

# Activity Report 2018



*Inria*

# Summary

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# Strategy



**Bruno Sportisse**  
Inria's CEO

**“We are responsible for developing an ambitious and dynamic approach to research and innovation in the digital technology sector, in France and throughout Europe”**

2018 marked the start of a new cycle for the Institute. Playing a unique role in digital research and innovation ecosystems, Inria has reasserted its goals of achieving scientific excellence and increasing its economic impact, while striking a balance between reinforcing its regional presence and enhancing its international standing.

These goals are being achieved in many different ways: from our internationally recognised research and the vitality of our entrepreneurial ecosystem, to the impact of the centres created ten years ago in Bordeaux, Saclay and Lille, and Inria's role in developing an open web via the European node of the W3C.

Remaining true to our motto: “scientific excellence and transfer”, we have begun to define a new institutional policy. Digital technology is “engulfing” the world, disrupting everything in its path and making it more necessary than ever for research institutes such as Inria to embark on a new era.

For research and innovation are changing quickly and radically: interdisciplinarity and the hybridisation of competencies, the ability to become a key player in open ecosystems and rapid experimentation with new and therefore risky methods and procedures, are major challenges. To meet them, Inria must rethink its positioning, its choices and how it operates. We are

well equipped to do so, because digital technology is, of course, embedded in the Institute's DNA, but we must not underestimate the challenges posed by the speed of the developments, which we were so impatient to see! For example, other centres of high-level expertise in digital technology are emerging or growing stronger: universities, major private groups and start-ups.

In this context, our institutional policy has reasserted Inria's key responsibility as the national institute for research in the digital sector, by setting ambitious goals: **increasing the momentum of digital research and innovation in order to raise France's profile while boosting its scientific and economic attractiveness, supporting the digital transformation of society, and using digital technology to improve the research, higher education and innovation ecosystems.** The State has therefore asked Inria to coordinate the research component of the National Artificial Intelligence Plan – a role that needs to be defined, for everyone's benefit.

This responsibility also requires choices to be made in order to encourage the emergence of ambitious entrepreneurial projects. In research, we need to adopt a positioning based on a long-term perspective and on embracing risk, while prioritising key issues such as cybersecurity, responsible AI, or health and energy applications. In innovation, our challenge is to scale up our activities, using procedures that favour technological entrepreneurship, to develop our economic fabric. For all that, the choices made must not cast our priorities in stone. As the Institute's track record shows, Inria must remain an agile organisation.

These choices will guide our actions for the years to come.

# 8 Research Centres in France



54  
ERC

2500  
Inria's employees

More than  
160  
start-ups founded

92  
associate teams with  
foreign universities  
and research bodies.

4300  
papers

236  
million euros  
budget, 26% of which  
is self-funded

1350  
PhD researchers

180  
project teams

# Increasing the impact on society and the economy

Inria is developing its new institutional policy in response to a major challenge over the coming years: increasing the impact of digital research and innovation on society and the French economy.

This impact is a central concern in the development of the Institute's new Objectives and Performance Contract.

**technological infrastructure for innovative firms, and support the digital ambitions of our regions.**

And lastly, because our society has become a digital society, it is incumbent upon the Institute to meet the challenges of digital transformation by improving the dissemination of

scientific knowledge, by shedding light on all the issues – including ethical concerns – raised by digital transformation, and by contributing to the creation of a digital society built on innovation and trust by participating in the implementation of national public policies.

Firstly, the Institute needs to produce scientific results that will make a major contribution to furthering knowledge, and perhaps, to invent new disciplines in which digital technology will play a formative role.

We also need to optimise the economic impact of our research, especially by creating and supporting a large number of technological start-ups created by our project teams or working in partnership with them: job-creating start-ups which will then become "true" companies, or which will be acquired by existing companies based in our regions, and from which internationally important players may emerge.

This requires us to **contribute to the revitalisation and sustainability of a French and European industrial base in the digital sector, create a**

## 4 major priorities to ensure success

*The following priority actions have been defined to accomplish these aims*

- **Maintaining the pursuit of scientific excellence,** in our core digital activities but also in our interdisciplinary undertakings. This excellence is the bedrock on which Inria, as a research institute, is built;
- **Increasing the economic impact of the Institute;**
- **Creating an efficient and smooth-running organisational structure;**
- **Enhancing Inria's contribution** to the emergence of major, world-class research universities and consolidating its value added for the French research and innovation ecosystem, in support of public policies.

# Support functions, the backbone of the Institute

All of the staff working in support of Inria's project teams are essential to the success of our ambitious and dynamic approach to research and innovation. They are at the heart of Inria's organisational structure and are also responsible for the Institute's performance.

Promoting the emergence of ambitious scientific projects and providing support for entrepreneurial projects both require the services of Inria's highly competent support teams working to promote the Institute's ambitions. One of the keys to Inria's positioning resides in **its ability to establish itself as a hotbed of scientific and technological vitality, as an innovation driver**, and as a public infrastructure that is central to the French digital ecosystem and at its service.

Via the project teams, upon which Inria's organisational model is based, the researchers must be able to attain their goals with the support of an agile framework built on academic excellence, in a context that promotes interdisciplinarity and integration into local ecosystems with international ambitions. Researchers, engineers and PhD researchers must also be able to participate in start-up projects under the best possible conditions, which is the ideal way to go beyond the confines of scientific activity. The entrepreneurs in our regions must be able to access technologies and competencies. Companies based in France and Europe must be able to develop ambitious research partnerships.

These are central concerns of the support teams' missions, which provide support for the technological development of project teams and industrial partnerships, but also for the creation and accelerated development of technological start-ups in the digital sector. They also support Inria's activities in the European Research and Innovation Area. The support teams also play an active role in the digital transformation of the Institute itself, whose positioning requires the adoption of an exemplary approach. They guarantee the performance of two key functions: support for human resources and financial & asset management. Lastly, by implementing a communication policy that also promotes our public research partners, our support teams are contributing to the creation of the Inria brand and

enhancing the profile of France and our regions.

Support functions are carried out by administrative, technical and communications teams based in different departments, at Head Office and in the eight centres.

2018 was a transitional year for Inria, with **the priority given to reflecting upon the changes impacting professional functions, promoting the importance of support services as the backbone of the Institute** and the need to improve the fluidity of daily activities between the centres and the support departments. All these issues point towards the need to collaboratively develop a framework to facilitate risk-taking and enable the Institute to act quickly and collectively to achieve world-class performance.

## SonarQube, promoting collective performance

SonarQube won the Inria 2018 Research Support Prize. This innovative Open Source platform has been developed by engineers at the Lille, Rennes and Bordeaux centres. This software has been used at Inria since 2018 in order to test and measure the quality of the source code for IT projects. It is a benchmark solution on the market for continuous quality control.

# Committed to the success of public policies

Inria is a key player in the development of successful public policies for the rational development of digital technology in society. As such, the Institute is supporting highly significant policies, on artificial intelligence, cybersecurity and open science, for example.

The President of the French Republic set an ambitious target in March 2018: to make France a world-leader in artificial intelligence, by striking the right balance of performance and humanity.



## Promoting responsible AI based on trust

According to the “AI for Humanity” strategy, informed by a report by the Member of Parliament Cédric Villani, research and innovation must spearhead the development of AI. **Inria has been appointed to coordinate a national programme** which includes the establishment of the “3IA” network of Interdisciplinary Institutes for Artificial Intelligence based at academic institutions. Inria is

also participating in three of the four projects selected following the 3IA call for expressions of interest.

At the same time, Inria is actively involved in several French and European programmes.

The Institute is also running TransAlgo, a research and mediation platform dedicated to responsible and ethical algorithms and to responsible AI.

## Guaranteeing the security of cyberspace

France possesses a first-rate cybersecurity ecosystem with public players such as the National Cybersecurity Agency of France (ANSSI), the Government Arms Agency (DGA), several industrial groups, highly innovative technological start-ups and, of course, public research.

Around thirty Inria teams specialising in this ecosystem are rising to the scientific and technological challenges of cybersecurity. **A new Inria White Paper has just been published, in which the Institute, as a recognised scientific authority in this field, takes stock of the key issues and research activities carried out in these areas.**

## Reinforcing France's role in open science

The National Plan for Open Science, announced by the Minister of Higher Education, Research and Innovation, Frédérique Vidal, in July 2018, makes open access a mandatory requirement for publications and data derived from publicly funded research on projects. In numerous projects, Inria has confirmed its commitment to open and reproducible science, including the key issues posed by software and scientific data.





# Research



**Jean-Frédéric Gerbeau**  
Deputy CEO for Science

2018 was the first year of our new Scientific Strategic Plan. Among the five major challenges it contains, particular attention was paid to artificial intelligence (AI) and cybersecurity. In each of these strategic fields, a new post of Deputy Scientific Director will enable broader mobilisation within Inria. 2018 was also the fifth anniversary of Inria's involvement in MOOCs (Massive Open Online Courses), an activity aimed at a wide audience.

## Artificial Intelligence

With the launch of the National Plan, Inria is developing a new role: coordinating the research component of a public policy. Our participation in three of the four preselected proposals for the Interdisciplinary Institute of Artificial Intelligence (3IA) reflects Inria's national importance.

Inria is also prominently positioned on the global AI map. After 10 years of R&D, the launch of the “scikit-learn” consortium has brought together seven international industrial sponsors in a project to develop the second most downloaded machine-learning library in the world.

In another significant milestone, Inria is ranked 12th of 58 academic institutions and industrial establishments in terms of the number of articles accepted for ICML 2018 – one of the most prestigious IA conferences, and 7th among the academic institutions, rubbing shoulders with Oxford, Princeton, EPFL, ETHZ and Cornell. At NIPS – another major conference held in 2017 – Inria was ranked 14th out of 57, tied with Harvard.

In 2019, five project teams will be combining their expertise in an effort to move towards a human-centric form of AI, in the “HyAIAI” national incentive project. Their challenge is to enable the “interpretability” of machine learning, by combining approaches based on symbolic and numerical AI.

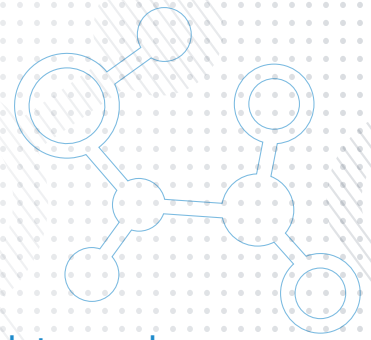
## Cybersecurity

In cybersecurity, one of Inria's strengths is the complementarity of our teams specialising in systems, networks, cryptography and program proofs, as set out in the Inria White Paper published at the start of 2019. Several of these teams have joined forces in two national incentive projects, SPAI and RIOT-FP. SPAI is seeking to guarantee the inviolability of security properties for the Internet of Things by using the Coq proof assistant to certify programs written in a multilevel language. RIOT-FP is developing cryptographic primitives and verified communication protocols for the RIOT Operating System dedicated to the Internet of Things.

## E-education

Inria regularly places its expertise at the service of society as a whole. In 2013, Inria helped to establish France Université Numérique, the French national platform dedicated to the use of massive open online courses, which now has more than 50 partners and one million subscriptions to its MOOCs. Inria Learning Lab has produced 19 MOOCs which have attracted 160,000 subscriptions. From the learning of programming and the protection of privacy to reproducible research and the training of trainers, Inria's MOOCs propose scientific innovations for the training of scientists and citizens.





# Inria Project Labs:

mobilising complementary teams to meet multidisciplinary and inclusive challenges

**Inria Project Labs (IPL) work on research topics that are too extensive for a single team and require additional complementary expertise. Such topics are generally consistent with the Institute's strategic plan and bring together researchers from different project teams, as well as external academic or industrial partners.**

## Algae in Silico: the potential of microalgae

Micro-algae can produce an extraordinary variety of molecules with a lower environmental impact than other energy sources. They are used in the energy, chemistry and nutrition sectors and are a rapidly developing source of innovation. Several project teams at Inria are conducting projects based on these organisms. Biocore (Sophia Antipolis) is developing tools to optimise the production of biofuels by microalgae and protein-rich formulas for animal feed or wastewater treatment. It forms part of the Algae in Silico Inria Project Lab (IPL) with other teams providing complementary expertise: Ange (Paris) for modelling the hydrodynamics of the microalgae growth medium, Coffee (Sophia Antipolis) on modelling microalgae biofilms, Pleiades (Bordeaux) on lipid production by micro-organisms, and Dyliss (Rennes) on the metabolism of microalgae. Algae in Silico is also a partnership with Université Pierre et Marie Curie, the French National Institute for Agricultural Research (INRA) and the French Research Institute for the Exploitation of the Sea (IFREMER). The

research priorities of this IPL include the development of a digital platform to assess the performance of micro-algae species given the growth process envisioned and the prevailing climate. Its goal is to save time and calibrate investments more accurately before establishing microalgae cultures, while also optimising production. **In 2018, Algae in Silico fostered a start-up – Inalve – which exploits some of the patents derived from the IPL.**

## Fratres: controlled nuclear fusion

At a time when 80% of the world's energy is produced by fossil resource-based processes, finding new alternative energy sources is becoming one of the major challenges for the coming years. Controlled nuclear fusion could be one of these alternatives, particularly via tokamaks: experimental machines which exploit the energy released by fusion. One of the main difficulties concerning the construction of these machines is that several different approaches from theoretical and numerical physics are used to describe them, all based on equations that

are very hard to solve numerically as they include numerous spatio-temporal scales. Several Inria teams are developing mathematical and numerical tools that will help to solve these problems. **Different areas of expertise are concerned: physical and mathematical modelling, algorithmics and software development, and the implementation of high-performance simulation codes (HPC).** The Fratres IPL organises the collaborations between these different scientific expertises. It brings together the Castor, Mingus and Tonus project teams, in partnership with IRFM-CEA Cadarache, Max Planck Institute-IPP Garching, LJLL-Jussieu and IMT-Toulouse. Fratres operates in association with national and European initiatives on nuclear fusion.

For example, the numeric code developed by the Castor team provided the key to finding the correct structural parameters for the ignition of the WEST tokamak (formerly Tore Supra) on the CEA Cadarache site. It is also contributing to the ITER fusion reactor project and two members of the IPL are among the group of scientists known as "ITER scientist fellows".

# 2018 Awards



**Stéphanie Chalita**  
L'Oréal-UNESCO Award

At the Inria Lille - Nord Europe research centre, Stéphanie Chalita develops research work on the field of cloud computing and in particular on the issue of heterogeneity of resources offered by Amazon, Google, OVH and many others. Its approach aims to unify all providers in order to mask the specificities of each of them, eliminate their dependency, ensure the migration of applications hosted on the cloud to other providers to protect them from potential failures or optimize costs and performance by combining the most advantageous offers from several providers.



**Fanny Orlhac**  
L'Oréal-UNESCO Award

At the Inria Sophia Antipolis research centre, she is working to improve the care of cancer patients by combining artificial intelligence and medical imaging. Fanny Orlhac's objective is to extract diagnostic and prognostic indicators from the images and combine them with other biological indicators (genomics, metabolomics,...) to accurately characterize tumor heterogeneity. This would allow early identification of patients who do not respond to standard treatment based on imaging and biological data available before treatment is implemented. This information would be provided to the practitioner so that he or she could consider alternative therapeutic approaches at the time of diagnosis.



**George Drettakis**  
ERC Advanced Grant

George Drettakis, senior researcher at the Sophia Antipolis – Méditerranée research centre and head of the Grapdeco project-team works in Computer Graphics, which is the technology used to create images for special effects in films, realistic video games, but also for the simulation of architectural and urban planning projects and product design, and the many recent applications of virtual reality (VR) and augmented reality. The field has seen rapid growth recently, with new applications constantly appearing.



**Xavier Pennec**  
ERC Advanced Grant

Xavier Pennec, senior researcher at the Sophia Antipolis - Méditerranée research centre in the Epione team, works on shape analysis, and in the variability of human organs in particular, a field called computational anatomy. The mathematical problems that these morphological statistics raise are particularly interesting because one cannot add or subtract shapes. His project will try to reinvent statistical methods to work in these non-linear spaces. The potential applications in medicine are numerous because shape statistics enables the encoding of a priori knowledge on normal or abnormal anatomy.



**Laura Grigori**  
ERC Synergy Grant

The Extreme-scale Mathematically-based Computational Chemistry (EMC2) multidisciplinary project led by Eric Cancès, Laura Grigori, Yvon Maday and Jean-Philip Piquemal is at the interface of chemistry, computer science, and mathematics. Molecular simulation can be used as a virtual microscope to study more or less complex molecules with atomic-scale space-time resolution. It can also be used as a tool for computer-aided design (CAD) and engineering of new molecules, materials and nano-devices.



**François Baccelli**  
ERC Advanced Grant

François Baccelli's project lies at the interface between mathematics and communications engineering. It focuses on stochastic geometry, a branch of probability theory, which looks at the probability distribution of geometric objects and wants to develop dynamical stochastic geometry tools in order to understand the dynamics of these objects. The tools that he developed are already widely used in the design of cellular networks. The dynamical version of these tools will make it possible to address major questions on these networks, but also to analyse other types of large networks, such as social networks or neural networks.



**Xavier Leroy**

Inria-French Académie des sciences Grand Prize

A world leader in the sciences of programming languages and program verification and a professor at the Collège de France on the permanent chair of Software Science, Xavier Leroy is particularly renowned for his theoretical contributions on typing and semantics and the role they can have in computer security. Two ambitious projects characterize its expertise: the OCaml programming language (one of the two most commonly used functional languages today) and the CompCert compiler, an essential component in the security chain for critical software. Xavier Leroy's contributions, both theoretical and practical, represent a considerable step forward in the field of safe programming of modern systems.



**Pierre-Yves Oudeyer**

The Inria - French Académie des sciences Young Researcher Award

Pierre-Yves Oudeyer, senior researcher at Inria, is one of the pioneers of "artificial curiosity", an approach to artificial intelligence through intrinsically motivated autonomous learning. For several years now, Pierre-Yves Oudeyer and his FLOWERS project team have been working in this field of activity, which aims to combine artificial intelligence and intrinsic motivation to develop educational technologies in the service of human learning. This research is of particular interest to the world of education and a project with a consortium of companies for large-scale experiments is being set up.



**Stéphane Cotin**

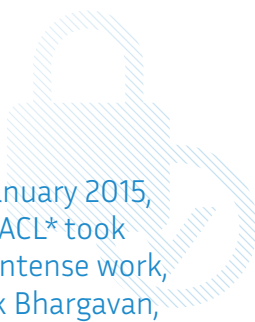
The Inria - French Académie des sciences  
Dassault Systèmes Innovation Award

Stéphane Cotin, as senior researcher with his MIMESIS project team, leads a high-level international research activity on digital medical simulation in the fields of surgical gesture training but also intraoperative assistance via augmented reality techniques. In February 2013, he and several fellow researchers, InSimo, created a start-up using SOFA, an open source interactive simulation software framework that he initiated. InSimo is a creator of surgical simulation applications on virtual organs with high fidelity behavior. Stéphane Cotin is particularly involved in clinical innovation.

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# *HACL\*, a cryptolibrary proving its worth*

Created by the Prosecco project team (Inria Paris) as part of the Everest project conducted in collaboration with Microsoft Research, the HACL\* cryptolibrary offers a high-assurance solution to improve transaction security on the Internet.



Initiated in January 2015, developing HACL\* took two years of intense work, led by Karthik Bhargavan, head of Prosecco, and his PhD researcher at the time, Jean-Karim Zinzindohoué.

A cryptographic library that is fast and formally verified, thereby guaranteeing that it is correct, secure and without covert channels... Those were the terms of reference of the Prosecco project team (Inria Paris) when the HACL\* (standing for High Assurance Crypto-Library) project was launched.

This was in 2015, a few months after Edward Snowden's revelations, and in the wake of an international cryptography conference at which a call had been made for more research work on formal verification.

**The challenge: find a way of overcoming the numerous security flaws in the OpenSSL library** in spite of its being the one most scrutinised by the entire "crypto" community.

The project was part of a partnership between Inria and Microsoft Research that started in 2005, and more particularly the Everest project, whose aim was to reinforce transaction security on the Internet by proposing a powerful and mathematically verified implementation of the HTTPS ecosystem. These efforts led to the creation of a high-assurance cryptographic library, written in the F\* programming language and proof assistant and compiled into C using the KreMLin compilers and CompCert, a formally verified C compiler that came out of the work of the Gallium project team (Inria Paris). The resulting code is also as fast as a library written in C from the start, like OpenSSL.

Two years after the beginning of the project, the library made its debut at several major conferences: ICFP, IEEE Symposium on Security and Privacy,

ACM CCS. Far from being confined to the role of a tool dedicated to fundamental research, HACL\* has always found its way into large-scale applications. Indeed, since September 2017, the library has been successfully implemented in the Mozilla Firefox browser, in the WireGuard VPN – soon to be implemented in the Linux kernel – as well as in the Tezos blockchain.

New developments are expected in the coming months, with a version including new parallel algorithms for optimum performance and work on the verification of more advanced cryptographic constructions, such as those based on postquantum cryptography.





# Innovation



**François Cuny**

Deputy CEO for Innovation

“ Throughout 2018, Inria maintained its commitment to technological development, strategic partnerships, the creation of start-ups and the development of Open Source consortia. ”

## Supporting start-up projects

In 2018, Inria's research centres continued to provide regular support for start-up projects. Participants in the second round of the Digital Startup programme, which focuses on the marketing, business and financial aspects of start-up projects, benefitted from new coaches and mentors. Inria also continued the Horizon Startup programme, which has raised the awareness of over two hundred scientists about the creation of start-ups and helped to promote an entrepreneurial culture within the Institute.

Six start-ups were created in 2018: Dilepix, UT4H, Nurea, Denimbo, Neurinnov and OneAngstrom. These successes were accompanied by two excellent fundraising operations for Therapixel and Mensia Technologies and an Emmy Award in the Technology & Engineering category for Golaem.

At the beginning of 2018, Inria opened a branch at French Tech Central, at the heart of Station F, with the aim of developing relationships between public research and start-ups. A number of master classes were organised, giving fledgling entrepreneurs an opportunity to discover the technologies being developed at Inria.

## Software consortia

The InriaSoft initiative continues to pursue its goals of ensuring the sustainability and promoting the commercial development of key scientific software developed by Inria project teams. By the end of 2018, some ten InriaSoft engineers were supporting nine software programs and the associated consortia from a variety of fields ranging from artificial intelligence, programming languages and software security, to bio-informatics and medical imaging.

## Strategic partnerships

In 2018, a framework agreement was signed with Google and an OpenLab focusing on artificial intelligence was launched with PSA. Our long-standing collaboration with ANDRA (the French National Radioactive Waste Management Agency) on the modelling of underground radioactive waste storage facilities was renewed, as were partnerships with Microsoft and Nokia, reflecting the researchers' commitment to projects developed with industrial partners and management's strong involvement in maintaining these collaborations.

# Dilepix and OneAngstrom, two Inria start-ups

Inria plays a key role in supporting the creation of start-ups, this being one of its preferred modes of transfer. There are currently more than 120 companies marketing technological developments with their roots in work carried out by the Institute's research teams. Let's take a closer look at five start-ups that were created in 2018.

“Being able to turn to research teams with a global reputation has given a real sense of credibility to our project”

Alban Polba, co-founder of Dilepix

## Dilepix - making life easier for farmers

Dilepix offer an online image analysis service used to automate the process of monitoring agricultural holdings.

Behind this project: Aurélien Yol, engineer and researcher within the Lagadic project team (Inria Rennes), specialising in robotic vision.

“Agriculture is a sector undergoing a process of digital transition, and one in which our vision equipment has enormous potential”, says the engineer. Intelligent sensors and cameras have been added to a number of holdings and are used to observe livestock and crops or to detect the presence of pests. **Dilepix help farmers to decipher the data from this monitoring equipment.** They supply an image analysis

system that functions automatically, immediately notifying farmers in the event of a problem. In order to put the finishing touches to their start-up project, it was supported by InriaHub, the Institute's development unit. They also sought assistance from an expert in robotics and precision agriculture, Alban Polba. In 2018, Dilepix were one of 64 prize-winners at national i-Lab awards which aims to support innovative start-ups. Dilepix were also awarded the Crisalide Numérique 2018 prize in the Greentech category and were participants at the Consumer Electronic Show (CES) in Las Vegas in January 2019.

## OneAngstrom - Towards revolutionizing the practice of molecular modelling

Founded in October 2018, the start-up OneAngstrom came about as a result of a process started ten years earlier within the Nano-D team (Grenoble Rhône-Alpes). The project team, started in 2008 by Stéphane Redon to develop algorithms for computational nanoscience, is behind SAMSON, a software platform that allows users to simulate, analyse and design drugs, materials, electronic components, nanosystems, etc. Molecular

modelling is a complex topic, in which the diversity of sciences and techniques (quantum mechanics, molecular dynamics, deep learning, high performance computing, etc.) makes collaboration and scientific advances difficult.

The unique open architecture of the SAMSON platform makes it able to address this problem. **OneAngstrom has a dual value proposition, aimed at both consumers and producers of tools, data and services for molecular modelling, whether academic or industrial.**

Having previously been awarded a Starting Grant by the European Research Council (ERC) in 2012, Stéphane Redon also received in 2016 a Proof of Concept grant that enabled him to put together a business model around SAMSON, which led to the creation of OneAngstrom.

After raising money in December 2018, OneAngstrom is off to a good start and is fully focused on its commercial development.



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# *The scikit-learn initiative, a reference software library for machine learning*

The scikit-learn initiative, a partnership with companies, has been launched on september 2019. Its objectives are to support the development of this reference software: sustaining its high quality and adding new functionalities. Scikit-learn is a library in Python programming language. It is dedicated to statistical learning.



## **Ten years of research and development**

Initially launched in 2007 by members of the Python scientific community, the scikit-learn project had a new start in 2009 with the investment of Inria's Parietal project team.

To conduct research on brain imaging, the team needed a predictive modelling tool that integrated with the Python ecosystem. It then organised an open participatory development with the objective of building an open source tool for statistical data analysis. Two years later, a first version was released.

Scikit-learn is now supported by a very large team of developers based in Paris, New York, Sydney and around the world. It is in the top three most popular machine learning software programs on GitHub.

## **Diversified fields of application**

Scikit-learn can process complex data (databases, texts and images) and classify them using state-of-the-art techniques for automated decision making. Scikit-learn is on an open source and available under BSD license.

A community of developers (inside and outside Inria) quickly formed, which made it possible to accelerate the development of the tool and foster many applications.

**Scikit-learn is used by a large number of Web companies to predict user buying behaviour, offer product recommendations and detect trends and abusive behaviour (fraud, spam, etc.).**

One of scikit-learn's strong points is its generic nature, which ensures great versatility and diverse applications, such as fighting against fraud and spam, analyzing medical images, prediction of user behaviour and optimization of industrial and logistic processes.

## **The scikit-learn consortium**

To support and stimulate the scikit-learn ecosystem, a consortium of sponsors (BCG Gamma, Microsoft, Axa, BNP Paribas Cardif, Intel, Nvidia and Dataiku) has been created with the support of the Inria Foundation. It will found engineers to ensure the quality of the project and the integration of new contributions, as well as the addition of ambitious new features. These efforts will be lead in close connection with scikit-learn's vast community of users and developers. Both the foundation's partners and the open-source community will be involved in defining the development priorities.

# A joint laboratory with Nokia Bell Labs

Joining forces to meet the scientific challenges of the future... This is the main thrust of the partnership between the Institute and Nokia. For the past 10 years, they have been collaborating by running a joint laboratory, with the aim of developing communication networks for the Future Internet. A fruitful partnership which has been renewed for the next four years.

Launched in 2008, the partnership between the Institute and Nokia Bell Labs\* – the telecommunication giant's research centre – was renewed in late 2017 for another four years. A joint laboratory brings together researchers, doctoral students and postdoctoral researchers who pool their knowledge and work collaboratively on communications networks. The aim of this collaboration is to develop optimised network resources that meet Future Internet requirements. From IoT to the driverless car, smart cities to e-health... just some of the burgeoning fields with numerous technical challenges still to be overcome. **Future networks must be capable of managing this multitude of connected objects, of hosting and ensuring the massive interconnection of distributed functions and displaying unprecedented agility in their management of these multiple and demanding situations of use.**

Inria and Nokia Bell Labs are collaborating on all these issues. Both parties possess renowned expertise in information theory, machine learning, graph theory, game theory, cybersecurity, network virtualisation and advanced software control. Over the next four years, the joint

laboratory will be concentrating on four research priorities: information theory and algorithms to overcome IoT challenges; machine learning and analysis to optimise virtualised networks dynamically and automatically; distributed and evolutionary learning and control in order to exploit complex IoT networks containing dynamic elements with augmented intelligence; cybersecurity to ensure the confidentiality and integrity of data and develop resilience in response to intrusions. Very high-level research projects will be carried out to develop innovations that will enhance the products developed by Nokia in the future.

\*Formerly Alcatel-Lucent Bell Labs.

*“On the strength of their rich and productive relationship established over the last twenty years, Inria and Nokia Bell Labs are trailblazers in this adventure. We have even higher expectations and more ambitious plans for our future collaboration via our joint laboratory focusing on the fundamental challenges facing humanity in the connected world of the future”*

**Marcus Weldon,**  
CTO of Nokia and President  
of Nokia Bell Labs

# Inria's commitment

## **Humanity must be at the heart of our projects.**

Inria has adopted meaningful strategic priorities based on the principles of transparency and ethics: the main cause supported by the Institute is the use of digital technology to help the disabled.

In its institutional development project for the 2019-2023 period, Inria has therefore undertaken to become an exemplary institution in this regard by incorporating a series of deserving disability-related actions into its “Disability Programme” and ensuring their coherence.





## *Regarding research*

**25 project teams** are working on this issue, combining several types of expertise for an optimal impact;

## *With respect to innovation*

**these actions will be defined** according to the needs expressed by users, in collaboration with associations and innovative firms, including start-ups;

## *Regarding the digital accessibility*

of our content: **Inria must set out to be exemplary in its provision of access to digital content**, by promoting (as the European host of W3C) and applying the WCAG (Web Content Accessibility Guidelines) standards to its own activities.

## *As an employer*

through its “Workers with disabilities” scheme, **Inria is developing an integration** policy that promotes training, competencies and professional experience.

### **The POTIOC project team in Bordeaux**

has developed an audio-tactile augmented reality system that makes interfaces accessible to people with visual impairments. Here is a botanical atlas based on real plants that enables users to discover their actual textures and understand their different parts which are listed in a caption.



### **UT4H, a start-up**

created in 2018, is developing Home-Assist – a comprehensive connected solution designed to simplify and facilitate the daily life of elderly people living alone, their loved ones and professional carers. Via connected objects in the home linked to a secure health data platform, Home-Assist helps with everyday activities, facilitates social contact and enables users to live more safely in their own homes.

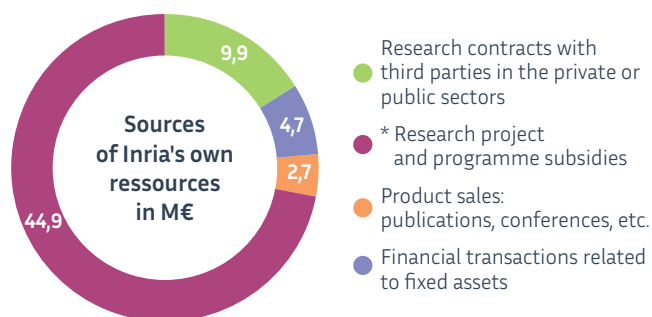
# Financial report

## ANNUAL BUDGET REPORT FOR 2018 FINANCIAL YEAR

Inria's **initial budget** for 2018, adopted in November 2017, was established in terms of revenue and expenditure for a total sum of €236.5M, increased to €240.6M in the last amending budget adopted in November 2018.

Regarding execution of the 2018 budget in terms of revenue, the **Subsidy for Public Service Expenses (SCSP)** was €172.1M in 2018 compared with €170.6M in 2017 and €167.5M in 2016. This subsidy accounted for 72% of revenue received for the 2018 financial year.

**Own resources** amounted to €66.8M, i.e. a 104% execution rate compared with the amounts set in the last amending budget. This accounted for 28% of all Inria's resources for 2018. The main sources of Inria's own resources are:



\* Including: €11.3M from the ANR, €14.2M from other public-sector partners, €20.4M from the European Commission and €8.9M from private-sector partners.

**Total revenue** was **€239M** in 2018, i.e. an execution rate of **101.2%** compared with the amending budget.

**By nature**, expenditure is broken down as follows: €167.1M for payroll costs (69.5% of total expenditure), including €133.6M for the Restrictive Wage Bill and €33.5M for the Non-Restrictive Wage Bill.

The workforce of staff whose salaries are capped as financed under the SCSP was 1,616 in full-time equivalent terms (FTE), compared with 1,579 in 2017, 1,604 in 2016 and an initial 2018 budget forecast of 1,603 FTE. The workforce of staff whose salaries are not capped as financed out of own resources was 730 FTE, compared with 729 FTE in 2017 and 805 FTE in 2016.

€51.3M for **non-scheduled investment and operating costs (FCI)**; €9.1M in **expenditure related to scheduled investment transactions (OIP)**;

Total disbursements in 2018 came to €227.6M, compared with an initial forecast of **€236.5M**, i.e. a 96.2% execution rate.

**By purpose**, expenditure in 2018 included:

- €160.1M on scientific activities at the research centres (Aggregate 1), i.e. 70% of total expenditure in 2018;
- €23.1M on joint research activity (Aggregate 2), i.e. 10%;
- €44.4M on support functions (Aggregate 3), i.e. 20 %.

The scientific themes relating to Inria's key objectives are shown in the table below and factor in all expenditure, regardless of funding source and all aggregates combined.

TEAM EXPENDITURE PER THEME €M	116,6
Applied Mathematics, Computing and Simulation	18,4
Algorithms, Programming, Software and Architectures	26,2
Networks, Systems and Services, Distributed Calculation	19,4
Perception, Cognition and Interaction	29,6
Healthcare, Biology and Digital Planet	23,0

## CERTIFICATION OF THE FINANCIAL ACCOUNT

As has been the case since 2010, the 2018 accounts have been the subject of certification by two auditors. The certifiers have reiterated the qualified opinion previously issued (register of trade payables; physical inventory and monitoring of fixed assets).

The 2018 financial account shows a profit of + €1.4M (compared with a profit of + €0.8M the previous year).

This evolution is due to several factors, mainly:

- the decrease in grants and related income (- €4.2M), despite a slight increase in the subsidy for public service expenses (+ €1.5M);
- almost entirely offset by the increase in direct income from activity (+ €4.0M), driven in particular by the increase in income from contracts with private-sector partners (+ €3.5m);
- the increase in other income (+ €1.5M), which is mainly due to the increase in write-backs of provisions;
- the decrease in the use of goods and supplies, works and services (- €4.2M);
- the latter more than offset by the increase in payroll costs (+ €4.4M) and in depreciation, amortization and provision allowances (+ €0.5M).

The balance sheet total (assets and liabilities) amounts to €257.8M compared with €253.9M in 2017.

## INCOME STATEMENT 1/2

	2018	2017	Variation 2018 / 2017
ITEM	Amount (in euros)	Amount (in euros)	%
Subsidy for public service expenses	172,132,749	170,614,575	0.9%
Operating subsidies granted by the State and other public entities	33,912,234	39,611,017	-14.4%
Subsidies allocated to funding maintenance costs	-	-	-
Donations and bequests	508,706	522,667	-2.7%
Allocated tax income	-	-	-
<b>SUBSIDIES AND SIMILAR INCOME</b>	<b>206,553,689</b>	<b>210,748,259</b>	<b>-2.0%</b>
Sales of goods or services	14,440,560	11,295,342	27.8%
Income from the sale of assets	29,731	29,344	1.3%
Other management income	2,089,954	1,188,157	75.9%
Inventory and self-constructed assets	-	-	-
Income earned for provision of a public service	-	-	-
<b>DIRECT INCOME FROM ACTIVITY</b>	<b>16,560,245</b>	<b>12,512,843</b>	<b>32.3%</b>
Write-backs on depreciation and provisions	15,251,013	13,163,265	15.9%
Write-backs of asset-related funds	6,192,438	6,770,584	-8.5%
<b>OTHER INCOME</b>	<b>21,443,451</b>	<b>19,933,849</b>	<b>7.6%</b>
<b>OPERATING INCOME</b>	<b>244,557,385</b>	<b>243,194,951</b>	<b>0.6%</b>
Purchases	119,741	103,481	15.7%
Use of goods and supplies, works and services	38,053,394	42,230,932	-9.9%
Payroll costs	155,822,975	151,472,276	2.9%
Other operating costs (incl. losses/write-offs)	19,670,196	19,605,280	0.3%
Depreciation and provisions, Net accounting value of assets disposed of	29,469,555	28,973,397	1.7%
<b>OPERATING COSTS</b>	<b>243,135,861</b>	<b>242,385,366</b>	<b>0.3%</b>
<b>NET INCOME (OR LOSS) FROM ACTIVITY</b>	<b>1,421,524</b>	<b>809,585</b>	<b>75.6%</b>

## INCOME STATEMENT 2/2

	2018	2017	Variation 2018 / 2017
ITEM	Amount (in euros)	Amount (in euros)	%
Income from shares and loans	-	-	-
Net income from sale of financial assets	-	-	-
Interest on non-capital receivables	-	-	-
Income from short-term investments and cash	-	-	-
Income from sales of short-term investments	-	-	-
Foreign exchange gains	10,666	20,615	-48.3%
Other financial income	39,808	-	-
Write-backs on depreciation and provisions	-	-	-
<b>FINANCIAL INCOME</b>	<b>50,474</b>	<b>20,615</b>	<b>144.8%</b>
Interest	-	-	-
Net loss on disposal of securities	-	-	-
Foreign exchange losses	20,862	6,032	245.9%
Other financial costs	-	-	-
Depreciation and provisions for financial costs	-	-	-
<b>FINANCIAL COSTS</b>	<b>20,862</b>	<b>6,032</b>	<b>245.9%</b>
<b>NET FINANCIAL INCOME (OR LOSS)</b>	<b>29,612</b>	<b>14,583</b>	<b>103.1%</b>
Corporate tax	-	-	-
<b>FISCAL YEAR PROFIT OR LOSS</b>	<b>1,451,136</b>	<b>824,168</b>	<b>76.1%</b>





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