", Linear and Nonlinear Programming - International Series in Operations Research & Management Science, pp.439-449, 2019
4. Cruz, NA, "Optimizing the Power Budget of Hovering AUVs", 2019 IEEE International Underwater Technology Symposium, UT 2019 - Proceedings, 2019
5. dos Santos, PL, Perdicoulis, TPA, "A Kernel Principal Component Regressor for LPV System Identification", IFAC Papersonline, vol.52, pp.7-12, 2019
6. Farrag, M, Marques, D, Bagiami, M, van der Most, M, Smit, W, Malheiro, B, Ribeiro, C, Justo, J, Silva, MF, Ferreira, P, Guedes, P, "Multipurpose Urban Sensing Equipment—An EPS@ISEP 2018 Project", Linear and Nonlinear Programming - International Series in Operations Research & Management Science, pp.415-427, 2019
7. Foss, J, Shirley, B, Malheiro, B, Kepplinger, S, Nixon, LJB, Philipp, B, Mezaris, V, Ulisses, A, "DATATV 2019: 1st international workshop on data-driven personalisation of television", TVX 2019 - Proceedings of the 2019 ACM International Conference on Interactive Experiences for TV and Online Video, pp.286-292, 2019
8. Guedes, P, Viana, N, Silva, J, Amaral, G, Ferreira, H, Dias, A, Almeida, JM, Martins, A, Silva, E, "Low Cost Underwater Acoustic Positioning System with a Simplified DoA Algorithm", Oceans 2019 MTS/IEEE Seattle, 2019
9. Leal, F, Malheiro, B, Burguillo, JC, "Incremental Hotel Recommendation with Inter-guest Trust and Similarity Post-filtering", Advances in Intelligent Systems and Computing, vol.930, pp.262-272, 2019
10. Leite, P, Silva, R, Matos, A, Pinto, AM, "An Hierarchical Architecture for Docking Autonomous Surface Vehicles", 2019 19TH IEEE International Conference on Autonomous Robot Systems and Competitions (ICARSC 2019), pp.200-205, 2019
11. Marques, MM, Mendonca, R, Marques, F, Ramalho, T, Lobo, V, Matos, A, Ferreira, B, Simoes, N, Castelao, I, "REX 16-Robotic Exercises 2016 Multi-robot field trials", 2019 IEEE Underwater Technology (UT), 2019
12. Rodrigues, PM, Cruz, NA, Pinto, AM, "Altitude control of an underwater vehicle based on computer vision", OCEANS 2018 MTS/IEEE Charleston, Ocean 2018, 2019
13. Sevastiadou, A, Luts, A, Pretot, A, Trendafiloski, M, Basurto, R, Blaszczyk, S, Malheiro, B, Ribeiro, C, Justo, J, Silva, MF, Ferreira, P, Guedes, P, "Vertical Farming—An EPS@ISEP 2018 Project", Linear and Nonlinear Programming - International Series in Operations Research & Management Science, pp.428-438, 2019
14. Silva, R, Leite, P, Campos, D, Pinto, AM, "Hybrid Approach to Estimate a Collision-Free Velocity for Autonomous Surface Vehicles", 2019 19TH IEEE International Conference on Autonomous Robot Systems and Competitions (ICARSC 2019), pp.194-199, 2019
15. Teixeira, B, Silva, H, Matos, A, Silva, E, "Deep Learning Approaches Assessment for Underwater Scene Understanding and Egomotion Estimation", Oceans 2019 MTS/IEEE Seattle, 2019
16. Truppel, A, Tseng, TM, Bertozzi, D, Alves, JC, Schlichtmann, U, "PSION: Combining Logical Topology and Physical Layout Optimization for Wavelength-Routed ONoCs", Proceedings of the 2019 International Symposium on Physical Design (ISPD '19), pp.49-56, 2019

17. Veloso, B, Leal, F, Malheiro, B, Moreira, F, "Distributed Trust & Reputation Models using Blockchain Technologies for Tourism Crowdsourcing Platforms", Procedia Computer Science, vol.160, pp.457-460, 2019

18. Veloso, B, Malheiro, B, Foss, JD, "Stream recommendation using individual hyper-parameters", CEUR Workshop Proceedings, vol.2423, 2019

Books

Blank

Chapters/Papers in Books

1. Silva, MF, Malheiro, B, Guedes, P, Ferreira, P, "Airfoil Selection and Wingsail Design for an Autonomous Sailboat", Advances in Intelligent Systems and Computing - Robot 2019: Fourth Iberian Robotics Conference, pp.305-316, 2019

Publications (Editor)

Blank

Dissertations (PhD)

Blank

10.4 C-BER – ACTIVITY RESULTS IN 2019

10.4.1 Activity indicators

The following tables present C-BER research team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.4.1 - CBER - Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	3	2	2	0
		Academic Staff	6	6	7	1
		Grant Holders and Trainees	21	19	11	-8
		Total Core Researchers	**30**	**27**	**20**	**-7**
		Total Core PhD	**11**	**11**	**10**	**-1**
	Affiliated Researchers		4	0	1	1
	Administrative and Technical	Employees	0	1	1	0
		Grant Holders and Trainees	0	0	0	0
		Total Admin and Tech	**0**	**1**	**1**	**0**
		Total Integrated HR	**34**	**28**	**22**	**-6**
		Total Integrated PhD	**15**	**11**	**11**	**0**

Table 10.4.2 – CBER - Project funding

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes - FCT	147	182	215	33
PN-PICT	National R&D Programmes - S&T Integrated Projects	199	354	52	-302
PN-COOP	National Cooperation Programmes with Industry		1		-1
PUE-FP	EU Framework Programmes				
PUE-DIV	EU Cooperation Programmes - Other				
SERV-NAC	R&D Services and Consulting - National	26	7	3	-4
SERV-INT	R&D Services and Consulting - International				
OP	Other Funding Programmes				
Closed Projects		1		2	2
	Total Funding	**372**	**544**	**272**	**-272**

Table 10.4.3 – CBER - Summary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	17	19	22
Indexed Conferences	27	32	29
Books		1	
Book Chapters		1	4
Concluded PhD Theses - Members	1		
Concluded PhD Theses - Supervised	1	1	1

Table 10.4.4 – CBER - Summary of IP protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	2	2	2
Software copyright registrations	0	2	0
Patent first priority filings (New inventions)	0	1	0
Patent applications (Internationalization)	11	6	9
Granted patents	0	5	2
Licence agreements	0	0	0
Spin-offs established	0	0	1
Spin-offs in development	0	1	2

Table 10.4.5 – CBER - Summary of dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	1
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	3
International events in which INESC TEC members participate in the program committees	5
Participation in events such as fairs, exhibitions or similar	3

Table 10.4.6 – CBER - Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	4
Participants in the conferences, workshops and scientific sessions organised by the Centre	125
Advanced training courses organised by the Centre	0

Table 10.4.7 – CBER - List of projects

Type of Project	Short Nme	Leader	Starting date	Ending date (planned)
PN-FCT	VR2Market	João Paulo Cunha	15/07/2014	30/06/2019
PN-FCT	LNDetector	Aurélio Campilho	01/06/2016	30/11/2019
PN-FCT	SCREEN-DR	Aurélio Campilho	01/04/2016	31/03/2020
PN-FCT	PERFECT-1	João Paulo Cunha	01/07/2018	29/06/2020
PN-FCT	LUCAS-1	João Paulo Cunha	26/07/2018	25/07/2021
PN-PICT	NanoStima-RL1	João Paulo Cunha	01/07/2015	30/06/2019
PN-PICT	NanoStima-RL5-1	Aurélio Campilho	01/07/2015	30/06/2019
PN-PICT	SMILES-1	João Paulo Cunha	01/07/2015	30/06/2019
PN-COOP	TexBoost	Miguel Velhote Correia	01/07/2017	30/06/2020
SERV-NAC	Serv_Neuro	João Paulo Cunha	01/06/2019	01/10/2019

Type of Project:

PN-FCT	National R&D Programmes - FCT
PN-PICT	National R&D Programmes - S&T Integrated Projects
PN-COOP	National Cooperation Programmes with Industry
PUE-FP	EU Framework Programme
PUE-DIV	EU Cooperation Programmes - Other
SERV-NAC	National R&D Services and Consulting
SERV-INT	International R&D Services and Consulting
OP	Other Funding Programmes

10.4.2 List of Publications

International Journals with Scientific Referees

1. Al Hajj, H, Lamard, M, Conze, PH, Roychowdhury, S, Hu, XW, Marsalkaite, G, Zisimopoulos, O, Dedmari, MA, Zhao, FQ, Prellberg, J, Sahu, M, Galdran, A, Araujo, T, Vo, DM, Panda, C, Dahiya, N, Kondo, S, Bian, ZB, Vandat, A, Bialopetravicius, J, Flouty, E, Qiu, CH, Dill, S, Mukhopadhyay, A, Costa, P, Aresta, G, Ramamurthys, S, Lee, SW, Campilho, A, Zachow, S, Xia, SR, Conjeti, S, Stoyanov, D, Armaitis, J, Heng, PA, Macready, WG, Cochener, B, Quellec, G, "CATARACTS: Challenge on automatic tool annotation for cataRACT surgery", Medical Image Analysis, vol.52, pp.24-41, 2019
2. Aresta, G, Araujo, T, Kwok, S, Chennamsetty, SS, Safwan, M, Alex, V, Marami, B, Prastawa, M, Chan, M, Donovan, M, Fernandez, G, Zeineh, J, Kohl, M, Walz, C, Ludwig, F, Braunewell, S, Baust, M, Vu, QD, To, MNN, Kim, E, Kwak, JT, Galal, S, Sanchez Freire, V, Brancati, N, Frucci, M, Riccio, D, Wang, YQ, Sun, LL, Ma, KQ, Fang, JN, Kone, ME, Boulmane, LS, Campilho, ARLO, Eloy, CTRN, Polonia, AONO, Aguiar, PL, "BACH: Grand challenge on breast cancer histology images", Medical Image Analysis, vol.56, pp.122-139, 2019
3. Aresta, G, Jacobs, C, Araujo, T, Cunha, A, Ramos, I, Ginneken, BV, Campilho, A, "iW-Net: an automatic and minimalistic interactive lung nodule segmentation deep network", Scientific Reports, vol.9, 2019
4. Leclerc, S, Smistad, E, Pedrosa, J, Ostvik, A, Cervenansky, F, Espinosa, F, Espeland, T, Berg, EAR, Jodoin, PM, Grenier, T, Lartizien, C, Dhooge, J, Lovstakken, L, Bernard, O, "Deep Learning for Segmentation using an Open Large-Scale Dataset in 2D Echocardiography", IEEE Transactions on Medical Imaging, pp.1-1, 2019
5. Mesquita, IA, Pereira da Fonseca, PFP, Vieira Pinheiro, ARV, Paiva Velhote Correia, MFPV, Costa da Silva, CIC, "Methodological considerations for kinematic analysis of upper limbs in healthy and poststroke adults Part II: a systematic review of motion capture systems and kinematic metrics", Topics in Stroke Rehabilitation, pp.1-9, 2019

6. Mesquita, IA, Vieira Pinheiro, ARV, Paiva Velhote Correia, MFPV, Costa da Silva, CIC, "Methodological considerations for kinematic analysis of upper limbs in healthy and poststroke adults. Part I: A systematic review of sampling and motor tasks", Topics in Stroke Rehabilitation, pp.1-11, 2019

7. Oliveira, J, Renna, F, Coimbra, M, "A Subject-Driven Unsupervised Hidden Semi-Markov Model and Gaussian Mixture Model for Heart Sound Segmentation", IEEE Journal of Selected Topics in Signal Processing, vol.13, pp.323-331, May, 2019

8. Oliveira, J, Renna, F, Mantadelis, T, Coimbra, M, "Adaptive Sojourn Time HSMM for Heart Sound Segmentation", IEEE Journal of Biomedical and Health Informatics, vol.23, pp.642-649, Mar, 2019

9. Paiva, JS, Jorge, PAS, Ribeiro, RSR, Sampaio, P, Rosa, CC, Cunha, JPS, "Optical fiber-based sensing method for nanoparticle detection through supervised back-scattering analysis: a potential contributor for biomedicine", International Journal of Nanomedicine, vol. 14, pp.2349-2369, 2019

10. Pedrosa, J, Duchenne, J, Queiros, S, Degtiarova, G, Gheysens, O, Claus, P, Voigt, JU, D'hooge, J, "Non-invasive myocardial performance mapping using 3D echocardiographic stress-strain loops", Physics in Medicine and Biology, vol.64, Jun, 2019

11. Petrescu, A, Santos, P, Orlowska, M, Pedrosa, J, Bézy, S, Chakraborty, B, Cvijic, M, Dobrovie, M, Delforge, M, D'hooge, J, Voigt, JU, "Velocities of Naturally Occurring Myocardial Shear Waves Increase with Age and in Cardiac Amyloidosis", JACC: Cardiovascular Imaging, 2019

12. Pimentel, G, Rodrigues, S, Silva, PA, Vilarinho, A, Vaz, R, Silva Cunha, JPS, "A wearable approach for intraoperative physiological stress monitoring of multiple cooperative surgeons", International Journal of Medical Informatics, vol.129, pp.60-68, 2019

13. Renna, F, Oliveira, J, Coimbra, MT, "Deep Convolutional Neural Networks for Heart Sound Segmentation", IEEE Journal of Biomedical and Health Informatics, vol.23, pp.2435-2445, Nov, 2019

14. Riaz, F, Naeem, S, Nawaz, R, Coimbra, M, "Active Contours Based Segmentation and Lesion Periphery Analysis for Characterization of Skin Lesions in Dermoscopy Images", IEEE Journal of Biomedical and Health Informatics, vol.23, pp.489-500, MAR, 2019

15. Rodrigues, S, Sinval, J, Queiros, C, Maroco, J, Kaiseler, M, "Transitioning from recruit to officer: An investigation of how stress appraisal and coping influence work engagement", International Journal of Selection and Assessment, 2019

16. Santos, P, Petrescu, AM, Pedrosa, JP, Orlowska, M, Komini, V, Voigt, JU, D'Hooge, J, "Natural shear wave imaging in the human heart: normal values, feasibility and reproducibility", IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control, pp.1-1, 2019

17. Seixas, A, Vilas Boas, MD, Carvalho, R, Coelho, T, Ammer, K, Vilas Boas, JP, Mendes, J, Silva Cunha, JPS, Vardasca, R, "Skin temperature of the foot: comparing transthyretin Familial Amyloid Polyneuropathy and Diabetic Foot patients", Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization, pp.1-8, 2019

18. Shakibapour, E, Cunha, A, Aresta, G, Mendonca, AM, Campilho, A, "An unsupervised metaheuristic search approach for segmentation and volume measurement of pulmonary nodules in lung CT scans", Expert Systems with Applications, vol.119, pp.415-428, 2019

19. Soares, C, Vilas Boas, MD, Lopes, EM, Choupina, H, Soares dos Reis, R, Fitas, D, Silva Cunha, JPS, Monteiro, P, Linhares, P, Rosas, MJ, "Automated and objective measures of gait dynamics in camptocormia Parkinson's Disease subthalamic deep brain stimulation", Clinical Neurology and Neurosurgery, vol.186, Nov, 2019

20. Sultan, MS, Martins, N, Costa, E, Veiga, D, Ferreira, MJ, Mattos, S, Coimbra, MT, "Virtual M-Mode for Echocardiography: A New Approach for the Segmentation of the Anterior Mitral Leaflet", IEEE J. Biomedical and Health Informatics, vol.23, pp.305-313, 2019

21. Vilas Boas, MD, Pereira Choupina, HMP, Rocha, AP, Fernandes, JM, Silva Cunha, JPS, "Full-body motion assessment: Concurrent validation of two body tracking depth sensors versus a gold standard system during gait", Journal of Biomechanics, vol.87, pp.189-196, 2019

22. Vilas Boas, MD, Rocha, AP, Pereira Choupina, HMP, Cardoso, MN, Fernandes, JM, Coelho, T, Silva Cunha, JPS, "Validation of a Single RGB-D Camera for Gait Assessment of Polyneuropathy Patients", Sensors, vol.19, Nov, 2019

International Conference Proceedings with Scientific Referees

1. Carvalho, C, Marques, S, Peixoto, C, Pignatelli, D, Beires, J, Silva, J, Campilho, A, "Deep Learning Approaches for Gynaecological Ultrasound Image Segmentation: A Radio-Frequency vs B-mode Comparison", Lecture Notes in Computer Science - Image Analysis and Recognition, pp.295-306, 2019
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3. Costa, P, Araujo, T, Aresta, G, Galdran, A, Mendonca, AM, Smailagic, A, Campilho, A, "EyeWeS: Weakly Supervised Pre-Trained Convolutional Neural Networks for Diabetic Retinopathy Detection", 2019 16th International Conference on Machine Vision Applications (MVA), 2019
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Books

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Chapters/Papers in Books

1. Rodrigues, C, Correia, MV, Abrantes, JMCS, Nadal, J, Rodrigues, MAB, "Lower Limb Joint Angle Coordination Assessment at Sagittal Plane on Human Vertical Countermovement", VipIMAGE 2019 - Lecture Notes in Computational Vision and Biomechanics, pp.29-40, 2019
2. Rodrigues, C, Correia, MV, Abrantes, JMCS, Nadal, J, Rodrigues, MAB, "Validation of Whole-Body COM Movement from 3D Anthropometric Image with Dynamic Data at Different Human Standard MVJ", VipIMAGE 2019 - Lecture Notes in Computational Vision and Biomechanics, pp.353-365, 2019
3. Silva Cunha, JP, Rodrigues, S, Dias, D, Branda~o, P, Aguiar, A, Oliveira, I, Maria Fernandes, J, Maia, C, Tedim, AR, Barros, A, Azuaje, O, Soares, E, de La Torre, F, "VitalResponder®: wearable wireless platform for vitals and body-area environment monitoring of first response teams", Wearable Technologies and Wireless Body Sensor Networks for Healthcare, pp.387-416, 2019
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Publications (Editor)

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Dissertations (PhD)

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10.5 CPES – ACTIVITY RESULTS IN 2019

10.5.1 Activity indicators

The following tables present CPES research team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.5.1 - CPES – Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	14	18	21	3
		Academic Staff	12	10	10	0
		Grant Holders and Trainees	48	53	48	-5
		Total Core Researchers	**74**	**81**	**79**	**-2**
		Total Core PhD	**25**	**25**	**26**	**1**
	Affiliated Researchers		3	6	7	1
	Administrative and Technical	Employees	2	1	1	0
		Grant Holders and Trainees	0	0	0	0
		Total Admin and Tech	**2**	**1**	**1**	**0**
		Total Integrated HR	**79**	**88**	**87**	**-1**
		Total Integrated PhD	**28**	**30**	**32**	**2**

Table 10.5.2 - CPES – Project funding

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes – FCT	254	405	488	83
PN-PICT	National R&D Programmes - S&T Integrated Projects	28	34	4	-30
PN-COOP	National Cooperation Programmes with Industry	65	56	21	-35
PUE-FP	EU Framework Programmes	642	855	977	122
PUE-DIV	EU Cooperation Programmes – Other	292	192	88	-105
SERV-NAC	R&D Services and Consulting - National	821	870	796	-74
SERV-INT	R&D Services and Consulting - International	182	98	12	-86
OP	Other Funding Programmes	55	27	155	128
Closed Projects		23	199	42	-158
	Total Funding	**2 362**	**2 738**	**2 583**	**-155**

Table 10.5.3 - CPES– Summary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	46	71	95
Indexed Conferences	74	73	65
Books			
Book Chapters	2	8	5
Concluded PhD Theses - Members	1	3	1
Concluded PhD Theses - Supervised	4	5	2

Table 10.5.4 - CPES – Summary of IP protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	0	4	1
Software copyright registrations	0	0	0
Patent first priority filings (New inventions)	0	0	1
Patent applications (Internationalization)	4	0	1
Granted patents	0	1	1
Licence agreements	0	0	0
Spin-offs established	0	0	0
Spin-offs in development	0	0	0

Table 10.5.5 - CPES – Summary of participation in dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	10
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	1
International events in which INESC TEC members participate in the program committees	29
Participation in events such as fairs, exhibitions or similar	3

Table 10.5.6 - CPES - Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	3
Participants in the conferences, workshops and scientific sessions organised by the Centre	637
Advanced training courses organised by the Centre	1

Table 10.5.7 – CPES - List of projects

List of Project	Short Name	Leader	Starting date	Ending date (planned)
PN-FCT	INFUSE	Vladimiro Miranda	01/04/2016	31/03/2019
PN-FCT	ESGRIDS	João Peças Lopes	01/01/2017	31/12/2019
PN-FCT	SGEVL	Luís Seca	01/07/2017	29/06/2020
PN-FCT	UNiTED	João Catalão	01/06/2018	31/05/2021
PN-PICT	iMAN-5	Luís Seca	01/07/2015	30/06/2019
PN-COOP	NEXTSTEP	Clara Sofia Gouveia	01/12/2016	30/11/2019
PUE-DIV	REStable	Carlos Moreira	01/04/2016	31/03/2019
PUE-DIV	GReSBAS	Filipe Joel Soares	01/04/2016	30/09/2019
PUE-DIV	SmartGuide	André Guimarães Madureira	01/04/2016	31/03/2019
PUE-DIV	INDuGRID	Carlos Moreira	01/09/2016	31/12/2019
PUE-FP	SENSIBLE	Ricardo Jorge Bessa	01/01/2015	01/12/2018
PUE-FP	InteGrid	Ricardo Jorge Bessa	01/01/2017	30/06/2020
PUE-FP	TDX-ASSIST	Leonel Magalhães Carvalho	01/10/2017	30/09/2020
PUE-FP	EU-SysFlex	Bernardo Silva	01/11/2017	31/10/2021
PUE-FP	FEEdBACk	Filipe Joel Soares	01/11/2017	31/10/2020
PUE-FP	AmBIENCe	Nilufar Neyestani	01/06/2019	30/11/2021
PUE-FP	EMB3Rs	Tiago André Soares	02/09/2019	01/09/2022
PUE-FP	Smart4RES	Ricardo Jorge Bessa	01/10/2019	01/04/2023
PUE-FP	XFLEX	Bernardo Silva	01/09/2019	31/08/2023
PUE-FP	InterConnect	David Emanuel Rua	01/10/2019	01/10/2023
SERV-NAC	EFACEC-DMS	Jorge Correia Pereira	15/04/2001	31/12/2030
SERV-NAC	CP_T_Dinamicas	João Tomé Saraiva	01/02/2015	31/10/2019
SERV-NAC	MORA	Leonel Magalhães Carvalho	04/04/2016	31/12/2019
SERV-NAC	SACC	Filipe Joel Soares	01/01/2016	30/06/2019
SERV-NAC	PANACea	José Nuno Fidalgo	08/08/2016	30/05/2019
SERV-NAC	Graciosa	João Peças Lopes	25/11/2016	30/09/2019
SERV-NAC	INTERLIG_PT_MA	Bernardo Silva	01/03/2017	31/12/2019
SERV-NAC	INFRA_PT	João Peças Lopes	20/07/2017	06/11/2019
SERV-NAC	GridCodeMadeira	João Peças Lopes	20/05/2018	29/03/2019
SERV-NAC	OTGEN3	João Peças Lopes	01/09/2017	31/12/2019
SERV-NAC	EstinvestQoS	José Nuno Fidalgo	01/12/2017	31/12/2019
SERV-NAC	Prob2	José Nuno Fidalgo	01/12/2017	13/05/2019
SERV-NAC	AO_Perdas	Luís Seca	01/01/2018	31/12/2019
SERV-NAC	Perfis_Perdas	José Nuno Fidalgo	01/01/2018	31/03/2019
SERV-NAC	LowCarbon	João Peças Lopes	02/04/2018	31/12/2019
SERV-NAC	GEST_STORAGE	Clara Sofia Gouveia	02/04/2018	31/12/2019
SERV-NAC	HEAD-1	João Peças Lopes	01/01/2018	30/09/2019
SERV-NAC	PriceMining	Ricardo Jorge Bessa	01/05/2018	30/04/2019
SERV-NAC	Storage_Maria	Carlos Moreira	07/06/2018	30/09/2019
SERV-NAC	TarifasRenovMadeira	João Tomé Saraiva	19/07/2018	30/05/2019
SERV-NAC	REG_CODE_RAM	João Peças Lopes	25/07/2018	30/08/2019
SERV-NAC	FLEXERGY	Clara Sofia Gouveia	01/09/2018	31/03/2020
SERV-NAC	LPVAnalytics	Ricardo Jorge Bessa	01/06/2018	30/06/2020
SERV-NAC	AutomatismoMT	Clara Sofia Gouveia	17/10/2018	31/12/2019
SERV-NAC	RedeDistDigital	Clara Sofia Gouveia	17/10/2018	31/12/2019
SERV-NAC	NazaréSustentável	Luís Seca	10/01/2019	31/12/2019
SERV-NAC	Grid4water	Leonel Magalhães Carvalho	01/01/2019	31/07/2019
SERV-NAC	BatIlhasConc	Manuel Matos	01/01/2019	31/12/2019

List of Project	Short Name	Leader	Starting date	Ending date (planned)
SERV-NAC	Sglab_MA	Luís Seca	01/01/2019	30/09/2019
SERV-NAC	AvalCapMadeira2020	João Peças Lopes	03/09/2018	27/02/2019
SERV-NAC	AvalCapMadeira2020-F2	João Peças Lopes	02/11/2018	27/02/2019
SERV-NAC	CampusREN2019	João Peças Lopes	15/03/2019	15/11/2019
SERV-NAC	FlutuacoesPV	Helena Vasconcelos	21/03/2019	21/07/2019
SERV-NAC	perdasCHP	Filipe Joel Soares	15/05/2019	15/07/2019
SERV-NAC	perdasOFFSHORE	Filipe Joel Soares	15/05/2019	15/08/2019
SERV-NAC	LossPD	José Nuno Fidalgo	02/05/2019	31/03/2020
SERV-NAC	Perfis_Perdas_2020	José Nuno Fidalgo	21/05/2019	21/12/2019
SERV-NAC	PDIRT20202029	João Tomé Saraiva	15/03/2019	15/06/2019
SERV-NAC	ReqTecLPV	Carlos Moreira	15/04/2019	15/06/2019
SERV-NAC	IeM_QST	José Nuno Fidalgo	16/08/2019	16/06/2020
SERV-NAC	ProtTerrasR	João Peças Lopes	01/07/2019	30/06/2020
SERV-NAC	GridPlan	Filipe Joel Soares	01/10/2019	01/10/2020
SERV-NAC	BNL	Luís Seca	15/10/2019	15/01/2022
SERV-INT	fof.PLAN	Ricardo Jorge Bessa	01/01/2018	31/03/2019
SERV-INT	SECRETS	Luís Seca	01/12/2013	31/05/2019
OP	VEARREN2030	João Peças Lopes	01/06/2019	30/09/2020
OP	EFAcademy	Jorge Correia Pereira	01/01/2019	10/07/2019
OP	SEST2019	Jorge Correia Pereira	01/05/2019	01/01/2020

Type of Project:

PN-FCT	National R&D Programmes - FCT
PN-PICT	National R&D Programmes - S&T Integrated Projects
PN-COOP	National Cooperation Programmes with Industry
PUE-FP	EU Framework Programme
PUE-DIV	EU Cooperation Programmes - Other
SERV-NAC	National R&D Services and Consulting
SERV-INT	International R&D Services and Consulting
OP	Other Funding Programmes

10.5.2 List of publications

International Journals with Scientific Referees

1. Abreu, C, Soares, I, Oliveira, L, Rua, D, Machado, P, Carvalho, L, Pecas Lopes, JAP, "Application of genetic algorithms and the cross-entropy method in practical home energy management systems", IET Renewable Power Generation, vol.13, pp.1474-1483, 2019
2. Abreu, T, Soares, T, Carvalho, L, Morais, H, Simao, T, Louro, M, "Reactive power management considering stochastic optimization under the portuguese reactive power policy applied to der in distribution networks", Energies, vol.12, pp.4028, 2019
3. Askarpour, M, Aghaei, J, Khooban, MH, Shafie khah, M, Catalao, JPS, "Voltage control of critical and non-critical loads in distribution networks with electric spring", Electric Power Systems Research, vol.177, pp.105988, 2019
4. Ata, M, Erenoglu, AK, Sengor, I, Erdinc, O, Tascikaraoglu, A, Catalao, JPS, "Optimal operation of a multi-energy system considering renewable energy sources stochasticity and impacts of electric vehicles", Energy, vol.186, 2019

5. Badakhshan, S, Hajibandeh, N, Shafie khah, M, Catalao, JPS, "Impact of solar energy on the integrated operation of electricity-gas grids", Energy, vol.183, pp.844-853, 2019
6. Bashian, A, Assili, M, Anvari Moghaddam, A, Catalao, JPS, "Optimal Design of a Wide Area Measurement System Using Hybrid Wireless Sensors and Phasor Measurement Units", Electronics, vol.8, Oct, 2019
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8. Ciapessoni, E, Cirio, D, Pitto, A, Omont, N, Carvalho, LM, Vasconcelos, MH, "An advanced platform for power system security assessment accounting for forecast uncertainties", International Journal of Management and Decision Making, vol.18, pp.1, 2019
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10. da Silva, DM, Costa, FB, Miranda, V, Leite, H, "Wavelet-based analysis and detection of traveling waves due to DC faults in LCC HVDC systems", International Journal of Electrical Power and Energy Systems, vol.104, pp.291-300, 2019
11. de Castro, R, Pinto, C, Varela Barreras, J, Araujo, RE, Howey, DA, "Smart and Hybrid Balancing System: Design, Modeling, and Experimental Demonstration", IEEE Transactions on Vehicular Technology, vol.68, pp.11449-11461, 2019
12. Erdinc, O, Tascikaraoglu, A, Paterakis, NG, Catalao, JPS, "Novel Incentive Mechanism for End-Users Enrolled in DLC-Based Demand Response Programs Within Stochastic Planning Context", IEEE Transactions on Industrial Electronics, vol.66, pp.1476-1487, 2019
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14. Filipe, J, Bessa, RJ, Moreira, C, Silva, B, "Optimal bidding strategy for variable-speed pump storage in day-ahead and frequency restoration reserve markets", Energy Systems, 2019
15. Filipe, J, Bessa, RJ, Reis, M, Alves, R, Povoa, P, "Data-driven predictive energy optimization in a wastewater pumping station", Applied Energy, vol.252, 2019
16. Frade, PMS, Osorio, GJ, Santana, JJE, Catalao, JPS, "Regional coordination in ancillary services: An innovative study for secondary control in the Iberian electrical system", International Journal of Electrical Power & Energy Systems, vol.109, pp.513-525, Jul, 2019
17. Frade, PMS, Pereira, JP, Santana, JJE, Catalao, JPS, "Wind balancing costs in a power system with high wind penetration – Evidence from Portugal", Energy Policy, vol.132, pp.702-713, 2019
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19. Ganesan, K, Saraiva, JT, Bessa, RJ, "On the use of causality inference in designing tariffs to implement more effective behavioral demand response programs", Energies, vol.12, pp.2666, 2019
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55. Sheikh, M, Aghaei, J, Nikoobakht, A, Osório, GJ, Shafie Khah, M, Lotfi, M, Catalao, JPS, "Computational Simulation Results in Power Systems Operation to Integrate Reliability in the Security Constrained Optimization Problem", 2nd International Conference on Next Generation Computing Applications 2019, NextComp 2019 - Proceedings, 2019

56. Sheikh, M, Aghaei, J, Rajabdorri, M, Shafie khah, M, Lotfi, M, Javadi, MS, Catalao, JPS, "Multiobjective Congestion Management and Transmission Switching Ensuring System Reliability", Proceedings - 2019 IEEE International Conference on Environment and Electrical Engineering and 2019 IEEE Industrial and Commercial Power Systems Europe, EEEIC/I and CPS Europe 2019, 2019

57. Soares, T, Cruz, M, Matos, M, "Cost Allocation of Distribution Networks in the Distributed Energy Resources Era", SEST 2019 - 2nd International Conference on Smart Energy Systems and Technologies, 2019

58. Soares, T, Fonseca, C, Morais, H, Ramos, S, Sousa, T, "Assessment of real-time tariffs for electric vehicles in Denmark", 2019 IEEE Milan PowerTech, PowerTech 2019, 2019

59. Talari, S, Mende, D, Stock, DS, Shafie Khah, M, Catalao, JPS, "Stochastic Demand Side Management in European Zonal Price Market", SEST 2019 - 2nd International Conference on Smart Energy Systems and Technologies, 2019

60. Travassos Valdez, MT, Machado Ferreira, CM, Maciel Barbosa, FPM, "Enhancing electric energy systems final project through real engineering design problems", IEEE Global Engineering Education Conference, EDUCON, vol.April-2019, pp.823-826, 2019
61. Vahid Ghavidel, M, Catalão, JPS, Shafie Khah, M, Barhagh, SS, Mohammadi Ivatloo, B, "IGDT opportunity method in the trading framework of risk-seeker demand response aggregators", 2019 IEEE Milan PowerTech, PowerTech 2019, 2019
62. Vasconcelos, MH, Gonçalves, C, Meirinhos, J, Omont, N, Pitto, A, Ceresa, G, "Evaluation of the uncertainties used to perform flow security assessment: A real case study", 2019 IEEE Milan PowerTech, PowerTech 2019, 2019
63. Viana, J, Bessa, RJ, Sousa, J, "Load forecasting benchmark for smart meter data", 2019 IEEE Milan PowerTech, PowerTech 2019, 2019
64. Wu, D, Yang, L, Wei, W, Chen, L, Lotfi, M, Catalao, JPS, "Maximum Loadability of Meshed Networks: A Sequential Convex Optimization Approach", SEST 2019 - 2nd International Conference on Smart Energy Systems and Technologies, 2019
65. Yener, B, Erenoglu, AK, Sengor, I, Erdinc, O, Tascikaraoglu, A, Catalao, JPS, "Development of a Smart Thermostat Controller for Direct Load Control Based Demand Response Applications", SEST 2019 - 2nd International Conference on Smart Energy Systems and Technologies, 2019

Books

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Chapters/Papers in Books

1. Amini, MH, Talari, S, Arasteh, H, Mahmoudi, N, Kazemi, M, Abdollahi, A, Bhattacharjee, V, Shafie Khah, M, Siano, P, Catalão, JPS, "Demand Response in Future Power Networks: Panorama and State-of-the-art", Studies in Systems, Decision and Control - Sustainable Interdependent Networks II, pp.167-191, 2019
2. Bessa, R, Moreira, C, Silva, B, Matos, M, "Handling Renewable Energy Variability and Uncertainty in Power System Operation", Advances in Energy Systems, pp.1-26, 2019
3. Gazafroudi, AS, Shafie Khah, M, Fitiwi, DZ, Santos, SF, Corchado, JM, Catalão, JPS, "Impact of Strategic Behaviors of the Electricity Consumers on Power System Reliability", Studies in Systems, Decision and Control - Sustainable Interdependent Networks II, pp.193-215, 2019
4. Gouveia, C, Moreira, C, Madureira, AG, Gouveia, J, Issicaba, D, Pecas Lopes, JA, "Black start and islanding operations of microgrid", Variability, Scalability and Stability of Microgrids, pp.463-495, 2019
5. Lopes, JAP, Madureira, AG, Moreira, C, "A View of Microgrids", Advances in Energy Systems, pp.149-166, 2019

Publications (Editor)

Blank

Dissertations (PhD)

1. Iria, J., “Optimal Participation of an Aggregator of Prosumers in the Electricity Markets”.

10.6 CESE – ACTIVITY RESULTS IN 2019

10.6.1 Activity indicators

The following tables present CESE research team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.6.1 - CESE - Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	14	17	21	4
		Academic Staff	10	7	5	-2
		Grant Holders and Trainees	34	37	30	-7
		Total Core Researchers	**58**	**61**	**56**	**-5**
		Total Core PhD	**16**	**12**	**15**	**3**
	Affiliated Researchers		3	6	7	1
	Administrative and Technical	Employees	2	2	2	0
		Grant Holders and Trainees	0	0	0	0
		Total Admin and Tech	**2**	**2**	**2**	**0**
		Total Integrated HR	**63**	**69**	**65**	**-4**
		Total Integrated PhD	**18**	**16**	**22**	**6**

Table 10.6.2 - CESE - Project funding

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes - FCT	122	156	231	76
PN-PICT	National R&D Programmes - S&T Integrated Projects	143	173	17	-157
PN-COOP	National Cooperation Programmes with Industry	367	364	330	-34
PUE-FP	EU Framework Programmes	221	501	576	75
PUE-DIV	EU Cooperation Programmes - Other	114	67	38	-28
SERV-NAC	R&D Services and Consulting - National	431	510	487	-24
SERV-INT	R&D Services and Consulting - International	13	32	43	11
OP	Other Funding Programmes				
Closed Projects		24	3	-1	-4
	Total Funding	**1 435**	**1 806**	**1 720**	**-86**

Table 10.6.3 - CESE - S ummary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	15	14	14
Indexed Conferences	24	26	7
Books			
Book Chapters	2	3	2
Concluded PhD Theses - Members	3	4	4
Concluded PhD Theses - Supervised	4	5	3

Table 10.6.4 - CESE - Summary of IP protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	2	1	0
Software copyright registrations	0	0	0
Patent first priority filings (New inventions)	0	0	0
Patent applications (Internationalization)	0	0	0
Granted patents	0	0	0
Licence agreements	0	1	1
Spin-offs established	0	0	0
Spin-offs in development	0	0	0

Table 10.6.5 – CESE - Summary of dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	5
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	0
International events in which INESC TEC members participate in the program committees	9
Participation in events such as fairs, exhibitions or similar	8

Table 10.6.6 - CESE- Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	1
Participants in the conferences, workshops and scientific sessions organised by the Centre	60
Advanced training courses organised by the Centre	0

Table 10.6.7 – CESE - List of projects

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
PN-FCT	VR2Market-1	Ana Cristina Barros	15/07/2014	30/06/2019
PN-FCT	EasyFlow	Alexandra Sofia Marques	01/06/2016	31/08/2019
PN-FCT	DM4Manufacturing-1	César Toscano	01/11/2016	31/10/2019
PN-FCT	3SLM	António Lucas Soares	10/08/2017	09/08/2019
PN-FCT	opti-MOVES	Tânia Daniela Fontes	26/07/2018	24/01/2021
PN-FCT	StoSS	Ana Maria Rodrigues	15/10/2018	14/10/2021
PN-FCT	Tec-FEL-1	Alexandra Sofia Marques	04/04/2018	03/04/2021
PN-PICT	iMAN	Américo Azevedo	01/07/2015	30/06/2019
PN-COOP	ADIRA_I4.0	António Correia Alves	01/09/2016	28/02/2020
PN-COOP	AdaptPack	Luís Miguel Costa	01/09/2016	31/08/2019
PN-COOP	FAMEST	Rui Diogo Rebelo	01/11/2017	31/10/2020
PN-COOP	GOTECFOR-1	Alexandra Sofia Marques	01/01/2017	31/12/2020
PN-COOP	PRODUTECH_SIF	António Correia Alves	01/10/2017	30/09/2020
PUE-DIV	BIOTECFOR-1	Alexandra Sofia Marques	01/01/2017	31/12/2019
PUE-DIV	MANUFACTUR4.0-1	Ana Cristina Barros	17/04/2017	31/12/2019
PUE-FP	ScalABLE4.0-1	César Toscano	01/01/2017	30/06/2020
PUE-FP	Fasten	César Toscano	01/11/2017	31/10/2020
PUE-FP	MANU-SQUARE	António Lucas Soares	01/01/2018	31/12/2020
PUE-FP	NEXT-NET	Ana Cristina Barros	01/10/2017	31/12/2019
PUE-FP	DIVA-1	Alexandra Sofia Marques	01/04/2018	31/03/2021
SERV-NAC	RIDDIG	António Correia Alves	03/05/2017	31/08/2019
SERV-NAC	GLP-i4.0	Américo Azevedo	01/02/2018	30/04/2019
SERV-NAC	ACCi40	Rui Diogo Rebelo	03/06/2018	31/03/2019
SERV-NAC	COATING4.0	Rui Diogo Rebelo	01/05/2018	30/06/2019
SERV-NAC	PFF_SIM18	Rui Diogo Rebelo	27/09/2018	26/03/2019
SERV-NAC	ETMA4.0	António Correia Alves	05/11/2018	04/11/2019
SERV-NAC	Refinação4.0	Américo Azevedo	01/09/2018	31/07/2019
SERV-NAC	ARi4.0	Rui Diogo Rebelo	18/01/2019	17/05/2019
SERV-NAC	DCTL-Injection-PT	Luís Guardão	01/11/2018	31/03/2019
SERV-NAC	I4IPTE	Américo Azevedo	12/02/2019	11/07/2019
SERV-NAC	i4BDLE	Américo Azevedo	01/01/2019	30/04/2019
SERV-NAC	PLACORTE_AP-1	José Soeiro Ferreira	19/11/2018	31/12/2019
SERV-NAC	ACCLAMIN	Rui Diogo Rebelo	15/02/2019	15/05/2019
SERV-NAC	CMF_BH2019	Luís Guardão	01/03/2019	01/01/2020
SERV-NAC	AIsales	Rui Diogo Rebelo	06/05/2019	06/11/2019
SERV-NAC	ACCMES40III	Rui Diogo Rebelo	31/05/2019	31/03/2020
SERV-NAC	AI_PLN_F2	Luís Guardão	01/04/2019	30/06/2019
SERV-NAC	AR40II	Rui Diogo Rebelo	28/06/2019	28/12/2019
SERV-NAC	NDTECH	Rui Diogo Rebelo	01/07/2019	01/09/2019
SERV-NAC	T4CDTKC	Américo Azevedo	01/09/2019	31/03/2020
SERV-NAC	PSETSE	António Correia Alves	07/11/2019	31/07/2020

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
SERV-NAC	BM_Planning	Luís Guardão	02/12/2019	02/04/2020
SERV-NAC	WR_SI_PLN	Luís Guardão	15/11/2019	15/11/2020
SERV-NAC	ConsForestWise-1	Alexandra Sofia Marques	01/02/2019	31/12/2019
SERV-INT	IzaroGrey	António Correia Alves	01/01/2007	31/12/2999
SERV-INT	NantongSIM	Paulo Sá Marques	11/07/2019	11/09/2019

Type of Project:

PN-FCT National R&D Programmes - FCT
PN-PICT National R&D Programmes - S&T Integrated Projects
PN-COOP National Cooperation Programmes with Industry
PUE-FP EU Framework Programme
PUE-DIV EU Cooperation Programmes - Other
SERV-NAC National R&D Services and Consulting
SERV-INT International R&D Services and Consulting
OP Other Funding Programmes

10.6.2 List of publications

International Journals with Scientific Referees

1. Barbosa, C, Azevedo, A, "Assessing the impact of performance determinants in complex MTO/ETO supply chains through an extended hybrid modelling approach", International Journal of Production Research, pp.1-21, 2019
2. Barros, N., Carvalho, M., Silva, C., Fontes, T., Prata, J.C., Sousa, A., Manso, M.C., “Environmental and biological monitoring of benzene, toluene, ethylbenzene and xylene (BTEX) exposure in residents living near gas stations”, Journal of Toxicology and Environmental Health - Part A, 82(9):550-563, 2019
3. Dalmarco, G, Ramalho, FR, Barros, AC, Soares, AL, "Providing industry 4.0 technologies: The case of a production technology cluster", Journal of High Technology Management Research, 2019
4. Fontes, T., Manso, M.C., Prata, J.C., Carvalho, M., Silva, C., Sousa, A., Barros, N., “Exposure to BTEX in buses: the influence of vehicle fuel type”, Environmental Pollution, 255(1):113100, 2019
5. Kandasamy, S, Morla, R, Ramos, P, Ricardo, M, "Predicting throughput in IEEE 802.11 based wireless networks using directional antenna", Wireless Networks, pp.1-18, 2019
6. Krueger, V, Rovida, F, Grossmann, B, Petrick, R, Crosby, M, Charzoule, A, Garcia, GM, Behnke, S, Toscano, C, Veiga, G, "Testing the vertical and cyber-physical integration of cognitive robots in manufacturing", Robotics and Computer-Integrated Manufacturing, vol.57, pp.213-229, 2019
7. Neuenfeldt Junior, A, Silva, E, Gomes, M, Soares, C, Oliveira, JF, "Data mining based framework to assess solution quality for the rectangular 2D strip-packing problem", Expert Systems with Applications, vol.118, pp.365-380, 2019
8. Oliveira, JM, Ramos, P, "Assessing the Performance of Hierarchical Forecasting Methods on the Retail Sector", Entropy, vol.21, pp.436, 2019
9. Santos, A, Carvalho, A, Barbosa Povoa, AP, Marques, A, Amorim, P, "Assessment and optimization of sustainable forest wood supply chains - A systematic literature review", Forest Policy and Economics, vol.105, pp.112-135, Aug, 2019
10. Santos, C, Abubakar, S, Barros, AC, Mendonca, J, Dalmarco, G, Godsell, J, "Joining Global Aerospace Value Networks: Lessons for Industrial Development Policies", Space Policy, 2019
11. Santos, MJ, Amorim, P, Marques, A, Carvalho, A, Póvoa, A, "The vehicle routing problem with backhauls towards a sustainability perspective: a review", TOP, 2019

12. Sato, AK, Martins, TC, Gomes, AM, Guerra Tsuzuki, MSG, "Raster penetration map applied to the irregular packing problem", European Journal of Operational Research, vol.279, pp.657-671, 2019
13. Soares, R, Marques, A, Amorim, P, Rasinmaki, J, "Multiple vehicle synchronisation in a full truck-load pickup and delivery problem: a case-study in the biomass supply chain", European Journal of Operational Research, 2019
14. Sousa, R, Antunes, J, Coutinho, F, Silva, E, Santos, J, Ferreira, H, "Robust cepstral-based features for anomaly detection in ball bearings", International Journal of Advanced Manufacturing Technology, 2019

International Conference Proceedings with Scientific Referees

1. Azevedo, A, Santiago, SB, "Design of an assessment industry 4.0 maturity model: An application to manufacturing company", Proceedings of the International Conference on Industrial Engineering and Operations Management, pp.208-217, 2019
2. Azevedo, MM, Crispim, JA, de Sousa, JP, "A dynamic multiobjective model for designing machine layouts", IFAC Papersonline, vol.52, pp.1896-1901, 2019
3. Marques, CM, Moniz, S, de Sousa, JP, "Challenges in Decision-Making Modelling for New Product Development in the Pharmaceutical Industry", Computer Aided Chemical Engineering, vol.46, pp.1411-1416, 2019
4. Rivolli, A, Amaral, C, Guardão, L, de Sá, CR, Soares, C, "KnowBots: Discovering Relevant Patterns in Chatbot Dialogues", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11828 LNAI, pp.481-492, 2019
5. Silva, HD, Soares, AL, Bettoni, A, Francesco, AB, Albertario, S, "A Digital Platform Architecture to Support Multi-dimensional Surplus Capacity Sharing", IFIP Advances in Information and Communication Technology, vol.568, pp.323-334, 2019
6. Simoes, A, Oliveira, L, Rodrigues, JC, Simas, O, Dalmarco, G, Barros, AC, "Environmental Factors Influencing the Adoption of Digitalization Technologies in Automotive Supply Chains", Proceedings - 2019 IEEE International Conference on Engineering, Technology and Innovation, ICE/ITMC 2019, 2019
7. Simoes, AC, Soares, AL, Barros, AC, "Drivers Impacting Cobots Adoption in Manufacturing Context: A Qualitative Study", Lecture Notes in Mechanical Engineering - Advances in Manufacturing II, pp.203-212, 2019

Books

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Chapters/Papers in Books

1. Hernández, E, Senna, P, Silva, D, Rebelo, R, Barros, AC, Toscano, C, "Implementing RAMI4.0 in Production - A Multi-case Study", Lecture Notes in Mechanical Engineering - Progress in Digital and Physical Manufacturing, pp.49-56, 2019
2. Soares, R, Marques, A, Gomes, R, Guardão, L, Hernández, E, Rebelo, R, "Exploring the Linkages Between the Internet of Things and Planning and Control Systems in Industrial Applications", Lecture Notes in Mechanical Engineering - Progress in Digital and Physical Manufacturing, pp.65-72, 2019

Publications (Editor)

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Dissertations (PhD)

1. Cunha, T., “Recommending Recommender Systems: tackling the Collaborative Filtering algorithm selection problem”;
2. Guimarães, L., “Contributions for network design in urban freight distribution systems”;

3. Marques, C., “Optimization-based approaches to augment the value of integrated decision-making in the chemical-pharmaceutical industry”;
4. Messina, D., “Visibility in complex supply chains: an information management approach to support risk and disruption management decisions”.

10.7 CRIIS – ACTIVITY RESULTS IN 2019

10.7.1 Activity indicators

The following tables present CRIIS research team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.7.1 – CRIIS - Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	5	6	8	2
		Academic Staff	21	12	12	0
		Grant Holders and Trainees	19	23	23	0
		Total Core Researchers	**45**	**41**	**43**	**2**
		Total Core PhD	**25**	**15**	**18**	**3**
	Affiliated Researchers		0	5	5	0
	Administrative and Technical	Employees	3	3	2	-1
		Grant Holders and Trainees	2	0	0	0
		Total Admin and Tech	**5**	**3**	**2**	**-1**
		Total Integrated HR	**50**	**49**	**50**	**1**
		Total Integrated PhD	**25**	**20**	**23**	**3**

Table 10.7.2 - CRIIS – Project funding

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes - FCT	72	169	202	32
PN-PICT	National R&D Programmes - S&T Integrated Projects	62	31	8	-23
PN-COOP	National Cooperation Programmes with Industry	139	133	78	-55
PUE-FP	EU Framework Programmes	274	357	505	148
PUE-DIV	EU Cooperation Programmes - Other	35	178	170	-8
SERV-NAC	R&D Services and Consulting - National	432	291	145	-145
SERV-INT	R&D Services and Consulting - International		41	5	-36
OP	Other Funding Programmes			32	32
Closed Projects		3	5	2	-3
	Total Funding	**1 018**	**1 205**	**1 147**	**-58**

Table 10.7.3 – CRIIS - Summary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	18	29	29
Indexed Conferences	54	46	66
Books			2
Book Chapters	2	9	3
Concluded PhD Theses - Members	1		3
Concluded PhD Theses - Supervised	6	5	6

Table 10.7.4 - CRIIS – Summary of IP protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	2	1	1
Software copyright registrations	0	0	0
Patent first priority filings (New inventions)	0	1	0
Patent applications (Internationalization)	0	0	3
Granted patents	0	0	0
Licence agreements	0	0	0
Spin-offs established	0	0	0
Spin-offs in development	0	0	0

Table 10.7.5 - CRIIS – Summary of dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	2
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	3
International events in which INESC TEC members participate in the program committees	3
Participation in events such as fairs, exhibitions or similar	3

Table 10.7.6 - CRIIS - Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	4
Participants in the conferences, workshops and scientific sessions organised by the Centre	1500
Advanced training courses organised by the Centre	2

Table 10.7.7 - CRIIS – List of projects

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
PN-FCT	DM4Manufacturing	António Paulo Moreira	01/11/2016	31/10/2019
PN-FCT	COBOTIS	António Paulo Moreira	01/06/2018	31/05/2021
PN-FCT	SAFER-1	Filipe Neves Santos	01/07/2018	30/06/2021
PN-FCT	MetBots-1	Filipe Neves Santos	26/07/2018	24/07/2020
PN-PICT	iMAN-3	António Paulo Moreira	01/07/2015	30/06/2019
PN-COOP	AdaptPack-1	Manuel Santos Silva	01/09/2016	31/08/2019
PN-COOP	ROMOVI	Filipe Neves Santos	07/01/2017	30/11/2019
PN-COOP	SmartFarming	Filipe Neves Santos	01/10/2016	30/11/2018
PN-COOP	GOTECFOR	Filipe Neves Santos	01/01/2017	31/12/2020
PN-COOP	PRODUTECH_SIF-1	António Paulo Moreira	01/10/2017	30/09/2020
PN-COOP	FDControlo	Filipe Neves Santos	02/01/2018	31/12/2021
PUE-DIV	Water4Ever	Filipe Neves Santos	01/07/2017	30/06/2020
PUE-DIV	AGRINUPES	José Boaventura	01/04/2017	31/03/2020
PUE-DIV	MANUFACTUR4.0	Luís Freitas Rocha	17/04/2017	31/12/2019
PUE-DIV	BIOTECFOR	Filipe Neves Santos	01/01/2017	31/12/2019
PUE-FP	ColRobot	Germano Veiga	01/02/2016	31/01/2019
PUE-FP	ScalABLE4.0	Germano Veiga	01/01/2017	30/06/2020
PUE-FP	Fasten-1	Rafael Lírio Arrais	01/11/2017	31/10/2020
PUE-FP	DIVA-2	Filipe Neves Santos	01/04/2018	31/03/2021
PUE-FP	HORSE	Rafael Lírio Arrais	01/10/2018	31/08/2019
PUE-FP	Rosin	Rafael Lírio Arrais	01/05/2019	31/10/2019
PUE-FP	AgRoBoFood	Filipe Neves Santos	01/06/2019	31/05/2023
PUE-FP	DEMETER	Filipe Neves Santos	01/09/2019	28/02/2023
SERV-NAC	RIDDIG-1	Germano Veiga	03/05/2017	31/08/2019
SERV-NAC	SistemaDPA	Filipe Neves Santos	01/05/2017	31/08/2019
SERV-NAC	FED	Luís Freitas Rocha	01/05/2018	28/02/2019
SERV-NAC	COATING4.0-1	António Paulo Moreira	01/05/2018	30/06/2019
SERV-NAC	PBA	Héber Miguel Sobreira	05/11/2018	04/05/2019
SERV-NAC	Smart-Fertilizers	Filipe Neves Santos	01/01/2019	30/11/2020
SERV-NAC	Refinação4.0-1	António Paulo Moreira	01/09/2018	31/07/2019
SERV-NAC	Jales	Joaquim João Sousa	01/08/2019	01/09/2019
SERV-NAC	T4CDTKC-1	António Paulo Moreira	01/01/2019	31/03/2020
SERV-NAC	PIVOTBOT	Filipe Neves Santos	01/09/2019	01/03/2021
SERV-INT	DroneTool	Filipe Neves Santos	30/11/2017	29/05/2019
OP	SAFE	António Paulo Moreira	01/01/2019	31/12/2020
OP	ROBOTICA2019	António Paulo Moreira	01/01/2019	01/07/2019
OP	Robotica_ICARSC_2019	António Paulo Moreira	01/10/2018	28/05/2019

Type of Project:

PN-FCT National R&D Programmes - FCT
PN-PICT National R&D Programmes - S&T Integrated Projects
PN-COOP National Cooperation Programmes with Industry
PUE-FP EU Framework Programme
PUE-DIV EU Cooperation Programmes - Other
SERV-NAC National R&D Services and Consulting
SERV-INT International R&D Services and Consulting
OP Other Funding Programmes

10.7.2 List of publications

International Journals with Scientific Referees

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2. Pereira, T., “Robot-Dependent Maps for Coverage and Perception Task Planning”;
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10.8 CEGI – ACTIVITY RESULTS IN 2019

10.8.1 Activity indicators

The following tables present CEGI research team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.8.1 - CEGI – Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	0	4	8	4
		Academic Staff	19	13	13	0
		Grant Holders and Trainees	37	30	27	-3
		Total Core Researchers	**56**	**47**	**48**	**1**
		Total Core PhD	**28**	**27**	**26**	**-1**
	Affiliated Researchers		5	7	6	-1
	Administrative and Technical	Employees	1	1	1	0
		Grant Holders and Trainees	0	0	0	0
		Total Admin and Tech	**1**	**1**	**1**	**0**
		Total Integrated HR	**62**	**55**	**55**	**0**
		Total Integrated PhD	**33**	**33**	**32**	**-1**

Table 10.8.2 – CEGI – Project funding

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes - FCT	115	148	310	161
PN-PICT	National R&D Programmes - S&T Integrated Projects	162	210	35	-175
PN-COOP	National Cooperation Programmes with Industry	10	23	34	11
PUE-FP	EU Framework Programmes	11		95	95
PUE-DIV	EU Cooperation Programmes - Other				
SERV-NAC	R&D Services and Consulting - National	150	109	104	-5
SERV-INT	R&D Services and Consulting - International				
OP	Other Funding Programmes	22	12	4	-8
Closed Projects			2		-2
	Total Funding	**471**	**504**	**581**	**78**

Table 10.8.3 - CEGI – Summary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	34	30	30
Indexed Conferences	14	13	8
Books	1		
Book Chapters	2	2	1
Concluded PhD Theses - Members	4	3	2
Concluded PhD Theses - Supervised	7	4	5

Table 10.8.4- CEGI – Summary of IP protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	0	1	0
Software copyright registrations	0	0	0
Patent first priority filings (New inventions)	0	0	0
Patent applications (Internationalization)	0	0	0
Granted patents	0	0	0
Licence agreements	1	1	1
Spin-offs established	0	0	0
Spin-offs in development	0	0	0

Table 10.8.5 - CEGI – Summary of participation in dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	8
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	4
International events in which INESC TEC members participate in the program committees	10
Participation in events such as fairs, exhibitions or similar	1

Table 10.8.6 - CEGI – Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	0
Participants in the conferences, workshops and scientific sessions organised by the Centre	0
Advanced training courses organised by the Centre	0

Table 10.8.7 - CEGI – List of projects

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
PN-FCT	mKEP	Ana Viana	01/04/2016	30/09/2019
PN-FCT	EasyFlow-1	Pedro Amorim	01/06/2016	31/08/2019
PN-FCT	DM4Manufacturing-2	Pedro Amorim	01/11/2016	31/10/2019
PN-FCT	DoubleChain	Pedro Amorim	01/09/2018	31/08/2019
PN-FCT	ASAP	Maria Antónia Carravilla	01/06/2018	31/05/2021
PN-FCT	LASTMILE	João Pedro Pedroso	26/07/2018	25/07/2021
PN-FCT	SiuSMS	Maria Antónia Carravilla	26/07/2018	25/07/2021
PN-FCT	DeltaC&P	José Fernando Oliveira	26/07/2018	25/07/2021
PN-FCT	Tec-FEL	Pedro Amorim	04/04/2018	03/04/2021
PN-FCT	opti-MOVES-1	Teresa Galvão	26/07/2018	24/01/2021
PN-PICT	iMAN-2	Luís Guimarães	01/07/2015	30/06/2019
PN-PICT	CORAL-TOOLS-6	João Pedro Pedroso	01/01/2016	31/12/2018
PN-COOP	KnowLOGIS	Ana Viana	01/04/2017	27/09/2019
PUE-DIV	ENCKEP	Ana Viana	07/05/2019	07/05/2023
PUE-FP	FIN-TECH-1	Pedro Amorim	01/01/2019	31/12/2020
PUE-FP	MANU-SQUARE-1	Mário Amorim Lopes	01/01/2018	31/12/2020
PUE-FP	XFLEX-1	Armando Leitão	01/09/2019	31/08/2023
PUE-FP	POCITYF-1	Lia Patrício	01/09/2019	01/08/2024
PUE-FP	InteGrid-4	Pedro Amorim	01/01/2017	30/06/2020
SERV-NAC	HEAD	Luís Guimarães	01/01/2018	30/09/2019
SERV-NAC	BEEF	Pedro Amorim	30/05/2018	13/02/2019
SERV-NAC	VAR	Luís Guimarães	01/01/2019	01/05/2019
SERV-NAC	ValProduct	Sara Sofia Martins	01/03/2019	01/07/2019
SERV-NAC	PLACORTE_AP	José Fernando Oliveira	19/11/2018	31/12/2019
SERV-NAC	OCP_STOCK	Ana Viana	01/04/2019	01/06/2019
SERV-NAC	PortoAmbiente	Ana Viana	01/03/2019	01/05/2019
SERV-NAC	T4CDTKC-3	Pedro Amorim	01/09/2019	31/03/2020
SERV-NAC	KnowlogisII	Ana Viana	17/06/2018	17/06/2020
OP	Atena	Maria Antónia Carravilla	14/10/2016	13/10/2019

Type of Project:

PN-FCT	National R&D Programmes - FCT
PN-PICT	National R&D Programmes - S&T Integrated Projects
PN-COOP	National Cooperation Programmes with Industry
PUE-FP	EU Framework Programme
PUE-DIV	EU Cooperation Programmes - Other
SERV-NAC	National R&D Services and Consulting
SERV-INT	International R&D Services and Consulting
OP	Other Funding Programmes

10.8.2 List of publications

International Journals with Scientific Referees

1. Alvelos, F, Klimentova, X, Viana, A, "Maximizing the expected number of transplants in kidney exchange programs with branch-and-price", Annals of Operations Research, pp.1-16, 2019
2. Amorim Lopes, M, Almeida, A, Almada Lobo, B, "Physician Emigration: Should they Stay or Should they Go? A Policy Analysis", Computational Economics, 2019

3. Barbosa, F, Berbert Rampazzo, PCB, Yamakami, A, Camanho, AS, "The use of frontier techniques to identify efficient solutions for the Berth Allocation Problem solved with a hybrid evolutionary algorithm", COMPUTERS & OPERATIONS RESEARCH, vol.107, pp.43-60, JUL, 2019

4. Biró, P, van de Klundert, J, Manlove, D, Pettersson, W, Andersson, T, Burnapp, L, Chromy, P, Delgado, P, Dworczak, P, Haase, B, Hemke, A, Johnson, R, Klimentova, X, Kuypers, D, Nanni Costa, A, Smeulders, B, Spieksma, F, Valentín, MO, Viana, A, "Modelling and optimisation in European Kidney Exchange Programmes", European Journal of Operational Research, 2019

5. Borges, J, "A contextual family tree visualization design", Information Visualization, vol.18, pp.439-454, OCT, 2019

6. Campelo, P, Neves Moreira, F, Amorim, P, Almada Lobo, B, "Consistent vehicle routing problem with service level agreements: A case study in the pharmaceutical distribution sector", European Journal of Operational Research, 2019

7. Cardoso Grilo, T, Monteiro, M, Oliveira, MD, Amorim Lopes, M, Barbosa Povoa, A, "From problem structuring to optimization: A multi-methodological framework to assist the planning of medical training", European Journal of Operational Research, 2019

8. Cherri, LH, Carravilla, MA, Ribeiro, C, Bragion Toledo, FMB, "Optimality in nesting problems: New constraint programming models and a new global constraint for non-overlap", Operations Research Perspectives, vol.6, 2019

9. De Regge, M, Van Baelen, F, Beiroã, G, Den Ambtman, A, De Pourcq, K, Dias, JC, Kandampully, J, "Personal and Interpersonal Drivers that Contribute to the Intention to Use Gerontechnologies", Gerontology, pp.1-11, 2019

10. Dias, TG, "Driverless Cars-Another Piece of the Puzzle", IEEE Technology and Society Magazine, vol.38, pp.36-38, JUN, 2019

11. Joly, MP, Teixeira, JG, Patricio, L, Sangiorgi, D, "Leveraging service design as a multidisciplinary approach to service innovation", Journal of Service Management, vol.ahead-of-print, 2019

12. Jones, T, Willis, E, Amorim Lopes, M, Drach Zahavy, A, "Advancing the science of unfinished nursing care: Exploring the benefits of cross-disciplinary knowledge exchange, knowledge integration and transdisciplinarity", Journal of Advanced Nursing, 2019

13. Lopes, RL, Figueira, G, Amorim, P, Almada Lobo, B, "Cooperative coevolution of expressions for (r,Q) inventory management policies using genetic programming", International Journal of Production Research, pp.1-17, 2019

14. Martins, S, Ostermeier, M, Amorim, P, Huebner, A, Almada Lobo, B, "Product-oriented time window assignment for a multi-compartment vehicle routing problem", European Journal of Operational Research, 2019

15. Miguéis, VL, Camanho, AS, Falcão e Cunha, J, "Evaluating the short-term effect of cross-market discounts in purchases using neural networks: A case in retail sector", Expert Systems, 2019

16. Neuenfeldt Junior, A, Silva, E, Gomes, M, Soares, C, Oliveira, JF, "Data mining based framework to assess solution quality for the rectangular 2D strip-packing problem", Expert Systems with Applications, vol.118, pp.365-380, 2019

17. Neves Moreira, F, Almada Lobo, B, Cordeau, JF, Guimaraes, L, Jans, R, " Solving a large multi-product production-Routing problem with delivery time windows", Omega, 2019

18. Oliveira, BB, Carravilla, MA, Oliveira, JF, Costa, AM, "A co-evolutionary matheuristic for the car rental capacity-pricing stochastic problem", European Journal of Operational Research, 2019

19. Oliveria, R, Zanella, A, Camanho, AS, "The Assessment of Corporate Social Responsibility: the construction of an industry ranking and identification of potential for improvement", European Journal of Operational Research, 2019

20. Pires, M, Camanho, A, Amorim, P, "Solving the grocery backroom sizing problem", International Journal of Production Research, 2019
21. Santos, A, Carvalho, A, Barbosa Povoa, AP, Marques, A, Amorim, P, "Assessment and optimization of sustainable forest wood supply chains - A systematic literature review", Forest Policy and Economics, vol.105, pp.112-135, Aug, 2019
22. Silva, EF, Oliveira, LT, Oliveira, JF, Bragion Toledo, FMB, "Exact approaches for the cutting path determination problem", Computers & Operations Research, vol.112, DEC, 2019
23. Silva, MCA, Camanho, AS, Barbosa, F, "Benchmarking of secondary schools based on Students' results in higher education", Omega (United Kingdom), 2019
24. Soares, R, Marques, A, Amorim, P, Rasinmaki, J, "Multiple vehicle synchronisation in a full truck-load pickup and delivery problem: a case-study in the biomass supply chain", European Journal of Operational Research, 2019
25. Sobral, T, Galvao, T, Borges, J, "Visualization of urban mobility data from intelligent transportation systems", Sensors (Switzerland), vol.19, pp.332, 2019
26. Stumbriene, D, Camanho, AS, Jakaitiene, A, "The performance of education systems in the light of Europe 2020 strategy", Annals of Operations Research, 2019
27. Teixeira, JG, de Pinho, NF, Patricio, L, "Bringing service design to the development of health information systems: The case of the Portuguese national electronic health record", International Journal of Medical Informatics, vol.132, pp.103942, 2019
28. Teixeira, JG, Patricio, L, Tuunanen, T, "Advancing service design research with design science research", Journal of Service Management, vol.30, pp.577-592, 2019
29. Wei, WC, Amorim, P, Guimaraes, L, Almada Lobo, B, "Tackling perishability in multi-level process industries", International Journal of Production Research, pp.1-20, 2019
30. Woerbelauer, M, Meyr, H, Almada Lobo, B, "Simultaneous lotsizing and scheduling considering secondary resources: a general model, literature review and classification", OR Spectrum, 2019

International Conference Proceedings with Scientific Referees

1. Barbosa, F, Oliveira, JF, Carravilla, MA, Curcio, EF, "A Benders Decomposition Algorithm for the Berth Allocation Problem", Springer Proceedings in Mathematics and Statistics, vol.278, pp.29-41, 2019
2. Costa, V, Fontes, T, Borges, JL, Dias, TG, "Prediction of Journey Destination for Travelers of Urban Public Transport: A Comparison Model Study", Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering - Intelligent Transport Systems, From Research and Development to the Market Uptake, pp.113-132, 2019
3. Couto, M, Camanho, A, "Performance Evaluation of European Power Systems", Springer Proceedings in Mathematics and Statistics, vol.278, pp.73-89, 2019
4. de Amorim, DM, Dias, TG, Ferreira, MC, "Usability Evaluation of a Public Transport Mobile Ticketing Solution", Advances in Intelligent Systems and Computing, vol.876, pp.345-351, 2019
5. Ferreira, MC, Dias, TG, e Cunha, JF, "With Whom Transport Operators Should Partner? An Urban Mobility and Services Geolocation Data Analysis", Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering - Intelligent Transport Systems, From Research and Development to the Market Uptake, pp.133-143, 2019
6. Martins, MPG, Miguéis, VL, Fonseca, DSB, Alves, A, "A Data Mining Approach for Predicting Academic Success – A Case Study", Advances in Intelligent Systems and Computing, vol.918, pp.45-56, 2019
7. Martins, S, Amorim, P, Almada Lobo, B, "Consistent Consolidation Strategies in Grocery Retail Distribution", Springer Proceedings in Mathematics and Statistics, vol.278, pp.159-171, 2019
8. Saputro, TE, Figueira, G, Almada Lobo, B, "Integration of Supplier Selection and Inventory Management under Supply Disruptions", IFAC Papersonline, vol.52, pp.2827-2832, 2019

Books

Blank

Chapters/Papers in Books

1. Cruz-Gomes, S, Amorim-Lopes, M, Almada-Lobo, B, "The Demand for Healthcare Services and Resources: Patterns, Trends and Challenges in Healthcare Delivery", Operational Research - Springer Proceedings in Mathematics & Statistics, pp.91-106, 2019

Publications (Editor)

Blank

Dissertations (PhD)

1. Melo, A., “A Machine Learning Approach to the Optimization of Inventory Management Policies”;
2. Silva, T., “Semantic Integration of Urban Mobility Data through Ontologies for Supporting Data Visualization”.

10.9 CITE – ACTIVITY RESULTS IN 2019

10.9.1 Activity indicators

The following tables present CITE research team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.9.1 – CITE – Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	3	3	3	0
		Academic Staff	1	1	1	0
		Grant Holders and Trainees	5	4	3	-1
		Total Core Researchers	**9**	**8**	**7**	**-1**
		Total Core PhD	**4**	**3**	**3**	**0**
	Affiliated Researchers		7	1	1	0
	Administrative and Technical	Employees	0	0	1	1
		Grant Holders and Trainees	0	0	0	0
		Total Admin and Tech	**0**	**0**	**1**	**1**
		Total Integrated HR	**16**	**9**	**9**	**0**
		Total Integrated PhD	**10**	**4**	**5**	**1**

Table 10.9.2 – CITE – Project funding

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes - FCT		15	16	2
PN-PICT	National R&D Programmes - S&T Integrated Projects	33	53	4	-48
PN-COOP	National Cooperation Programmes with Industry				
PUE-FP	EU Framework Programmes	54	95	57	-37
PUE-DIV	EU Cooperation Programmes - Other	36	77	81	3
SERV-NAC	R&D Services and Consulting - National	37	46	37	-8
SERV-INT	R&D Services and Consulting - International				
OP	Other Funding Programmes	126	18	2	-16
Closed Projects				18	18
	Total Funding	**286**	**303**	**216**	**-87**

Table 10.9.3 - CITE – Summary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	19	10	14
Indexed Conferences	2	3	2
Books		1	
Book Chapters	2	5	
Concluded PhD Theses - Members	3	2	
Concluded PhD Theses - Supervised	3	2	1

Table 10.9.4 - CITE - Summary of participation in dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	1
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	2
International events in which INESC TEC members participate in the program committees	13
Participation in events such as fairs, exhibitions or similar	14

Table 10.9.5 - CITE – Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	4
Participants in the conferences, workshops and scientific sessions organised by the Centre	100
Advanced training courses organised by the Centre	0

Table 10.9.6 - CITE – List of projects

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
PN-FCT	SCREEN-DR-1	Catarina Maia	01/04/2016	31/03/2020
PN-FCT	DigEcoBus	Vânia Guiomar Gonçalves	03/07/2018	02/07/2021
PN-PICT	SMILES-2	João Claro	01/07/2015	30/06/2019
PUE-DIV	TouriSMEShare	Alexandra Xavier	15/12/2017	30/11/2019
PUE-DIV	PROTOATLANTIC-1	Alexandra Xavier	01/11/2017	31/10/2020
PUE-DIV	EEN2019	Alexandra Xavier	01/01/2019	31/12/2019
PUE-FP	DIVA	Alexandra Xavier	01/04/2018	31/03/2021
PUE-FP	EEN-Innovate	Alexandra Xavier	01/01/2019	31/12/2019
SERV-NAC	ConsForestWise	Abílio Pereira Pacheco	01/02/2019	30/06/2020
OP	CEE'2018	Alexandra Xavier	10/04/2018	31/12/2019

Type of Project:

PN-FCT	National R&D Programmes - FCT
PN-PICT	National R&D Programmes - S&T Integrated Projects
PN-COOP	National Cooperation Programmes with Industry
PUE-FP	EU Framework Programme
PUE-DIV	EU Cooperation Programmes - Other
SERV-NAC	National R&D Services and Consulting
SERV-INT	International R&D Services and Consulting
OP	Other Funding Programmes

10.9.2 List of publications

International Journals with Scientific Referees

1. Almeida, F, "Proposal of a Distributed Apriori Algorithm for Heterogeneous Performance Machines", Journal of Science and Arts, pp.945-952, 2019
2. Almeida, F, Adao, D, Martins, C, "Decision Support System for Assigning Members to Agile Teams", International Journal of Information Technologies and Systems Approach, vol.12, pp.43-60, 2019
3. Almeida, F, Almeida, J, Mota, M, "Perceptions and Trends of Booking Online Payments in Tourism", Journal of Tourism And Services, vol.10, pp.1-15, 2019
4. Almeida, F, Buzady, Z, "Assessment of Entrepreneurship Competencies Through the Use of FLIGBY", Digital Education Review, pp.151-169, Jun, 2019
5. Almeida, F, Buzády, Z, "Learning Entrepreneurship in Higher Education Through Flow Theory and FLIGBY Game", International Journal of Virtual and Personal Learning Environments, vol.9, pp.1-15, 2019
6. Almeida, F, Kennedy, AJ, Lin, B, Nowak, IV, "Measuring innovation through a crowd source initiative", International Journal of Innovation Science, vol.11, pp.471-488, 2019
7. Almeida, F, Miranda, E, Falcão, J, "Challenges and facilitators practices for knowledge management in large-scale scrum teams", Journal of Information Technology Case and Application Research, pp.1-13, 2019
8. Almeida, F, Silva, P, Araujo, F, "Performance Analysis and Optimization Techniques for Oracle Relational Databases", Cybernetics and Information Technologies, vol.19, pp.117-132, 2019
9. Almeida, F, Simões, J, "Moving from Waterfall to Agile: Perspectives from IT Portuguese Companies", International Journal of Service Science, Management, Engineering, and Technology, vol.10, pp.30-43, 2019
10. Almeida, F, Simoes, J, "The Role of Serious Games, Gamification and Industry 4.0 Tools in the Education 4.0 Paradigm", Contemporary Educational Technology, pp.120-136, 2019
11. Buzady, Z, Almeida, F, "FLIGBY—A Serious Game Tool to Enhance Motivation and Competencies in Entrepreneurship", Informatics, vol.6, pp.27, 2019
12. Farkat Diogenes, JRF, Claro, J, Rodrigues, JC, "Barriers to onshore wind farm implementation in Brazil", Energy Policy, vol.128, pp.253-266, 2019
13. Loureiro, MV, Claro, J, Fischbeck, P, "Coordinating cross-border electricity interconnection investments and trade in market coupled regions", International Journal of Electrical Power & Energy Systems, vol.104, pp.194-204, Jan, 2019
14. Poritskiy, N, Oliveira, F, Almeida, F, "The benefits and challenges of general data protection regulation for the information technology sector", Digital Policy, Regulation and Governance, vol.21, pp.510-524, 2019

International Conference Proceedings with Scientific Referees

1. Simoes, A, Oliveira, L, Rodrigues, JC, Simas, O, Dalmarco, G, Barros, AC, "Environmental Factors Influencing the Adoption of Digitalization Technologies in Automotive Supply Chains", Proceedings - 2019 IEEE International Conference on Engineering, Technology and Innovation, ICE/ITMC 2019, 2019
2. Terra, N, Rodrigues, JC, Maia, C, "Business model evolution in university startups of the healthcare sector", Proceedings - 2019 IEEE International Conference on Engineering, Technology and Innovation, ICE/ITMC 2019, 2019

Books

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Chapters/Papers in Books

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Publications (Editor)

Blank

Dissertations (PhD)

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10.10 CSIG – ACTIVITY RESULTS IN 2019

10.10.1 Activity indicators

The following tables present CSIG research team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.10.1 - CSIG - Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	10	13	13	0
		Academic Staff	30	24	25	1
		Grant Holders and Trainees	56	50	46	-4
		Total Core Researchers	**96**	**87**	**84**	**-3**
		Total Core PhD	**42**	**31**	**29**	**-2**
	Affiliated Researchers		16	18	19	1
	Administrative and Technical	Employees	1	1	1	0
		Grant Holders and Trainees	0	0	0	0
		Total Admin and Tech	**1**	**1**	**1**	**0**
		Total Integrated HR	**113**	**106**	**104**	**-2**
		Total Integrated PhD	**56**	**49**	**48**	**-1**

Table 10.10.2 - CSIG – Project funding

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes - FCT	117	183	366	183
PN-PICT	National R&D Programmes - S&T Integrated Projects	294	230	48	-182
PN-COOP	National Cooperation Programmes with Industry	80	126	68	-58
PUE-FP	EU Framework Programmes	262	350	371	21
PUE-DIV	EU Cooperation Programmes - Other	64	55	49	-6
SERV-NAC	R&D Services and Consulting - National	214	148	273	125
SERV-INT	R&D Services and Consulting - International		32	16	-16
OP	Other Funding Programmes	111	123	110	-14
Closed Projects		38	64	13	-51
	Total Funding	**1 180**	**1 311**	**1 314**	**3**

Table 10.10.3 - CSIG - Summary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	42	34	40
Indexed Conferences	74	113	77
Books		1	1
Book Chapters	5	6	3
Concluded PhD Theses - Members	7	9	1
Concluded PhD Theses - Supervised	13	16	1

Table 10.10.4 - CSIG - Summary of IP protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	0	2	0
Software copyright registrations	0	0	0
Patent first priority filings (New inventions)	0	1	0
Patent applications (Internationalization)	0	1	1
Granted patents	0	0	0
Licence agreements	0	0	0
Spin-offs established	0	1	0
Spin-offs in development	0	0	0

Table 10.10.5 - CSIG - Summary of dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	17
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	26
International events in which INESC TEC members participate in the program committees	70
Participation in events such as fairs, exhibitions or similar	11

Table 10.10.6 - CSIG - Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	2
Participants in the conferences, workshops and scientific sessions organised by the Centre	410
Advanced training courses organised by the Centre	0

Table 10.10.7 – CSIG - List of projects

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
PN-FCT	TAIL	Cristina Ribeiro	30/05/2016	30/09/2019
PN-FCT	CONTEXTWA	João Paiva Cardoso	01/06/2016	31/12/2019
PN-FCT	Icarefordepression	Artur Rocha	01/06/2016	29/02/2020
PN-FCT	C4G	Artur Rocha	15/06/2017	13/06/2020
PN-FCT	NIE	João Barroso	10/08/2017	18/04/2019
PN-FCT	eCSAAP	Hugo Paredes	01/09/2018	29/02/2020
PN-FCT	MoST	Alexandre Carvalho	01/06/2018	27/11/2020
PN-FCT	PERFECT	Maximino Bessa	01/07/2018	20/12/2020
PN-FCT	PAINTER	Rui Pedro Rodrigues	01/07/2018	30/06/2021
PN-FCT	M2S	António Coelho	01/07/2018	30/06/2021
PN-FCT	PromoTourVR	Maximino Bessa	26/07/2018	25/07/2021
PN-FCT	SCReLProg	Leonel Morgado	01/10/2018	30/09/2021
PN-FCT	Wex-Atlantic	João Barroso	20/07/2018	19/07/2021
PN-FCT	EPISA	Cristina Ribeiro	01/01/2019	31/12/2021
PN-PICT	FOUREYES-2	Sérgio Nunes	01/07/2015	30/06/2019
PN-PICT	SMILES-5	João Paiva Cardoso	01/07/2015	30/06/2019
PN-PICT	CORAL-SENSORS-3	Susana Alexandra Barbosa	01/01/2016	31/12/2018
PN-PICT	CORAL-TOOLS-3	Artur Rocha	01/01/2016	31/12/2018
PN-PICT	NanoStima-RL2	João Barroso	01/07/2015	30/06/2019
PN-PICT	NanoStima-RL3-2	Ângelo Martins	01/07/2015	30/06/2019
PN-PICT	NanoStima-RL4-3	Carla Lopes	01/07/2015	30/06/2019
PN-COOP	Simprove	António Gaspar	15/03/2017	14/09/2019
PN-COOP	FDControlo-1	Lino Oliveira	02/01/2018	31/12/2021
PN-COOP	INFRAVINI	Lino Oliveira	01/07/2019	30/06/2021
PUE-DIV	GReSBAS-1	António Coelho	01/04/2016	30/09/2019
PUE-DIV	MarRisk	Artur Rocha	01/07/2017	30/09/2020
PUE-DIV	RADARONRAIA	Lino Oliveira	01/01/2018	31/12/2021
PUE-FP	BEACONING	António Coelho	01/01/2016	30/04/2019
PUE-FP	RECAP	Artur Rocha	01/01/2017	31/03/2021
PUE-FP	MELOA	Artur Rocha	01/12/2017	28/02/2021
PUE-FP	FEEdBACk-1	António Coelho	01/11/2017	31/10/2020
PUE-FP	RDA-pt	Cristina Ribeiro	01/12/2018	31/05/2020
PUE-FP	iReceptor+	Artur Rocha	01/01/2019	31/12/2022
PUE-FP	EUCAN_CONNECT	Artur Rocha	01/01/2019	31/12/2023
PUE-FP	TIPES	Susana Alexandra Barbosa	01/09/2019	31/08/2023
PUE-FP	INCLUDING	Maximino Bessa	01/08/2019	31/07/2024
SERV-NAC	IMOPORTAL	José Correia	01/07/2016	31/07/2019
SERV-NAC	ARQNET	José Correia	26/10/2016	31/01/2020
SERV-NAC	PalacioDaAgua	José Martins	01/06/2018	31/05/2020
SERV-NAC	RUTE-1	Ana Cristina Paiva	01/10/2018	29/02/2020
SERV-NAC	PPD-Parlamento	Gabriel David	03/10/2018	31/03/2019
SERV-NAC	VRTrainingIndustry	Maximino Bessa	13/02/2019	12/02/2021
SERV-NAC	MuseuPorto	António Coelho	15/11/2018	31/03/2020

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
SERV-NAC	ProtocolsForITS	Paulo Monteiro	08/03/2019	08/11/2019
SERV-NAC	consult_ARQT_EMPR	José Correia	11/06/2019	28/02/2020
SERV-NAC	ICON	Gabriel David	13/05/2019	13/03/2020
SERV-NAC	SIGMAIA2	Ricardo Henriques	30/07/2019	30/01/2022
SERV-NAC	TRANSFORM	António Gaspar	02/12/2019	02/07/2020
SERV-INT	MBSupport	José Pedro Ornelas	18/10/2018	17/12/2020
SERV-INT	MBIntervention	José Pedro Ornelas	20/12/2018	30/06/2020
OP	Atena-1	Carla Lopes	14/10/2016	13/10/2019
OP	HDR4RTT	Maximino Bessa	30/09/2016	30/06/2020
OP	StopPropagHate	Sérgio Nunes	06/02/2018	30/06/2019
OP	RADCAMIN	Susana Alexandra Barbosa	01/01/2019	01/01/2021
OP	AmbiVideo360	Rui Pedro Rodrigues	01/09/2019	01/09/2020
OP	EuroVis2019	António Coelho	23/09/2017	23/06/2019
OP	TPDL/DublinCore	Cristina Ribeiro	23/10/2017	30/04/2019
OP	CSCWD2019	Hugo Paredes	01/05/2018	30/04/2020

Type of Project:

PN-FCT	National R&D Programmes - FCT
PN-PICT	National R&D Programmes - S&T Integrated Projects
PN-COOP	National Cooperation Programmes with Industry
PUE-FP	EU Framework Programme
PUE-DIV	EU Cooperation Programmes - Other
SERV-NAC	National R&D Services and Consulting
SERV-INT	International R&D Services and Consulting
OP	Other Funding Programmes

10.10.2 List of publications

International Journals with Scientific Referees

1. Arabnejad, H, Bispo, J, Cardoso, JMP, Barbosa, JG, "Source-to-source compilation targeting OpenMP-based automatic parallelization of C applications", Journal of Supercomputing, 2019
2. Bashford Rogers, T, Melo, M, Marnerides, D, Bessa, M, Debattista, K, Chalmers, A, "Learning Preferential Perceptual Exposure for HDR Displays", IEEE Access, vol.7, pp.36800-36809, 2019
3. Besnard, L, Pinto, P, Lasri, I, Bispo, J, Rohou, E, Cardoso, JMP, "A framework for automatic and parameterizable memoization", SoftwareX, vol.10, 2019
4. Chaves, R, Schneider, D, Correia, A, Motta, CLR, Borges, MRS, "Crowdsourcing as a Tool for Urban Emergency Management: Lessons from the Literature and Typology", Sensors, vol.19, pp.5235, 2019
5. Cherri, LH, Carravilla, MA, Ribeiro, C, Bragion Toledo, FMB, "Optimality in nesting problems: New constraint programming models and a new global constraint for non-overlap", Operations Research Perspectives, vol.6, 2019
6. Coelho, H, Melo, M, Martins, J, Bessa, M, "Collaborative immersive authoring tool for real-time creation of multisensory VR experiences", Multimedia Tools and Applications, 2019
7. Cooper Ordonez, REC, Vanhoucke, M, Coelho, J, Anholon, R, Novaski, O, "A Study of the Critical Chain Project Management Method Applied to a Multiproject System", Project Management Journal, pp.875697281983220, 2019

8. da Silva, JR, Ribeiro, C, Lopes, JC, "Ranking Dublin Core descriptor lists from user interactions: a case study with Dublin Core Terms using the Dendro platform", International Journal on Digital Libraries, pp.1-20, 2019

9. Devezas, J, Nunes, S, "Hypergraph-of-entity", Open Computer Science, vol.9, pp.103-127, 2019

10. Dias, JR, Penha, R, Morgado, L, da Veiga, PA, Carvalho, ES, Fernandes Marcos, A, "Tele-Media-Art: Feasibility Tests of Web-Based Dance Education for the Blind Using Kinect and Sound Synthesis of Motion", IJTHI, vol.15, pp.11-28, 2019

11. Diogo, CC, da Costa, LM, Pereira, JE, Filipe, V, Couto, PA, Geuna, S, Armada da Silva, PA, Mauricio, AC, Varejao, ASP, "Kinematic and kinetic gait analysis to evaluate functional recovery in thoracic spinal cord injured rats", Neuroscience and Biobehavioral Reviews, vol.98, pp.18-28, 2019

12. Fava, F, Soares, CM, Carvalhais, M, "Playful design, empathy and the nonhuman turn", Technoetic Arts, vol.17, pp.141-154, JUN, 2019

13. Fernandes, H, Costa, P, Filipe, V, Paredes, H, Barroso, J, "A review of assistive spatial orientation and navigation technologies for the visually impaired", Universal Access in the Information Society, pp.1-14, 2019

14. Fernando, HJS, Mann, J, Palma, JMLM, Lundquist, JK, Barthelmie, RJ, Belo Pereira, M, Brown, WOJ, Chow, FK, Gerz, T, Hocut, CM, Klein, PM, Leo, LS, Matos, JC, Oncley, SP, Pryor, SC, Bariteau, L, Bell, TM, Bodini, N, Carney, MB, Courtney, MS, Creegan, ED, Dimitrova, R, Gomes, S, Hagen, M, Hyde, JO, Kigle, S, Krishnamurthy, R, Lopes, JC, Mazzaro, L, Neher, JMT, Menke, R, Murphy, P, Oswald, L, Otarola Bustos, S, Pattantyus, AK, Veiga Rodrigues, CV, Schady, A, Sirin, N, Spuler, S, Svensson, E, Tomaszewski, J, Turner, DD, van Veen, L, Vasiljevic, N, Vassallo, D, Voss, S, Wildmann, N, Wang, Y, "The Perdigão: Peering into Microscale Details of Mountain Winds", Bulletin of the American Meteorological Society, 2019

15. Gaspar, H, Morgado, L, Mamede, H, Oliveira, T, Manjón, B, Gütl, C, "Research priorities in immersive learning technology: the perspectives of the iLRN community", Virtual Reality, 2019

16. Hatchett, J, Toffoli, D, Melo, M, Bessa, M, Debattista, K, Chalmers, A, "Displaying detail in bright environments: A 10,000 nit display and its evaluation", Signal Processing-Image Communication, vol.76, pp.125-134, Aug, 2019

17. Kemmeren, LL, van Schaik, DJF, Smit, JH, Ruwaard, J, Rocha, A, Henriques, MR, Ebert, DD, Titzler, I, Hazo, JB, Dorsey, M, Zukowska, K, Riper, H, "Unraveling the Black Box: Exploring Usage Patterns of a Blended Treatment for Depression in a Multicenter Study", JMIR Mental Health, vol.6, pp.12707, 2019

18. Lopes, CT, Da Silva, BG, "A classification scheme for analyses of messages exchanged in online health forums", Information Research-An International Electronic Journal, vol.24, Mar, 2019

19. Martins, J, Branco, F, Au Yong Oliveira, M, Goncalves, R, Moreira, F, "Higher Education Students Perspective on Education Management Information Systems: An Initial Success Model Proposal", IJTHI, vol.15, pp.1-10, 2019

20. Martins, J, Branco, F, Goncalves, R, Au Yong Oliveira, M, Oliveira, T, Naranjo Zolotov, M, Cruz Jesus, F, "Assessing the success behind the use of education management information systems in higher education", Telematics and Informatics, 2019

21. Martins, J, Costa, C, Oliveira, T, Goncalves, R, Branco, F, "How smartphone advertising influences consumers' purchase intention", Journal of Business Research, 2019

22. Monteiro, P, Coelho, H, Goncalves, G, Melo, M, Bessa, M, "Comparison of Radial and Panel Menus in Virtual Reality", IEEE Access, vol.7, pp.116370-116379, 2019

23. Morgado, IC, Paiva, ACR, "The iMPAcT tool for android testing", Proceedings of the ACM on Human-Computer Interaction, vol.3, 2019

24. Mukherjee, R, Debattista, K, Rogers, TB, Bessa, M, Chalmers, A, "Uniform Color Space based High Dynamic Range Video Compression", IEEE Transactions on Circuits and Systems for Video Technology, pp.1-1, 2019

25. Naranjo Zolotov, M, Oliveira, T, Cruz Jesus, F, Martins, J, Goncalves, R, Branco, F, Xavier, N, "Examining social capital and individual motivators to explain the adoption of online citizen participation", Future Generation Computer Systems, 2019

26. Narciso, D, Bessa, M, Melo, M, Coelho, A, Vasconcelos Raposo, J, "Immersive 360° video user experience: impact of different variables in the sense of presence and cybersickness", Universal Access in the Information Society, pp.1-11, 2019

27. Narciso, D, Melo, M, Raposo, JV, Cunha, J, Bessa, M, "Virtual reality in training: an experimental study with firefighters", Multimedia Tools and Applications, 2019

28. Nobre, R, Bispo, J, Carvalho, T, Cardoso, JMP, "Nonio — modular automatic compiler phase selection and ordering specialization framework for modern compilers", SoftwareX, vol.10, 2019

29. Paulino, D, Reis, A, Paredes, H, Fernandes, H, Barroso, J, "Usage of artificial vision cloud services as building blocks for blind people assistive systems", International Journal of Recent Technology and Engineering, vol.8, pp.453-458, 2019

30. Paulino, NMC, Ferreira, JC, Cardoso, JMP, "Dynamic Partial Reconfiguration of Customized Single-Row Accelerators", IEEE Transactions on Very Large Scale Integration (VLSI) Systems, pp.1-10, 2019

31. Raza, M, Faria, JP, Salazar, R, "Assisting software engineering students in analyzing their performance in software development", Software Quality Journal, 2019

32. Rocha, A, Ornelas, JP, Lopes, JC, Camacho, R, "Empowering Distributed Analysis Across Federated Cohort Data Repositories Adhering to FAIR Principles", ERCIM News, vol.2019, 2019

33. Rocha, T, Goncalves, C, Fernandes, H, Reis, A, Barroso, J, "Submitted to the WorldCIST'17: The AppVox mobile application, a tool for speech and language training sessions", Expert Systems, pp.12373, 2019

34. Santos, F, Almeida, A, Martins, C, Goncalves, R, Martins, J, "Using POI functionality and accessibility levels for delivering personalized tourism recommendations", Computers, Environment and Urban Systems, 2019

35. Silvano, C, Agosta, G, Bartolini, A, Beccari, AR, Benini, L, Besnard, L, Bispo, J, Cmar, R, Cardoso, JMP, Cavazzoni, C, Cesarini, D, Cherubin, S, Ficarelli, F, Gadioli, D, Golasowski, M, Libri, A, Martinovic, J, Palermo, G, Pinto, P, Rohou, E, Slaninova, K, Vitali, E, "The ANTAREX domain specific language for high performance computing", Microprocessors and Microsystems, vol.68, pp.58-73, Jul, 2019

36. Sousa e Silva, JSE, Goncalves, R, Branco, F, Pereira, A, Au Yong Oliveira, M, Martins, J, "Accessible software development: a conceptual model proposal", Universal Access in the Information Society, vol.18, pp.703-716, Aug, 2019

37. Tavares, B, Correia, FF, Restivo, A, "A survey on blockchain technologies and research", Journal of Information Assurance and Security, vol.14, pp.118-128, 2019

38. Vanhoucke, M, Coelho, J, "Resource-constrained project scheduling with activity splitting and setup times", Computers & Operations Research, 2019

39. Vasconcelos Raposo, J, Bessa, M, Teixeira, CM, Cabral, L, Melo, M, "Adaptation and Validation of the Temple Presence Inventory in a Portuguese Population", International Journal of Human–Computer Interaction, pp.1-7, 2019

40. Vasconcelos Raposo, J, Melo, M, Teixeira, C, Cabra, L, Bessa, M, "Adaptation & Validation of the ITC - Sense of Presence Inventory for the Portuguese language", Int. Journal of Human-Computer Studies, 2019

International Conference Proceedings with Scientific Referees

1. Aguiar, A, Restivo, A, Correia, FF, Ferreira, HS, Dias, JP, "Live software development", Proceedings of the 3rd International Companion Conference on Art, Science, and Engineering of Programming - Programming '19, 2019

2. Almeida, S, Paiva, ACR, Restivo, A, "Mutation-Based Web Test Case Generation", Quality of Information and Communications Technology - 12th International Conference, QUATIC 2019, Ciudad Real, Spain, September 11-13, 2019, Proceedings, vol.1010, pp.339-346, 2019

3. Amaral, D, Domingues, G, Dias, JP, Ferreira, HS, Aguiar, A, Nóbrega, R, "Live Software Development Environment for Java using Virtual Reality", Proceedings of the 14th International Conference on Evaluation of Novel Approaches to Software Engineering, 2019

4. Amaral, D, Domingues, G, Dias, JP, Ferreira, HS, Aguiar, A, Nóbrega, R, Correia, FF, "Live Software Development Environment Using Virtual Reality: A Prototype and Experiment", Communications in Computer and Information Science - Evaluation of Novel Approaches to Software Engineering, pp.83-107, 2019

5. Antunes, H, Lopes, CT, "Analyzing the Adequacy of Readability Indicators to a Non-English Language", Experimental IR Meets Multilinguality, Multimodality, and Interaction - 10th International Conference of the CLEF Association, CLEF 2019, Lugano, Switzerland, September 9-12, 2019, Proceedings, vol.11696, pp.149-155, 2019

6. Antunes, H, Lopes, CT, "Readability of web content an analysis by topic", 2019 14TH Iberian Conference on Information Systems and Technologies (CISTI), vol.2019-June, 2019

7. Belezas, F, Au Yong Oliveira, M, Branco, F, Goncalves, R, "Blockchain in collaborative economy business models: A comparative case study [A Blockchain nos modelos de negócio da Economia Colaborativa: Um estudo de caso comparativo]", Iberian Conference on Information Systems and Technologies, CISTI, vol.2019-June, 2019

8. Branco, F, Moreira, F, Martins, J, Au Yong Oliveira, M, Gonçalves, R, "Conceptual Approach for an Extension to a Mushroom Farm Distributed Process Control System: IoT and Blockchain", Advances in Intelligent Systems and Computing - New Knowledge in Information Systems and Technologies, pp.738-747, 2019

9. Brandao, A, Mamede, HS, Goncalves, R, "A Smart City's Model Secured by Blockchain", Trends and Applications in Software Engineering (CIMPS 2018), vol.865, pp.249-260, 2019

10. Brito, M, Nóbrega, R, Jacob, J, Rodrigues, R, Coelho, A, "Fall-prevention exergames using balance board systems", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11747 LNCS, pp.406-426, 2019

11. Campos, CJ, Pinto, HF, Miguel, J, Coelho, AF, Nobrega, R, "Vegetation modeling for driving environments", Iberian Conference on Information Systems and Technologies, CISTI, vol.2019-June, 2019

12. Canuto, L, Santos, L, Vieira, L, Goncalves, R, Rabadao, C, "CoAP flow signatures for the Internet of Things", 2019 14TH Iberian Conference on Information Systems and Technologies (CISTI), vol.2019-June, 2019

13. Cardoso, L, Martins, J, Goncalves, R, Branco, F, Moreira, F, Au Yong Oliveira, M, "A proposal for an electronic negotiation platform for tourism in low-density regions: Characterizing a functional analysis and prototype for the douro valley", Advances in Intelligent Systems and Computing, vol.865, pp.280-292, 2019

14. Carvalho, J, Santos, A, Paredes, H, "Data quality improvement in crowdsourcing systems by enabling a positive personal user experience", Proceedings of the 2019 IEEE 23rd International Conference on Computer Supported Cooperative Work in Design, CSCWD 2019, pp.255-260, 2019

15. Cesário, V, Coelho, A, Nisi, V, "Co-designing Gaming Experiences for Museums with Teenagers", Lecture Notes of the Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering, LNICST, vol.265, pp.38-47, 2019

16. Chaves, R, Schneider, D, Correia, A, Borges, MRS, Motta, C, "Understanding crowd work in online crowdsourcing platforms for urban planning: Systematic review", Proceedings of the 2019 IEEE 23rd International Conference on Computer Supported Cooperative Work in Design, CSCWD 2019, pp.273-278, 2019

17. Choma, J, Guerra, E, da Silva, TS, Zaina, LAM, Correia, FF, "Towards an artifact to support agile teams in software analytics activities", The 31st International Conference on Software Engineering and Knowledge Engineering, SEKE 2019, Hotel Tivoli, Lisbon, Portugal, July 10-12, 2019., vol.2019-July, pp.88-122, 2019

18. Coelho, H, Melo, M, Barbosa, L, Martins, J, Teixeira, MS, Bessa, M, "Authoring tools for creating 360 multisensory videos—Evaluation of different interfaces", Expert Systems, pp.e12418, 2019

19. Coelho, H, Melo, M, Branco, F, Vasconcelos Raposo, J, Bessa, M, "The impact of gender, avatar and height in distance perception in virtual environments", Advances in Intelligent Systems and Computing, vol.931, pp.696-705, 2019

20. Correia, A, Fonseca, B, Paredes, H, Schneider, D, Jameel, S, "Development of a Crowd-Powered System Architecture for Knowledge Discovery in Scientific Domains", 2019 IEEE International Conference on Systems, Man and Cybernetics (SMC), 2019

21. Correia, A, Jameel, S, Schneider, D, Fonseca, B, Paredes, H, "The effect of scientific collaboration on CSCW Research: A scientometric study", Proceedings of the 2019 IEEE 23rd International Conference on Computer Supported Cooperative Work in Design, CSCWD 2019, pp.129-134, 2019

22. Correia, A, Paredes, H, Schneider, D, Jameel, S, Fonseca, B, "Towards Hybrid Crowd-AI Centered Systems: Developing an Integrated Framework from an Empirical Perspective", 2019 IEEE International Conference on Systems, Man and Cybernetics (SMC), 2019

23. Costa, CM, Veiga, G, Sousa, A, Rocha, L, Augusto Sousa, AA, Rodrigues, R, Thomas, U, "Modeling of video projectors in OpenGL for implementing a spatial augmented reality teaching system for assembly operations", 19th IEEE International Conference on Autonomous Robot Systems and Competitions, ICARSC 2019, 2019

24. Devezas, JL, Lopes, CT, Nunes, S, "Graph-of-entity: A model for combined data representation and retrieval", OpenAccess Series in Informatics, vol.74, 2019

25. Dias, JP, Ferreira, HS, Sousa, TB, "Testing and deployment patterns for the internet-of-things", Proceedings of the 24th European Conference on Pattern Languages of Programs - EuroPLop '19, 2019

26. Dias, P, Rodrigues, J, Aguiar, A, David, G, "Planning and managing data for Smart Cities: An application profile for the UrbanSense project", 2018 IEEE International Smart Cities Conference, ISC2 2018, 2019

27. Domingues, G, Lopes, CT, "Characterizing and comparing Portuguese and English Wikipedia medicine-related articles", Companion of the World Wide Web Conference (WWW 2019), pp.1203-1207, 2019

28. Ferreira, AC, Cardoso, JMP, "Graph-Based Code Restructuring Targeting HLS for FPGAs", Applied Reconfigurable Computing - 15th International Symposium, ARC 2019, Darmstadt, Germany, April 9-11, 2019, Proceedings, vol.11444, pp.230-244, 2019

29. Ferreira, HS, Restivo, A, Sousa, TB, "Towards a pattern language for the masters student", Proceedings of the 24th European Conference on Pattern Languages of Programs - EuroPLop '19, 2019

30. Ferreira, J, Paiva, ACR, "Android Testing Crawler", Communications in Computer and Information Science, vol.1010, pp.313-326, 2019

31. Ferreira, PJS, Cardoso, JMP, Moreira, JM, "Automatic Switching Between Video and Audio According to User's Context", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11805 LNAI, pp.196-207, 2019

32. Ferreira, PJS, Magalhães, RMC, Garcia, KD, Cardoso, JMP, Moreira, JM, "An Efficient Scheme for Prototyping kNN in the Context of Real-Time Human Activity Recognition", Intelligent Data Engineering and Automated Learning - IDEAL 2019 - 20th International Conference, Manchester, UK, November 14-16, 2019, Proceedings, Part I, vol.11871, pp.486-493, 2019

33. Fonseca, E, Oliveira, I, Lobo, J, Mota, T, Martins, J, Au Yong Oliveira, M, "Kitchen Robots: The Importance and Impact of Technology on People's Quality of Life", Dynamic Programming for Impulse Feedback and Fast Controls - Lecture Notes in Control and Information Sciences, pp.186-197, 2019

34. Fortuna, P, Company, JS, Nunes, S, "Stop PropagHate at SemEval-2019 Tasks 5 and 6: Are abusive language classification results reproducible?", Proceedings of the 13th International Workshop on Semantic Evaluation, SemEval@NAACL-HLT 2019, Minneapolis, MN, USA, June 6-7, 2019, pp.745-752, 2019

35. Gonçalves, G, Melo, M, Bessa, M, "Virtual Reality Games: A Study about the Level of Interaction vs. Narrative and the Gender in Presence and Cybersickness", Proceedings - ICGI 2018: International Conference on Graphics and Interaction, 2019

36. Gonçalves, G, Melo, M, Martins, J, Vasconcelos Raposo, J, Bessa, M, "The Effect of Multisensory Stimuli on Path Selection in Virtual Reality Environments", Dynamic Programming for Impulse Feedback and Fast Controls - Lecture Notes in Control and Information Sciences, pp.686-695, 2019

37. Gusmão, P, Almeida, T, Lopes, F, Muryn, Y, Martins, J, Au Yong Oliveira, M, "Microtransactions in the Company's and the Player's Perspective: A Manual and Automatic Analysis", Agency, Freedom and Choice - Theory and Decision Library A: pp.440-451, 2019

38. Khanal, SR, Sampaio, J, Barroso, J, Filipe, V, "Classification of Physical Exercise Intensity Based on Facial Expression Using Deep Neural Network", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11573 LNCS, pp.455-467, 2019

39. Koch, I, Freitas, N, Ribeiro, C, Lopes, CT, da Silva, JR, "Knowledge Graph Implementation of Archival Descriptions Through CIDOC-CRM", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11799 LNCS, pp.99-106, 2019

40. Krassmann, AL, Nunes, FB, Bessa, M, Tarouco, LMR, Bercht, M, "Virtual Companions and 3D Virtual Worlds: Investigating the Sense of Presence in Distance Education", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11591 LNCS, pp.175-192, 2019

41. Leal, R, Santos, L, Vieira, L, Goncalves, R, Rabadao, C, "MQTT flow signatures for the Internet of Things", 2019 14TH Iberian Conference on Information Systems and Technologies (CISTI), vol.2019-June, 2019

42. Lima, B, "Automated Scenario-Based Integration Testing of Time-Constrained Distributed Systems", 2019 IEEE 12th Conference on Software Testing, Validation and Verification (ICST 2019), pp.486-488, 2019

43. Lima, B, Faria, JP, Hierons, R, "Local Observability and Controllability Enforcement in Distributed Testing", Communications in Computer and Information Science - Quality of Information and Communications Technology, pp.327-338, 2019

44. Lopes, CT, Moura, D, "Normalized Google Distance in the identification and characterization of health queries", 2019 14th Iberian Conference on Information Systems and Technologies (CISTI), vol.2019-June, 2019

45. Lopes, CT, Ribeiro, C, "Interplay of Documents' Readability, Comprehension and Consumer Health Search Performance Across Query Terminology", Proceedings of the 2019 Conference on Human Information Interaction and Retrieval, CHIIR 2019, Glasgow, Scotland, UK, March 10-14, 2019, pp.193-201, 2019

46. Lopes, CT, Sousa, H, "Assisting Health Consumers While Searching the Web through Medical Annotations", Proceedings of the 2019 Conference on Human Information Interaction and Retrieval, CHIIR 2019, Glasgow, Scotland, UK, March 10-14, 2019, pp.219-223, 2019

47. Lourenço, P, Dias, JP, Aguiar, A, Ferreira, HS, "CloudCity: A Live Environment for the Management of Cloud Infrastructures", Proceedings of the 14th International Conference on Evaluation of Novel Approaches to Software Engineering, 2019

48. Lourenço, P, Dias, JP, Aguiar, A, Ferreira, HS, Restivo, A, "Experimenting with Liveness in Cloud Infrastructure Management", Communications in Computer and Information Science - Evaluation of Novel Approaches to Software Engineering, pp.58-82, 2019

49. Maciel, D, Paiva, ACR, Da Silva, AR, "From requirements to automated acceptance tests of interactive apps: An integrated model-based testing approach", ENASE 2019 - Proceedings of the 14th International Conference on Evaluation of Novel Approaches to Software Engineering, pp.265-272, 2019

50. Magalhães, D, Martins, J, Branco, F, Au Yong Oliveira, M, Gonçalves, R, Moreira, F, "A proposal for a 360° information system model for private health care organizations", Expert Systems, pp.e12420, 2019

51. Magalhães, RMC, Cardoso, JMP, Moreira, JM, "Energy Efficient Smartphone-Based Users Activity Classification", Progress in Artificial Intelligence, 19th EPIA Conference on Artificial Intelligence, EPIA 2019, Vila Real, Portugal, September 3-6, 2019, Proceedings, Part II., vol.11805, pp.208-219, 2019

52. Marques, BM, da Silva, JR, Devezas, T, "Visualization in reproducible science", Iberian Conference on Information Systems and Technologies, CISTI, vol.2019-June, 2019

53. Marto, A, Gonçalves, A, Martins, J, Bessa, M, "Applying UTAUT model for an acceptance study alluding the use of augmented reality in archaeological sites", VISIGRAPP 2019 - Proceedings of the 14th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications, vol.2, pp.111-120, 2019

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64. Raza, M, Faria, JP, "Automatic calibration of performance indicators for performance analysis in software development", Proceedings of the International Conference on Software Engineering and Knowledge Engineering, SEKE, vol.2019-July, pp.646-649, 2019

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Chapters/Papers in Books

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2. Karimova, Y, Castro, JA, Ribeiro, C, "Data Deposit in a CKAN Repository: A Dublin Core-Based Simplified Workflow", Communications in Computer and Information Science - Digital Libraries: Supporting Open Science, pp.222-235, 2019
3. Pedrosa, D, Cruz, G, Morgado, L, "Multimodal Narratives as a Tool for In-Service Teachers in an Online Professional Development Course", Multimodal Narratives in Research and Teaching Practices - Advances in Educational Technologies and Instructional Design, pp.191-210, 2019

Publications (Editor)

Blank

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1. Carvalho, T., “Programming and mapping strategies for embedded computing runtime adaptability”.

10.11 LIAAD – ACTIVITY RESULTS IN 2019

10.11.1 Activity indicators

The following tables present LIAADresearch team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.11.1 – LIAAD - Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	0	3	3	0
		Academic Staff	28	22	22	0
		Grant Holders and Trainees	50	24	27	3
		Total Core Researchers	**78**	**49**	**52**	**3**
		Total Core PhD	**41**	**30**	**29**	**-1**
	Affiliated Researchers		6	4	5	1
	Administrative and Technical	Employees	0	0	0	0
		Grant Holders and Trainees	0	0	0	0
		Total Admin and Tech	**0**	**0**	**0**	**0**
		Total Integrated HR	**84**	**53**	**57**	**4**
		Total Integrated PhD	**47**	**34**	**34**	**0**

Table 10.11.2 – LIAAD - Project funding

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes - FCT	46	64	229	165
PN-PICT	National R&D Programmes - S&T Integrated Projects	355	242	51	-191
PN-COOP	National Cooperation Programmes with Industry	41	41		-41
PUE-FP	EU Framework Programmes	74	107	95	-12
PUE-DIV	EU Cooperation Programmes - Other				
SERV-NAC	R&D Services and Consulting - National	19	93	141	47
SERV-INT	R&D Services and Consulting - International				
OP	Other Funding Programmes	4	13	2	-11
Closed Projects			6	8	2
	Total Funding	**539**	**567**	**526**	**-41**

Table 10.11.3 – LIAAD - Summary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	36	44	46
Indexed Conferences	44	59	33
Books	1	4	
Book Chapters	7	6	2
Concluded PhD Theses - Members	2	2	2
Concluded PhD Theses - Supervised	6	3	5

Table 10.11.4 – LIAAD - Summary of IP protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	0	1	0
Software copyright registrations	0	0	0
Patent first priority filings (New inventions)	0	1	0
Patent applications (Internationalization)	0	1	0
Granted patents	0	0	0
Licence agreements	0	0	0
Spin-offs established	0	0	0
Spin-offs in development	0	0	0

Table 10.11.5 – LIAAD - Summary of dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	18
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	21
International events in which INESC TEC members participate in the program committees	63
Participation in events such as fairs, exhibitions or similar	4

Table 10.11.6 – LIAAD - Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	16
Participants in the conferences, workshops and scientific sessions organised by the Centre	500
Advanced training courses organised by the Centre	1

Table 10.11.7 – LIAAD - List of projects

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
PN-FCT	Dynamics2	Alberto Pinto	01/06/2016	31/08/2019
PN-FCT	FAST-manufacturing	Dalila Fontes	01/07/2018	30/06/2021
PN-FCT	MDG	Alberto Pinto	01/10/2018	30/09/2021
PN-FCT	NITROLIMIT	Luís Torgo	01/10/2018	30/09/2021
PN-FCT	MaLPIS	Paula Brito	01/10/2018	30/09/2021
PN-FCT	FailStopper	Rita Paula Ribeiro	01/12/2018	30/11/2020
PN-PICT	FOUREYES-3	Alípio Jorge	01/07/2015	30/06/2019
PN-PICT	iMAN-4	Dalila Fontes	01/07/2015	30/06/2019
PN-PICT	SMILES-7	João Gama	01/07/2015	30/06/2019
PN-PICT	CORAL-TOOLS-5	Luís Torgo	01/01/2016	31/12/2018
PN-PICT	NanoStima-RL4-2	Rui Camacho	01/07/2015	30/06/2019
PN-PICT	NanoStima-RL5-2	Carlos Ferreira	01/07/2015	30/06/2019
PUE-FP	RECAP-1	Rui Camacho	01/01/2017	31/03/2021
PUE-FP	NEXT-NET-1	Pedro Campos	01/10/2017	31/12/2019
PUE-FP	FIN-TECH	Alípio Jorge	01/01/2019	31/12/2020
PUE-FP	Humane_AI	João Gama	01/03/2019	29/02/2020
SERV-NAC	PANACea-1	João Gama	08/08/2016	30/05/2019
SERV-NAC	FLOWTEE	Pedro Brito	01/01/2018	31/12/2019
SERV-NAC	RUTE	Alípio Jorge	01/10/2018	29/02/2020
SERV-NAC	MLABA	João Gama	01/03/2019	01/02/2020
SERV-NAC	RISKSENS	João Mendes Moreira	01/07/2019	01/05/2020
SERV-NAC	PELICAN	João Gama	01/09/2019	03/02/2020
SERV-NAC	NDTECH-1	Ricardo Teixeira Sousa	01/07/2019	01/09/2019
SERV-NAC	TerraAlva	Alípio Jorge	01/12/2018	01/03/2019
OP	Coop_India	João Gama	01/01/2018	31/12/2019

Type of Project:

PN-FCT	National R&D Programmes - FCT
PN-PICT	National R&D Programmes - S&T Integrated Projects
PN-COOP	National Cooperation Programmes with Industry
PUE-FP	EU Framework Programme
PUE-DIV	EU Cooperation Programmes - Other
SERV-NAC	National R&D Services and Consulting
SERV-INT	International R&D Services and Consulting
OP	Other Funding Programmes

10.11.2 List of publications

International Journals with Scientific Referees

1. Accinelli, E, Martins, F, Oviedo, J, "Evolutionary Game Theory: A Generalization of the ESS Definition", International Game Theory Review, pp.1950005, 2019
2. Accinelli, E, Martins, F, Pinto, AA, "Evolutionary dynamics for the generalized Baliga–Maskin public good model", Chaos, Solitons and Fractals, pp.109496, 2019

3. Afsar, A, Martins, F, Oliveira, BMPM, Pinto, AA, "A fit of CD4+ T cell immune response to an infection by lymphocytic choriomeningitis virus", Mathematical Biosciences and Engineering, vol.16, pp.7009-7021, 2019
4. Babo, M, Poinhos, R, Franchini, B, Afonso, C, Oliveira, BMPM, Vaz de Almeida, MDV, "The relationship between health self-perception, food consumption and nutritional status among Portuguese older adults", European Journal of Clinical Nutrition, 2019
5. Branco, P, Torgo, L, Ribeiro, RP, "Pre-processing approaches for imbalanced distributions in regression", Neurocomputing, vol.343, pp.76-99, 2019
6. Brito, PQ, McGoldrick, PJ, Raut, UR, "Shopping Centre Patronage: Situational Factors Against Affect", Vision, 2019
7. Cerqueira, V, Torgo, L, Pinto, F, Soares, C, "Arbitrage of forecasting experts", Machine Learning, 2019
8. Cretú, B, Faculdade de Economia da Universidade do Porto, Porto, Portugal, Fontes, DBMM, Mahdi Homayouni, S, "A Genetic Algorithm for A Multi-Product Distribution Problem", International Journal for Quality Research, vol.13, pp.901-914, 2019
9. de Sousa, AGG, Tomasino, MP, Duarte, P, Fernandez Mendez, M, Assmy, P, Ribeiro, H, Surkont, J, Leite, RB, Pereira Leal, JB, Torgo, L, Magalhaes, C, "Diversity and Composition of Pelagic Prokaryotic and Protist Communities in a Thin Arctic Sea-Ice Regime", Microbial Ecology, vol.78, pp.388-408, Aug, 2019
10. Enes, T, Lousada, J, Aranha, J, Cerveira, A, Alegria, C, Fonseca, T, "Size–Density Trajectory in Regenerated Maritime Pine Stands after Fire", Forests, vol.10, pp.1057, 2019
11. Fam, K, Brito, PQ, Gadekar, M, Richard, JE, Jargal, U, Liu, WC, "Consumer attitude towards sales promotion techniques: a multi-country study", Asia Pacific Journal of Marketing and Logistics, vol.31, pp.437-463, 2019
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14. Ferreira, F, Gago, MF, Bicho, E, Carvalho, C, Mollaei, N, Rodrigues, L, Sousa, N, Rodrigues, PP, Ferreira, C, Gama, J, "Gait stride-to-stride variability and foot clearance pattern analysis in Idiopathic Parkinson's Disease and Vascular Parkinsonism", Journal of Biomechanics, vol.92, pp.98-104, 2019
15. Figueira, A, Guirnaraes, N, Torgo, L, "A Brief Overview on the Strategies to Fight Back the Spread of False Information", Journal of Web Engineering, vol.18, pp.319-352, Jun, 2019
16. Figueiredo, F, Jorge, A, "Identifying topic relevant hashtags in Twitter streams", Information Sciences, vol.505, pp.65-83, DEC, 2019
17. Fontes, DB, LIAAD-INESC L.A., Faculdade de Economia, Universidade do Porto, 4200-464 Porto, Portugal, Pereira, PA, Fontes, FA, Universidade do Minho 4800-058 Guimarães, Portugal, Universidade do Porto, 4200-465 Porto, Portugal, , "A decision support system for TV self-promotion Scheduling", International Journal of Advanced Trends in Computer Science and Engineering, vol.8, pp.134-140, 2019
18. Fontes, DBMM, Homayouni, SM, "Joint production and transportation scheduling in flexible manufacturing systems", Journal of Global Optimization, pp.1-30, 2019
19. Gomes, D, Mendes Moreira, J, Sousa, I, Silva, J, "Eating and Drinking Recognition in Free-Living Conditions for Triggering Smart Reminders", Sensors, vol.19, pp.2803, 2019
20. Jahromi, HN, Jorge, AM, "Data science applications in oil and gas exploration: an in-depth perspective", Proceedings of the Institution of Civil Engineers-Energy, vol.172, pp.122-133, AUG, 2019
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22. Lima, WS, Souto, E, El Khatib, K, Jalali, R, Gama, J, "Human Activity Recognition Using Inertial Sensors in a Smartphone: An Overview", Sensors, vol.19, pp.3213, 2019

23. Lu, J, Liu, AJ, Dong, F, Gu, F, Gama, J, Zhang, GQ, "Learning under Concept Drift: A Review", IEEE Transactions on Knowledge and Data Engineering, pp.1-1, 2019

24. Maharaj, EA, Teles, P, Brito, P, "Clustering of interval time series", Statistics and Computing, 2019

25. Martins, J, Pinto, A, Stollenwerk, N, "The maximum curvature reinfection threshold", Ecological Complexity, vol.40, pp.100791, Dec, 2019

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28. Nabizadeh, AH, Jorge, AM, Leal, JP, "Estimating time and score uncertainty in generating successful learning paths under time constraints", Expert Systems, pp.12351, 2019

29. Neves, F, Campos, P, Silva, S, "Innovation and Employment: An Agent-Based Approach", Jasss-The Journal of Artificial Societies and Social Simulation, vol.22, 2019

30. Nogueira, DM, Ferreira, CA, Gomes, EF, Jorge, AM, "Classifying Heart Sounds Using Images of Motifs, MFCC and Temporal Features", Journal of Medical Systems, vol.43, 2019

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33. Pereira, T, Dias, E, Fontes, DBMM, "A Mcda Model for Olive Oil Supplier Selection Using Macbeth", International Journal for Quality Research, vol.13, pp.849-862, 2019

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35. Raut, UR, Brito, PQ, Pawar, PA, "Analysis of Brand Resonance Measures to Access, Dimensionality, Reliability and Validity", Global Business Review, 2019

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42. Tavares, AH, Raymaekers, J, Rousseeuw, PJ, Brito, P, Afreixo, V, "Clustering genomic words in human DNA using peaks and trends of distributions", Advances in Data Analysis and Classification, 2019

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International Conference Proceedings with Scientific Referees

1. Andrade, T, Cancela, B, Gama, J, "Discovering Common Pathways Across Users' Habits in Mobility Data", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11805 LNAI, pp.410-421, 2019

2. Borges, A, Fontes, DBMM, Gonçalves, JF, "Modeling Supply Chain Network: A Need to Incorporate Financial Considerations", Springer Proceedings in Mathematics and Statistics, vol.278, pp.57-72, 2019

3. Castilho, D, Gama, J, Mundim, LR, de Carvalho, ACPLF, "Improving Portfolio Optimization Using Weighted Link Prediction in Dynamic Stock Networks", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11538 LNCS, pp.340-353, 2019

4. Coutinho, JC, Moreira, JM, de Sá, CR, "Mining Frequent Distributions in Time Series", Intelligent Data Engineering and Automated Learning - IDEAL 2019 - 20th International Conference, Manchester, UK, November 14-16, 2019, Proceedings, Part II, vol.11872, pp.271-279, 2019

5. Etemad, M, Soares, A, Matwin, S, Torgo, L, "On Feature Selection and Evaluation of Transportation Mode Prediction Strategies", Proceedings of the Workshops of the EDBT/ICDT 2019 Joint Conference, EDBT/ICDT 2019, Lisbon, Portugal, March 26, 2019., vol.2322, 2019

6. Ferreira Pereira, PFF, Rodrigues, F, Ferreira, C, "Code generator from mockups", 2019 14th Iberian Conference on Information Systems and Technologies (CISTI), vol.2019-June, 2019

7. Ferreira, PJS, Cardoso, JMP, Moreira, JM, "Automatic Switching Between Video and Audio According to User's Context", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11805 LNAI, pp.196-207, 2019

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9. Fontes, DBMM, Pereira, T, Oliveira, M, "Selection of a Strategic Plan Using an Integrated AHP-Goal Programming Approach", Bioinformatics and Biomedical Engineering - Lecture Notes in Computer Science, pp.125-141, 2019

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11. Homayouni, SM, Fontes, DBMM, "Joint scheduling of production and transport with alternative job routing in flexible manufacturing systems", 14th International Global Optimization Workshop (LeGO), 2019

12. Jatowt, A, Campos, R, Bhowmick, SS, Doucet, A, "Document in context of its time (DICT): Providing temporal context to support analysis of past documents", International Conference on Information and Knowledge Management, Proceedings, pp.2869-2872, 2019

13. Jorge, AM, Campos, R, Jatowt, A, Bhatia, S, "The 2nd International Workshop on Narrative Extraction from Text: Text2Story 2019", Lecture Notes in Computer Science - Advances in Information Retrieval, pp.389-393, 2019

14. Loureiro, D, Jorge, AM, "Language Modelling Makes Sense: Propagating Representations through Word Net for Full-Coverage Word Sense Disambiguation", 57th Annual Meeting of the Association for Computational Linguistics (ACL 2019), pp.5682-5691, 2019

15. Magalhães, RMC, Cardoso, JMP, Moreira, JM, "Energy Efficient Smartphone-Based Users Activity Classification", Progress in Artificial Intelligence, 19th EPIA Conference on Artificial Intelligence, EPIA 2019, Vila Real, Portugal, September 3-6, 2019, Proceedings, Part II., vol.11805, pp.208-219, 2019

16. Mahdi Homayouni, S, Fontes, DBMM, Fontes, FACC, "A BRKGA for the integrated scheduling problem in FMSs", Proceedings of the Genetic and Evolutionary Computation Conference Companion on - GECCO '19, 2019

17. Mansouri, B, Zahedi, MS, Campos, R, Farhoodi, M, "Exploring Video Game Searches on the Web", Companion of the World Wide Web Conference (WWW 2019), pp.1161-1170, 2019

18. Moulton, RH, Viktor, HL, Japkowicz, N, Gama, J, "Clustering in the presence of concept drift", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11051 LNAI, pp.339-355, 2019

19. Moutinho, V, Brazdil, P, Cordeiro, J, "Association and temporality between news and tweets", IC3K 2019 - Proceedings of the 11th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management, vol.1, pp.500-507, 2019

20. Nogueira, DM, Zarmehri, MN, Ferreira, CA, Jorge, AM, Antunes, L, "Heart Sounds Classification Using Images from Wavelet Transformation", Progress in Artificial Intelligence - Lecture Notes in Computer Science, pp.311-322, 2019

21. Oliveira, J, Nogueira, DM, Ramos, C, Renna, F, Ferreira, CA, Coimbra, MT, "Using Soft Attention Mechanisms to Classify Heart Sounds", 2019 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), 2019

22. Oliveira, M, Moniz, N, Torgo, L, Santos Costa, V, "Biased Resampling Strategies for Imbalanced Spatio-Temporal Forecasting", 2019 IEEE International Conference on Data Science and Advanced Analytics (DSAA), 2019

23. Pais, S, Cordeiro, J, Martins, R, Albardeiro, M, "Socialnetcrawler - Online social network crawler", 11th International Conference on Management of Digital EcoSystems, MEDES 2019, pp.16-22, 2019

24. Pasquali, A, Mangaravite, V, Campos, R, Jorge, AM, Jatowt, A, "Interactive system for automatically generating temporal narratives", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11438 LNCS, pp.251-255, 2019

25. Pedroto, M, Jorge, A, Mendes Moreira, J, Coelho, T, "Impact of Genealogical Features in Transthyretin Familial Amyloid Polyneuropathy Age of Onset Prediction", Practical Applications of Computational Biology and Bioinformatics, 12th International Conference, PACBB 2018, Toledo, Spain, 20-22 May, 2018., vol.803, pp.35-42, 2019

26. Roque, LAC, Paiva, LT, Fernandes, MCRM, Fontes, DBMM, Fontes, FACC, "Layout optimization of an airborne wind energy farm for maximum power generation", Energy Reports, 2019

27. Saadallah, A, Moreira Matias, L, Sousa, R, Khiari, J, Jenelius, E, Gama, J, "BRIGHT - Drift-aware demand predictions for taxi networks (Extended Abstract)", Proceedings - International Conference on Data Engineering, vol.2019-April, pp.2145-2146, 2019

28. Silva, A, Campos, P, Ferreira, CA, "Sequence and Network Mining of Touristic Routes Based on Flickr Geotagged Photos", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11805 LNAI, pp.133-144, 2019
29. Vazquez, N, Rocha, S, Lopez Fernandez, H, Torres, A, Camacho, R, Fdez Riverola, F, Vieira, J, Vieira, CP, Reboiro Jato, M, "EvoPPI: A Web Application to Compare Protein-Protein Interactions (PPIs) from Different Databases and Species", Practical Applications of Computational Biology and Bioinformatics, vol.803, pp.149-156, 2019
30. Veloso, B, Leal, F, Malheiro, B, Moreira, F, "Distributed Trust & Reputation Models using Blockchain Technologies for Tourism Crowdsourcing Platforms", Procedia Computer Science, vol.160, pp.457-460, 2019
31. Veloso, B, Malheiro, B, Foss, JD, "Stream recommendation using individual hyper-parameters", CEUR Workshop Proceedings, vol.2423, 2019
32. Vinagre, J, Jorge, AM, Bifet, A, Ghossein, MA, "ORSUM 2019 2nd workshop on online recommender systems and user modeling", Proceedings of the 13th ACM Conference on Recommender Systems, RecSys 2019, Copenhagen, Denmark, September 16-20, 2019., pp.562-563, 2019
33. Zgraja, J, Gama, J, Wozniak, M, "Active learning by clustering for drifted data stream classification", Communications in Computer and Information Science, vol.967, pp.80-90, 2019

Books

Blank

Chapters/Papers in Books

1. Agra, A, Cerveira, A, Requejo, C, "Logistic Operations in a Hospital: A Multi-item Inventory Distribution Problem with Heterogeneous Fleet", Pharmaceutical Supply Chains - Medicines Shortages - Lecture Notes in Logistics, pp.215-227, 2019
2. Moulton, RH, Viktor, HL, Japkowicz, N, Gama, J, "Clustering in the Presence of Concept Drift", Machine Learning and Knowledge Discovery in Databases - Lecture Notes in Computer Science, pp.339-355, 2019

Publications (Editor)

1. Monreale, A, Alzate, C, Kamp, M, Krishnamurthy, Y, Paurat, D, Mouchaweh, MS, Bifet, A, Gama, J, Ribeiro, RP, "ECML PKDD 2018 Workshops - DMLE 2018 and IoTStream 2018, Dublin, Ireland, September 10-14, 2018, Revised Selected Papers", DMLE/IOTSTREAMING@PKDD/ECML, vol.967, 2019

Dissertations (PhD)

1. Cerqueira, V., “Ensembles for Time Series Forecasting”;
2. Martins, M., “Political mobilization in Brazil from 2013 to 2017: a technopolitical analysis using surveys and social network data mining”.

10.12 CRACS – ACTIVITY RESULTS IN 2019

10.12.1 Activity indicators

The following tables present CRACS research team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.12.1 – CRACS - Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	1	1	1	0
		Academic Staff	14	14	15	1
		Grant Holders and Trainees	38	37	21	-16
		Total Core Researchers	**53**	**52**	**37**	**-15**
		Total Core PhD	**22**	**21**	**18**	**-3**
	Affiliated Researchers		1	0	2	2
	Administrative and Technical	Employees	1	1	1	0
		Grant Holders and Trainees	1	0	0	0
		Total Admin and Tech	**2**	**1**	**1**	**0**
		Total Integrated HR	**56**	**53**	**40**	**-13**
		Total Integrated PhD	**24**	**21**	**19**	**-2**

Table 10.12.2 - CRACS - Project funding

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes - FCT	126	81	65	-16
PN-PICT	National R&D Programmes - S&T Integrated Projects	317	295	25	-270
PN-COOP	National Cooperation Programmes with Industry				
PUE-FP	EU Framework Programmes	65	77	70	-7
PUE-DIV	EU Cooperation Programmes - Other			15	15
SERV-NAC	R&D Services and Consulting - National	78	45	49	4
SERV-INT	R&D Services and Consulting - International				
OP	Other Funding Programmes				
Closed Projects				4	4
	Total Funding	**585**	**499**	**229**	**-270**

Table 10.12.3 - CRACS - Summary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	14	11	16
Indexed Conferences	45	41	22
Books			
Book Chapters	1	1	2
Concluded PhD Theses - Members	1	1	1
Concluded PhD Theses - Supervised	1	1	1

Table 10.12.4 – CRACS - Summary of IP protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	0	1	1
Software copyright registrations	0	0	0
Patent first priority filings (New inventions)	0	1	0
Patent applications (Internationalization)	0	1	2
Granted patents	0	0	0
Licence agreements	0	0	0
Spin-offs established	0	0	0
Spin-offs in development	0	0	0

Table 10.12.5 – CRACS - Summary of dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	3
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	2
International events in which INESC TEC members participate in the program committees	32
Participation in events such as fairs, exhibitions or similar	1

Table 10.12.6 - CRACS - Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	0
Participants in the conferences, workshops and scientific sessions organised by the Centre	0
Advanced training courses organised by the Centre	0

Table 10.12.7 – CRACS - List of projects

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
PN-FCT	ELVEN	Vítor Santos Costa	01/07/2016	30/06/2019
PN-FCT	Angerona	Luís Filipe Antunes	01/09/2018	31/08/2019
PN-FCT	CRADLE	Vítor Santos Costa	15/06/2018	14/06/2021
PN-PICT	FOUREYES-4	José Paulo Leal	01/07/2015	30/06/2019
PN-PICT	SMILES-3	Fernando Silva	01/07/2015	30/06/2019
PN-PICT	NanoStima-RL3	Luís Filipe Antunes	01/07/2015	30/06/2019
PN-PICT	NanoStima-RL4	Luís Filipe Antunes	01/07/2015	30/06/2019
PUE-DIV	FGPE	Ricardo Queirós	01/09/2018	31/05/2021
PUE-FP	Digi-NewB	Luís Filipe Antunes	01/03/2016	29/02/2020
SERV-NAC	AuthenticusNF	Fernando Silva	01/08/2018	31/01/2019
SERV-NAC	EFA-Cloud	Luís Filipe Antunes	01/01/2019	31/12/2020
SERV-NAC	Authenticus19_20	Luís Filipe Antunes	01/09/2019	01/01/2020

Type of Project:

PN-FCT	National R&D Programmes - FCT
PN-PICT	National R&D Programmes - S&T Integrated Projects
PN-COOP	National Cooperation Programmes with Industry
PUE-FP	EU Framework Programme
PUE-DIV	EU Cooperation Programmes - Other
SERV-NAC	National R&D Services and Consulting
SERV-INT	International R&D Services and Consulting
OP	Other Funding Programmes

10.12.2 List of publications

International Journals with Scientific Referees

1. Aparicio, D, Ribeiro, P, Milenkovic, T, Silva, F, "Temporal network alignment via GoT-WAVE", Bioinformatics, 2019
2. Araujo, M, Ribeiro, P, Song, HA, Faloutsos, C, "TENSORCAST: forecasting and mining with coupled tensors", Knowledge and Information Systems, vol.59, pp.497-522, Jun, 2019
3. Areias, M, Rocha, R, "Multi-dimensional lock-free arrays for multithreaded mode-directed tabling in Prolog", Concurrency and Computation: Practice and Experience, pp.4491, 2019
4. Chattopadhyay, A, Koucky, M, Loff, B, Mukhopadhyay, S, "Simulation Theorems via Pseudo-random Properties", Computational Complexity, vol.28, pp.617-659, DEC, 2019
5. Costa, J, Silva, C, Antunes, M, Ribeiro, B, "Boosting dynamic ensemble's performance in Twitter", Neural Computing and Applications, 2019
6. Ferreira, CA, Gama, J, Costa, VS, "Contrasting logical sequences in multi-relational learning", Progress in Artificial Intelligence, 2019
7. Figueira, A, Guirnaraes, N, Torgo, L, "A Brief Overview on the Strategies to Fight Back the Spread of False Information", Journal of Web Engineering, vol.18, pp.319-352, Jun, 2019
8. Goncalves Ferreira, D, Sousa, M, Bacelar Silva, G, Frade, S, Antunes, L, Beale, T, Cruz Correia, R, "OpenEHR and General Data Protection Regulation: Evaluation of Principles and Requirements", JMIR Medical Informatics, vol.7, 2019
9. Martins, R, Correia, ME, Antunes, L, Silva, F, "Iris: Secure reliable live-streaming with opportunistic mobile edge cloud offloading", Future Generation Computer Systems, vol.101, pp.272-292, 2019

10. Nabizadeh, AH, Jorge, AM, Leal, JP, "Estimating time and score uncertainty in generating successful learning paths under time constraints", Expert Systems, pp.12351, 2019
11. Nwebonyi, FN, Martins, R, Correia, ME, "Reputation based approach for improved fairness and robustness in P2P protocols", Peer-to-Peer Networking and Applications, 2019
12. Queiros, R, "PROud-A Gamification Framework Based on Programming Exercises Usage Data", Information, vol.10, pp.54, Feb, 2019
13. Resende, JS, Martins, R, Antunes, L, "A Survey on Using Kolmogorov Complexity in Cybersecurity", Entropy, vol.21, pp.1196, 2019
14. Resende, JS, Sousa, PR, Martins, R, Antunes, L, "Breaking MPC implementations through compression", International Journal of Information Security, 2019
15. Silva, J, Aparício, D, Silva, F, "Feature-enriched author ranking in incomplete networks", Applied Network Science, vol.4, 2019
16. Zarmehri, MN, Castro, L, Santos, J, Bernardes, J, Costa, A, Santos, CC, "On the prediction of foetal acidaemia: A spectral analysis-based approach", Computers in Biology And Medicine, vol.109, pp.235-241, Jun, 2019

International Conference Proceedings with Scientific Referees

1. Alves, J, Pinto, A, "On the use of the blockchain technology in electronic voting systems", Advances in Intelligent Systems and Computing, vol.806, pp.323-330, 2019
2. Alves, S, Broda, S, "Pre-grammars and Inhabitation for a Subset of Rank 2 Intersection Types", Electronic Notes in Theoretical Computer Science, vol.344, pp.25-45, 2019
3. Aparício, D, Ribeiro, P, Silva, F, Silva, JMB, "Finding Dominant Nodes Using Graphlets", Studies in Computational Intelligence, vol.881 SCI, pp.77-89, 2019
4. Cabral, B, Figueira, Á, "On the Development of a Model to Prevent Failures, Built from Interactions with Moodle", Lecture Notes in Computer Science - Advances in Web-Based Learning – ICWL 2019, pp.352-356, 2019
5. Cabral, B, Figueira, A, "Preventing Failures by Predicting Students' Grades through an Analysis of Logged Data of Online Interactions", Proceedings of the 11th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management, 2019
6. de Sousa, HR, Pinto, A, "On the feasibility of blockchain for online surveys with reputation and informed consent support", Advances in Intelligent Systems and Computing, vol.806, pp.314-322, 2019
7. Ferreira, J, Zhygulskyy, M, Antunes, M, Frazao, L, "Performance of Hash Functions in Blockchain Applied to IoT Devices", 2019 14th Iberian Conference on Information Systems and Technologies (CISTI), vol.2019-June, 2019
8. Figueira, Á, Guimarães, N, Pinto, J, "A System to Automatically Predict Relevance in Social Media", Procedia Computer Science, vol.164, pp.105-112, 2019
9. Leite, R, Rocha, R, "A lock-free coalescing-capable mechanism for memory management", International Symposium on Memory Management, ISMM, pp.79-88, 2019
10. Leite, R, Rocha, R, "LRMalloc: A Modern and Competitive Lock-Free Dynamic Memory Allocator", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11333 LNCS, pp.230-243, 2019
11. Loff, B, Mukhopadhyay, S, "Lifting Theorems for Equality", Electronic Colloquium on Computational Complexity (ECCC), vol.25, pp.175, 2019
12. Moreno, P, Areias, M, Rocha, R, "Memory reclamation methods for lock-free hash tries", Proceedings - Symposium on Computer Architecture and High Performance Computing, vol.2019-October, pp.188-195, 2019

13. Nwebonyi, FN, Martins, R, Correia, ME, "Reputation-Based Security System for Edge Computing", Proceedings of the 13th International Conference on Availability, Reliability and Security, ARES 2018, Hamburg, Germany, August 27-30, 2018, pp.39:1-39:8, 2019
14. Nwebonyi, FN, Martins, R, Correia, ME, "Security and Fairness in IoT Based e-Health System: A Case Study of Mobile Edge-Clouds", 2019 International Conference on Wireless and Mobile Computing, Networking and Communications, WiMob 2019, Barcelona, Spain, October 21-23, 2019, pp.318-323, 2019
15. Oliveira, M, Moniz, N, Torgo, L, Santos Costa, V, "Biased Resampling Strategies for Imbalanced Spatio-Temporal Forecasting", 2019 IEEE International Conference on Data Science and Advanced Analytics (DSAA), 2019
16. Pereira Cunha, PM, Leal, JP, "Quarmic: A data-driven web development framework", OpenAccess Series in Informatics, vol.74, 2019
17. Ribeiro, G, Grabovschi, M, Antunes, M, Frazao, L, "Ncryptr: a symmetric and asymmetric encryption application", 2019 14th Iberian Conference on Information Systems and Technologies (CISTI), vol.2019-June, 2019
18. Shehu, AS, Pinto, A, Correia, ME, "Privacy preservation and mandate representation in identity management systems", Iberian Conference on Information Systems and Technologies, CISTI, vol.2019-June, 2019
19. Sousa, PR, Cirne, A, Resende, JS, Martins, R, Antunes, L, "pTASC: trustable autonomous secure communications", Proceedings of the 20th International Conference on Distributed Computing and Networking, ICDCN 2019, Bangalore, India, January 04-07, 2019, pp.193-202, 2019
20. Sousa, PR, Resende, JS, Martins, R, Antunes, L, "Secure Provisioning for Achieving End-to-End Secure Communications", Ad-Hoc, Mobile, and Wireless Networks - 18th International Conference on Ad-Hoc Networks and Wireless, ADHOC-NOW 2019, Luxembourg, October 1-3, 2019, Proceedings, vol.11803, pp.498-507, 2019
21. Sousa, PR, Resende, JS, Martins, R, Antunes, L, "Secure Provisioning for Achieving End-to-End Secure Communications", Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), vol.11803 LNCS, pp.498-507, 2019
22. Swacha, J, Queiros, R, Paiva, JC, "Towards a framework for gamified programming education", Proceedings - 2019 International Symposium on Educational Technology, ISET 2019, pp.144-149, 2019

Books

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Chapter/Paper in Books

1. Cabral, B, Figueira, Á, "A Machine Learning Model to Early Detect Low Performing Students from LMS Logged Interactions", Learning and Analytics in Intelligent Systems - Innovation in Information Systems and Technologies to Support Learning Research, pp.145-154, 2019
2. Grácio, L, Ribeiro, P, "An efficient approach for counting occurring induced subgraphs", Springer Proceedings in Complexity, pp.33-45, 2019

Publications (Editor)

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Dissertations (PhD)

1. Aparício, D., “Network Comparison and Node Ranking in Complex Networks”.

10.13 HASLAB – ACTIVITY RESULTS IN 2019

10.13.1 Activity indicators

The following tables present HASLab research team composition and evolution and the main indicators of its activity carried out in 2019 - participation in projects under contract, scientific production, IP valorisation and knowledge dissemination. The information on publications for 2019 has been obtained from different indexing sources (ISI, SCOPUS and DBLP) gathered by the Authenticus platform and from CORE (Computing Research and Education Association of Australasia).

Table 10.13.1 - HASLab - Research team composition

Type of Human Resources			2017	2018	2019	Δ 2018-19
Integrated HR	Core Research Team	Employees	1	6	7	1
		Academic Staff	21	14	16	2
		Grant Holders and Trainees	41	49	30	-19
		Total Core Researchers	**63**	**69**	**53**	**-16**
		Total Core PhD	**34**	**30**	**27**	**-3**
	Affiliated Researchers		1	7	6	-1
	Administrative and Technical	Employees	0	0	1	1
		Grant Holders and Trainees	2	3	1	-2
		Total Admin and Tech	**2**	**3**	**2**	**-1**
		Total Integrated HR	**66**	**79**	**61**	**-18**
		Total Integrated PhD	**35**	**37**	**33**	**-4**

Table 10.13.2 - HASLab - Project funding Table

Funding Source		Total Income (k€)			Δ (k€)
		2017	2018	2019	2018-19
PN-FCT	National R&D Programmes - FCT	11	68	228	160
PN-PICT	National R&D Programmes - S&T Integrated Projects	189	195	34	-161
PN-COOP	National Cooperation Programmes with Industry	16	34	2	-32
PUE-FP	EU Framework Programmes	554	566	452	-114
PUE-DIV	EU Cooperation Programmes - Other				
SERV-NAC	R&D Services and Consulting - National	60	79	72	-6
SERV-INT	R&D Services and Consulting - International		61	113	52
OP	Other Funding Programmes	19	91	249	158
Closed Projects		19	-1	6	7
	Total Funding	**869**	**1 094**	**1 158**	**63**

10.13.3 - HASLab - Summary of publications by members of the Centre

Publication Type	Total Publications		
	2017	2018	2019
Indexed Journals	15	15	12
Indexed Conferences	56	39	31
Books			1
Book Chapters	1		2
Concluded PhD Theses - Members	3	3	1
Concluded PhD Theses - Supervised	3	3	1

Table 10.13.4 - HASLab - Summary of IP protection, exploitation and technology transfer

Type of Result	2017	2018	2019
Invention disclosures	1	0	0
Software copyright registrations	0	1	0
Patent first priority filings (New inventions)	1	0	0
Patent applications (Internationalization)	1	0	0
Granted patents	0	0	0
Licence agreements	0	0	0
Spin-offs established	0	0	1
Spin-offs in development	0	1	0

Table 10.13.5 - HASLab - Summary of participation in dissemination activities

Type of Activity	2019
Participation as principal editor, editor or associated editor in journals	1
Conferences organized by INESC TEC members (in the organizing committee or chairing technical committees)	6
International events in which INESC TEC members participate in the program committees	33
Participation in events such as fairs, exhibitions or similar	8

Table 10.13.6 - HASLab - Summary of dissemination activities organised by the Centre

Type of Activity	2019
Conferences, workshops and scientific sessions organised by the Centre	3
Participants in the conferences, workshops and scientific sessions organised by the Centre	687
Advanced training courses organised by the Centre	5

Table 10.13.7 - HASLab - List of projects

Type of Project	Short Name	Leader	Starting date	Ending date (planned)
PN-FCT	GSL	Rui Maranhão	01/07/2016	31/12/2019
PN-FCT	KLEE	Luís Soares Barbosa	01/06/2018	31/05/2021
PN-FCT	SAFER	Alcino Cunha	01/07/2018	30/06/2021
PN-FCT	DaVinci	José Paiva Proença	26/07/2018	25/07/2021
PN-FCT	HADES	Manuel Barbosa	01/10/2018	30/09/2021
PN-FCT	MaLPIS-1	Ricardo Morla	01/10/2018	30/09/2021
PN-PICT	SMILES	Carlos Baquero	01/07/2015	30/06/2019
PN-PICT	NanoStima-RL1-4	José Creissac Campos	01/07/2015	30/06/2019
PN-PICT	NanoStima-RL3-4	Manuel Barbosa	01/07/2015	30/06/2019
PN-COOP	Cloud-Setup-1	Manuel Barbosa	01/07/2016	31/01/2019
PUE-FP	SafeCloud	Rui Carlos Oliveira	01/09/2015	31/08/2018
PUE-FP	Lightkone	Carlos Baquero	01/01/2017	31/12/2019
PUE-FP	CloudDBAppliance	Rui Carlos Oliveira	01/12/2016	30/11/2019
PUE-FP	InteGrid-1	Manuel Barbosa	01/01/2017	30/06/2020
PUE-FP	InterConnect-2	Fábio André Coelho	01/10/2019	01/10/2023
SERV-NAC	RCS	Fábio André Coelho	01/03/2018	29/02/2020
SERV-NAC	OLM	José Creissac Campos	10/08/2018	31/12/2019
SERV-NAC	CLOUD4CANDY-1	Alcino Cunha	15/04/2019	15/05/2019
SERV-NAC	INCMchaves	José Bacelar Almeida	15/04/2019	15/10/2019
SERV-NAC	OLM2	José Creissac Campos	01/05/2019	29/02/2020
SERV-NAC	MobileID	Vítor Francisco Fonte	01/10/2019	01/04/2021
SERV-INT	CRDB	Carlos Baquero	21/01/2018	20/01/2020
SERV-INT	KMSEC	Manuel Barbosa	01/04/2018	30/06/2019
OP	FM'19	José Nuno Oliveira	01/08/2018	31/03/2020

Type of Project:

PN-FCT	National R&D Programmes - FCT
PN-PICT	National R&D Programmes - S&T Integrated Projects
PN-COOP	National Cooperation Programmes with Industry
PUE-FP	EU Framework Programme
PUE-DIV	EU Cooperation Programmes - Other
SERV-NAC	National R&D Services and Consulting
SERV-INT	International R&D Services and Consulting
OP	Other Funding Programmes

10.13.2 List of publications

International Journals with Scientific Referees

1. Allahdadi, A, Morla, R, "Anomaly Detection and Modeling in 802.11 Wireless Networks", Journal of Network and Systems ManagemenT, vol.27, pp.3-38, 2019
2. Almeida, PS, Baquero, C, "Scalable eventually consistent counters over unreliable networks", Distributed Computing, vol.abs/1307.3207, 2019
3. Azad, MA, Morla, R, "Rapid detection of spammers through collaborative information sharing across multiple service providers", Future Generation Computer Systems, 2019
4. Cunha, A, Macedo, N, "Validating the Hybrid ERTMS/ETCS Level 3 concept with Electrum", International Journal on Software Tools for Technology Transfer, 2019
5. Fernandes, JP, Martins, P, Pardo, A, Saraiva, J, Viera, M, "Memoized zipper-based attribute grammars and their higher order extension", Science of Computer Programming, 2019

6. Gomes, L, HASLab INESC TEC, Universidade do Minho, R. da Universidade, 4710-057 Braga, Portugal, , Madeira, A, Barbosa, LS, CIDMA, Universidade de Aveiro, Campus Universitario de Santiago, 3810-193 Aveiro, Portugal, , Universidade do Minho, R. da Universidade, 4710-057 Braga, Portugal & Quantum Software Engineering Group, INL, , "Generalising KAT to Verify Weighted Computations", Scientific Annals of Computer Science, vol.29, pp.141-184, 2019
7. Harrison, MD, Freitas, L, Drinnan, M, Campos, JC, Masci, P, di Maria, C, Whitaker, M, "Formal techniques in the safety analysis of software components of a new dialysis machine", Science of Computer Programming, vol.175, pp.17-34, 2019
8. Harrison, MD, Masci, P, Campos, JC, "Verification Templates for the Analysis of User Interface Software Design", IEEE Transactions on Software Engineering, vol.45, pp.802-822, AUG, 2019
9. Hofmann, D, Neves, R, Nora, P, "Limits in Categories of Vietoris Coalgebras", Mathematical Structures in Computer Science, vol.29, pp.552-587, 2019
10. Kandasamy, S, Morla, R, Ramos, P, Ricardo, M, "Predicting throughput in IEEE 802.11 based wireless networks using directional antenna", Wireless Networks, pp.1-18, 2019
11. Lopes, SO, Pereira, RMS, Pereira, PA, Caldeira, AC, Fonte, VF, "Optimal Control Applied to an Irrigation Planning Problem: a real case study in Portugal", International Journal of Hydrology Science and Technology, vol.1, pp.1, 2019
12. Silva, JM, Carvalho, P, Bispo, KA, Rito Lima, S, "e-LiteSense: Self-adaptive energy-aware data sensing in WSN environments", International Journal of Communication Systems, 2019

International Conference Proceedings with Scientific Referees

1. Abreu, H, Ferreira, L, Coelho, F, Alonso, AN, Pereira, J, "Recovery in CloudDBAppliance's High-availability Middleware", Proceedings of the 8th International Conference on Data Science, Technology and Applications, 2019
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1. Silva, C., “Using Predictive and Descriptive Cognitive Models for Evaluation of Interactive Computing Systems”.