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SPACE • INNOVATION • SOCIETY

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October 2015




INNOVATION

BOOSTING EMPLOYMENT




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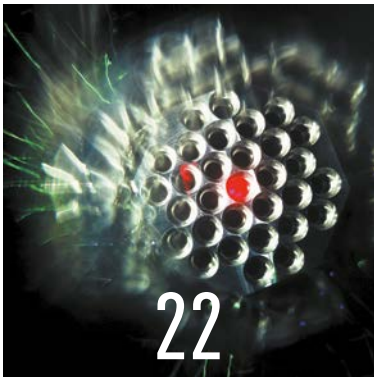
INSIDE



PARTNERS

Mentioned in this issue: p.10 Created in January 1998, Telespace Participation, a wholly-owned subsidiary of CNES, manages its share portfolio with a view to spawning new uses of space technology and their development. p.21 Airbus Safran Launchers (ASL) is now the main shareholder in Europe's space launch company. An embedded ESA/CNES team is working at its facility in Les Mureaux.

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UNITED STATES

6 January 2015, CNES and Thales Alenia Space signed a contract covering the French-U.S. SWOT satellite that is being funded through the PIA future investment programme to the tune of €78 million.

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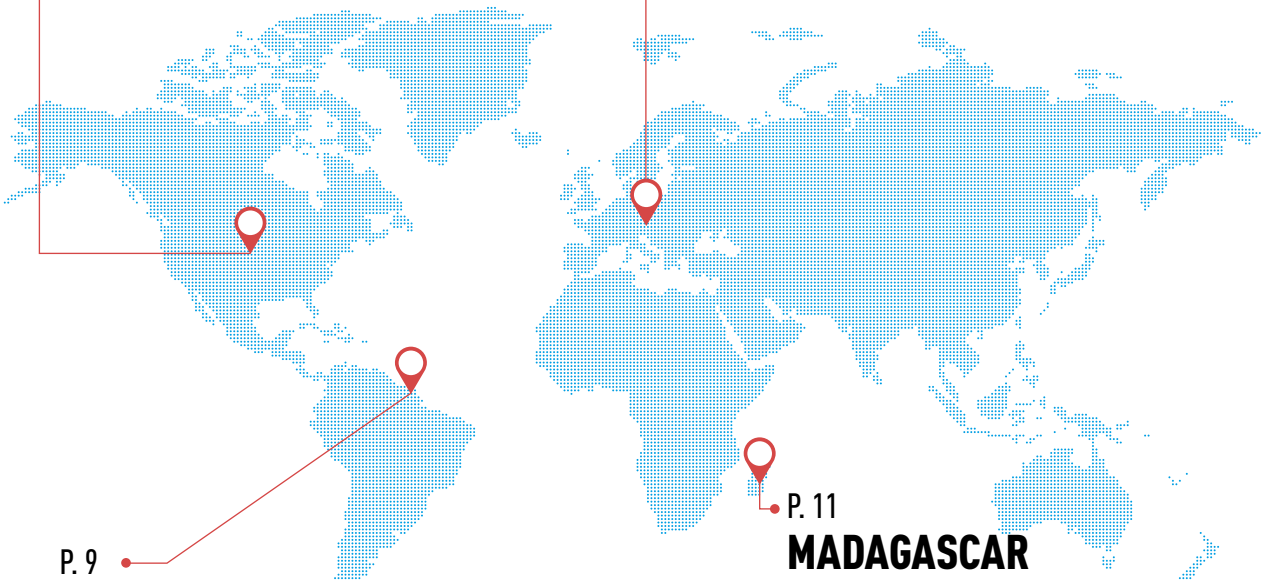
EUROPE

The first ESA BIC (Business Incubation Centre) was created in Belgium in 2010. Since then, the agency has set up centres in the Netherlands, Germany, Italy, the United Kingdom, France, Spain and Portugal. New centres in Sweden and the Czech Republic are set to open soon.



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FRENCH GUIANA

For the first time, French Guiana will be at ActInSpace2 next year.

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MADAGASCAR

In June 2015, CLS was chosen by the Indian Ocean Commission to set up two fisheries monitoring centres in Madagascar and Mauritius.

CONTRIBUTORS

EMMANUEL GRIMAULT

We gave *carte blanche* to roving photographer Emmanuel Grimault, who took off on a tour of France to meet entrepreneurs from the space sector. A photographer and author, his portraits restore expression and posture as the focus of a picture. His motto: *"In photography, I prefer the uncertainty of the unknown to the comfort of the straight and narrow."*

MARIE-CLAIRE FONTEBASSO

Photo researcher and editor

Marie-Claire Fontebasso has been working for CNES's photo library for 20 years, during which she has helped to shape Cnesmag's visual identity from the very first issue. Determined, studious and passionate about the Universe, she loves hunting out, disseminating and archiving pictures of space exploration.

ROMAIN DESPLATS

Romain Desplats began his career in CNES's component testing laboratory. Today, he's working with the agency's inventors to devise patents in all of the fields it covers. For this issue, he was our key contact guiding us through the ins and outs of starting a business, from concept to commercialization.

FRANÇOIS FOYARD

As a child, François Foyard saw cartoonists as magicians who could bring characters to life in fantastic, imaginary worlds with a few strokes of their pencil. Since those formative years, he's picked up a few tricks himself and made it his living. For us, he put his artistic talents to work to illustrate the news in this issue of the magazine.

CNES MAG

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EDITORIAL

In this issue of *Cnesmag*, we turn the spotlight on innovation and employment, the two key drivers of our agency's strategy. Because today, space is undergoing a seismic shift with the arrival of new players from the Internet sphere and emerging nations for which it is much more a means than an end. The result is that we are seeing burgeoning demand for ever-more-diverse and precise applications, where the discriminator is innovation and the creation of hundreds and even thousands of new jobs is at stake. In response to this new paradigm, CNES is pulling out all the stops: outside the agency, supporting new entrants with the unfaltering backing of the government (see our interview with Louis Schweitzer); and within, through our new Directorate of Innovation geared to meeting the needs of users of space technologies—so that in this fast-moving world, CNES is more than ever fuelling innovation for jobs.

JEAN-YVES LE GALL
CNES PRESIDENT

ACTINSPACE

A helping hand for young entrepreneurs

This year's Paris Air Show confirmed the huge success of the first ActInSpace. Modelled on a hackathon and initiated by CNES, this competition encourages young people to adopt an entrepreneurial approach. The 200 participants enthusiastically took up the challenges they were set. Among them was the Start-Track team (see photo), who adapted a CNES-made software application to healthcare. Young people are drawing strong inspiration from space technology spinoffs, with five times more teams expected for next year's event in May, which will be extended to Europe through ESA BIC Sud France's network.

FRANCE BREVETS

A LEVER FOR INNOVATION

A subsidiary of the government and the Caisse des Dépôts et Consignations, France's principal public financial institution, France Brevets was formed in 2011 to support government-funded research. This investment fund has the dual mission of spinning off patents and helping to defend industrial property. It also boosts patents' market potential through its global profile. It sought out CNES to harness the agency's excellence in fertile space telecommunications and geolocation technologies, and contracts covering patents related to applications in both these areas have been signed.

+ WWW.FRANCEBREVETS.COM

45

Average number of patents filed by CNES every year. The agency is in the top 50 applicants in the rankings established by INPI, the national industrial property institute.

PIA

FUNDING FUTURE SATELLITES

Managed by the Commissioner General for Investment, the PIA future investment programme was initiated in 2010 to fund innovative and promising investments in France. CNES is responsible for the programme's space actions and in charge of the 'Future Satellites' project. The PIA has already helped French manufacturers Airbus Defence & Space and Thales Alenia Space to join the European ARTES 14 NEOSAT advanced research programme dedicated to new-generation satellite buses, with a view to anticipating satellite operators' future needs. SMEs are also involved in the project with support from the PIA.

COSPACE

BOOSTING THE SPACE ECONOMY

CoSpace[1] is a highly motivated and tightly knit 'team France' working closely together to pool expertise and make the space industry more competitive, notably in export markets. This committee brings together manufacturers, SMEs and government agencies like CNES in an effort to prime industry for today's fiercely competitive environment. Its 'Booster' structure supports development of space applications through competitiveness clusters to encourage other sectors to draw on space technologies. The challenge is to assure access to space data for players from the digital sphere, which it is hoped will optimize synergies between start-ups and research bodies. Following a call for candidates, the first three 'boosters' will be selected before year-end to submit concrete proposals by early next year. This initiative is expected to run for two years and could be extended.

1. Government-industry space coordination committee overseen by the ministries of Defence, Research and the Economy.

SPINOFF

WALDO'S FIRST STEPS

You probably don't have the gift of ubiquity. Not to worry: start-up Immersive Robotics has developed it for us with a teleportation project based on Waldo, an immersive robot capable of acting as your eyes even when you're somewhere else. Combining robotics with immersive techniques, this avatar is a pure product of virtual reality. Immersive Robotics is a spinoff from CNES, which helps its employees to buy or start their own business. Laurent Boireau, an engineer at the agency's Launch Vehicles Directorate (DLA), chose to spin off a space technology. Waldo is a precursor for future robots performing domestic or professional tasks.

RESEARCH FUELLING

1982

Spinoff of public research is declared a 'key driver' of the economy

1999

The statute on innovation provides a formal framework for setting up incubators as industrial and commercial services

GUIANA MISSION

ALTOA TAKES TO HIGH GROUND

Specializing in topographic surveys of remote areas using airborne lidar technology, French Guianese firm Altoa is today the market leader in its field. Its rise began in 2006 when Walid Mostafa took up the challenge to grow the company with funding from the Guiana Mission. Formed in 2000 to support French Guiana's economic and social development, this devolved directorate of CNES has forged a strong partnership with the regional council, national government (notably through European funding) and local authorities, offering assistance to a wide variety of projects through its close involvement in business support networks. Such support enabled Walid Mostafa to invest in 2007 in a new lidar and then in 2009 to move into research and development. Since then, his company has expanded into export markets and today Altoa has a team of eight people and annual revenues of more than €1,350,000. Customers in its portfolio include the French forestry commission ONF, the IRD development research institute and local authorities and missions in metropolitan France, Suriname and the West Indies.

→ WWW.CNES-CSG.FR

15%

Impact of space on the economy of French Guiana, in terms of the active population. More than 50 different trades are employed at the Guiana Space Centre, while space sustains 1,700 direct jobs, 2,500 jobs at subcontractors and 5,000 indirect jobs. The determined launchers strategy confirms CNES's end-to-end systems expertise.

900

Jobs created in the Midi-Pyrenees region in space oceanography in the last 20 years. Besides creating jobs, oceanography has also become one of the region's defining traits.

15/YEAR

Average number of hires by Collecte Localisation Satellites (CLS) every year for the last 30 years on the back of its strong growth. In the last six years, CLS has acquired six firms to broaden its range of activities, expand its international footprint and seek out new sources of growth.

THE ECONOMY

2006

The Research Code confirms the shift of research towards a 'knowledge-based economy'

2011

The France Brevets investment fund is created under the government's PIA future investment programme and CNES signs an agreement covering exploitation of its patents

2012

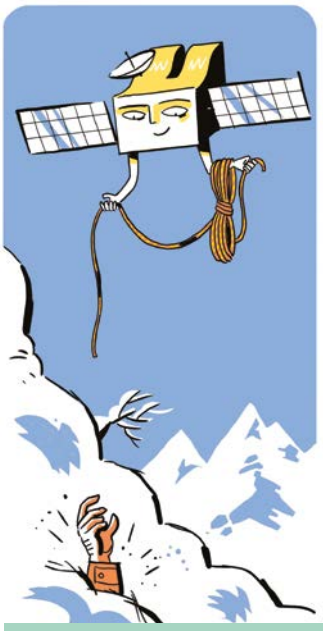
The first SATTs, a new type of company geared to accelerating technology transfer, are launched

2013

The higher education and research bill reaffirms technology spinoff as a government mission, while the first ESA business incubation centre (BIC) is set up in France

2014

The Pepite network is set up by the government to encourage student entrepreneurs



INSPACE

A GUIDE TO INFORM LOCAL AUTHORITIES

The Decazeville-Aubin mining basin has been testing satellite applications for managing hazards like landslides and floods, while the Piémont Pyrénéen borough community is looking to organize mountain rescue operations and develop e-tourism. Studies are now underway to gauge the return on investment of these applications and their impact will be analysed in partnership with InSpace. Created this year by the Midi-Pyrenees regional council, the InSpace institute provides expertise to inform local authorities' decisions on land planning, development and public services. Alongside this mission, InSpace also helps service suppliers to break into the often hard-to-penetrate local government market. Lastly, the institute seeks to pool solutions for the benefit of authorities keen to achieve savings.

+ WWW.INSPACE-INSTITUTE.COM

MARKET

TELESPACE PARTICIPATION SUPPORTS START-UPS

This April, Telespace Participation bought into AdEcho Tech, a firm specializing in biomedical applications. A wholly owned subsidiary of CNES, Telespace Participation is a financial holding company that funds start-ups or developing firms, providing guarantees to back their investment plans or investing directly—vital for young and innovative companies looking to develop satellite data services. Telespace Participation serves a broad range of projects drawing on space applications in sectors as varied as healthcare, agriculture and automobile manufacturing.

COMPETITIVENESS CLUSTER

INNOVATIVE CAMPUS IN A VIBRANT ECOSYSTEM

The TMA-Sud campus set to rise up on the site of the historic Aéropostale runway in Toulouse is designed to support a new vision of the space economy. Riding on the wave of the Aerospace Valley competitiveness cluster, the cross-cutting campus will be located in an urban district and intends to act as a showcase. TMA-Sud will also be an economic booster, encouraging market infusion of applications built around space technologies. CNES, which is participating actively in innovation-oriented structures such as ESA BIC Sud France, Aerospace Valley, IRT Saint-Exupéry and InSpace, has supported the project from the outset as a mediator and facilitator. Once the campus is on the rails, the agency will help to run the ecosystem and provide technical resources and expertise. The campus is planned to break ground at the end of the year and construction should be complete in 2017.

BPIFRANCE

PARTNERING FRENCH FIRMS

Public investment bank BPiFrance is the go-to contact in each region for start-ups, SMEs and big manufacturers alike. Innovation is its prime focus. *"We don't look at a company's size or business when deciding to provide funding, but rather base our decisions on risk analysis, prospects for achieving differentiation and creating value, and the economic challenges it faces,"* says Laurent Cambus, Innovation contact at BPiFrance Midi-Pyrenees. Aerospace in particular is a leading-edge sector driven by innovative technologies and technology spinoff. Offering guarantees, loans, funding for innovation and even direct investment, BPiFrance is a key government tool supporting the economy.

+ WWW.BPIFRANCE.FR

CLS

SUCCESS STORY

CLS[1] has been working to protect and preserve the planet and its populations for 30 years. This subsidiary of CNES, Ardian and Ifremer, the French institute of marine research and exploration, markets the Argos data collection and location system. Over the years, it has evolved as technologies have changed, adding systems for observing the oceans and surface waters and radar technologies to its catalogue of turnkey solutions. This diversification strategy has proved a winner. From 25 employees at its inception, today the CLS 'community' has grown to 540 people around the globe. *"Our customers expect intelligent services that compile and integrate data from which they can extract information,"* says CEO Christophe Vassal. *"Our scope of activity spans security, logistics and management of daily operations. We've developed the business by diversifying our systems and services and incorporating them in major projects like Indeso, a programme to preserve Indonesian ecosystems for which we're the prime contractor."* And with new contracts, notably in Asia, CLS has ambitious goals for the future with revenues this year set to exceed €100 million.

1. Collecte Localisation Satellites.

Christophe Vassal, CEO and the driving force behind dynamic firm CLS.

#COMMUNITY

Every day, CNES engages with you on social networks and you share your thoughts and questions with us. Below is a selection of messages that caught our attention. Join the conversation!

@ IGOR VUJIC

Ingénieur en informatique | Reprise d'études (@Master_MTI Mgt de la Technologie et de l'Innovation, @Paris_Dauphine) | Innovation/ Science/Tech enthusiast

1st prize at #ActInSpace :-). thanks to the team, organizers, @Master_MTI, C/K, supporters/family ->"Innovate with passion!" :-)

@ ROMAIN TALES

Data hunter & producteur owner of http://data.gouv.fr @etalab #OpenData #opengov #datalover #WebAnalytics #WebTV #DigitalEconomy

@rlacombe presents case studies of innovative start-ups striving to tackle climate change #changementclimatique #c3challenge.

@ START TRACK

#StartTrackTls est une application issue du spatial dans le but d'améliorer votre santé grâce à une pratique physique adaptée. Faites du sport en tout sécurité

Precision space technologies working for your health. Play sport and exercise safely @CNES #Sport #Santé https://goo.gl/geD8Xv

CNESfrance @CNES YouTube CNES

WEBSPACE DEDICATED TO INNOVATION

Businesses, partners, competitiveness clusters, students and young entrepreneurs... Looking for practical information to develop your business with space technologies? You'd like to use our technology platforms? To innovate with CNES? Keep an eye on the new dedicated space on CNES's website.

> entreprises.cnes.fr

#ACTINSPACE, A START-UP WEEKEND FROM SPACE

On 20-21 May 2016, come and solve the space technology teasers we'll be setting! The 2nd #ActInSpace is aimed not only at space entrepreneurs and engineers but also creative types, space aficionados, students, developers and anyone ready to rack their brains with us! Follow the event now on entreprises.cnes.fr/actinspace

> entreprises.cnes.fr/actinspace and on Twitter #ActInSpace

SPACE INNOVATION ON TWITTER

What space innovations can we expect in tomorrow's world? @CNES_techno is looking for your ideas, projects, start-ups and initiatives that could transform our daily lives. Join us!

VIDEO

Who benefits from the PIA programme?

Q & A

LOUIS SCHWEITZER

COMMISSIONER GENERAL FOR INVESTMENT

One of France's top civil servants and a leading light in economics, Louis Schweitzer is today in charge of coordinating the government's investment policy. He firmly believes the space industry is key to the country's competitiveness and is advocating a third PIA future investment programme capable of turning innovation into jobs.

HOW IMPORTANT IS SPACE INNOVATION TO THE GOVERNMENT'S INVESTMENT POLICY?

Louis Schweitzer: As a fast-moving industry, space has innovation in its genes. Take Ariane, which is an undisputed leader in the space launch market but would have been left behind if we'd stayed with Ariane 5. So it's very important to understand that nothing should ever be taken for granted. Space is today a major investment programme for the nation's future, because it generates numerous spinoffs and is synonymous with excellence and progress. In my view, it's central to the nation's innovation strategy and will spur its future growth.

HOW DOES INNOVATION BOOST EMPLOYMENT?

L. S.: Innovation doesn't have a quick quantitative effect on employment. When you create a company that provides a service to people, you can generate thousands of jobs within a few years. Innovation is a more qualitative thing. Just because a major space programme gets the go-ahead, you're not going to be announcing new jobs straight away. On the other hand, our ability to create new jobs in the future will depend on how we leverage innovation. And as a leading space power, France is making the most of this advantage. It will be a key global player in the years ahead.

THE KEY TO THE HEALTH OF COMPANIES DOING WELL TODAY APPEARS MORE THAN EVER TO BE THEIR LASER FOCUS ON R&D (DYSON, GOOGLE, APPLE, ETC.). HOW ARE INNOVATION AND R&D RELATED IN YOUR VIEW?

L. S.: The PIA future investment programme is focused on innovation and R&D. But innovation and R&D don't always go together. A nation like Japan, for example, is a leader in R&D as a proportion of its GDP but not in innovation. In France, we need to combine both aspects: innovation, which involves taking risks, and R&D spending. In space, it's the convergence of these two factors that makes or breaks a programme.

HOW WILL YOU GAUGE THE EXTENT OF NEW BUSINESS GENERATED BY THE PIA FUTURE INVESTMENT PROGRAMME?

L. S.: We're constantly looking to gauge the effectiveness of the PIA and funding is systematically set aside for our actions in this respect. Assessments cover three different timeframes: short term to determine the quality of programmes; medium term (3-5 years) to measure if results are meeting expectations; and longer term (10-20 years).

This last phase reflects our strong ambition to transform the nation. For example, we want French universities to be the best in the world and we want them to work with leading research bodies like CNES and with companies to develop very profitable businesses that create jobs. We've asked the OECD[1] to conduct an assessment of French research and innovation in 2010 and in 2020. We'll see then if France has changed.

HOW DO YOU EXPLAIN THE LAG BETWEEN INVESTMENT AND ACTUAL JOB CREATION?

L. S.: There are cases where investment creates measurable jobs immediately. If you invest in a factory, you know whether it's operating at full capacity by looking at how many people it employs. But in new fields involving more risk, things are not so easy to measure. For example, what CNES has been doing for 20 years goes beyond the number of people the agency employs or the jobs generated at the firms it works with, like Airbus Defence & Space, Thales Alenia Space and Arianespace. Its impact is far wider than that. You have to consider all those further down the line using the inventions, technologies and resources derived from satellites. So it's

"SPACE IS TODAY A MAJOR INVESTMENT PROGRAMME FOR THE NATION'S FUTURE, BECAUSE IT GENERATES NUMEROUS SPINOFFS AND IS SYNONYMOUS WITH EXCELLENCE AND PROGRESS."

LOUIS SCHWEITZER

COMMISSIONER GENERAL
FOR INVESTMENT.

"FRANCE IS THE EUROPEAN NATION NOW CREATING THE MOST NEW BUSINESSES; THE PROBLEM IS THAT THEY'RE NOT GROWING ENOUGH."

very hard to quantify job creation mechanically. But one thing is sure: if we stop innovating, we're going to be left behind. When NASA experienced a period of decline, its R&D lost its edge. Conversely, recent advances in our understanding of comets boost France's attractiveness. I believe the OECD study will enable us to measure this parameter beyond direct effects in terms of jobs.

YOU'RE ADVOCATING A THIRD PIA FUTURE INVESTMENT PROGRAMME. WHAT WILL ITS FOCUS BE?

L. S.: The reason we're considering a third PIA is that we believe in the first and the second ones, which met a dual need: to get France investing in innovation and to make it a renowned global centre of excellence. Since 2008-2009, we're dealing with a crisis that has forced governments to squeeze spending. At times like these, the tendency is always to sacrifice the future for the present. The PIA's goal is to assure excellence and look to the future. PIA 3 will follow in the same vein as its predecessors. It will be decided by the government and then submitted to parliament as part of the budget debate.
It will continue to invest through subsidies and directly in applied research in companies. France is the European nation now creating the most new businesses; the problem is that they're not growing enough. We must support those with the strongest growth potential. I believe the space adventure, outside the large agencies and big industry manufacturers, is fostering the creation of new businesses of this kind, either through developing new technologies or using satellite data to invent new applications.

WILL PIA 3 WORK IN THE SAME WAY AS THE EUROPEAN FUND FOR STRATEGIC INVESTMENTS (EFSI)?

L. S. : The PIA is focused on risk taking. We invest through subsidies, reimbursable advances and capital. European investment, in other words the Juncker plan, is based on loans and largely covers infrastructures, whereas the PIA normally doesn't fund that kind of thing. So we're not competing with the European plan, we're complementing it. When we invest in a technology in the early stages of development, the Juncker plan can take over later to disseminate it.

IN THIS CONTEXT, HOW DO YOU SEE THE ROLE OF AN AGENCY LIKE CNES?

L. S. : CNES is both the incarnation of the space odyssey and a coordinator, an anchor point and a key research body. Today, it embodies that role in a European project led by France and we must maintain that position.

1. Organisation for Economic Cooperation and Development.

Profile

1981
Principal Private Secretary to Laurent Fabius, Minister of the Budget, for whom he subsequently occupied the same post at the Ministry of Industry and then at Matignon, the Prime Minister's office.
1992
Chairman & CEO of Renault until 2005.
2011
Chairman of Initiative France.
2014
Commissioner General for Investment.

CUTTING-EDGE INNOVATION

In 2011, Guy Richard and three partners formed Syrlinks, a firm specializing in high-reliability RF systems. This project was the result of a long collaboration with CNES. After securing a first contract for the development of the Myriade Evolution satellite bus, Syrlinks is diversifying into other sectors like defence, for which it has designed jam-resistant GPS receivers, and safety-of-life applications using miniature transmitters. Its Emergency II watch is a jewel of technology. Syrlinks today employs some 50 people.

APPLIED HIGH-TECH

Aguila Technologie and its 15-strong team of employees was formed in 2009 by Hubert Forgeot, its current chairman. The firm's innovations aim to develop communication-enabled objects so they can collect data and relay them: for example, a bin able to communicate how full it is and transmit the weight of refuse for calculation of waste-collection taxes. CNES is supporting the work of Aguila, which came out top of the first crop of companies selected by ESA BIC France.

R&T

CNES's space systems R&T budget (external expenditures) is around €20 million a year. Averaged out over the 2011-2014 period, some 26% of this figure was devoted to SMEs, while the Demonstrator and Strategic Components budgets are about €5 million a year.

CONCENTRATED SPACE

Most space activities in France are concentrated in three dedicated competitiveness clusters: Aerospace Valley (Midi-Pyrenees and Aquitaine), ASTech (Paris-Ile de France) and Pegase (Provence-Alpes-Côte d'Azur). An estimated 13,800 people are employed by the space industry in these three regions (13,000, 200 and 600 respectively).

1 launcher = how many Airbuses?

AN ARIANE 5 COSTS ABOUT €150 MILLION, 2 to 2½ times less than an Airbus A380. Ariane 6 aims to cut costs by 40% to make it the average price of an Airbus A320. Note that the cost of launching a telecommunications satellite amounts to less than 3% of the revenues generated by the space telecommunications sector as a whole.

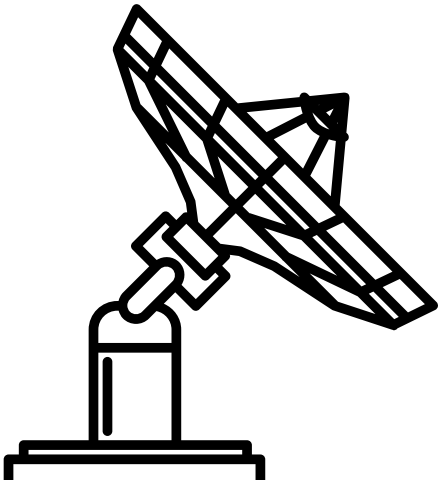
43%

PERCENTAGE OF MOBILE AND SMARTPHONES

with a GNSS positioning system. This is a huge market, since an estimated 2.8 billion downloads concern phone apps using such a system. In addition, 35% of GNSS receiver models support Galileo.

€178m

Amount allocated to space innovation in the PIA future investment programme. This includes SWOT (KaRIN instrument), Myriade Evolutions and the PFgeoNG/NEOSAT projects to equip the EOR bus and E172B telecommunications satellite with electric propulsion. It doesn't include the Ariane 6 project, classed as an industrial innovation.



INNOVATING TO WIN

TODAY'S SPACE INDUSTRY CAN CALL ON FULLY MATURE TECHNOLOGIES AND OFFERS GREAT POTENTIAL FOR DEVELOPMENT. IN THIS CONTEXT, CNES IS REORGANIZING WITH A NEW ROADMAP TO BOOST GROWTH AND JOBS THROUGH INNOVATION ACROSS THE SECTOR.

The SEIS seismometer for the French-U.S. InSight mission undergoing integration at the Toulouse Space Centre. SEIS will let scientists probe the interior of Mars for the very first time.

CNES is innovating every day, everywhere you look. Be it in launchers, satellites, data collection or space oceanography, since its inception in 1961 the agency has constantly blazed new trails in science and technology. Last year's stellar success of the Rosetta mission and its Philae lander simply confirmed and showcased this talent for innovation.

To sustain its built-in capabilities and achieve maximum efficiency, CNES is restructuring "*to make sure it doesn't rest on its laurels*," in the words of Lionel Suchet, Deputy Director of the Toulouse Space Centre (CST), and to prime itself for the challenges of the space revolution. The time when space was reserved for experts is long gone, as its applications reach an ever-wider audience and competition hots up across the globe. "*The business model that consisted in supplying data to an identified, often government customer, is now obsolete*," says Suchet. "*Besides traditional space missions, space applications are today finding their way not only into everyday services like telecoms and multimedia, but also areas like agriculture, fisheries, security, transport, land planning and even tracking of large construction and civil engineering projects.*" These new needs call for strategic changes to be operated.

Lionel Suchet, Deputy Director of the Toulouse Space Centre, heads the agency's new Directorate of Innovation, Applications and Science (DIA).

The Taranis satellite set to reveal the secrets of storms undergoes integration.

MORE MARKET PULL

Evolving usages could lead to a new industrial 'revolution'. Space has to play by stricter rules and doesn't have as much freedom to adapt to market trends as other sectors like the automobile industry, for example. In this respect, reforming production cycles and reinventing underlying business models could make the space industry more competitive. Historically, space has always been technology driven and could now gain from a more 'market pull' approach that more closely matches users' needs.

CNES is contributing to this effort to generate new careers and jobs to stimulate growth, working in close partnership with Airbus Defence & Space and Thales Alenia Space, as

35,000

Jobs

sustained by space in Europe. With 13,800 direct, highly qualified jobs located on its territory, 39% of the total workforce, France is the largest space employer in Europe.

well as with small and medium enterprises, start-ups and service suppliers.

GROWING POOL OF USERS

The stand-out feature of CNES's reorganization is its new Directorate of Innovation, Applications and Science (DIA), geared towards creating synergies with traditional—science, defence, etc.—and new user communities. "*Future innovations will emerge from this ability to interface differently with an ever-growing and diverse pool of users*," says Lionel Suchet. The challenge facing this directorate will therefore be to take on board the new needs of modern society. Almost all areas of activity can benefit from space applications, from agriculture to healthcare and administration. DIA will survey these services with an eye on the future. It will be leveraging existing assets and shaping orbital systems research and technology, and driving innovation processes across the agency. It will also be relying on the PASO[1] orbital systems architecture department (see article p.23), a think tank designed to conceive and test the utility of future missions and services.

Through its new directorate, CNES is therefore changing the way it anticipates future needs, but not the agency's end-purpose, as innovation still underpins everything it does.

€20

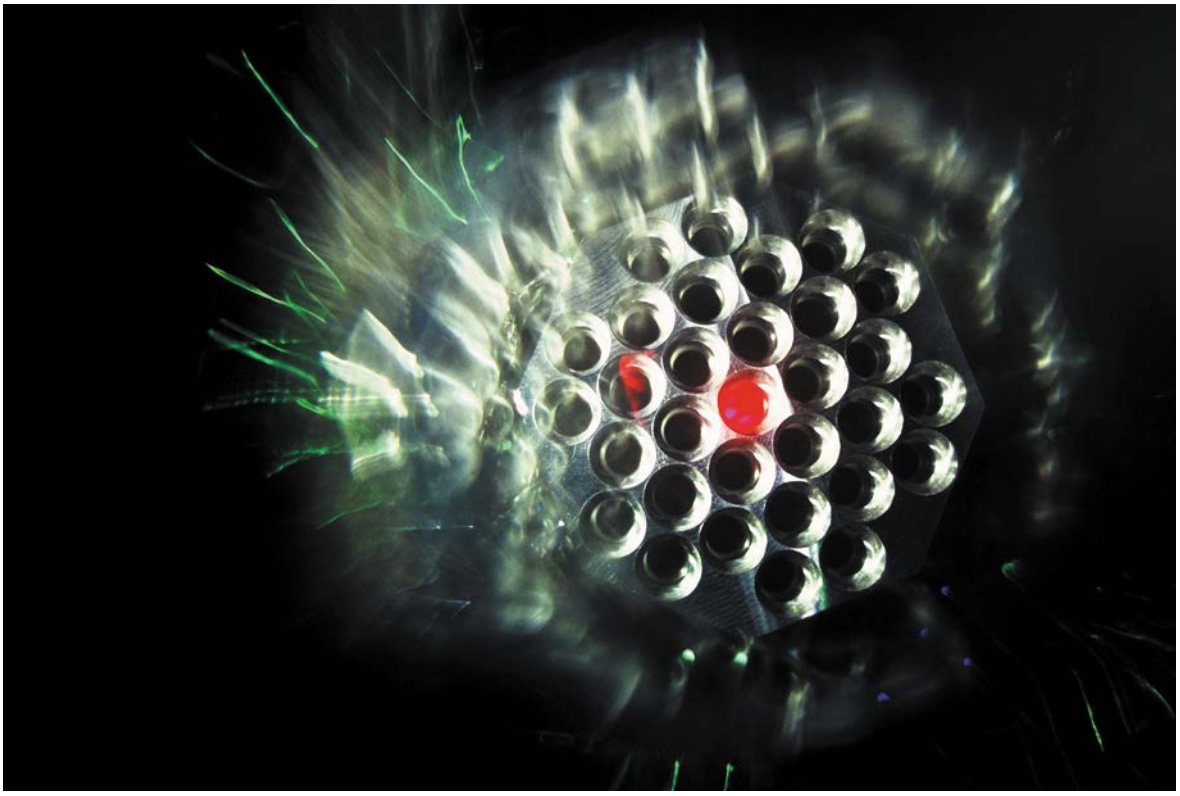
In spinoffs
to the economy for every euro invested in space.

1. Plateau d'architecture des systèmes orbitaux.

SPACE LAUNCHERS

CNES AND ASL WORKING TOGETHER

Decided in January in the wake of the ESA Ministerial Conference, the new governance structure of the launch vehicles sector puts the onus on industry to shoulder more responsibility in the commercial space launch market. This shift has led to the formation of Airbus Safran Launchers (ASL), now prime contractor. Since March, a small embedded team of ESA and CNES engineers has been working with ASL on site to provide engineering input, help assess risks and ensure an optimal flow of information. And the results have been conclusive. "*It's a completely new culture*," says Marie-Anne Clair, CNES's Deputy Director of Launch Vehicles. "*But it assures a people-centric relationship, which is a key factor in project success.*"

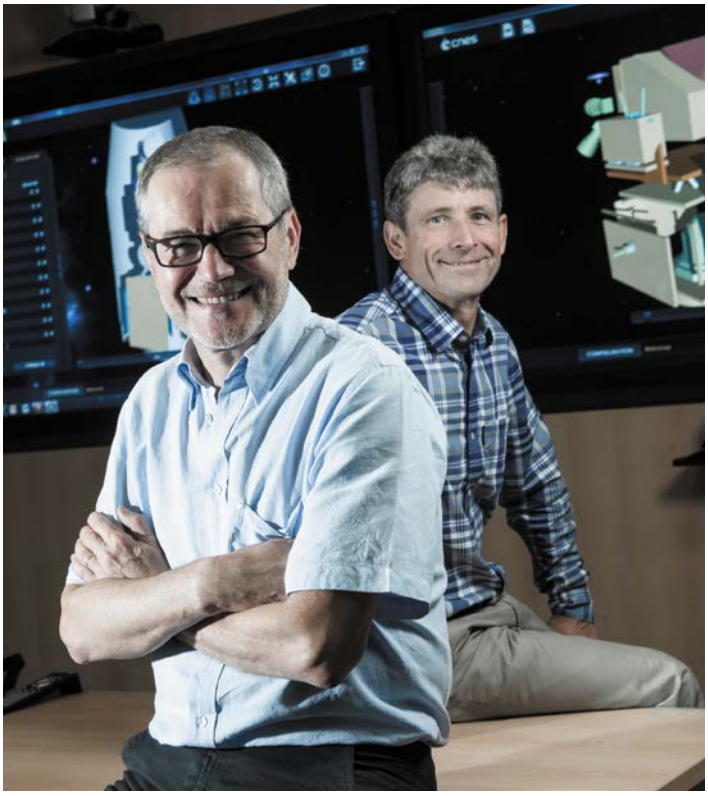


A multibeam telecommunications satellite antenna.

COMMUNITY
A VIRTUOUS DYNAMIC DRIVEN BY CNES

Everything CNES does has a knock-on effect on the space ecosystem. The utility of its R&T programmes, technical competency communities and technology platforms is well renowned.

Every year, CNES invests €20 million in its research and technology and demonstrators programme, which is crowned by the annual gatherings devoted to orbital systems and launchers. To prepare these events, CNES issues calls for ideas that have a significant lever effect, particularly for SMEs, and always draw a big response. In 2014, 300 proposals were received for launcher topics and 684 for orbital systems, from which 234 were down-selected. The selected projects are then presented at the enormously successful R&T day. For orbital systems, 500 to 600 people from and outside the space sector attend this event



Claude Fratter and Jean-Luc Le Gal, pillars of the PASO orbital systems architecture department.

PHASE 0

INCUBATING PROJECTS

The PASO orbital systems architecture department (Plateau d'Architecture des Systèmes Orbitaux) is designed to nurture future projects. CNES analyses needs, assesses the associated technical requirements and tailors the project to user needs and future applications. For example, the Launch Vehicles Directorate (DLA) has developed its Penelope[1] concurrent engineering method to test different architectures for tomorrow's launchers.

1. Plateforme d'Evaluation Numérique de l'Environnement Lanceur et d'Optimisation des Paramètres d'Etagement

every year in Toulouse, which spawns innovative concepts like the proposals regarding wide-swath altimetry last year. On the launchers side, the annual seminar stays in house but also hears constructive presentations from industry contractors.

ECLECTIC TOPICS

Besides this dedicated R&T programme, there are also cross-disciplinary structures like the 19 Technical Expertise Communities (CCTs) that CNES has set up since 1997, covering a broad range of topics such as the space environment, optics and project management to name a few. These CCTs bring together top experts in their field and spark spinoffs of space technology to other sectors like the automobile industry, agriculture, healthcare and the environment. But that's not all. CNES is also developing focused technology platforms like CESARS for telecommunications or GUIDE for geolocation, which its partners can use to help them devise new services.

Over the last 10 years, CNES has followed ESA's lead in establishing rigorous procedures to ensure that proposals are matched to needs, based on roadmaps to foster development of complementary, coherent and non-competing technologies. There are now 54 such roadmaps for technological projects like electric propulsion or flight software architecture, and 24 for infrastructures (e.g. platforms).

2,600

Members
of CNES's 19 CCTs.

PACT SUPPORTING SMEs: EVERYONE A WINNER

CNES is working closely with space SMEs through a pact and a targeted action plan.

For Olivier Guillaumon, CEO of MAP, today a leader in high-tech coatings, it all started with paints.

SMEs have the advantage of being agile and innovative. Those working in the space sector have specific skills and facilities to offer, which is why CNES is keen to involve them more in its industry-focused activities. Since 2010, the agency has been a member of Pacte PME ('SME Pact'), a unique association of SMEs founded by key public and private stakeholders, trade bodies and competitiveness clusters to forge closer ties with small firms. One of its initiatives is the 'win-win partnership' aimed at spotlighting SMEs that have forged ties with a member key stakeholder that go beyond the usual customer-supplier relationship. CNES is thus working closely with 20 French SMEs active in the space sector. Among them, Altoa (airborne laser topography), Erems (electronic equipment), Magellium (geoinformation), MAP (satellite and launcher coatings) and Syrlinks (onboard radio systems) have received CNES's 'patronage'.

OPENING DOORS TO GOVERNMENT BUSINESS

Through this pact, CNES is also pursuing an action plan to survey all of the agency's initiatives towards SMEs that are adding a lot of value to space projects in terms of innovation, flexibility, agility and costs. The plan intends to infuse such innovations into the space sector. For example, the systems providing the radio link between Europe's Philae lander on comet 67P/Churyumov-Gerasimenko and its Rosetta orbiter were designed and built by Syrlinks.

This plan also gives SMEs better access to government business, sustaining and boosting their relationship with CNES and fostering business development outside the agency's traditional markets, through export contracts, diversification, spinoff space applications and more. A questionnaire is sent out to SMEs to assess the quality of their relationship with the agency, providing valuable feedback on the results of its actions and areas for improvement.

69%

Satisfaction

rating obtained by CNES in the Pacte PME's 2015 'supplier barometer'. The mean rating for 2015 in the aerospace-defence sector is 57%.

ESA BIC SUD
AN INCUBATOR FOR SPACE START-UPS

Taking its cue from the European Space Agency (ESA), CNES is helping to support firms developing spinoff projects.

I-Sea is an innovative start-up specializing in space oceanography. Formed in August 2014 by Aurélie Dehouck (in blue), it markets innovative satellite-imagery products for coastal monitoring.

They're bold entrepreneurs with bags of enthusiasm, but today's business environment requires more than just derring-do and enthusiasm to succeed. To help project proponents to launch their start-ups, ESA's member states have developed a dedicated Business Incubation Centre (BIC) programme aimed at infusing innovation from space programmes into manufacturing and service industries. In France, the first such centre is ESA BIC Sud France, led by the Aerospace Valley competitiveness cluster in partnership with CNES, which encompasses five incubators[1]. "*ESA BIC Sud aims to start firms developing and using satellite data or downstream space applications to offer new products and services in other sectors*," explains CNES's Didier Lapierre. The firms concerned have been operating for less than five years and are investing in sustainable space-based innovations, to enable applications like intelligent car-sharing or environmental monitoring to name just two.

LEVER FOR JOBS

"*Being selected by renowned European experts gives you more credibility, including in the international arena*," admits Yann Hervouët of Instant System. "*And the incubator forces you to be rigorous and forward-looking, and to define a national and global sales strategy*," adds Virginie Lafon of I-sea.

CNES provides individual technical coaching, engineering support and access to its Technical Expertise Communities (CCTs). And it goes the extra mile with exploitation of patents and related spinoffs, strategic positioning, branding and the support of its existing network—in all, a substantial boost and a lever for jobs, since all of the start-ups incubated have recruited personnel.

1. In the Aquitaine, Midi-Pyrenees and Provence Alpes Côte d'Azur regions.

VIDEO

On the trail of new recruit Olivier Regniers

19

Start-ups
incubated since 2013 by ESA BIC Sud France. It aims to create 15 start-ups a year, 75 in total, by 2018.

79

Jobs
created by start-ups incubated by ESA BIC Sud France since 2013.

THE SATELLITE IMAGERY CHALLENGE

Faced with competition from the big Internet players and emerging nations, CNES can no longer rely on its satellites alone to stay ahead in the Earth-imagery market. The time has come to develop a new offering tailored to today's new applications.

Satellite imagery has long served institutional and professional uses and applications, but today the profusion of consumer applications and easy access to free imagery on the Internet are changing the game. Historic suppliers catering to government customers for security, defence and other applications are now being challenged by new private operators who have broken the mould of the traditional business model, operators like Skybox+Google and Planet Labs from the world of Web 2.0 and the Internet. Since acquiring Skybox Imaging in June last year, Google now has the capability to generate and supply its own imagery. And it is not alone. Planet Labs launched its Dove cubesats at the start of 2014 and dreams of operating the largest constellation of Earth-imaging satellites yet. Meanwhile, Urthecast has put its cameras on the International Space Station to film the planet 24/7. All of these players are looking to develop mass application services using fleets of small satellites. Their standard products are designed to be low cost, but not low value.

WINDFALL EFFECT

Besides these new entrants, another game-changing factor in the satellite imagery market is that nations like China—previously buyers of imagery—now have their own satellites to sustain their national mapping programmes. As a result, they are creating a shortfall in the order books of traditional operators and becoming potential suppliers of imagery. Other emerging nations are set to follow suit. CNES is closely monitoring these evolutions and seeking to boost development of downstream space applications. Although still not clearly defined, this diffusion of standard-quality imagery could have a windfall effect that will spawn new applications and jobs to benefit the wider economy.

At the other end of the spectrum, missions with very exacting quality standards will continue to require the detail and performance that only very-high-resolution imagery can offer—and France remains one of the few nations with this kind of capability.

SYSVEO'S DRONE TAKES TO THE SKIES

IN JULY 2013, CLÉMENT ALAGUILLAUME ACQUIRED A PATENT FILED BY CNES based on Mario Delail's work to design a Mars rover. At Sysveo, the start-up he subsequently created, he pursued the analogy between rovers and drones to devise an augmented-reality software application. Built into a drone, this software combines the virtual environment with the real world. The concept has caught the eye of architects, urban planners, construction and civil engineering firms, and heating, ventilating and air conditioning (HVAC) engineers. With this patent extension, civil drone manufacturer Sysveo has seen its business grow quickly and is now supplying its drones as part of the consortium leading the innovative Drones for Life pre-industrial health project in Bordeaux.

+ HTTP://WWW.SYSVEO.FR

VIDEO

Behind the scenes at Sysveo

TIMELINE

SPINNING OFF

STEP 1
PROTECT
YOUR IDEAS

Creating a start-up or SME requires know-how and perseverance. Working in CNES's component testing laboratory, Xavier Lafontan completed a thesis[1] on microsystems. With his PhD in microelectronics under his belt, he decided to exploit the results of his research and create his first start-up, NovaMems, which proposes innovative methods and tools for analysing new technologies. Whatever the project, conceptors need to protect their ideas with a patent or licence to ensure they bring an exclusive product to market.

1. Every year, CNES provides grants for 60 PhD research projects.

STEP 2
HONE
YOUR BUSINESS CASE

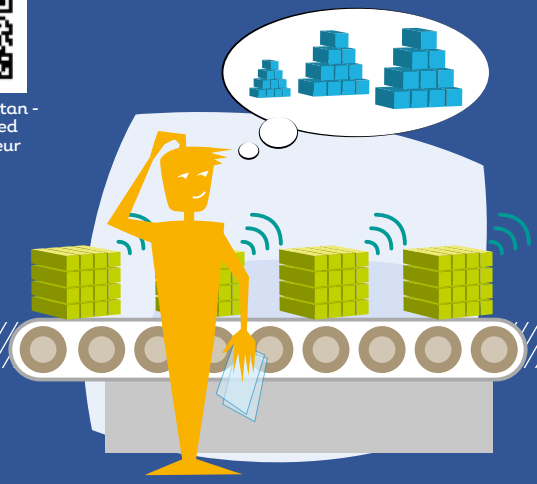
The second crucial step is the business plan. You need to plan and structure the project and set short-term and medium-term goals. The business plan outlines how the project will be managed and serves as the blueprint for refining the concept, studying its feasibility, assessing the competition and choosing the right business model. The business plan is also the 'pitch' to get potential funders on board.

TIMELINE

FROM CONCEPT TO COMMERCIALIZATION, THERE ARE SEVERAL STEPS TO CREATING A START-UP. THE PATH TAKEN BY XAVIER LAFONTAN, A FORMER POSTGRAD ENGINEER AT CNES WHO TODAY HEADS A FAST-EXPANDING COMPANY SPECIALIZED IN THE INTERNET OF THINGS (IoT), IS A CASE IN POINT.

VIDEO

Xavier Lafontan - A connected entrepreneur



STEP 3

OBTAIN FUNDING

Once the project is structured, it's time to look for funding. In France, government bodies like BPiFrance or the PIA future investment programmes provide funding for start-ups and growing businesses. Priming funds also support creation of SMEs, while research tax credits and certain government subsidies perform a similar function. Private networks like Business Angels may also invest in innovative businesses with strong growth potential.

STEP 4

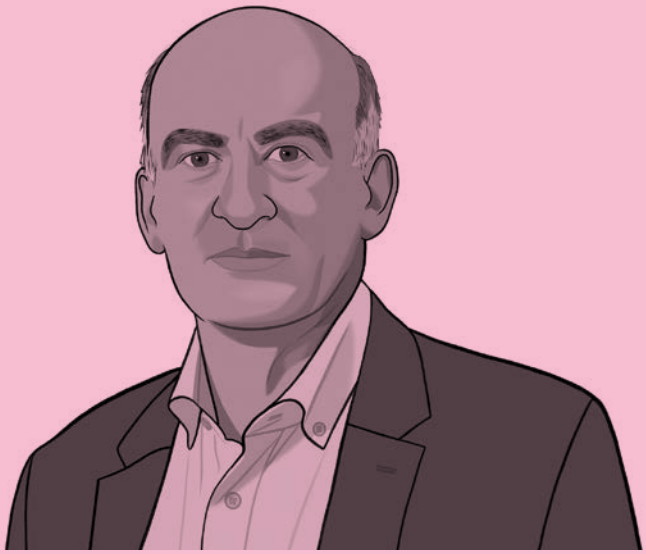
LAUNCH YOUR COMPANY

Getting to market is one thing, staying there is quite another. That's what Xavier Lafontan has succeeded in doing with NovaMems. In fact, he has diversified the business and created a second start-up, Intesens, which makes wireless sensors. The products are in the engineering and manufacturing development phase and ready for market. Intesens is targeting the global space market (10% of its business) and other sectors like aviation and robotics. It is positioning itself in the highly innovative and promising Internet of Things (IoT) sector.

THIERRY DUHAMEL

R&D Manager at Airbus Defence & Space France.

"Raising the international profile of innovative SMEs and start-ups..."



Thierry Duhamel takes a cross-cutting, multidisciplinary view of the space industry. In charge of R&D at Space Systems France, a subsidiary of Airbus Defence & Space, his role is to understand change and prepare for it. *"From electrical and mechanical systems to thermal control, attitude control and propulsion,* ***space operations don't rely on one dominant technology, but on a combination of technologies spanning a diverse array of specialist fields,"*** he explains. *"The difficulty is blending together all this expertise in a seamless fashion, but it's also what makes the job so exciting. Behind every end-product—the focus of attention—is a host of operations, each with its own set of challenges."* Within the company, Thierry is the facilitator who understands the impact of innovative technologies and supports development of product roadmaps. His suppliers are found within the group in the aerospace sector, working through technology spinoffs. Outside it, he's the main point of contact for a vast network of laboratories, SMEs, start-ups and space agencies.[1]

"Technology partnerships with SMEs are vital and have spawned numerous success stories. *They work on all or part of the system, and the technologies they develop help ensure it's competitive. It's important to listen to them and keep an eye on all sectors and the best technologies in each field."* Thierry has some high-level responsibilities within the space ecosystem today. A member of the SME Pact in France, Airbus Defence & Space has joined forces with CNES and Aerospace Valley in the Comets initiative. Number 1 in Europe and number 2 worldwide in the space industry, **Airbus Defence & Space is a significant backer for SMEs seeking to open up and expand internationally.** *"Raising the international profile of innovative SMEs and start-ups is an important part of our commitment, because our success is tied to theirs."*

1. ESA, CNES and DLR in Germany.

FLORENCE GHIRON

Founder of Capital High Tech.

"Whatever the sector, what's important is each business's continued growth..."

After graduating from the Sup'Aero aerospace engineering school in Toulouse, Florence Ghiron didn't go straight into industry. **Passionate about technologies and how they drive economic development,** she moved to the UK to prepare for an MBA in the use of new technologies. "*I was interested in how they add value*," she says. At Bertin Technologies, she was in charge of the Technology Management department. A decade later, she relocated to Brussels to bring her expertise to the European Commission and ESA. When Belgium's Wallonia region and the Liège Space Centre set up the first incubator as a model for the ESA Business Incubation Centres (ESA-BICs), she was keen to get in on the action. Working with SMEs in the aviation, space and e-mobility sectors, she became more closely involved in the new technologies ecosystem than ever before. Under the Space project of the 7th Framework R&T Programme, she identified new business models for value-added technology service providers.

In 2003, Florence set up Capital High Tech, which provides support for SMEs and start-ups, drawing on her expertise in preparing business plans, leading networks of high-tech companies and assessing the **potential for direct and indirect job creation.** "*Our clients' success is our success, so we help them at every stage in their growth*," she continues. "*Whatever the sector, what's important is their continued growth.*" Capital High Tech is an integral part of the space ecosystem and a stakeholder in the ESA BIC Sud France business incubator. She supported CNES in organizing the ActInSpace competition. **In 10 years, Capital High Tech, now a 10-strong team, has helped around 100 businesses get off the ground or back on track.** And it doesn't stop there. Indeed, Florence is as enthusiastic as ever: "*We've got a thousand things planned!*"

1. Master of Business Administration.

DIDIER LE BOULCH

Head of R&D at Thales Alenia Space.

"Space is at the crossroads where cutting-edge industries meet the digital revolution..."

Head of R&D at Thales Alenia Space (TAS), Didier Le Boulch believes innovation is vital to business growth and says the "*pace of change really is picking up*". Space is a high-risk environment where regulations are strict, so this strategic sector tends to be particularly cautious in its approach to new technology. But innovation isn't just about technology. ***"In today's competitive global marketplace, innovation must infuse our industrial, commercial and legal approaches and involve our partners in the space ecosystem,"*** he says. TAS has set up an Innovation Cluster to incubate its best ideas. "*About half of the added value of our high-tech solutions is developed within the company. The other half comes from partners and suppliers, which is why it's so important to foster relationships of trust with the rest of the ecosystem.*" To this end, TAS has adopted the 'agility and trust' approach, promoted in the aerospace sector by the Aerospace Valley competitive cluster, and tailored it to the specific requirements of space. **The goal of any innovation is to add tangible value for customers, which is made easier when a sector of excellence pulls together and functions efficiently as a whole.** This more collective and open construct is one of the levers the space economy could utilize even more, while maintaining a healthy level of competition within it. Didier Le Boulch isn't worried about the future. "*We live in exciting times*," he says. And the changes taking place—not least the growing interest in space solutions from the big digital players—offer more opportunities than threats. "*Space is at the crossroads where highly selective cutting-edge industries meet the global digital revolution. From fast broadband and on-demand content streaming to location-based services and environmental monitoring,* ***we're entering a new era of consumer-driven services combining space and digital technologies. In tomorrow's connected society, this synergy will be the decisive asset driving growth for our sector,"*** he concludes.

Jacques Arnould,
science historian and
theologian, CNES
ethics officer.

ETHICS CORNER

JACQUES **ARNOULD**

FURTHER BEYOND...

After the seafaring explorers of the modern age who braved the oceans and the scientists who revolutionized astronomy, our world has entered a new era of innovation. But what does it take to keep finding "something new under the Sun"?

We come from a far-off place, from a world and a time where the "real" was understood as a beautifully ordered whole, like a "cosmos" to use a Greek word. Such a vision of reality, developed by the philosophers of Antiquity and adapted by Western thinkers, imposed a layer of reassurance on beings, things and events—a sort of cosmetic that would make us say and repeat: "There's nothing new under the Sun" and "All is for the best in the best of all possible worlds". Indeed, we come from a far-off place, from a world and a time where innovation was rare, because it threatened to undermine the established order.

PUSHING BACK FRONTIERS

Sailors needed to venture past the Pillars of Hercules, which marked the end of the then-known and familiar world, while astronomers needed newly invented optical instruments to peer into the mists beyond the bows of those boats to make out previously uncharted lands, only to point them heavenward to behold a thousand spheres of crystal in all their beauty, around which the planets were believed to quietly follow their courses. Columbus and Magellan, Galileo and Kepler discovered new worlds, which, while not the same, were not unlike their own world, now suddenly "old". Braving the unknown, they were no less courageous in challenging the age-old tradition and contending with the inquisitors of their time, both political and religious. They dared to claim there could be something new under the Sun, our own Sun. They adopted the maxim of the Latins—"*plus ultra*", or "further beyond", reflecting their determination to push back the geographic frontiers and the reassuring and oft-repeated beliefs of their day. Through their voyages, calculations and discoveries, the cosmos of old gave way to a universe whose centre was now everywhere and whose edge was nowhere.

The centuries since those early conquistadors, seafarers and scholars have also produced their share of illustrious individuals, who have crossed other frontiers, whether geographic, scientific or technical, economic or political, social or cultural. Innovation became the bedrock and ambition of many a company in the modern era and continues to be so today. But innovation by its very nature is never wholly achieved, never satisfied and never "cosmological" either: before anything new can be revealed, it demands that we question what we think we know, despite all the evidence and assurances to the contrary. A complex alchemy that can be summed up in a simple motto: *Plus ultra.*

R&T DAY

LONG-AWAITED EVENT

CNES is holding its next annual R&T Day on Future Space Systems in Toulouse, 26 January 2016. The event will be attended by hundreds of participants from science and technology research bodies and industry. CNES will present its R&T plan and new ideas and early work on the technologies of tomorrow will be the focus of debate. Over the years, CNES's R&T Day has become a must-attend event for everyone in the European space systems industry.

INTERNET

APOGÉE: THE NEW SOCIAL NETWORK

The JC2 Forum is a chance for the young researchers co-funded by CNES to present their work. At this year's event, scheduled to take place mid-October, the CNES teams unveiled Apogée, a new social network for the CNES young researcher community. The network serves as a fully functional online directory. Accessed via LinkedIn, Facebook and Twitter, it enables industry to view the profiles and expertise of all CNES PhD students and postdoctoral researchers.

+ HTTP://CNES.CBORG.FR/JC2/2015

INNOVATION

C3 CROSSES **THE FINISH LINE**

CNES helped organize the Climate Change Challenge (C3), a whistle-stop tour of the country to find innovative ways to combat global warming. C3 is about harnessing collective intelligence to devise new solutions to prevent and mitigate climate change, cope with its effects and raise awareness. In Paris, Nantes, Toulouse and Lyon, over 600 members of the public, government agencies, businesses, experts and students took part. The best projects will be presented at the COP21 climate conference in December.

HUMAN RESOURCES

RECRUITMENTS ON THE HORIZON

Each year, 30 to 40 new hires join the engineering department at the Toulouse Space Centre (CST). To prepare for the future in a constantly changing environment, the department needs to recruit the best talent. Selection is in two stages: GPEC prospective employment management to determine the skills the CST needs to maintain and develop, followed by definition of recruitment profiles by HR and managers.

BOOKS

A NEW LOOK AT LAUNCHERS

Art photographer Dominique Sarraute sees the world through different eyes, which is why CNES chose her to illustrate its book, *Ariane, l'art des lanceurs*. The result is a series of striking images of high-tech hardware design for power, speed and space. With words by writer Viviane Moore, the book conveys the commitment of Europe's space launch sector to combine energies to achieve success. At a critical time for spacefaring Europe, this innovative interpretation also looks at the future of the Ariane family.

Ariane, l'art des lanceurs, – 152 p., Published by CNES

DIARY

22 SEPTEMBER 2015
First meeting of space agency managers responsible for technology reuse and transfer, organized by ESA at its European Space Research and Technology Centre (ESTEC)
Noordwijk, Netherlands

14-16 OCTOBER 2015
JC2 young researchers' forum
Cité de l'espace, Toulouse

7-8 NOVEMBER 2015
Climate Change Challenge (C3) Innovation Jam: last stage of C3 (open to all)
Paris, Nantes, Toulouse, Lyon

2-6 AND 23-27 NOVEMBER 2015
Space technology courses (TTVS/ spacecraft techniques and technologies)
Diagora centre, Labège

26 JANUARY 2016
CNES R&T Day on Orbital Systems 2016
Pierre Baudis conference centre, Toulouse

20-21 MAY 2016
Second ActInSpace challenge

28-30 JUNE 2016
Toulouse Space Show International rendezvous for space applications
Pierre Baudis conference centre, Toulouse

AN IPAD TO NAVIGATE THE COSMOS

Star trackers were much in evidence at the ActInSpace competition, where a patent set as a challenge to participants has given birth to a start-up. Its proposed innovation is a mini iPad to guide satellites through space.

Satellites find their bearings in space just as sailors once did: by looking at the stars. They use a type of camera known as a star tracker, which mission engineers put through its paces before the satellite is launched. But here on Earth, only part of the celestial sphere is visible from any given point, whereas in space the satellite needs a panoramic view to position itself correctly. The mini iPad is placed in front of the star tracker so that it can scan all of the stars in the sky in all possible positional configurations. Using a mini iPad offers two advantages: first, it ensures a good quality image with a very dark black background that closely mimics the skies as seen in space; and second, its small size means it can be placed really close to the star tracker and thus display the moving sky as it will appear in orbit.

SUCCESSFUL COLLABORATION

This well-conceived idea is the culmination of a great adventure. In 2014, CNES set its patent for qualifying star trackers as a challenge at the ActInSpace competition. Three engineers and students took it up. José Iriarté, a young engineer, is now pursuing the adventure with CNES and students from the ISAE aeronautics and space institute, looking to break into the star tracker market with his start-up Transitonic. And that's not all: the mini iPad solution could well find applications outside the space community.