The CNRS, a pioneer in open innovation

Joint research structures between the CNRS and industry

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Editorial by Alain Fuchs

The unprecedented study presented in these pages is the opportunity for the CNRS to look into the nature of the collaborations — some dating back many years — that our institution has forged with industry. It brings to the fore a number of enlightening experiences which should help show the way forward.

First of all, the preconceived notion that public research and the economic world are two separate entities, wary of each other, must be dispelled once and for all. Not only do they co-exist in symbiosis, but they are also connected through laboratories that form an integral part of the research scene. From about 50 in 2009, the number of joint research structures between the CNRS and at least one industrial partner has increased to 126 today. Enhanced in 2013 by the ANR "LabComs" program and further boosted by the recent creation of "OpenLabs", this momentum now encompasses nearly every scientific discipline. While industrial collaborations tend to nurture research in chemistry and engineering, as might be expected, the joint research model also attracts disciplines previously removed from the economic world. This success in itself is extremely positive, debunking the old myth. The days of mutual distrust are behind us, as we enter a new era of constructive cooperation.

The study discussed herein also confirms a second key observation: the working relationship established between the CNRS research teams and their industrial partners has contributed to creating a unique model that has reached an unparalleled level of maturity. The CNRS signs thousands of corporate cooperation agreements each year. Its joint research structures with industry go even further, involving shared research programs and governance over the medium and long term. Their singularity lies in their capacity to adapt to the maturity of each research project. The relationship between the two partners is most often one of free cooperation, but it can also be a real merger: the associated laboratory, which does not necessarily require specific premises and permanent staff, is the simplest and most frequent form, but these cooperative research structures also include joint units with a project necessitating substantial human and financial investments. Demonstrating its flexibility, the model proves appealing in cases involving another academic partner, and calling for a mutual commitment at an international scale. Here again, the union's adaptability is its strength. The joint research structure is compatible with our operational methods and pace, and the same is true for our industrial partners. After all, the "OpenLab" is simply the modern-day version of the associated laboratory.

The third conclusion to be drawn from this study is that even though they opt for flexible — and thus reversible — forms of cooperation, the various partners maintain long-term relationships. Although still relatively new in the history of research, the joint structures' life span already testifies to their viability, as half have been in existence for more than four years. This is the proof that these joint operations help build a mutual confidence that becomes the cornerstone of a long-term partnership. While corporate research fields and subjects of interest are constantly renewed, the strong, stable relationship with the laboratories enables the teams in the joint structures to switch rapidly to new research areas and challenges, in keeping with the interests of everyone involved.

The final lesson, and not the least, is that this model appeals as much to small and medium-sized enterprises (SMEs) as to the research departments of industrial groups. The fact that Solvay, Total and Saint-Gobain benefit from such collaborations by no means excludes medium-sized companies that show ambition and research ability. Joint structures also allow startups to access, through public laboratories, the expertise and scientific strength they need for rapid growth.

Overall, this study provides an insight into the current state of open innovation in France, an area in which the CNRS, with its industrial partners, has been a pioneer. Ultimately, the much-heralded concept of open innovation is nothing more than the symbiosis between scientific research that is open to the world and economic players who are aware that, in an era of disruptive technologies, they need to be one step ahead, nurturing innovation at the source: in the academic laboratories, where cutting-edge research is being conducted.

Each of these 126 joint research structures is thus an outpost of open innovation, uniting the country's remarkable scientific assets and the companies that drive its economic development. This is a very promising situation, and one in which we all can take pride.

Introduction

The study presented in this report provides a complete overview of joint research structures, one of the most accomplished forms of collaboration between the CNRS and its economic partners. These structures operate in a context of close-knit relations with the industrial world, which also give rise to numerous patents, framework agreements with multinationals and startups derived from CNRS laboratories.

In the past ten years, considerable progress has been achieved in this area. In 2009-10, the French Ministry of Higher Education and Research listed 155 public/private research structures in the country, of which 55 involved the CNRS. An internal CNRS survey in 2014 identified 103. The study conducted in 2016 showed a total of 126 CNRS joint research structures with industry. No doubt this increase of approximately 20% in two years is linked to the ANR LabCom program, launched by the government in 2013 to promote this type of collaboration.

These joint structures take a variety of forms: joint research units (UMRs), associated laboratories, international joint units (UMIs), ANR LabComs, etc. Their diversity is in turn a response to a range of needs, both on the part of industry — whether SMEs or large groups — and laboratories, depending on their disciplines and orientations. The examples of CNRS joint research structures featured in this document bear witness to their broad operational scope.

This diversity makes the model effective — but the identification of the structures themselves difficult. The study includes specific data: the number and evolution of these structures over the previous years, their respective locations, scientific disciplines, operational models, human and financial resources, the types of companies involved, the practical application of research findings, etc. The resulting new body of statistical information sheds light on a form of public/private research partnership that has the favor of the corporate world.

Lastly, this study shows that the CNRS joint research structures with industry are by no means a transient phenomenon: nearly half were set up more than four years ago. These collaboration resources are meant to be long-term fixtures in the research landscape.

The CNRS: cutting-edge research and innovation in all fields

First research institution in the world in terms of scientific publications and level of innovation (2015 Scimago rankings), the CNRS comprises **10** Institutes and **1,018** laboratories encompassing all scientific disciplines.

21
Nobel laureates

12
Fields Medal winners

5,629
patent families

1,281
active licenses

7th
patent filer in France in 2015

One of the world's
100
leading innovators
(Thomson Reuters 2015 Top 100 Global Innovators)

Twice winner
of the European Patent Office's Inventor Award

Number 1
in the Scimago Institutions Rankings (2015)

126
joint research structures with industry

26
framework agreements

More than
1,200
startups

1,773
research contracts with industry

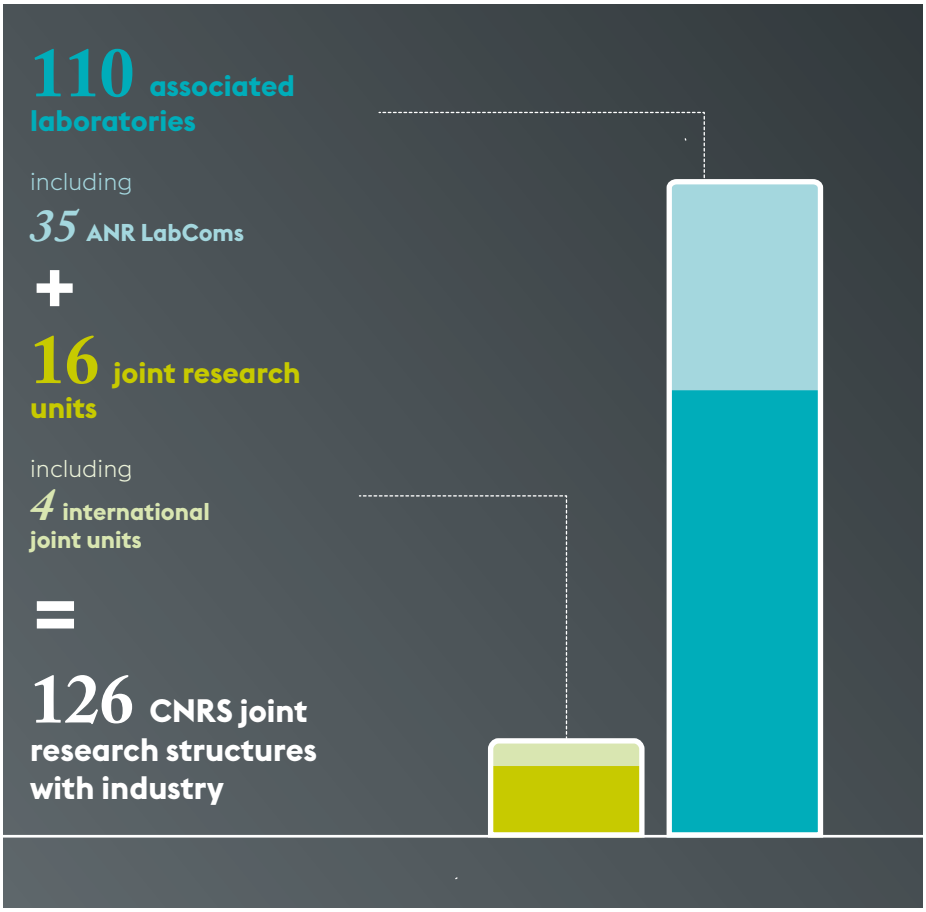
1

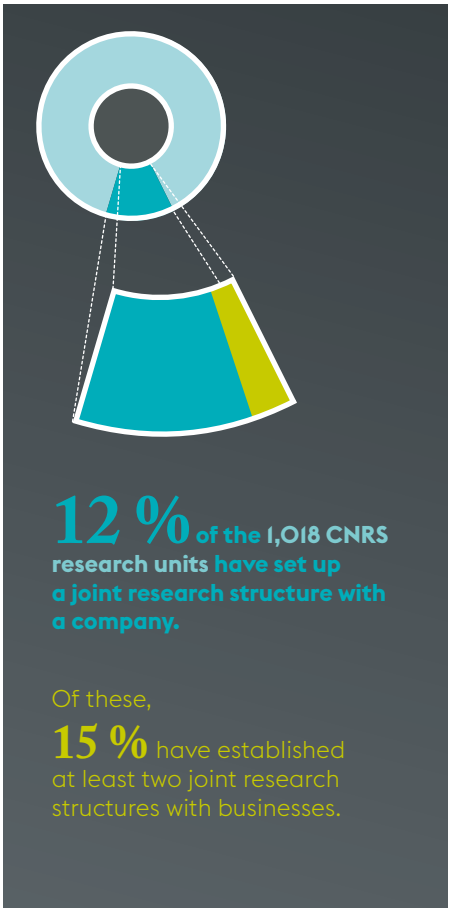
Number, breakdown, life span: a first complete overview

Methodology

Conducted between January and August 2016, the study mobilized all of the key players in innovation and technology transfer at the CNRS (Institutes, the Innovation and Business Relations Department, regional offices, laboratories). It reveals a number of clear trends, paving the way for in-depth strategic planning with a view to further developing these structures.

Results





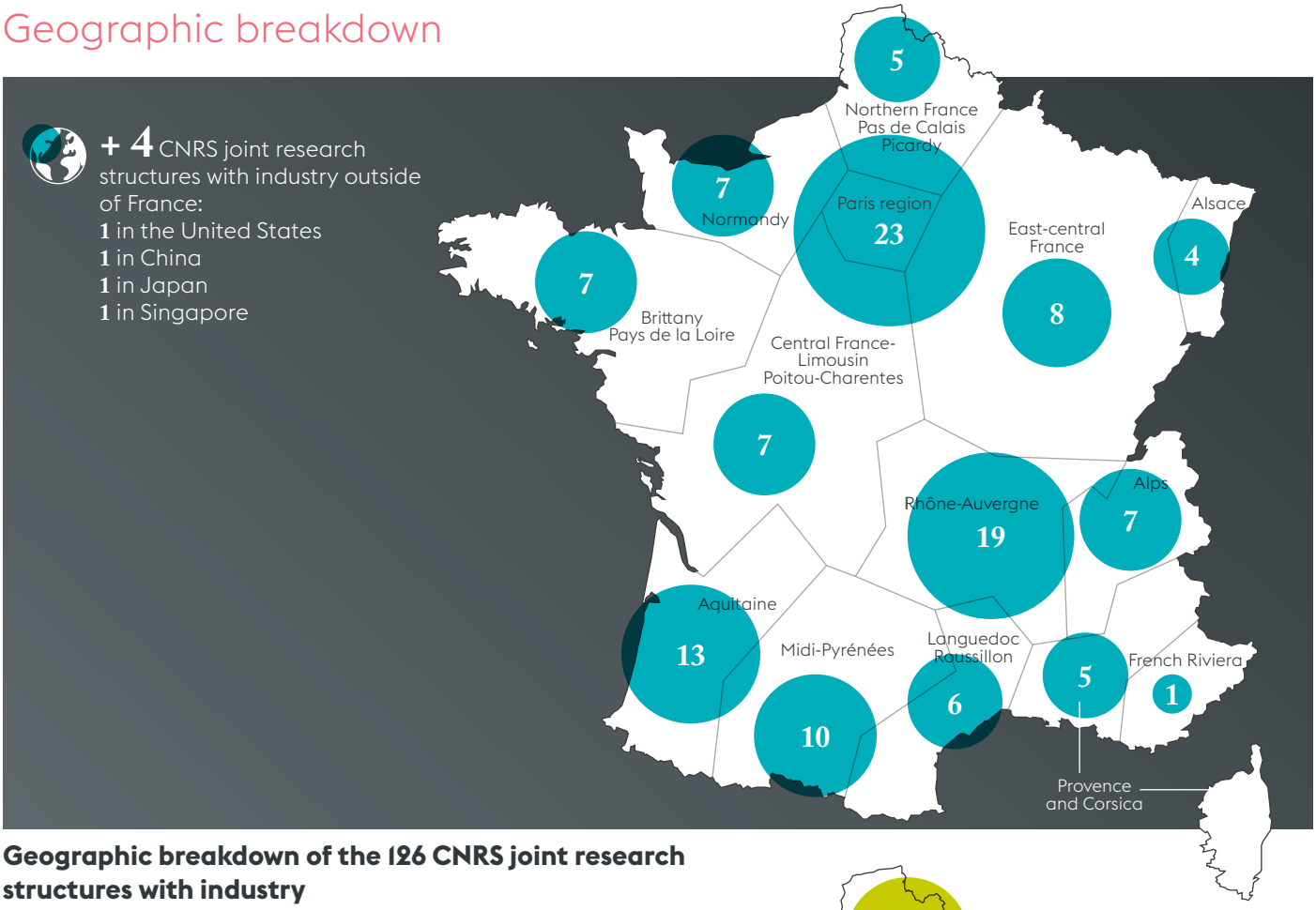
The joint research structures go beyond traditional partnerships governed by collaboration contracts. More than simple short-term projects, their research programs pursue goals that are regularly updated via adequate governance.

The 126 CNRS joint research structures with industry identified in the study are divided into two main groups: 16 joint research units and 110 associated laboratories. The CNRS joint research units with industry are comparable to those it operates with its academic partners, primarily universities. The joint research teams are hosted in shared premises, sometimes outside of France (international joint units).

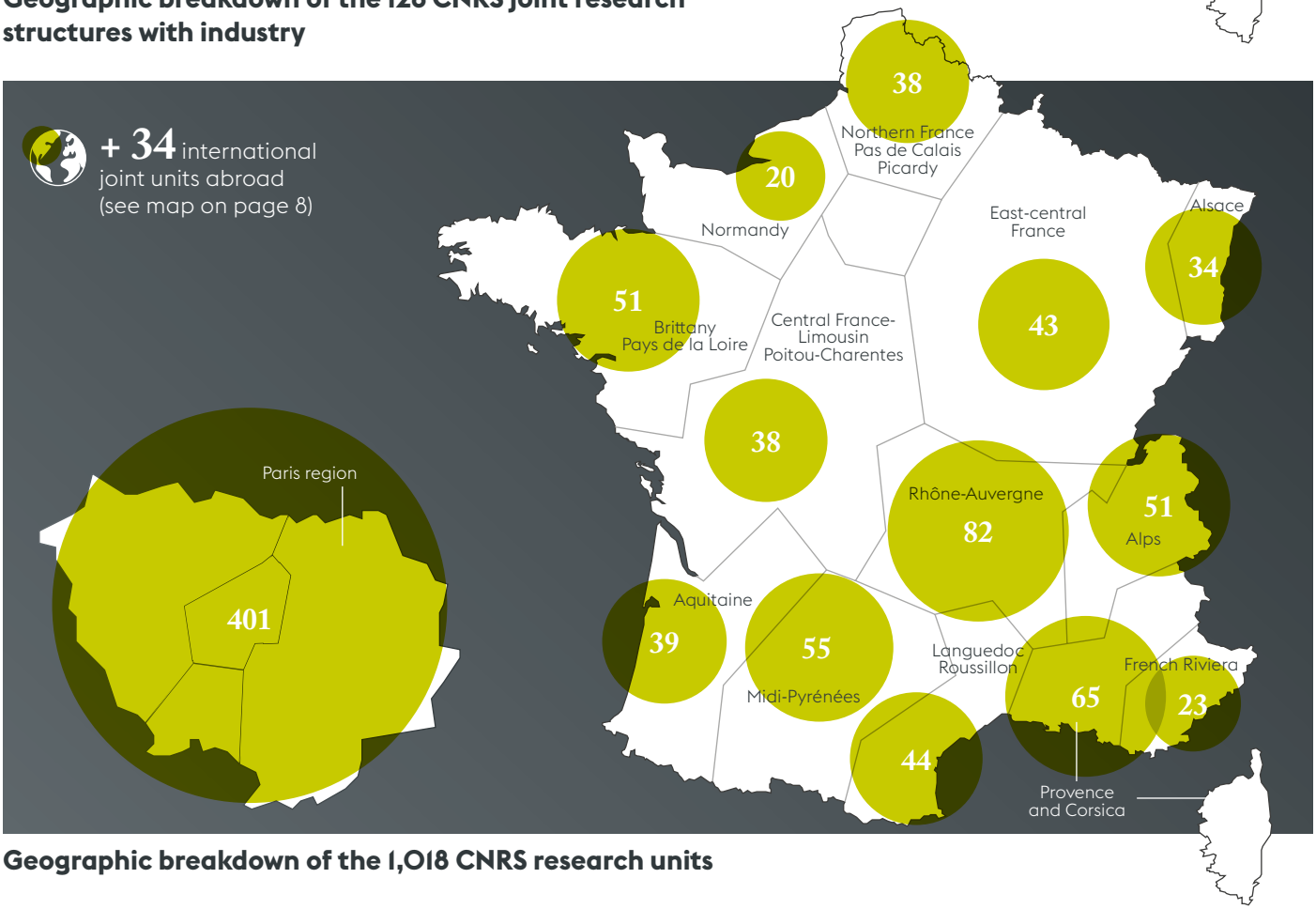
Created to pursue a common medium- to long-term research program, the associated laboratories are of variable form and size, and do not necessarily require specific premises or permanent staff. Within the laboratories, various forms of partnerships can be developed, such as the OpenLabs or the ANR LabComs (laboratories operated exclusively with SMEs and funded by the French National Research Agency).

Some CNRS units share several joint research structures with different companies, but most (85%) have a single structure with one industrial partner.

Geographic breakdown



Geographic breakdown of the 126 CNRS joint research structures with industry



Geographic breakdown of the 1,018 CNRS research units

The geographic breakdown of these structures reflects the number of CNRS units present in each region, as well as the size and vitality of regions that facilitate the development of this type of partnership. Predictably, the Paris area concentrates more than 20% of the total, followed by the Rhône-Auvergne region with about 15% of the 126 structures identified in the study.

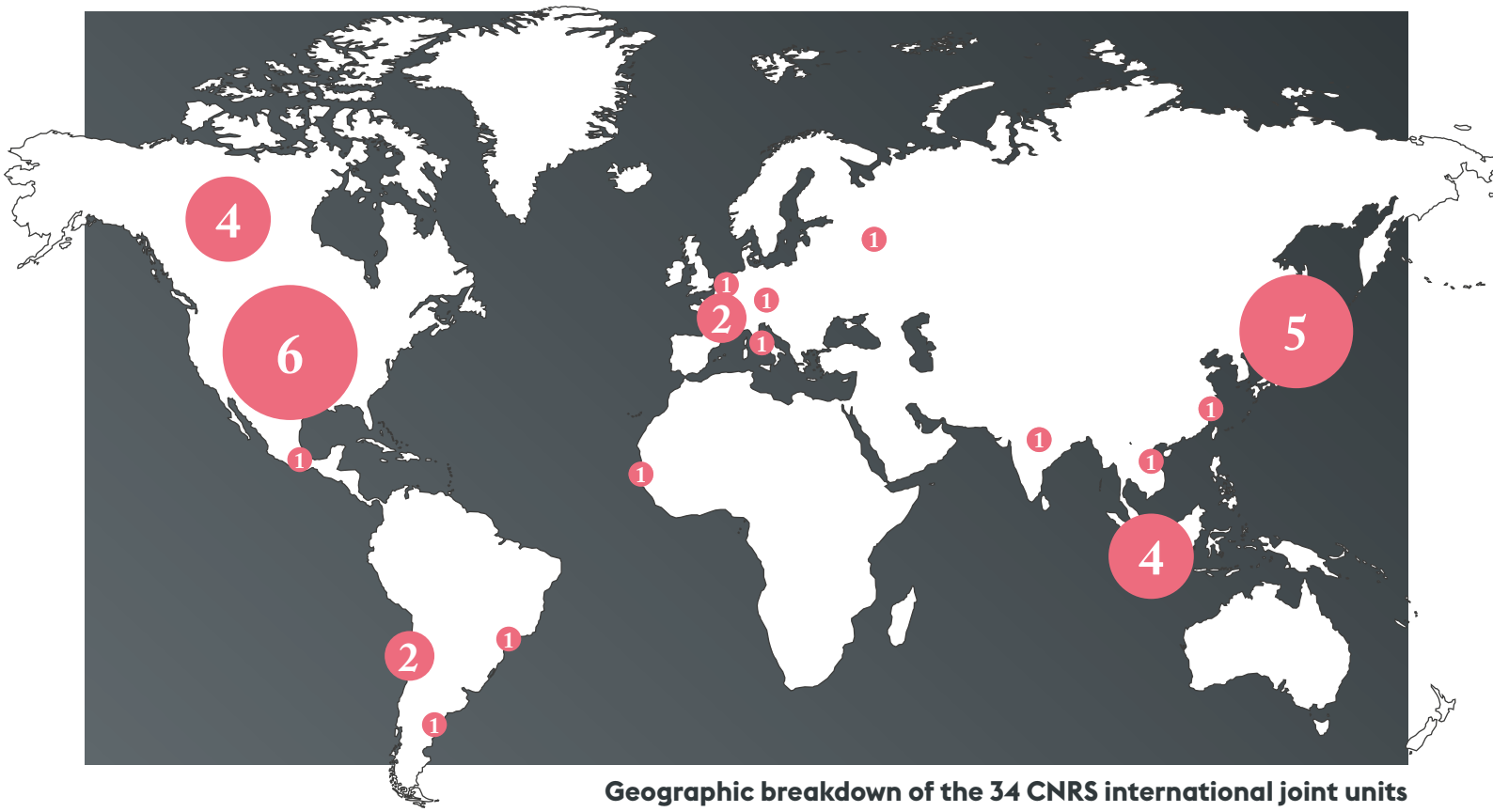
Along with the 34 international joint units operated by the CNRS and one or more foreign institutions, which are the flagship of our organization's international scientific cooperation, joint structures have also been established with long-standing industrial partners of the CNRS in other countries. Today there are four:

• **One in China: the E2P2L** (Eco-Efficient Products & Processes Laboratory), a green chemistry lab created in 2011 in Shanghai, uniting the CNRS and the Solvay group.

• **One in the United States: the COMPASS** (Complex Assemblies of Soft Matter Laboratory), founded in Pennsylvania in 2009, bringing together the CNRS, the University of Pennsylvania and the Solvay Group to conduct research on the production, manipulation and understanding of soft matter.

• **One in Japan: the LINK** (Laboratory for Innovative Key Materials and Structures), which for the past two years has associated the CNRS with the Saint-Gobain Group and the National Institute for Materials Science in Tsukuba.

• **One in Singapore: the CINTRA** (CNRS International – NTU – Thales Research Alliance), set up in 2009 between the CNRS, Singapore's Nanyang Technological University and Thales. It conducts research on nanotechnologies, electronics and photonics of the future and related applications.

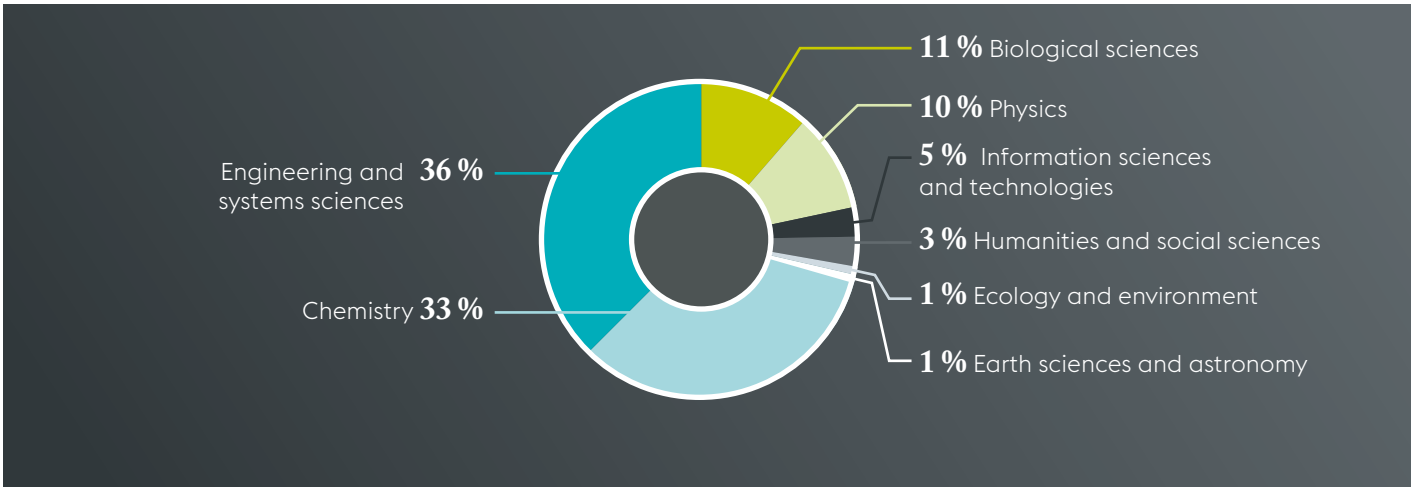


Geographic breakdown of the 34 CNRS international joint units

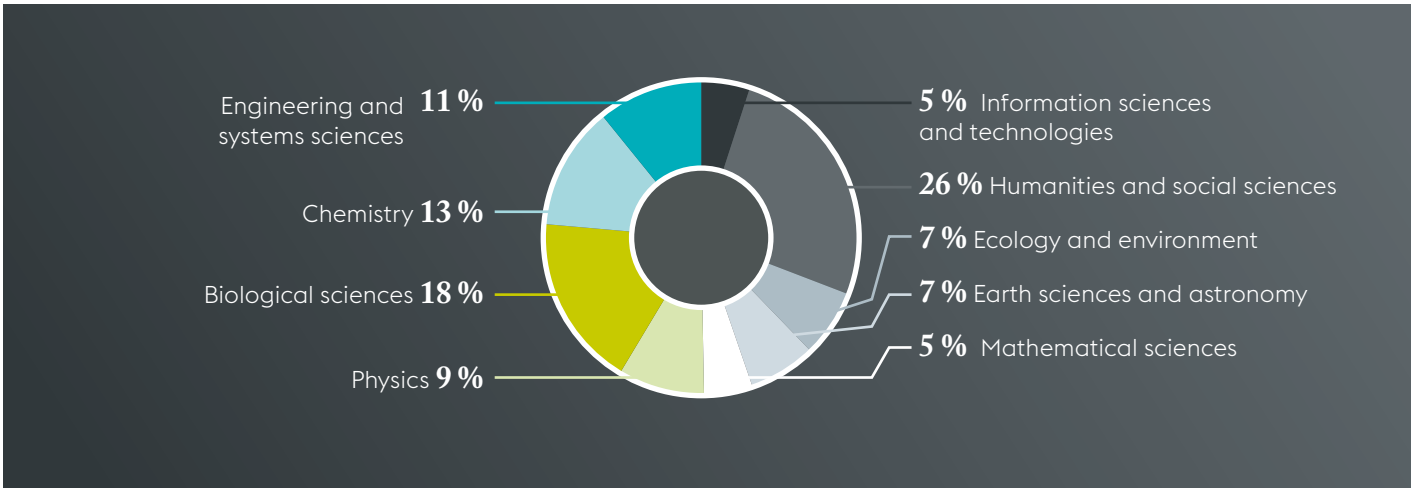
> *"The potential of the LINK, our international joint unit created with the CNRS in Japan, extends well beyond the projects for which it was initially formed."*
>
> **François CREUZET,** scientific director, Saint-Gobain Research

Other international joint units maintain strong ties with the industrial world, even if no corporate partner was involved in their founding. The LN2 (Laboratoire Nanotechnologies et Nanosystèmes) in Sherbrooke, Québec (Canada), has signed a partnership agreement for 2012-17 with ST Microelectronics to finance its research operations. Similarly, the MSE (Multiscale Materials Science for Energy and Environment), at the Massachusetts Institute of Technology (MIT), funds much of its research through partnerships with industrial groups including Schlumberger, Shell and Arcelor Mittal. In Japan, the joint research unit JRL (Joint Robotics Laboratory) has an excellence chair financed by Airbus. For François Creuzet, "this is proof that high-level research structures with strong technical potential increasingly appeal to industry."

Breakdown by scientific discipline



Breakdown of CNRS joint research structures with industry by scientific discipline



Breakdown of the 1,018 CNRS research units by scientific discipline

The study reveals that 70% of the joint research structures are concentrated in chemistry and the engineering and systems sciences. This disciplinary focus largely corroborates the results of the CNRS survey of startups derived from its laboratories' activities, illustrating the vitality of these two fields.

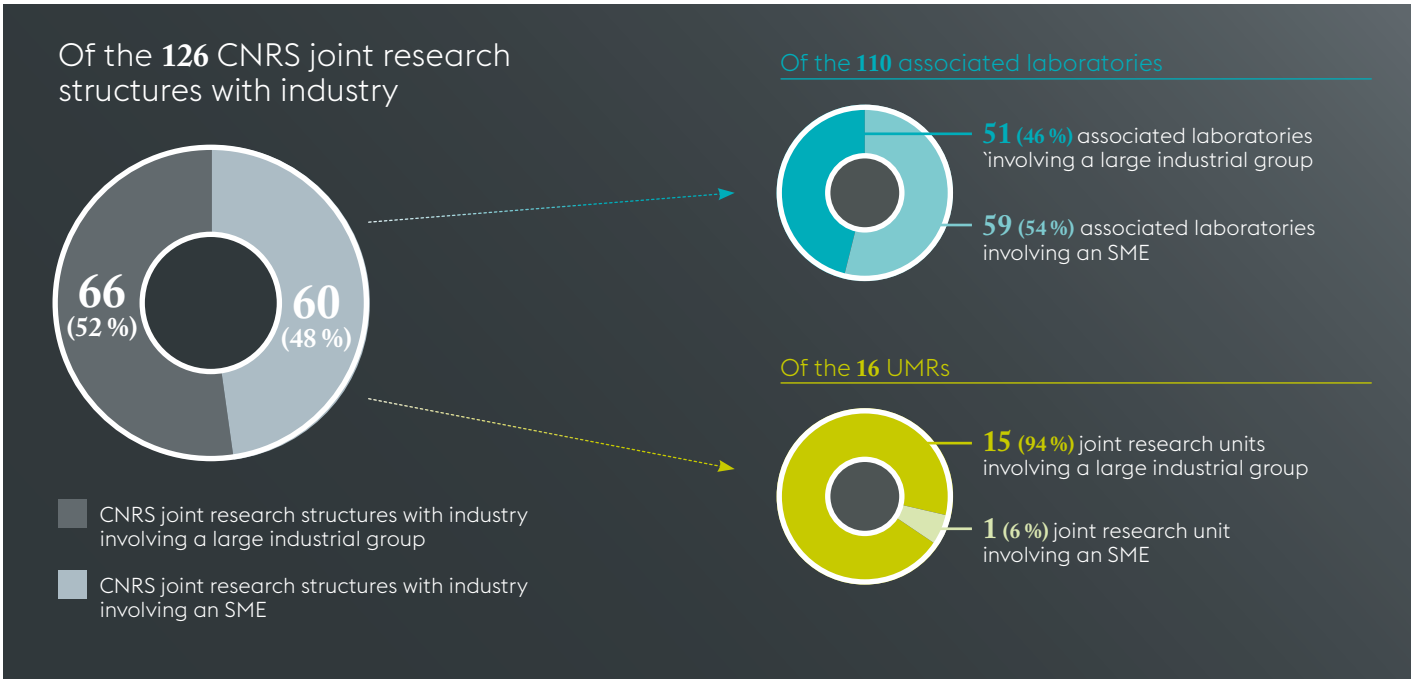
One discipline, mathematics, has no joint research structure with industry. This scientific realm does nonetheless have close ties with the corporate world, but under different forms.

More than two-thirds of the joint research units focus on chemistry, including three outside of France, in the United States, China and Japan.

A surge of innovation in the humanities and social sciences

In 2010, there were no CNRS joint research structures with industry in the humanities and social sciences, but six have been created over the past five years. Co-directed with the Université de Bordeaux, the GREThA laboratory has acquired, in the field of innovative economics, leading-edge expertise on international sources of patent surveys that has enabled it to develop resources for diagramming ongoing research and making optimal use of results. This high-level know-how has led to the creation of joint structures with Groupe PSA, Michelin, Avril (SIA) and Ceva Santé Animale, as well as an expression of interest from Airbus. In parallel, the ANR program has given rise to two LabComs — Géo-Héritage (CNRS-Eveha) and Letra (CNRS-Archean Technologies) — that are emblematic of the current surge of innovation in the humanities and social sciences.

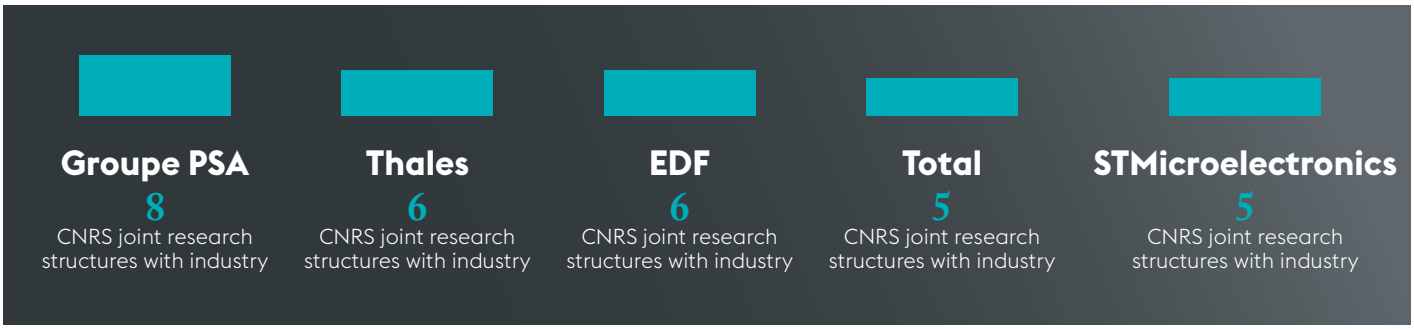
A variety of corporate profiles



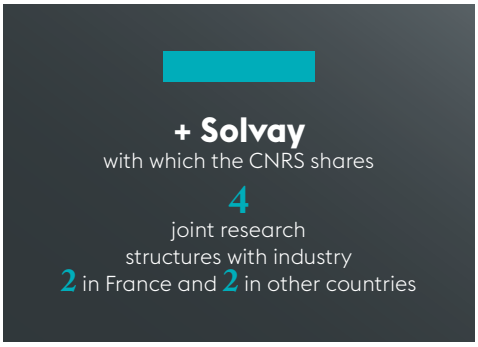
Breakdown of large industrial groups / SMEs

The CNRS joint research units with industry operate almost exclusively with large industrial groups. Indeed, this type of cooperative structure requires substantial human and financial investment over the long-term.

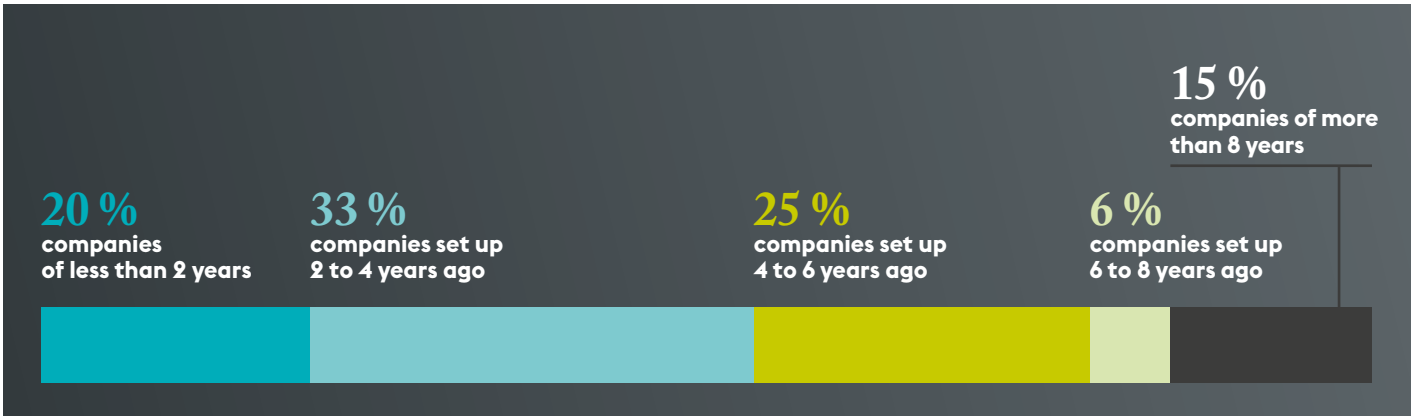
More than half of the associated laboratories involve SMEs. This is partly due to the ANR LabCom program, combined with the CNRS's effort to develop relationships with this type of company in recent years. The associated laboratory format has proved as appealing to smaller companies as to large groups, and SMEs and multinationals are now represented in roughly comparable proportions.



The top 5 CNRS partners in terms of joint research structures



Age of CNRS joint research structures with industry



Breakdown of CNRS joint research structures with industry by age

The study shows the extent to which the joint research structures have been instrumental in establishing a long-term public-private partnership. Until now, even though it was not mandatory, most CNRS joint research structures with industry were set up for four years, based on the former contractual periods of the standard CNRS research units. The study reveals that 46% of these structures have now been in operation for more than four years, and nearly 15% for more than 8 years.

The CNRS joint research structures with industry thus represent perennial collaboration resources, which also include the most flexible associated laboratories. These new figures show that they are not a recent phenomenon, but a trend that can be traced back many years. Today's difficult economic situation could discourage potential partners from committing to a joint structure based on the new five-year contractual period. For this reason, the CNRS intends to promote shorter-term partnerships, e.g. for two to three years.

> *"Founded in 1995, the CNRS/Thales joint physics unit, UmPhy, dates back to more than 20 years!"*
>
> UmPhy director **Frédéric NGUYEN VAN DAU**

2

Two main models

I- The joint research unit, a highly structured partnership

The CNRS joint research units with industry operate on the same principle as the conventional joint units uniting the organization and its academic partners. Created under the terms of five-year cooperation agreements, they are supervised by the same governing bodies (e.g. a laboratory council) and regularly evaluated by the High Council for Evaluation of Research and Higher Education (HCERES).

The directors of the joint research units are appointed, subject to mutual agreement, by the "supervisory authorities", i.e. the CNRS and the industrial party, plus an academic partner if applicable, all of which contribute to this structured partnership by investing human, financial and/or material resources. Today there are as many directors from the academic world (CNRS, universities, etc.) as the industrial sector.

In the field, the academic and industrial personnel of the CNRS joint research structures with industry share the same clearly designated premises, which in theory can belong to either of the supervisory authorities. However, in practice, these premises are those of the industrial partner in two thirds of cases. The CNRS joint research units are full-fledged, integral components of the research mechanisms of each of the supervisory bodies. This capacity for assimilation is undeniably one of the key advantages of this model.

"The LINK, our international joint unit in Japan, allows the CNRS to engage in basic research, publish in prominent journals and participate in international conferences. For Saint-Gobain, it is a means of exploring possible avenues for the future with the best scientists in the field, testing new technologies and increasing its expertise."

Didier ROUX, R&D and Innovation director, Saint-Gobain

UmPhy : a Thales/CNRS joint research unit
at the heart of the Plateau de Saclay

In the 1980s, the physicist Albert Fert and his former doctoral student Alain Friederich began working together on magnetic metallic multilayers. This informal collaboration led to the discovery in 1988 of giant magnetoresistance, which most computers rely on today — and that earned Fert a Nobel Prize in 2007! Building on this success, the joint physics unit UmPhy was founded in 1995.

At the Thales research center in the Paris suburb of Palaiseau, the strategy of the UmPhy is shared between its supervisory authorities — a relatively rare model in the field of physics in France. The unit is directed by Frédéric Nguyen Van Dau from Thales, assisted by CNRS senior researcher Frédéric Petroff as deputy director, with Albert Fert handling the scientific direction.

Today the UmPhy has an 80-strong staff focusing on three main research areas: spintronics and nanomagnetism; high critical temperature superconductors and signal processing; and functional oxides. It also explores other fields, including memristors, superconducting/ferroic hybrids, nanotechnologies and LIGA technology.

The UmPhy's annual budget averages €7 million. Each of the two employers, the CNRS and Thales, pays the salaries of its own staff, while the overhead costs are mostly covered by Thales, which hosts the joint unit.

"At the UmPhy, academic researchers benefit from a real immersion in the Thales research center, working towards the development of concrete applications."

Frédéric NGUYEN VAN DAU, director of the joint physics unit with Thales

2- The associated laboratory, a model of flexibility

Compared with the joint research unit, the associated laboratory is a far more flexible format, also much appreciated by corporate partners. It does not require a clearly designated workspace or permanent staff. In fact, in 47% of the 110 associated laboratories identified in the study, the industrial partner has not assigned specific employees to the dedicated team. Similarly, in 63% of cases, the laboratory does not involve any full-time academic researchers or engineers.

Nonetheless, the CNRS associated laboratory with industry is a solid entity — and not a "downgraded" or preliminary form of joint research unit. Established on the basis of a renewable agreement for a minimum of four years, it defines a common strategy, with a shared research program whose goals are regularly reviewed and updated whenever necessary.

It is also subject to joint governance (but with no obligation to form a specific supervisory body), rules for the practical application of collaborative research results, and predefined principles for sharing intellectual property. Each partner contributes human resources and tangible or intangible assets as needed.

"The partnerships forged with the CNRS laboratories have allowed us to pursue ongoing scientific research and expand the scope of our investigations into the automotive technologies of the future, including self-driving vehicles and user-friendly interiors."

Bernard SAHUT, director of the OpenLabs "StelLab" network, Groupe PSA

Very often the creation of an associated laboratory represents a step up in the relationship between the CNRS and the company involved, reflecting the will to evolve into a more integrated partnership. It then becomes a co-investment in a mutually beneficial program.

The team may be large or small, made up of full-time or part-time researchers, working in the same location or communicating at a distance, focusing on a specific field or with a wider spectrum… The flexibility of the associated laboratory is very attractive to the companies involved, as the model can easily be adapted to a range of projects. On the other hand, this diversity of formats makes their identification and monitoring more difficult.

> *"The EM2VM, the associated laboratory that we have established with the CNRS, has given us access to high-level expertise and sophisticated equipment, as well as scientific results to substantiate the life span of the components used in our nuclear plants."*
>
> **Jean-Paul CHABARD,** R&D scientific director, EDF

Automotiv Motion Lab: Groupe PSA joins forces with the CNRS
to investigate man/machine interaction

The car manufacturer Groupe PSA and the Institut des Sciences du Mouvement (ISM — CNRS/ Aix-Marseille Université) have been developing scientific collaborations since 2004. To perpetuate this cooperative effort, an OpenLab was formalized in 2011. Called the Automotive Motion Lab (AML), it became the first laboratory in Groupe PSA's "StelLab" network.

The AML's researchers pursue a number of goals in the field of automotive technology: optimizing the realism of driving simulators and the sensation of presence in virtual reality, developing new protocols to validate driver assistance systems, offering innovative bio-inspired sensors, etc.

With the AML, Groupe PSA has access to unique expertise beyond its own resources, in addition to information on emerging, less codified trends in certain leading-edge fields. This OpenLab makes it possible to develop specific aspects of research projects to address the group's strategic challenges.

The AML is hosted by the ISM, with a configuration that allows all of the institute's researchers to participate. Groupe PSA has a resident engineer working full-time at the ISM. For each scientific project, budgetary costs are evenly divided between the partners, who identify external funding opportunities. In the case of inventions, the patents are jointly owned, giving Groupe PSA exclusive right of use in the automotive sector.

3- The ANR LabComs

Launched by the French National Research Agency (ANR) in 2013, the "LabCom" program significantly boosted the development of associated laboratories with SMEs, offering flexible governance and operational modes. In 54% of cases, the industrial partner does not assign specific employees to its associated LabCom team. However, the involvement of the company's management is often key to the success of these laboratories. Conversely, in 77% of cases, the ANR LabComs have no full-time academic researchers or engineers.

> *"Working with an industrial partner generates a lot of added value. It has become a necessity for me — I can't imagine conducting my research outside of the ANR LabCom."*
>
> **Christophe VIEU,** director of the ANR LabCom Biosoft (Innopsys/LAAS)

As of the end of 2016, 100 ANR LabComs had been created under this program, providing financial support to the academic partners for a period of three years. The sustainability of these structures is a crucial challenge and a criterion for success: the LabCom must rapidly find ways of becoming self-financing, with the private sector partner gradually assuming the operating costs. Current feedback suggests that three years is usually not enough for a LabCom to market an innovation and generate a return on investment (the famous "time to market").

> *"The best experiences are those in which the company management is directly involved, with its teams actively participating in the life of the LabCom via frequent meetings and discussions at a dedicated site."*
>
> **Philippe LEBARON,** vice president of the ANR LabCom program

LERAM, an Urgo/CNRS LabCom
dedicated to innovative adhesives

In the late 2000s, after an Urgo engineer took up a training program subsequently offered to the Polymers team of the Institut des Sciences Analytiques et de Physico-Chimie pour l'Environnement et les Matériaux (IPREM — Université Pau Pays de l'Adour/CNRS), several joint research projects were launched and Ph.D. student at the IPREM was hired by Urgo.

In 2014, these fruitful collaborations led to the creation of an ANR LabCom uniting Urgo and the IPREM. Called LERAM (Laboratoire d'Étude de la Rhéologie et de l'Adhésion des adhésifs destinés à des applications Médicales), its mission is to develop innovative broad-spectrum skin adhesives for healing and dermatological purposes: bandages, film-forming products to protect against ulcers, etc.

This associated laboratory has been a win-win venture for both partners. It allows Urgo to work with top-level academic researchers and access sophisticated characterization, modeling and implementation systems, while enabling the CNRS teams involved to perform industrial tests using Urgo's innovative "Nemo" production line. It also enables the two partners to file new patents and publish joint papers.

The LERAM is a laboratory "without walls" run by seven Urgo employees and seven academics. The budgets allocated by the ANR and the company have made it possible to hire three project engineers, two Ph.D. students, one postdoctoral fellow and two engineers, as well as trainees. The LERAM is headed by Christophe Derail of the IPREM, who shares the research themes with the Urgo team managed by Laurent Apert, the company's research director.

Any patents on inventions are co-owned, and the two parties have an agreement on the use of non-patentable research results. As the three-year ANR funding period comes to an end, other sources of financing are being envisaged, including submissions to calls for projects. The LERAM has already achieved its first success by obtaining co-funding from the Nouvelle Aquitaine region.

> *"Structures like associated laboratories can offer SMEs great flexibility."*
>
> **Christophe DERAIL,** director of the LERAM, an ANR LabCom with Urgo

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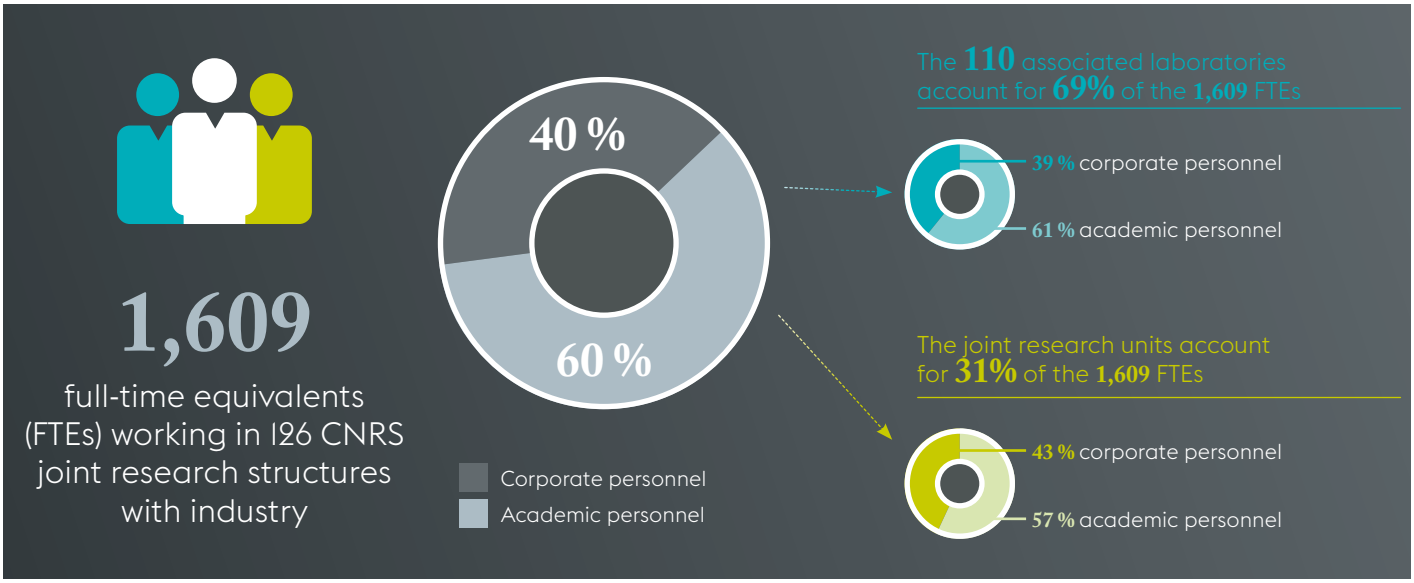
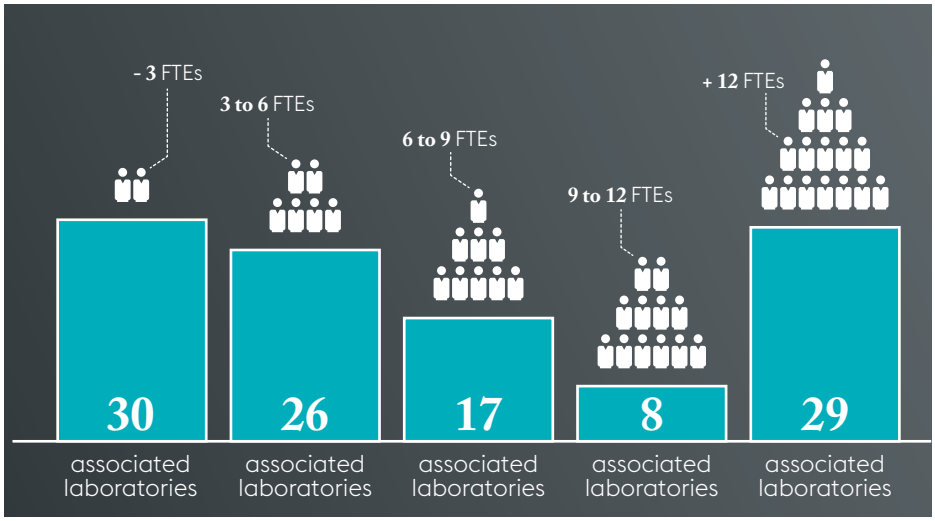
Human and financial resources

A significant human investment



With a total of 1,609 full-time equivalents (FTEs), the CNRS joint research structures with industry generate a non-negligible number of jobs. The associated laboratories account for more than two-thirds of the FTEs, with the remainder being divided among 16 joint research units. In both cases, the academic personnel outnumber the corporate personnel. However, the headcount varies widely within the associated laboratories, from fewer than three to more than 12 FTEs.

The study reveals that this diversity is primarily due to a distinct difference between the ANR LabComs dedicated to SMEs and the other structures. The former employ an average of about five FTEs, compared with ten for the latter. For further comparison, the 1,018 CNRS research units employ an average of about 26 FTEs.



Breakdown of FTEs in associated laboratories

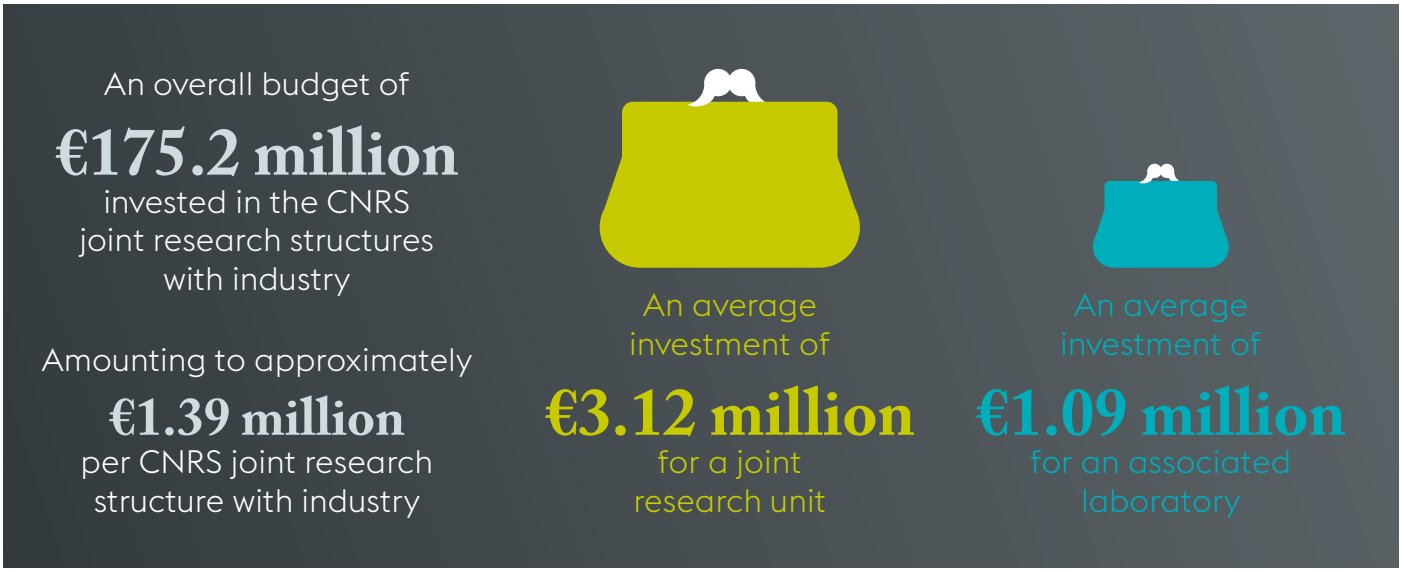
"The CNRS joint research structure with industry is also a means of attracting talents who want to pursue their research in fields with industrial applications. In addition, it acts as a training facility for promising young researchers to improve their skills, and for Solvay scientists to keep pace with academic research."

Pierre GUILLOT, director of the CNRS/Solvay Laboratoire du Futur

The CNRS joint research structures with industry are also effective for recruiting and training future researchers and engineers. They provide an environment that is conducive to cooperation between the public and private sectors and act as a springboard for R&D recruitment, creating a virtuous circle. This is reflected in the number of Ph.D. students and postdoctoral fellows hired by industrial partners in 2015, at the end of their assignment in a joint structure: 27 in joint research units and 60 in associated laboratories. Also in 2015, more than 70 scientific distinctions were awarded to members of the CNRS joint research structures with industry: 8 in joint research units and 66 in associated laboratories.

> *"It's above all a matter of interpersonal relations, whether for the development of expertise or for confidentiality issues."*
>
> **Philippe LEBARON,** director of the Pierre Fabre/CNRS joint unit

Significant financial resources



Nearly €200 million invested

> *"Experience shows that the CNRS joint research structures with industry are an incubator both for us and for our private sector partners — the Ph.D. students trained in these structures commend this type of partnership."*
>
> **Nicolas CASTOLDI,** technology transfer officer, CNRS

Today the overall budget invested in the joint research structures identified in the study exceeds €175 million, out of a total of €1.3 billion in public subsidies for cooperative research and the CNRS budget of €3.309 billion (2015). This figure includes just over €109 million in payroll costs (€61.5 million for the academic staff and €47.5 million for the corporate staff), €46 million in direct resources (contracts, public and private funds) and €20 million in indirect resources: equipment, premises and infrastructure.

The average budget of a CNRS joint research structure with industry is approximately €1.39 million, depending on the type of structure: more than €3 million for a joint research unit and around €1 million for an associated laboratory. Among the associated laboratories, the ANR LabComs have smaller budgets, averaging €680,000, compared with €1.57 million for the other labs.

> *"The annual budget of the EM2VM, our associated laboratory with the CNRS, is about €1 million, of which a 50 to 60% share is funded by EDF."*
>
> **Jean-Paul CHABARD,** R&D scientific director, EDF

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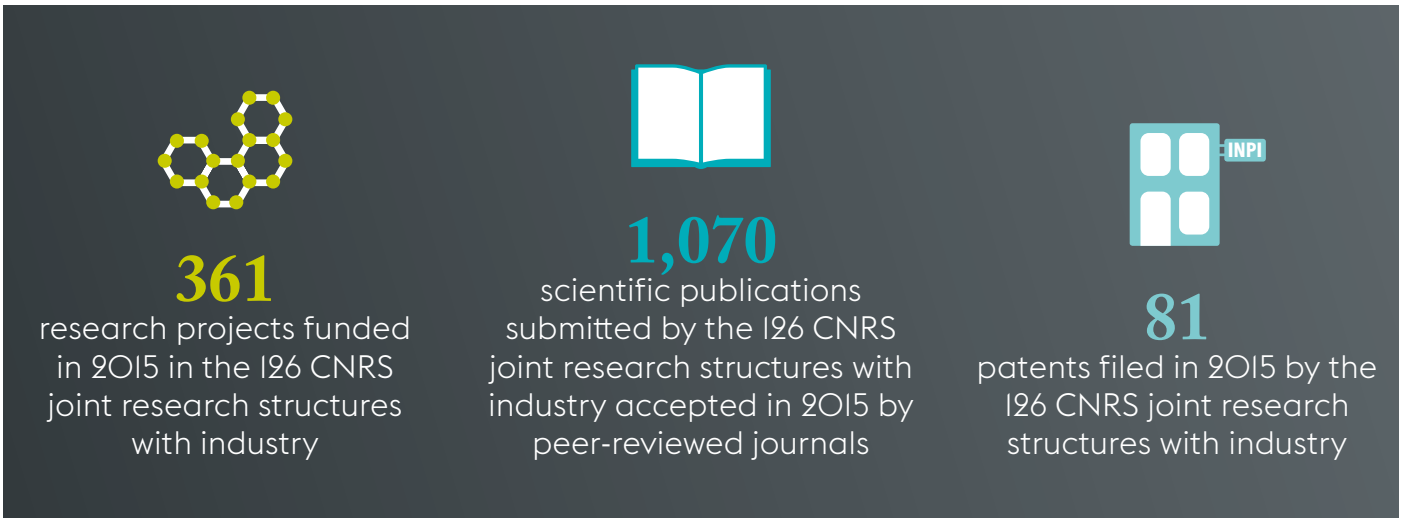
Making optimal use of projects, patents and publications

"The innovations in equipment and components belong to Riber, while those related to oxide growth processes are owned by the CNRS. If Riber markets a piece of equipment or component developed by the associated laboratory, a patent is filed in co-ownership."

Guillaume SAINT-GIRONS, director of an associated laboratory with the SME Riber



The joint research structures also provide a fertile ground for scientific and technological production.
In 2015, the 126 joint structures conducted 361 public/private research projects, funded by the ANR, the European Union or the Fonds Unique Interministériel (Single Interministerial Fund — FUI).

This research generated 1,070 publications in peer-reviewed scientific journals. The volume of publications varies depending on the type of structure, with an average of nearly 30 per joint research unit, more than 5 per associated laboratory and 1.2 per ANR LabCom.

Regarding industrial property, the CNRS joint research structures with industry filed 81 patents in 2015 out of a total of 719 for the CNRS as a whole. On average, 1.9 patents were filed per joint research unit, 0.76 per associated laboratory and 0.15 per ANR LabCom.

"All of the scientific results are co-owned, including the patents. In fact, we have already filed two international patents on bacterial substances, one of which is generating royalties."

Philippe LEBARON, director of the Pierre Fabre/CNRS joint unit

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A few success stories

AXIS: NEW COMPONENTS FOR SATELLITES

Axis, an associated laboratory uniting Thales Alenia Space and the XLIM laboratory (CNRS/Université de Limoges), was founded in January 2006 to further the development of new microwave frequency subsystems and components aimed at improving the flexibility of satellite payloads.
In recent years, the flexibility of payloads has become a major issue for operators that must anticipate the reconfiguration of a satellite's missions throughout its useful life of approximately 20 years.

Axis makes it possible to structure and sustain collaborations that bolster aerospace research and innovation, as well as train Ph.D. students in an applied field. The laboratory, which hosts the ANR "DEFIS-RF" industrial chair, employs some 20 researchers and engineers, as well as an average of six to eight Ph.D. students at a given time.

As part of this associated laboratory, and more specifically the MEMO project undertaken by Thales Alenia Space with the backing of the Centre National d'Etudes Spatiales (CNES), XLIM developed MEMS-RF microswitches that have been integrated into a satellite platform in geostationary orbit. The components were launched from Kourou (French Guiana) in early February 2014. After undergoing the qualification phases, they became the first MEMS-RF components sent into orbit on a satellite — an important step towards the use of this technology in aerospace systems.

LINK: EVER MORE INNOVATIVE MATERIALS

The Laboratory for Innovative Key Materials and Structures (LINK) is an international joint unit associating the CNRS and Saint-Gobain with the Japanese National Institute for Materials Science (NIMS), one of the world's leading laboratories in its field. The LINK's mission is to develop research on solid materials with potential applications for Saint-Gobain: ceramics, crystals, abrasives, etc.

In 2009, Saint-Gobain created a laboratory of excellence at the NIMS, which later joined forces with the CNRS, becoming an international joint unit.

Today the LINK is well known for its high-quality research, numerous publications, international conferences and scientific expertise, as well as for the technologies it has developed.

The LINK has a staff of about ten working at the NIMS site in Japan. It welcomes all NIMS researchers that propose a collaborative project with the CNRS or Saint-Gobain, and the teams evolve according to the subjects of investigation. Permanent researchers are paid by their respective employers (the CNRS or Saint-Gobain) and non-permanent ones by Saint-Gobain. Ownership of the industrial property is divided evenly, including royalties on patents.

A WEAPON AGAINST HIV

Abivax, a biotech company that conducts research on the immune system to combat viral diseases, the CNRS and the Université de Montpellier decided to set up an associated laboratory in order to accelerate the development of treatments against viruses, especially HIV.

A molecule called ABX464, based on research by professor Jamal Tazi and his team at the Institute of Molecular Genetics of Montpellier (IGMM — CNRS/Université de Montpellier), is now in phase IIa clinical studies on seropositive patients. Developed by Abivax, ABX464 has a novel mode of action that could induce a lasting reduction of the patients' viral load. The molecule's persistent impact could make it possible to reduce the dosage frequency and treatment time compared with current anti-HIV treatments.

THE POWER OF MARINE MICROORGANISMS

Over the past few years, the Observatoire Océanologique de Banyuls marine station in southwestern France has hosted a joint research team associating the Pierre Fabre laboratoires (LPF) and the Laboratory of Microbial Biodiversity and Biotechnology (LBBM — CNRS/UPMC). Its purpose is to improve understanding of the benefits of Avène thermal spring water and marine microorganisms, and find related applications in cosmetics and oncology.

The LPF and the LBBM began collaborating in 1995 to study the properties of Avène spring water. In 1997, Philippe Lebaron of the LBBM convinced Pierre Fabre to expand the scope of these investigations to the study of marine microorganisms. In 2001, the collaboration was strengthened by the creation of a joint research team, whose success owes a lot to the direct involvement of the LPF management.

Based at the LBBM, this joint team of about ten researchers has a contractual budget of around €300,000 per year for a consolidated budget of approximately €1.4 million. The collaboration enables sophisticated fundamental research, the publication of numerous papers, the filing of patents, access to an array of scientific equipment and resources (e.g. for the collection of marine bacteria) and the pooling of scientific expertise.

The results are shared by all partners and the patents are co-owned, including two international patents for bacterial substances, one of which is already generating royalties. In 2009, the joint unit entered a new phase when LPF decided to invest €4 million in the construction of a center aimed at finding applications for the research conducted on Mediterranean biodiversity. The regional authorities and the university partly financed the project, and much of the equipment was funded by the CNRS.

A DEDICATED REACTOR FOR OXIDES

The SME Riber — the world's leading manufacturer of molecular-beam epitaxy (MBE) reactors — and the team led by Guillaume Saint-Girons at the Lyon Institute of Nanotechnology (INL — CNRS/École Centrale de Lyon/École Supérieure de Chimie Physique Électronique de Lyon/INSA Lyon/Université Claude Bernard) had been cooperating for more than 20 years when they decided to launch an associated laboratory in 2011, with a view to developing a dedicated reactor for oxides.

Today this associated laboratory benefits both partners, by developing MBEs for the growth of functional oxide thin films with electronic properties that are useful in nanoelectronics, ultra-high-speed electronic components, MEMS, photonics, etc.

The associated laboratory offers the INL access to Riber's state-of-the-art epitaxy equipment, while allowing Riber to benefit from the INL's expertise and resources for testing new components on the high-potential oxide epitaxy market.

This laboratory "without walls" has a staff of twelve: six employees from Riber and six from the INL. Operations requiring the use of an epitaxy reactor or characterization systems are carried out at the INL, and those involving engineering and the development of components for epitaxy at Riber. The total annual budget is €100,000 per partner. To balance the collaboration, Riber provides the INL with the annual equivalent of €30,000 to €40,000 worth of equipment developed for the activities of the associated laboratory, which then becomes the exclusive property of the INL.

Innovations in equipment and components are owned by Riber, while those linked to oxide growth processes belong to the CNRS. If Riber markets a piece of equipment or component developed by the associated laboratory, a patent is filed in co-ownership.

Conclusion

Nicolas CASTOLDI, technology transfer officer, CNRS

Joint units operating as incubators for research and publications, associated laboratories focusing on a specific purpose or process, OpenLabs that truly deserve their name, with personnel turnover… The wide range of joint research structures brought to light in this unprecedented study also shows how important these R&D resources have become for the CNRS and its industrial partners. In addition, these collaborations involve both academic laboratories conducting highly applied research and those devoted to purely fundamental work. This family of structures represents a considerable investment of resources for a research institution like ours, proving once again that the CNRS is a driving force in technology transfer.

This vitality soundly gives the lie to the idea of mutual distrust between public research and industry. The gap that once existed between the academic and corporate sectors was bridged a long time ago. This cultural breakthrough took place quietly through the steady proliferation and strengthening of fruitful ties between both worlds. None of this required reforms or the implementation of new mechanisms — the parties involved simply made use of their existing arsenal to develop the resources that they rely on today. These joint research structures, in all their different forms, are precious assets that we intend not only to maintain but also to nurture, while supporting and optimizing all existing relations, sites and types of collaboration. Our goal now is to increase the number of CNRS joint research structures with industry by 25%, with a view to exceeding 150 between now and 2018.

Glossary

ANR LabComs
The ANR LabCom program was launched in 2013 to encourage public research players to create new structured partnerships in the form of associated laboratories with SMEs. An ANR LabCom is formalized by a contract that defines its intended function, a roadmap for research and innovation, the allocation of resources for jointly implementing it, and a strategy allowing the partner company to apply the results of the joint research. The ANR provides funding in the form of a subsidy whose maximum amount is fixed at €300,000 over a period of three years.

Open innovation and OpenLabs
"Open Innovation" is a concept developed by Henry Chesbrough, author of a groundbreaking book of that name published in 2003, to designate modes of innovation in R&D based on collaboration, sharing and dialogue. It defines a process through which a company can call upon ideas and expertise from outside its own walls. With that in mind, a number of companies have created "OpenLabs" in recent years.

Associated laboratory
Created as part of a medium- or long-term collaborative research program, an associated laboratory is the result of an agreement between a research team and one or more businesses. Of variable form and size, it does not necessarily require specific premises or permanent staff.

INPI
The Institut National de la Propriété Industrielle (INPI) is a public establishment in charge of implementing government policies related to intellectual property, the promotion of innovation and corporate competitiveness, and the fight against patent infringement. It processes registrations and delivers industrial property rights (patents, trademarks, technical drawings and models). The INPI also participates in the drafting of industrial property laws. It makes information on the protection of industrial property rights available to the public, provides training on industrial property issues for all economic players and raises their awareness thereof, and centralizes the national Registry of Commerce and Companies.

Scimago Institutions Rankings
The Scimago Institutions Rankings (SIR) is a list of worldwide academic and research institutions ranked by a composite indicator based on research performance, innovation output and societal impact measured by web visibility.

Thomson Reuters Top 100 Global Innovators
The Thomson Reuters Top 100 Global Innovators is an international classification of the world's most innovative companies. Launched in 2011, it is based on the companies' patent application success rate (patents approved as a percentage of applications), patent influence (number of times an original patent is cited by other applicants), global reach of the patent portfolio and overall patent volume over a five-year period.

Webometrics world rankings
Webometrics measures the Internet presence and influence of educational and research organizations. Its rankings are based on the amount of content available on the web and the accessibility of websites. It does not assess the level of teaching or research.

Time to market
"Time to market" is the average time span between the generation of an idea and its availability on the commercial market. It corresponds to the time needed to develop and perfect an innovation before it can be launched as a product or service.

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