

# FOUNDATIONS FOR CHANGE

ANNUAL REPORT 2018

LUXEMBOURG  
INSTITUTE OF SCIENCE  
AND TECHNOLOGY

LIST



LUXEMBOURG  
INSTITUTE OF SCIENCE  
AND TECHNOLOGY







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## A FEW WORDS FROM THE CHAIR OF THE BOARD OF DIRECTORS AND THE CEO

### FOUNDATIONS FOR CHANGE

Dear readers,

LIST, Luxembourg's largest research and technology organisation (RTO) continues to stand out on the domestic and European research scene. During 2018, its mission was bolstered by the signature, with the Luxembourg Ministry of Higher Education and Research, of a performance contract for the period 2018-2021. This multi-year agreement confirms LIST's growing leadership in three thematic areas: environmental research and innovation, developing innovative digital solutions, and cutting-edge research into advanced materials.

For example, LIST has pursued its collaboration with the Goodyear Tire and Rubber Company on durable mobility and materials of the future. This partnership has already given rise to some initial promising innovations. 2018 also saw the strengthening of a strategic partnership signed the previous year with the lunar exploration company ispace Europe, aimed specifically at detecting and analysing lunar resources using LIST-developed technology.

Furthermore, several new international industrial partnerships were concluded during the year: with STMicroelectronics on thin film technologies for intelligent systems, with Intel on low power consumption magnetoelectric materials, and with XNRGI on 3D micro-batteries. Finally, LIST is providing its expertise and know-how to MET-LUX to develop new, flexible, transparent packaging with very low gas permeability. At the national level, collaboration has begun with Arcelor and Ceratizit in the field of Data Analytics, as well as with Paul Wurth and Luxair in the field of the digital transformation of organisations, and with Polygone to resolve waste transformation issues. In 2018, LIST also supplied the first functional microturbines for Rotarex valves.

At the institutional level, new know-how was developed for use by public bodies. With its high resolution maps of flooded areas, generated by patented algorithms, LIST has helped the competent authorities in the aftermath of disasters, as well as international organisations around the globe, to respond effectively in times of crisis. Similarly, LIST processes satellite imagery in order to better monitor and understand phenomena affecting the Earth's surface. Thanks to these skills a cooperation agreement could be signed with the Luxembourg Directorate of Defence in the field of data processing. Finally, the GDPR Compliance Support Tool created by LIST for the Luxembourg National Commission for Data Protection took the special GDPR Initiative of the Year prize at the Information Security Awards 2018.



Scientific excellence is also at the heart of LIST's ambitions. The 133 competitive projects (110 in Luxembourg and 23 European), 223 scientific publications in the 1st quartile of their respective categories internationally and the 17 successfully defended PhD theses are testament to this. Furthermore, 21 LIST researchers have obtained PhD Supervision Rights at the University of Luxembourg, and four have gained Accreditation to Direct Research at French universities.

Finally, as part of its role to transfer innovation to the benefit of local industry, LIST worked on developing its latest spin-off company, Luxembourg Ion Optical Nano-Systems sàrl (LION), which launched in February 2018. It markets the VECTOR<sup>500</sup> SIMS, a single tool for high-resolution, high-sensitivity correlative microscopy, developed in the LIST laboratories. The research team behind this technology received an Outstanding Research-Driven Innovation Award at the 2018 FNR Awards.

LIST is generating impressive results that are gaining recognition, not only nationally, but also across Europe and even internationally. First and foremost we owe these results to the performance culture and team spirit at LIST.

We are proud to be a part of the exciting adventure that is LIST.



Georges Bourscheid  
Chair of the Board of Directors



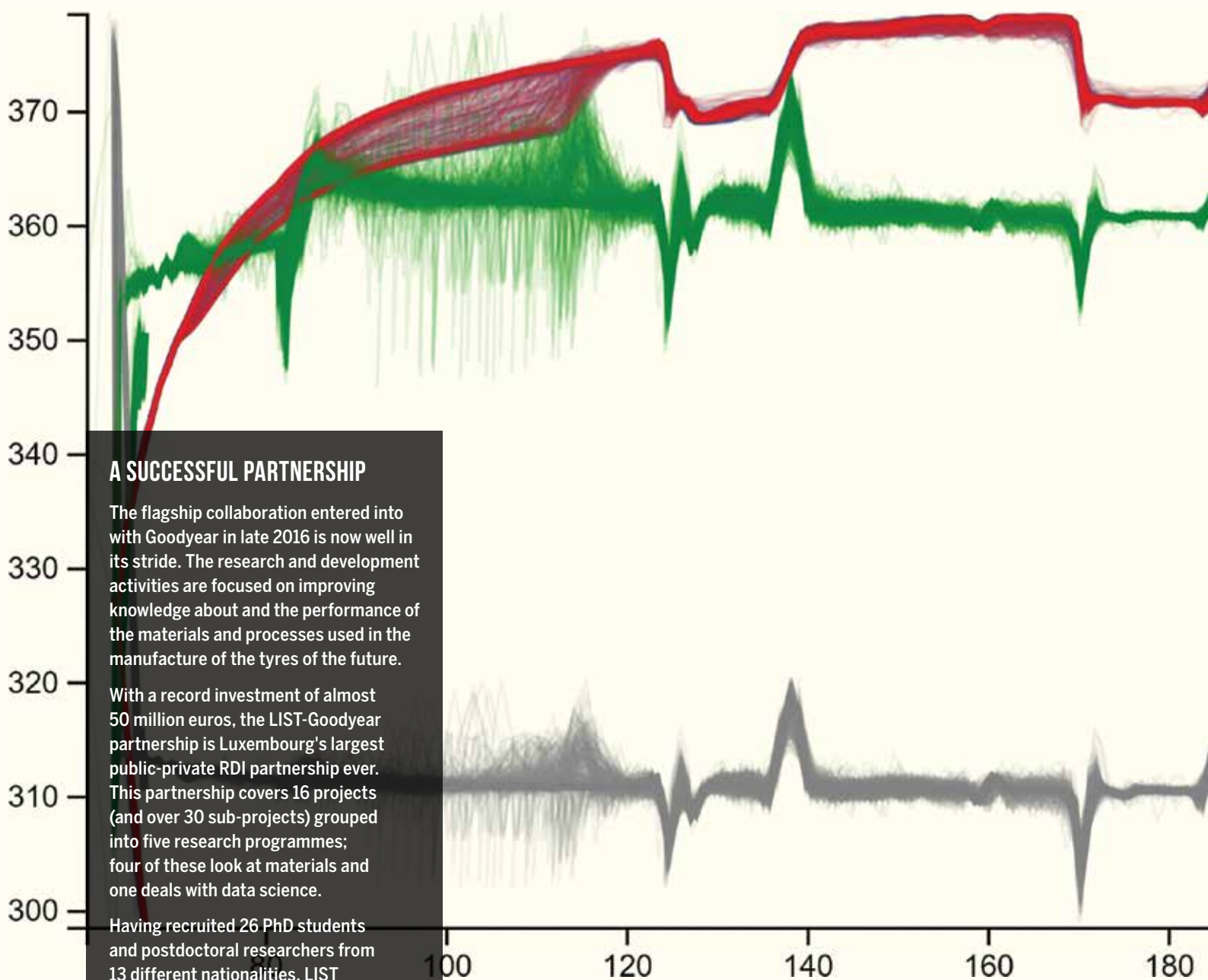
Dr Thomas Kallstenius  
CEO







# | MILESTONES

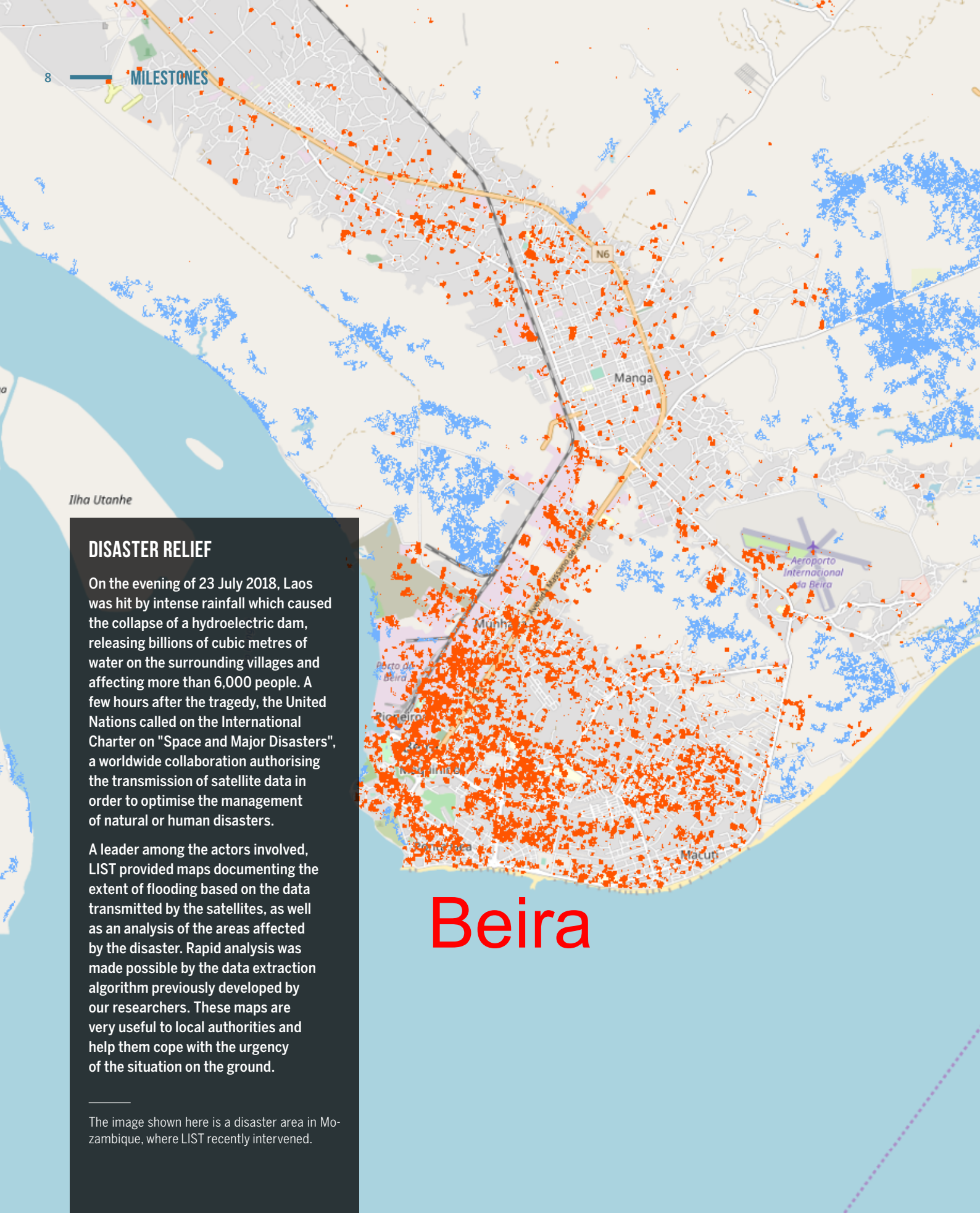




## RECOGNISED INNOVATION

The VECTOR<sup>500</sup> SIMS is a mass spectrometer which, coupled with a microscope, offers a spatial resolution of around 10 nanometres. This is five times more powerful than the instruments currently available on the market. This technology is the only one of its kind in the world and is the result of a combination of fundamental research on particle-matter interaction, and the development of instruments and applications. Since 2018, it has been marketed by Luxembourg Ion Optical Nano-Systems sàrl, a LIST spin-off.

The innovation cycle linked to the maturation of the VECTOR<sup>500</sup> SIMS was fully managed by LIST, from instrument design to product launch. This cycle was spotlighted at the 10<sup>th</sup> edition of the FNR Awards, which singles out excellent projects in the field of innovation. The research team that developed this technology received one of two Outstanding Research - Driven Innovation Awards that were presented by Marc Hansen, the former Deputy Minister for Higher Education and Research. This award recognises the multi-disciplinary R&D efforts in this field accomplished by LIST over more than seven years.



## DISASTER RELIEF

On the evening of 23 July 2018, Laos was hit by intense rainfall which caused the collapse of a hydroelectric dam, releasing billions of cubic metres of water on the surrounding villages and affecting more than 6,000 people. A few hours after the tragedy, the United Nations called on the International Charter on "Space and Major Disasters", a worldwide collaboration authorising the transmission of satellite data in order to optimise the management of natural or human disasters.

A leader among the actors involved, LIST provided maps documenting the extent of flooding based on the data transmitted by the satellites, as well as an analysis of the areas affected by the disaster. Rapid analysis was made possible by the data extraction algorithm previously developed by our researchers. These maps are very useful to local authorities and help them cope with the urgency of the situation on the ground.

The image shown here is a disaster area in Mozambique, where LIST recently intervened.

# Beira





## GREEN ECONOMY

LIST is contributing to the implementation of the Luxembourg Government's national circular economy strategy with the establishment of a Green Tech Innovation Centre (GTIC-L), which is in the process of being set up.

This centre places collaboration with industry at the heart of LIST's Smart Green vision, for a greener economy and green jobs. It will address themes related to construction, renewable energies, biomolecules of industrial interest, and the use of natural resources, as well as agriculture and food.



## ESSENTIAL SERVICE SECURITY

The Network and Information System Security (NIS) directive, adopted in 2016, pursues one key objective: ensuring a high and common level of security for European Union networks and information systems. It aims to increase business' maturity in terms of cyber security in order to make Europe stronger and more reliable. Two types of business are affected: essential service operators and digital service providers. The non-exhaustive list of target sectors includes: energy, transport, the banking sector, financial market infrastructures, health, drinking water supply and distribution, and digital infrastructures.

For the past seven years, LIST has been working on cyber security and related risks in cooperation with the Luxembourg Regulatory Institute (ILR), and with the support of the National Research Fund for certain projects. In 2018, LIST designed and deployed, together with the ILR and the High Commission for National Protection, an innovative methodology for identifying essential service operators. This methodology meets all the criteria advocated by the NIS directive. In addition, representatives and authorities from each of the sectors concerned were involved in its elaboration.

This first project forms part of a wider collaboration framework for the development of innovative tools aimed at implementing the NIS directive. In particular, instruments to assist the reporting of the various entities concerned will be developed.



## THE FIRST EVER LIST TECH DAY

On 21 June 2018, LIST held its first ever Technology Day: an event aimed at introducing business leaders and policy makers to the new technologies and solutions developed at LIST for the benefit of any business seeking to innovate.

Over 150 participants contributed to this day-long event devoted to innovation in Luxembourg, in the presence of representatives of the Ministry of Research and Higher Education, and the Ministry of the Economy.

Numerous practical examples of collaboration between LIST, and private and public partners were highlighted. From space research to nanotechnology, some fifteen manufacturers discussed their plans with LIST researchers. These partnerships attest to LIST's leading role in creating links between research and business.

Following the success of this first edition, LIST has decided to repeat the event so that the Tech Day becomes the annual forum for the advancement of collaborative research and industrial partnerships in Luxembourg.









# **| KEY FIGURES 2018**

At 31/12/2018

employees | **603****65%**  
men  **35%**  
women **45**  
nationalities**75%**researchers  
or innovation  
experts

## HUMAN RESOURCES

For the entirety of 2018

**79** | people recruited  
in 2018 **110** | PhD students  
hosted at LIST in  
2018

## SCIENCE AND TRANSFER

 **19****19**

paid licences

**223**scientific  
articles in  
1<sup>st</sup> quartile  
journals**1**

spin-off



## RESEARCH CONTRACT TYPES

- **Competitive projects** are research projects that have successfully undergone an international scientific evaluation following a call for projects under national or international programmes.
- **Collaborative projects** are research projects involving effective collaboration between at least two independent parties seeking a common goal based on a division of labour. The two parties jointly define the scope of the project, contribute to its execution, and share its risks and results.

Projects falling under public utility missions entrusted to LIST and European Space Agency (ESA) projects, as well as those co-funded by foundations, have been classed as collaborative projects.

Note that from 2018, Luxembourg National Research Fund (FNR) projects, including public-private partnerships, are included under collaborative projects. In 2017, these projects were classed as competitive projects.





# INTERNATIONAL COLLABORATION

## NUMBER OF CONTRACTS PER COUNTRY

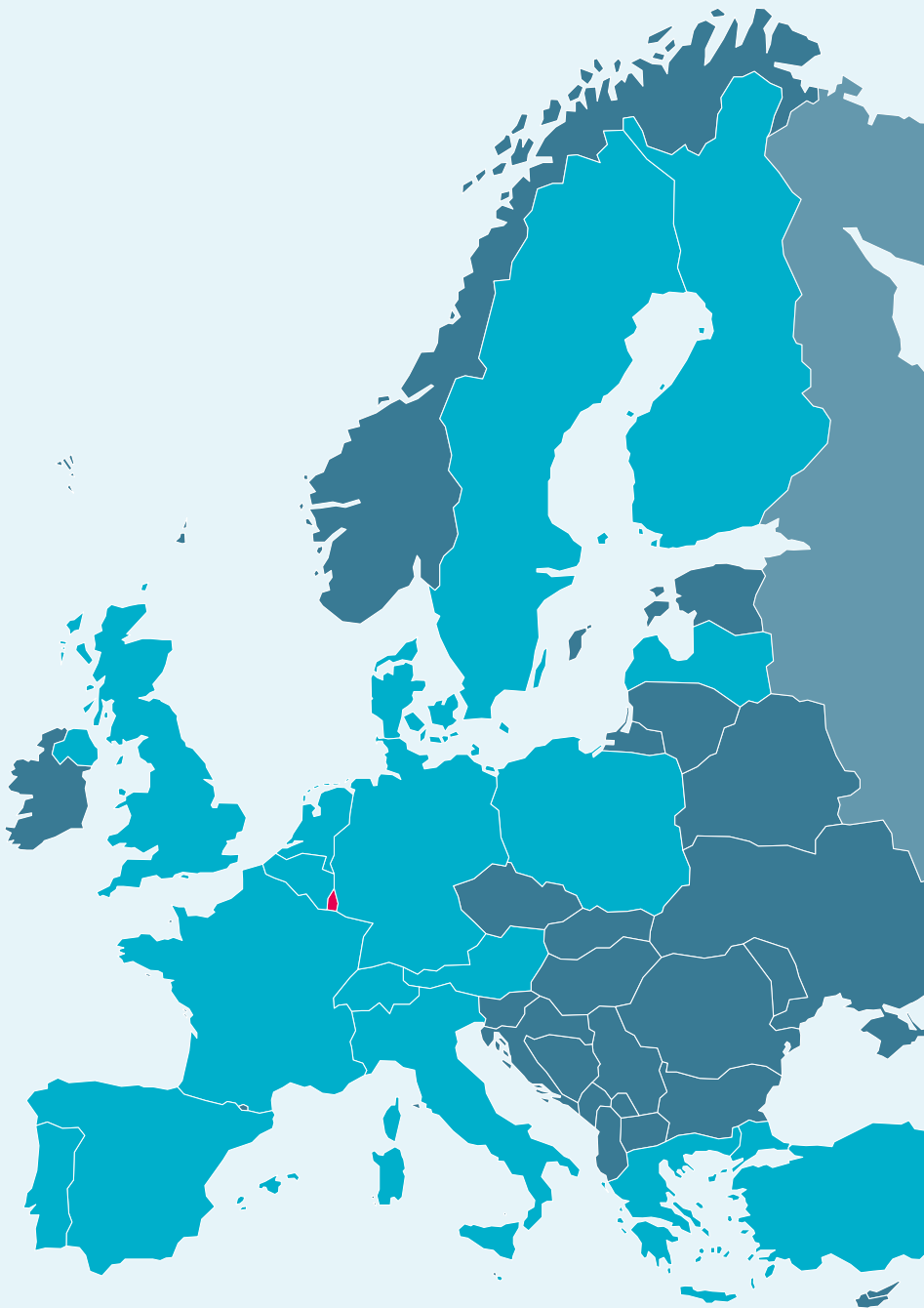
### EUROPE

France	28
Netherlands	8
Spain	6
Germany	5
Belgium	5
United Kingdom	5
Austria	4
Italy	4
Finland	3
Switzerland	3
Latvia	2
Poland	2
Portugal	2
Greece	1
Sweden	1
Turkey	1

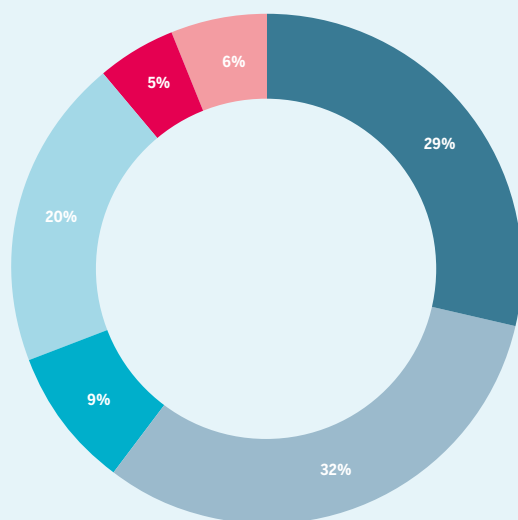
### WORLD

Brazil	1
United States	1

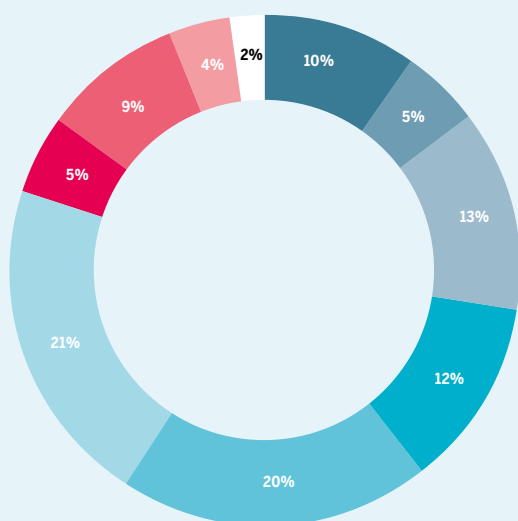
## GEOGRAPHICAL BREAKDOWN OF CONTRACTS SIGNED IN 2018



## BREAKDOWN OF PARTNERSHIPS SIGNED IN 2018 BY TYPE OF PARTNER



## BREAKDOWN OF PARTNERSHIPS SIGNED IN 2018 BY SECTOR



### Type of partner

- Businesses (24)
- Universities (26)
- Public institutions (7)
- Research centres (16)
- Foundations & associations (4)
- Other (5)

### Business sector

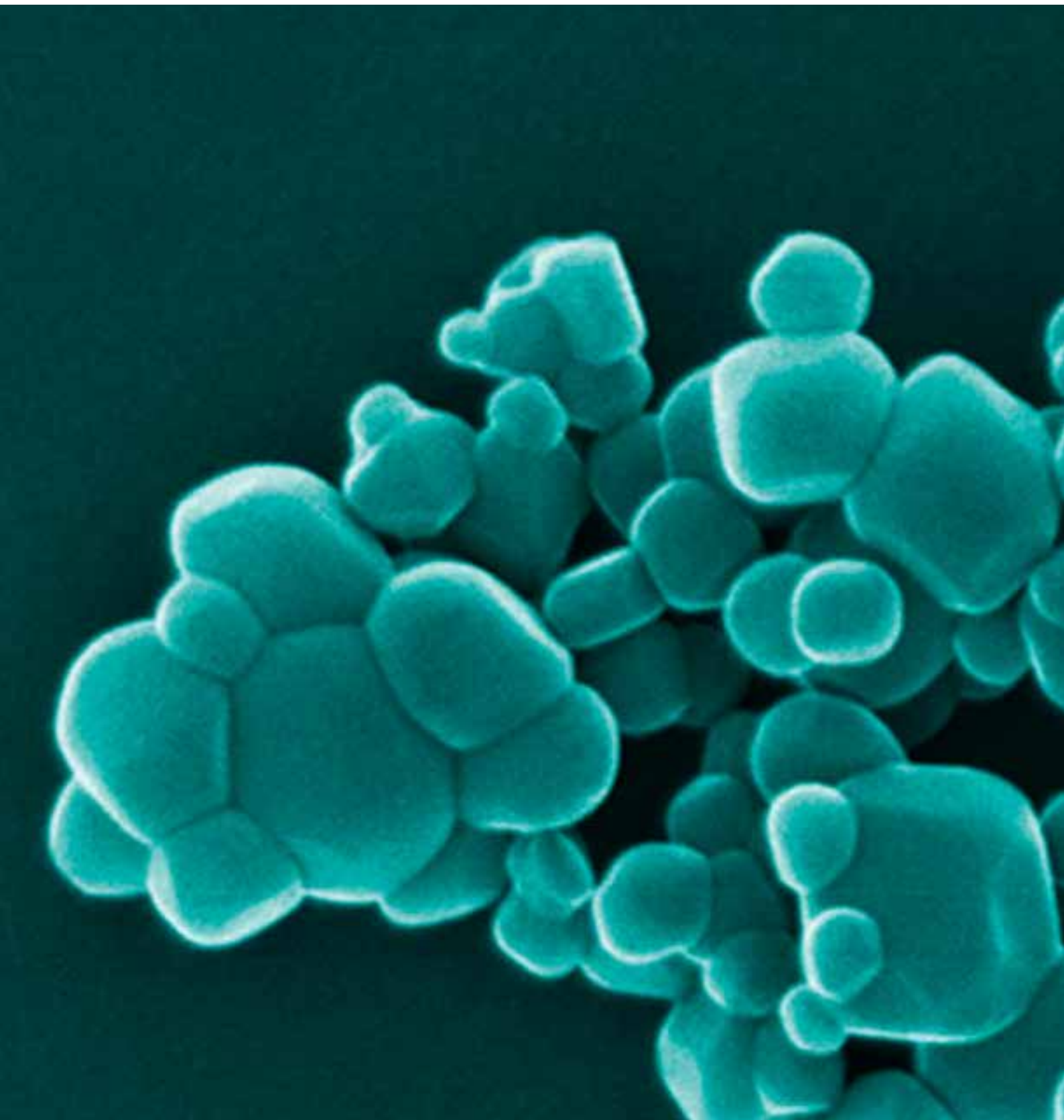
- Automotive (8)
- Biotechnology (4)
- Information Technology (11)
- Construction (10)
- Materials (16)
- Energy & Environment (17)
- Space (4)
- Mobility, Transport & Logistics (7)
- Instrumentation (3)
- Security (2)







# | FEATURES





Technology is an integral part of our daily lives. It influences and changes our behaviour and our perception of the world. By using their expertise on the subject, LIST researchers monitor, support and anticipate changes in our modern society.

LIST is exploring the potential of connected technologies, augmented reality and mixed technologies, as well as clean-tech, to build a world of tomorrow that is in tune with the needs of our society.



« **LIST seeks to help Luxembourg and European citizens make purchasing decisions in full knowledge of the contents of their basket.**

## BETTER CONSUMPTION THANKS TO DIGITAL

LIST is working on research projects that have a direct impact on citizens, in particular on their consumption behaviour.

With the European project LIFANA, LIST aims to improve the health and well-being of elderly and dependent people by setting up personalised services: meal recommendations information systems based on the advice of nutritionists, home delivery of food products, and personalised shopping lists offered by the Wikifood platform. Our goal is to simplify everyday food-related tasks and encourage people to change their dietary habits.

Within the framework of the European AskREACH project, LIST helps consumers and businesses to exercise their right to information about the substances of very high concern (SVHC) present in some consumer goods. Our furniture, clothing, and even our children's toys, may contain chemical substances that are potentially carcinogens, mutagens, toxic or disruptive to the endocrine system. LIST uses innovative IT tools to provide suppliers with a database and consumers with a related mobile app. In this way we seek to help Luxembourg and European citizens make purchasing decisions in full knowledge of the contents of their basket.

## DRONES TO THE RESCUE OF THE ENVIRONMENT

Drones and remote sensors are next-generation technologies that are of great interest for numerous applications and, in particular, those focussed on a more environmentally-friendly future. Images that are remotely detected using these technologies and deciphered by LIST provide crucial information for addressing precision farming and environmental monitoring issues.

Each summer, water recreation areas, in Luxembourg and elsewhere, have to tackle a proliferation of cyanobacteria. Some of these blue-green algae produce toxins that can affect people, aquatic fauna, pets and livestock. For many years, LIST has been closely monitoring the composition and proliferation of this bacteria by monitoring water resources in Luxembourg. We recently expanded our analytical capacity by procuring an unmanned drone fitted out to provide us with the most comprehensive information on the status of cyanobacteria proliferation in the fly zones. Our aim is to be able to inform, warn and mobilise the competent national authorities in order







to allow them to make decisions regarding citizen welfare as quickly as possible. In this context, LIST is part of the national alert plan for managing the risks associated with cyanobacteria.

Drones are also used in the BioVIM project. They should help to reduce pesticide use in viticulture. By flying a drone fitted with a hyperspectral imaging camera over vineyards, we can track the development of vine diseases and consider implementing an alert system. As a result, we hope to pave the way for precision viticulture techniques whereby emerging epidemics are treated at an early stage and exclusively in the places where they break out. The aim is to offer an alternative to pesticides in farming and to assist winemakers who are dedicated to an organic approach.

## DEVELOPING ETHICALLY RESPONSIBLE TECHNOLOGIES

In order to provide solutions to the current social problems, LIST does not limit its activities to using existing technologies. Our researchers also tackle the creation of innovative technologies.

In particular, a new technology has been developed to assess the consequences of exposure to pollutants in humans. This is a 3D *in vitro* lung model that makes it possible to measure potential respiratory sensitisation to inhalable chemical compounds. It is an alternative to animal testing aimed at assessing the respiratory sensitisation of industrial products. Within the framework of the VitralizeMe project, our model will be submitted to reference laboratories in order to obtain official approval. Thus, we are seeking to be part of a world that has greater respect for animal rights.



**Our 3D *in vitro* lung model makes it possible to measure potential respiratory sensitisation to inhalable chemical compounds. It is an alternative to animal testing.**





# DRIVING THE COMPETITIVENESS OF THE LUXEMBOURG ECONOMY



New technologies play a major role in our economic environment. As sources of innovation, added-value, growth prospects and new knowledge, they encourage the economic development of our modern societies.

LIST supports the development of businesses and public bodies by putting its expertise in terms of materials and data analytics technologies at their disposal. LIST also provides solutions in terms of digitisation and decarbonisation (development of new batteries, for example), as well as support to the ageing population (development of nano(bio)materials and biological sensors).





**Our aim is to simplify the spacecraft manufacturing process.**



## ALL EYES ON SPACE

With the PriSe project, LIST is focusing on the temperature and strain sensors installed on spacecraft. These sensors provide critical information about the behaviour of spacecraft, during both the assembly, integration and test (AIT) phase, and space missions. A single spacecraft requires several hundred sensors, and their installation is not only delicate but also very demanding in terms of time and budget. In an attempt to overcome this problem, LIST plans to select and evaluate different innovative printing techniques. At the end of the project, the aim is to identify the technique that will help speed up the sensor integration process and cut associated costs. Our aim is to thus simplify the spacecraft manufacturing process.

With the FOCALIDS project, we are adapting our innovative portable mass spectrometry technology to the specific needs of lunar prospecting. Our spectrometer allows cells the size of a nanogram to be analysed. Due to its unrivalled resolution and compact size, this exceptional technology has demonstrated its potential for space applications. Consequently, the Japanese lunar prospecting company ispace Europe has chosen to couple our mass spectrometer to the small and lightweight lunar rovers the company deploys on the Moon's surface. As a result, we hope to develop a compact mobile mass spectrometer capable of roving the lunar surface and detecting and analysing water resources potentially present on the Moon.

## SEEN FROM ABOVE

Remote sensing technologies, that make it possible to obtain information about a particular object without coming into contact with it, are opening up new horizons for analysing and understanding natural phenomena. Aerial images, taken from drones or planes, or obtained from satellites or hyperspectral cameras, have enormous potential for monitoring and managing the environment, agriculture and natural risks.

We have integrated a flood mapping and flood risk assessment tool (HASARD®) into the European Space Agency's servers, and more specifically into its Grid Processing On Demand (GPOD) platform. By using our technology, scientists from around the globe can generate their own flood maps, based on satellite images, in virtually any region of the world. This tool also enables us to provide assistance to the various authorities responsible for managing flooding in the world. Maps from our tool have already been used for the flooding caused by hurricanes Irma and Harvey in the US and, more recently, when a hydroelectric dam collapsed in the Lao People's Democratic Republic (Laos).

LIST also relies on Earth observation satellites to gain a better understanding of the functioning of terrestrial vegetation. With the European SENSECO project, we are seeking to improve protocols for detecting and classifying certain stress factors at different developmental stages of fruit and vegetation, in particular leaf development, flowering, fruiting and fruit ripening. Our aim is to provide political decision-makers and stakeholders from the world of agriculture with information that allows them to anticipate the growth and health conditions of vegetation in changing climate circumstances.





## DATA-DRIVEN COMPETITIVENESS

LIST helps businesses to exploit data by developing systems to collect, visualise and analyse them, in order to support the competitiveness of Luxembourg companies.

LIST supports businesses and local authorities in finding the solution to their daily challenges. We help them to make participatory decisions through the use of innovative technologies. In this context, the FNR SWAM project (BRIDGES programme) aims to develop an intelligent waste collection platform, by combining the data generated by sensors embedded in waste containers with information from the commercial databases of our partner Polygone. We want to provide Polygone with a system enabling it to manage its challenges in an intelligent and effective manner, and in line with its own demands and priorities, with the aim of improving its performance and productivity. In this way LIST is developing innovations that nurture specific applications that can be adapted and tailored to several activity sectors.

As part of the FEDER-DAP<sup>(1)</sup> project, we are deploying a high-performance data analytics and visualisation platform. This one-of-a-kind facility in Luxembourg, that is at the cutting-edge of technology, will incorporate a high-performance computing system, high-level data analytics capabilities and an interactive visualisation wall. This infrastructure will be linked to the business analysis solutions being developed at LIST. Our aim is to enable businesses and industries to take advantage of the latest analytics technologies to monitor and control operations, improve processes, and predict the performance of the system or process studied.

<sup>(1)</sup> The DAP Data Analytics Platform is co-funded by the ERDF. It aims to place advanced technologies and solutions in the fields of big data, data/business analytics and artificial intelligence at the disposal of research teams.



**Enabling businesses and industries to take advantage of the latest analytics technologies to monitor and control operations, improve processes, and predict the performance of the system or process studied.**





# PROFITING FROM A CUTTING-EDGE INFRASTRUCTURE



The quality and diversity of the equipment and instruments used by researchers is critical to the success of the research. LIST is investing considerable resources in its infrastructure (clean rooms, large-scale bioreactors, high performance computers, etc.). Such assets represent a real advantage for our researchers and partners.

## SUPER MATERIALS

Whether natural or synthetic, composite materials have the distinctive feature of combining different heterogeneous components. This combination of the inherent properties of each component in a single material gives the composite material unrivalled performance. Lightness, strength, performance, rigidity and flexibility are just some of the words regularly associated with these 'super materials'. The possible combinations seem endless, just like the fields of application. These materials have already invaded our lives: our chairs, our coffee machines or aircraft fuselages are just a few examples. Consequently, their future looks very bright.

Artificially creating custom-made composite materials requires the very best infrastructure. With this in mind, LIST has set up the Composites Manufacturing platform, accessible to our researchers, but also to businesses, and other research and innovation centres. Our laboratories are equipped with latest generation 3D printers co-developed in partnership with ANISOPRINT, a company that was recently established in the Grand Duchy. This collaboration illustrates our ecosystem's power of attraction. Complementary to the Materials Department chemical formulation laboratory, the Manufacturing Composites platform allows us to integrate our own materials (synthesis or mixture) and to launch new activities in the field of additives manufacture.

LIST's aim is to coordinate infrastructure and expertise to offer concrete and comprehensive solutions to our industrial partners' R&D challenges.

« The Composites Manufacturing platform is accessible to our researchers, but also to businesses and other research and innovation centres.

## CLIMATE AND NATURAL RESOURCES

Protecting and observing the environment, climate and natural resources are crucial to our future and that of subsequent generations. Human activity – the way we consume, work and make the things around us – has an impact on natural resources, and the climate more generally. Oil resources are not inexhaustible; fuel consumption impacts on air quality and contributes to global warming. LIST strives to contribute to the environmental challenge by offering solutions to quantify, observe and analyse the repercussions of our behaviour on Luxembourg territory.

Thanks to its state-of-the-art equipment, LIST is in a position to accurately observe the condition and evolution of natural resources. Gathering high-quality data makes it possible for us to describe the changes that Luxembourg will face in the years to come. This information will allow political actors to anticipate these changes and make informed decisions.

In our laboratories we have cutting-edge equipment for carrying out chemical, biological or environmental analyses at the molecular, cellular or whole organism level. We have field installations of the same high quality. We exploit a dense network of hydroclimatological measurements across the whole of Luxembourg, in partnership with numerous public partners. Consequently, we can provide answers to water authorities, municipalities, the food and pharmaceutical industries, research centres or universities.







« In our laboratories we have cutting-edge equipment for carrying out chemical, biological or environmental analyses at the molecular, cellular or whole organism level.

## SMART SPACES

A smart space is a space that uses new technologies (augmented reality, modelling or the Internet of Things, for example) to meet the common needs of several types of stakeholder within a company. All sectors - construction, finance, education - can benefit from this and all kinds of challenge - decision-making, problem resolution, reflection on development scenarios, etc. - can be tackled.

LIST offers an environment dedicated to these experiences, in which a large number of next-generation technologies have been incorporated. We physically replicate environments populated with objects, which interact directly with multiple users. We provide cooperative devices, such as multi-touch tables, virtual reality/augmented reality systems and wearables. Our laboratory is also equipped with several types of camera (infrared, visible and depth), microphones, sound, 360° projection, lighting, sensors and actuators. A design and prototyping workshop, including a dedicated electronics workbench, 3D printers and vinyl cutters is at users' disposal to fine-tune the progress and detail of piloting, with the support of our experts.







# SHAPING THE NEXT GENERATION OF WORLD-RENOUNDED RESEARCHERS



By hosting around a hundred PhD students each year, LIST is a veritable talent pool for business and the world of research. We are committed to promoting, shaping and supporting this new generation of highly-qualified experts to enter the job market.





**Special attention is paid to junior researchers in order to support them in developing high-quality skills that they will be able to apply throughout their career.**



## AT THE HEART OF OUR BUSINESS

Doctoral training is vitally important. Special attention is paid to junior researchers in order to support them in developing high-quality skills that they will be able to apply at LIST and throughout their career. The admission of PhD students also helps us maintain close ties with the academic world and work on cutting-edge topics. We welcome PhD students from all over the world (21 nationalities represented in 2018).

Some 15 PhD students work in our hydrological sciences doctoral training unit set up as part of the Hydro-CSI project. They benefit from the special relationships we have forged with prestigious European universities in the field: TU Wien in Austria, Karlsruhe Institute of Technology in Germany, Wageningen University and Research in The Netherlands, and the University of Luxembourg. Together, we want to encourage studies in the field of water resources research and better understand the basic hydrological functions of catchment basins, areas of land where running water feeds a common water course. We also want to design, develop, test and market innovative technological solutions that make it possible to predict rising water and water flows more reliably. The results and tools developed with the PhD students will be, among others, used to keep our national hydro-climatological observatory's technologies and methodologies on the cutting-edge of innovation. The observatory is located in the Alzette hydrographic area. The Alzette is one of the country's main rivers and crosses the country from south to north. It is the source of numerous floods.

We are also working with over 20 PhD students on the development of new materials for standalone sensors and their energy recovery. The aim is to improve the understanding and performance of the materials used in energy sensing and recovery so as to develop, ultimately, new applications and achieve better performance. These young researchers form part of a doctoral unit focusing on research areas in physics and materials science managed in partnership with the University of Luxembourg, as part of the MASSENA project. The materials on which the young researchers work will end up in tomorrow's smartphones, cars and computers.

Finally, some 30 PhD and postdoctoral students are involved in the partnership with the manufacturer Goodyear to develop the next generation of tyres. Their activities focus on five lines of research: reducing tyre weight, improving tyre structures and developing new additives, improved tyre-snow interaction, classification of new materials, and data-science. The latter research area focuses on data engineering, machine learning models, and data optimisation and visualisation. It aims to optimise research and development operations (production, supply chain and marketing).





## TRAINING


LIST endeavours to give PhD students the best possible grounding for joining the industrial or academic environments, as well as for developing and disseminating their expertise. To achieve this, we offer them infrastructures, and a multicultural and multidisciplinary work environment, and also a whole dedicated national system.

Each year, the organisation of LIST PhD Day – a day-long event dedicated to PhD students – is placed in the hands of PhD representatives from LIST. Through this, we hope to promote interaction within the entire LIST PhD community, including both PhD students and their supervisors. More broadly, we give PhD students the chance to spotlight the results of their research, and offer them the opportunity to acquire fundamental skills, such as project management, or designing and presenting scientific posters.



« We offer PhD students infrastructures, a multicultural and multidisciplinary work environment, and also a whole dedicated national system.





# **2018 ACHIEVEMENTS BY FIELD OF APPLICATION**

LIST's thematic areas cover five key fields of application corresponding to Luxembourg's socio-economic needs:

- Smart Cities
- Environmental Innovation  
(Agriculture, Bio-industries, Resource Management, Clean Energies)
- Industry 4.0
- Regulation (FinTech & RegTech)
- Space.

For each of these fields of application, 2018 was marked by the new RDI challenges entrusted to LIST by its partners and customers, the knowledge sharing or transfer activities conducted, new developments in its research infrastructures, and recognition from civil society or the academic world of certain skills.



## SMART CITIES

LIST is developing technologies for communities that allow them to find solutions and produce sustainable services, stimulate economic growth and improve citizens' standard of living. The following topics are explored:

### – Mobility

LIST is developing technologies that allow traffic congestion to be reduced, and faster, more environmentally-friendly and cheaper mobility options to be offered. These technologies are aimed at public authorities, as well as carriers, logistics operators and transport service providers.

### – Construction

LIST combines advanced manufacturing capabilities with the opportunities offered by the spread and adoption of information technologies in industry. It provides a range of solutions comprised of two components:

- Optimisation of data processing (optimisation of information gathering and use), development of calculation and modelling software,
- Development of cutting-edge materials.

### – Water

LIST is developing innovative solutions for the integrated management of water resources, both quantitatively and qualitatively. These solutions are mainly aimed at communities, whether large or small, and water utility companies.

### – Clean energy technologies

LIST offers companies that produce or consume energy, as well as energy distributors, solutions that enable them to better predict and manage their consumption, reduce their infrastructure needs, and improve service quality and customer satisfaction.

## New RDI challenges

- LIST is participating in the national initiative to rapidly deploy 5G Internet infrastructure in Luxembourg. As part of the H2020 5G-MOBIX project on the role of 5G in cross-border mobility, LIST is helping to create a cross-border corridor as a testing ground for autonomous vehicles.
- In collaboration with the Luxembourg Environment Agency (AEV), LIST has compiled an inventory of construction materials and developed a related guide for professionals involved in selective deconstruction works.
- LIST is modelling a digital participatory decision-making process for the efficient and smart planning of workspaces with the European Investment Bank (EIB).

## Knowledge sharing or transfer activities

In collaboration with the Resource Centre for Technologies and Innovation in Construction (CRTI-B), Neobuild, and the Order of Architects and Consulting Engineers (OAI), LIST organised the BIMLUX 2018 conference <sup>1</sup>. This event brought together more than 400 people to discuss Building Information Modelling (BIM) and the integration of the collaborative process at the national and European levels.

## Renowned expertise

A license has been granted to SENSAWILD to use the SEM (Smart Exchange Module) software component (group of middleware services developed by LIST) in the fields of tourism, outdoor leisure and natural space protection.



## ENVIRONMENTAL TRANSITION

The following topics are explored:

- **Low-pollution, soil-free, automated agriculture**
- **Climate change and natural risk management**
- **Sustainable energy systems**
- **Efficient use of renewable resources**
- **Preventing and controlling environmental pollution**
- **Ecosystem resilience.**

### New RDI challenges

- A tripartite agreement has been signed between LIST, the Luxembourg Ministry of the Environment and the Foundation of the World Alliance for Efficient Solutions. This agreement aims to assess the environmental benefit of the technologies submitted to the Foundation of the World Alliance for Efficient Solutions for labelling.

### Knowledge sharing or transfer activities

- LIST organised the Meeting the Pollinators - Importance, Decline and Perspectives conference, on the decline in pollinators.
- LIST runs several initiatives to raise awareness among businesses:
  - Organisation of three events (224 participants) via Betriber & Umwelt
  - Publications on the LIST website (2,800 visitors)
  - Disseminating newsletters (130 professional subscribers)
- The researchers Enrico Benetto (LIST), Kilian Gericke (University of Luxembourg) and Mélanie Guiton (LIST), published the Open Access work: Designing Sustainable Technologies, Products and Policies.

### Developing the research infrastructure

- Development and implementation of the GreenTech Innovation Centre thanks to the installation of laboratories allowing the set-up of a large-volume bioreactor platform (see Highlights pg. 9).

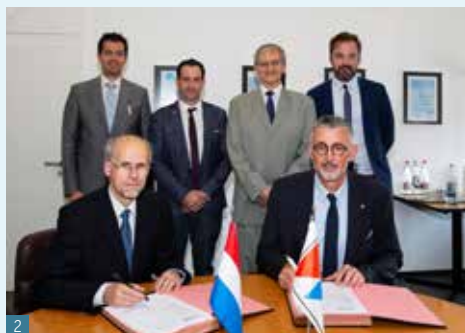
### Renowned expertise

- Aline Chary received the 2018 Lush Prize for Young Researchers – Rest of the World <sup>2</sup> for her work on a 3D *in vitro* lung model.
- Samuel Jourdan received the biannual Marcel Florkin prize for his work in the field of biotechnology studying a pathogenic bacteria that could be a natural herbicide. The results have significantly reduced the production costs of this herbicide and made it commercially viable.





1



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### INDUSTRY 4.0

LIST provides a range of solutions based on both information management optimisation (use of information, and calculation and modelling software) and advanced materials. These are designed using emerging processes resulting from work in nanotechnology, chemistry and biology.

#### New RDI challenges

- Together with MET-LUX, LIST is committed to developing new, flexible packaging that is transparent to light and gas impermeable. <sup>1</sup>
- LIST has signed a new framework agreement with Paul Wurth to, firstly, study and assess analytical software architecture in order to create innovative solutions and application programming interfaces (API) for cloud services and, secondly, explore new progressive deployment practices that slot perfectly into production ecosystems. <sup>2</sup>
- Together with Ceratizit, LIST has initiated a collaborative project aimed at the digital transformation of development and production processes, thanks to developments in Data Analytics and Artificial Intelligence.
- Arcelor and LIST have launched a collaborative project to improve production process quality through the use of advanced Data Analytics technologies.
- A project to develop digital solutions for the safe transport of dangerous goods was approved by the Luxembourg Directorate of Defence under a cooperation agreement signed in March 2018.
- LIST has signed a framework agreement with Luxair for collaboration in the field of the digital transformation of organisations (service innovation, process performance, resources and infrastructures).
- Together with Polygone, LIST is developing projects to optimise waste management (collection and sorting centre design).

#### Knowledge sharing or transfer activities

- LIST organised the first PRIDE-MASSENA PhD Students Business Day in the field of materials allowing energy sensing and recovery, in partnership with the University of Luxembourg.
- List co-organised two major events, namely the final conference of the European BIM4VET project coordinated by ITIS (100 participants) and the BIMLUX conference in partnership with NeoBuild, the Resource Centre for Technologies and Innovation in Construction (CRTI-B) and the Order of Architects and Consulting Engineers (OAI) (400 participants).

#### Developing the research infrastructure

- The design of the Composites Manufacturing platform as part of the national composites initiative has been finalised (See Features pg. 30).
- LIST inaugurated two new laboratories:
  - A powders and multi-functional nanomaterials laboratory
  - A 'chemistry' laboratory allowing an increase in wet method synthesis and surface functionalisation procedures.
- A new laboratory dedicated to polymer processing transformation, with new mixers and extruders, has been inaugurated. <sup>3</sup>
- The materials characterisation and testing platform installed in the Foetz laboratories in 2016 was opened to the public for the first time. <sup>4</sup>

### Renowned expertise

- The team that developed the VECTOR<sup>500</sup> SIMS technology, marketed by the spin-off Ion Optical Nano-Systems sàrl created in 2017, won the FNR-Awards. <sup>5</sup>
- Petru Lunca Popa won the Scientist Medal (International Association of Advanced Materials) for his research on new-era materials and energy technologies. <sup>6</sup>

### REGULATION (FINTECH & REGTECH)

LIST aims to drive the digital transformation of the financial sector by focusing its research on two priority areas. Firstly, it plans to create a smart regulatory environment that is able to adapt in real or almost real time to the risks associated with the introduction of new technologies. Secondly, it is working on improving the guidance given by the departments that deal with businesses and users by exploiting big data.

### New RDI challenges

- LIST developed, on behalf of the National Commission for Data Protection (CNPD), the GDPR Compliance Support Tool. This software aids compliance with the General Data Protection Regulation (GDPR) which came into force in May 2018. The GDPR Compliance Support Tool was transferred to e-Proseed in 2017, and now has over 1,500 users. It was awarded the special GDPR Initiative of the Year prize at the Information Security Awards 2018.
- LIST is pursuing its collaboration with the Luxembourg Regulatory Institute over the new European Directive on Network and Information System Security (NIS) and its impacts on critical and sensitive sectors (See Highlights pg. 10).
- Collaboration with the Luxembourg School of Finance was initiated under an FNR project about risk and return profiles for alternative investment funds.
- LIST signed a first collaboration with the Edmond de Rothschild banking group for the prospective study of innovation opportunities in the fund industry.
- The Luxembourg National Research Fund selected a LIST project on the subject of BlockChain and its impact on the financial sector.







## SPACE SECTOR

LIST covers two types of activity in the field of space: studying and developing materials and technologies specific to space applications, and developing analytical capacity for Earth observation data (supplied by satellites and drones). LIST combines the latter analyses with non-terrestrial observation data (*in situ* data, crowdsourcing, social media, socio-economic data) in order to develop services for businesses and the authorities, in particular in terms of natural risk management in the agricultural, forestry, viticulture and maritime surveillance sectors.

### New RDI challenges

- Together with ispace Europe, LIST has begun initial research work to develop compact mobile mass spectrometry technology, making it possible to prospect for lunar resources (See Features pg. 26). <sup>1</sup>
- LIST has integrated its HASARD® tool, allowing the high-spatial-resolution mapping of flooded areas, into the European Space Agency's Grid Processing On Demand platform (See Highlights pg. 8 and Features pg. 26).
- LIST provided UNOSAT (the operational satellite applications programme of the United Nations Institute for Training and Research - UNITAR) with satellite maps documenting the extent of the flooding that occurred following the collapse of a dam in Laos (see Highlights pg. 8 and Features pg. 26). <sup>2</sup>
- A project about the use of Earth observation data for decision-making has been approved by the Luxembourg Directorate of Defence under a cooperation agreement signed in March 2018. <sup>3</sup>

### Knowledge sharing or transfer activities

- LIST organised the 4<sup>th</sup> Luxembourg Earth Observation and Integrated Applications Day (LEO Day 2018) <sup>4</sup> and presented the Earth observation data platform designed in collaboration with adwäisEO SA.
- LIST helped organise the 2<sup>nd</sup> edition of the ASIME Conference 2018 (Asteroid Science Intersections with In-Space Mine Engineering) dedicated to international entrepreneurs and researchers in the field of asteroids.

### Renowned expertise

- The European Space Agency opted for a Geosynchronous–Continental Land–Atmosphere Sensing System on which LIST researchers are working in order to compete in the 10<sup>th</sup> Earth Explorer mission.
- Dr Ramona Pelich and Dr Simone Zorzan were selected to take part in the 2018 cycle of the NASA Frontier Development Lab (FDL).
- Researcher Dr Ramona Pelich (LIST) represented Luxembourg at the ISEF for Young Professionals (Y-ISEF) organised during the Second International Space Exploration Forum in Tokyo, Japan. <sup>5</sup>
- Compact mass spectrometry technology for space applications was presented to the Dutch and Luxembourg royal couples during a State visit to Luxembourg.



# **RESEARCH DEPARTMENTS**

The performance agreement signed with the Luxembourg Ministry of Higher Education and Research for the period 2018-2021 confirmed LIST's position in three key focus areas: environmental research and innovation, development of innovative IT solutions, and cutting-edge materials research in applicable technologies.

LIST organises its activities into three research departments corresponding to these three key focus areas. The departments develop complementary know-how that allows LIST to offer integrated and multidisciplinary solutions to its partners and customers, whether public or private (see Achievements by field of application pg. 37).

## ENVIRONMENTAL INNOVATION

The Environmental Research and Innovation (ERIN) Department provides interdisciplinary knowledge, expertise and technologies to help address major environmental challenges, such as climate change mitigation, ecosystem resilience, sustainable energy systems, and the proper use of renewable energies, as well as the prevention and control of environmental pollution.

ERIN's scientists and engineers in life sciences, environment and IT are broadly divided into four units:

- Environmental Sensing and Modelling
- Environmental and Industrial Biotechnologies
- Environmental Sustainability Assessment and Circularity
- Environmental Informatics

## KEY FIGURES 2018:

### At 31/12/2018:

- 176 employees

### During 2018:

- Participation in 61 competitive projects (11 European and one international), 51 collaborative projects and similar, and six other projects (Interreg, ERDF, Erasmus or COST)
- 18 main service contracts fulfilled
- Publication of 182 scientific articles in internationally peer-reviewed journals, including 129 published in first quartile journals and 90 in the top 10% of journals referenced in the scientific field in question
- Two patents filed in the field of the environment and biotechnology
- Supervision of 39 PhD students
- Seven PhD theses successfully defended

## THESES SUCCESSFULLY DEFENDED:

### AIZPURUA SAN ROMAN Olatz

"Species distribution models for birds. How useful are their outcomes for conservation applications?", University of Lleida, 14/09/2018.

### BEHR Marc

"Molecular investigation of cell wall formation in hemp stem tissues. Contribution to a multi-disciplinary approach aiming at understanding hemp cell wall dynamics", Université Catholique de Louvain, 26/03/2018.

### CORTE REAL Joana

"Bioavailability of carotenoids – Impact of high mineral concentration (BIOCAR)", TU Kaiserslautern, 17/10/2018.

### GERHARDS Max

"Advanced thermal remote sensing for water stress detection of agricultural crops", University of Trier, 08/02/2018.

### GUTSCH Annelie

"Studying the cell wall of *Medicago sativa* stems in response to long-term cadmium exposure", University of Hasselt, 22/11/2018.



**MORAGUES QUIROGA Cristina**

"Water mixing processes in the Critical Zone: evidence from trace elements and Sr-Nd-Pb-U isotopes", University of Strasbourg, 29/03/2018.

**TORREGROSSA Dario**

"A decision support system for energy saving in Waste Water Treatment Plants", University of Luxembourg, 11/07/2018.

**DIGITAL INNOVATION**

The IT for Innovative Services (ITIS) Department focuses on the digital transformation operations taking place in organisations in traditional environments and digital ecosystems, with the aim of improving their performance and capacity to innovate. The governing principle of ITIS is to develop more efficient use of big data to ensure the most appropriate decision-making process.

ITIS scientists and engineers are broadly divided into three research units:

- Human Dynamics in Cognitive Environments
- Business Analytics and Regulatory Technologies
- Trusted Service Systems

**KEY FIGURES 2018:****At 31/12/2018:**

- 107 employees

**During 2018:**

- Participation in 24 competitive projects (seven of which were European), 17 collaborative projects and similar, and five other projects (Interreg, ERDF, Erasmus or COST)
- 11 main service contracts fulfilled
- Two conferences organised
- Seven patents filed in Luxembourg on the following topics: Optimisation in the fields of logistics/transport, Security/safety/compliance and sensing body, crowds and surroundings
- Managing a portfolio of 18 paid licences
- Publication of 94 scientific articles in internationally peer-reviewed journals, including 16 published in first quartile journals and 9 in the top 10% of journals referenced in the scientific field in question
- Supervision of eight PhD students
- Three PhD theses successfully defended

**THESES SUCCESSFULLY DEFENDED:****BARAFORT Beatrix**

"Integrated Risk Management Process Improvement Framework in IT Settings based on ISO Standards", University of the Balearic Islands, 03/12/2018.

**BJEKOVIC Marija**

"Pragmatics of enterprise modelling languages: a framework for understanding and explaining", Radboud University Nijmegen (The Netherlands), 12/01/2018.

**CARDOSO Silvio Domingos**

"Evolution of semantic annotation", Paris-Sud University, 07/12/2018.

## MATERIALS INNOVATION

The Materials Research and Technology (MRT) Department contributes to the emergence of generic technologies that support the innovation processes of local and international industry. Its activities centre on three key focus areas: nanomaterials and nanotechnology, sustainable composite materials, and manufacturing technologies and processes, including scientific instrumentation.

MRT researchers and engineers are broadly divided into the following four units:

- Nanomaterials and Nanotechnologies,
- Scientific Instrumentation and Process Technology,
- Structural Composites,
- Functional Polymers,

and four study and analysis platforms (Characterisation, Composite, Testing, Prototyping).

### KEY FIGURES 2018:

#### At 31/12/2018:

- 175 employees

#### During 2018:

- Participation in 49 competitive projects (five of which were European), 33 collaborative projects and similar, and two other projects (Interreg, ERDF, Erasmus or COST)
- Seven main service contracts fulfilled
- One conference organised
- 10 patents filed
- One paid licence managed
- One spin-off created
- Publication of 104 scientific articles in internationally peer-reviewed journals, including 78 published in first quartile journals and 53 in the top 10% of journals referenced in the scientific field in question.
- Supervision of 63 PhD students, 53 of which were enrolled at the University of Luxembourg; 15 of these PhD students and 14 postdoctoral researchers were conducting their research work under public-private partnerships.
- Seven PhD theses successfully defended

### THESES SUCCESSFULLY DEFENDED:

#### DELMEE Maxime

"An innovative route for synthesis of hybrid metallic nanoparticles/plasma polymer coatings: Application to antibacterial materials", Université de Haute-Alsace Mulhouse, 31/05/2018.

#### LONG Hongtao

"Design of high performance electrodes for hydrogen fuel cell by means of spray deposition", University of Luxembourg, 22/01/2018.

**QUESADA GONZALEZ Miguel**

"Atmospheric-pressure and low-temperature chemical vapour deposition of doped-TiO<sub>2</sub> anatase thin films for versatile photocatalytic water splitting applications", University College London, 23/05/2018.

**RIGOUSSEN Alan**

"Une nouvelle approche de compatibilisation des mélanges immiscibles de polylactide et de poly(acrylonitrilebutadiène-styrène) par l'utilisation de composés phénoliques bio-sourcés" [A new approach to compatibilisation of immiscible polylactide and poly(acrylonitrile-butadiene-styrene) blends using bio-sourced phenolic compounds], University of Mons, 05/07/2018.

**SCHOBBER Alexandre**

"Advanced Raman Spectroscopy of Ultrathin RNiO<sub>3</sub> Films", University of Groningen/University of Liège/University of Luxembourg, 31/05/2018.

**SPIRITO David**

"Large-scale and Flexible Nanogenerator based on ZnO conical nanostructures by Nano-Imprint Lithography and Atomic Layer Deposition", University of Luxembourg, 26/03/2018.

**XIN Cong**

"Crystal growth and characterization of lead free piezoelectrics in the pseudo-ternary system BaZrO<sub>3</sub>-BaTiO<sub>3</sub>-CaTiO<sub>3</sub>", University of Luxembourg, 07/11/2018.







# | **GOVERNANCE**

## LIST AT A GLANCE

### BOARD OF DIRECTORS



Photo from left to right: Thomas Kallstenius, Robert Kerger, Etienne Jacqué, Eva Kremer, Marie-Christine Mariani, Nicolas Gengler, Georges Bourscheid, Diane Wolter, Isabelle Kolber, Amal Choury, Hubert Jacobs Van Merlen.  
(Absent: Stéphane Jacquemart, Fernand Reinig and Gaston Schmit)

### MEMBERS OF THE BOARD OF DIRECTORS

#### **Georges Bourscheid**

Chair of the Board of Directors

#### **Hubert Jacobs Van Merlen**

Vice-Chair of the Board of Directors

#### **Amal Choury**

Member, CEO of eKenz

#### **Nicolas Gengler**

Member, Professor at the University of Liège

#### **Etienne Jacqué**

Member, Corporate R&D Manager at CEBI International S.A.

#### **Isabelle Kolber**

Member, Head of Laboratory at SEBES

#### **Eva Kremer**

Member, Deputy Director of SNCI

#### **Marie-Christine Mariani**

Member, Founder and CEO, MCM Steel

#### **Diane Wolter**

Member, former Philanthropy Advisor at the Banque de Luxembourg

### OBSERVERS

#### **Thomas Kallstenius** (from 01/02/2019)

CEO

#### **Fernand Reinig** (until 31/01/2019)

CEO a.i.

#### **Stéphane Jacquemart**

Chair of the Staff Delegation

### GOVERNMENT COMMISSIONERS

#### **Robert Kerger** (from 01/02/2019)

Advisor to the Ministry of Higher Education and Research

#### **Gaston Schmit** (until 31/01/2019)

First Governmental Advisor to the Ministry of Higher Education and Research

## EXECUTIVE MANAGEMENT



**Dr Thomas Kallstenius**  
Chief Executive Officer  
(from 01/02/2019)



**Dr Fernand Reinig**  
Chief Executive Officer a.i.  
(until 31/01/2019)

## HUMAN RESOURCES



**Dr Fernand Reinig**  
Acting Human Resources Director  
(from 01/02/2019)



**Isabelle Hernalsteen**  
Human Resources Director  
(until 20/11/2018)

## FINANCE & ADMINISTRATION



**Laurent Cornou**  
Administrative and Financial Director  
(from 25/03/2019)



**Dr Aziz Zenasni**  
Director of Programmes

## PROGRAMMES

## DEPARTMENTS



**Prof. Dr Lucien Hoffmann**  
Director, Environmental Research and  
Innovation (ERIN)



**Prof. Dr Eric Dubois**  
Director, IT for Innovative Services  
(ITIS)



**Dr Damien Lenoble**  
Director, Materials Research and  
Technology (MRT)  
(from 01/09/2018)



**Prof. Dr Jens Kreisel**  
Director, Materials Research and  
Technology (MRT)  
(until 31/08/2018)







# **ANNUAL FINANCIAL STATEMENTS**

## APPROVAL OF ACCOUNTS

The accounts were audited by statutory auditors PricewaterhouseCoopers and approved by the Board of Directors during their meeting of 30 April 2019.

The full financial report is available at [www.list.lu](http://www.list.lu)

## BALANCE SHEET AT 31 DECEMBER 2018

Assets (in euros)	2018	2017
<b>Fixed assets</b>		
<b>Intangible fixed assets</b>	669,118.93	707,384.91
Concessions, patents, licences, trademarks and similar rights and assets	669,118.93	707,384.91
<b>Tangible fixed assets</b>	22,047,154.84	20,154,723.31
Land and buildings	1,008,591.58	1,570,931.80
Plants and machinery	17,405,068.64	15,243,340.35
Other fixtures and fittings, tools and equipment	1,324,468.13	1,468,103.00
Payments on account and tangible assets under development	2,309,026.49	1,872,348.16
<b>Financial fixed assets</b>	770,103.92	763,542.81
Shares in affiliated undertakings	410,938.20	404,377.09
Amounts owed by affiliated undertakings	359,165.72	359,165.72
<b>Total fixed assets</b>	<b>23,486,377.69</b>	<b>21,625,651.03</b>
<b>Current assets</b>		
<b>Inventories</b>	284,592.32	234,410.18
Raw materials and consumables	284,592.32	234,410.18
<b>Receivables</b>	22,884,152.60	26,499,297.70
Receivables from goods and services	2,730,781.20	5,443,475.06
Other Receivables	20,153,371.40	21,055,822.64
<b>Securities</b>	-	-
<b>Cash at bank and in hand</b>	65,758,027.08	58,940,593.09
<b>Total current assets</b>	<b>88,926,772.00</b>	<b>85,674,300.97</b>
<b>Accruals</b>	523,664.91	520,692.52
<b>Balance sheet total (assets)</b>	<b>112,936,814.60</b>	<b>107,820,644.52</b>
<b>Equity and liabilities (in euros)</b>		
<b>Equity</b>	81,297,539.66	77,100,175.77
Capital contribution	33,497,399.82	28,044,521.26
Reserves	43,602,775.95	43,602,775.95
Profit or loss brought forward	-	-
Profit or loss for the financial year	4,197,363.89	5,452,878.56
<b>Provisions</b>	95,504.85	416,494.60
Provisions for tax	-	299,574.35
Other provisions	95,504.85	116,920.25
<b>Liabilities</b>	29,133,750.82	29,244,588.68
Payments received on account for orders where not separately deducted from inventories	21,672,654.68	20,504,490.39
Trade creditors	2,015,043.88	3,743,677.76
Other liabilities	5,446,052.26	4,996,420.53
<b>Accruals</b>	2,410,019.27	1,059,385.47
<b>Balance sheet total (equity &amp; liabilities)</b>	<b>112,936,814.60</b>	<b>107,820,644.52</b>

# PROFIT AND LOSS ACCOUNT FOR THE FINANCIAL YEAR 2018

	2018	2017
Net turnover	7,087,108.90	6,358,589.72
Other operating income	60,673,954.70	59,890,542.58
Raw materials and consumables, and other external expenses	-12,197,275.17	-13,046,561.33
Raw materials and consumables	-4,109,401.57	-4,328,031.81
Other external expenses	-8,087,873.60	-8,718,529.52
Staff costs	-44,970,151.61	-42,495,459.07
Salaries and wages	-39,662,630.41	-37,425,637.94
Social security expenses	-5,261,501.46	-5,024,175.57
covering pensions	-3,114,948.76	-2,923,885.97
other social security expenses	-2,146,552.70	-2,100,289.60
Other staff costs	-46,019.74	-45,645.56
Value adjustments	-5,027,135.13	-4,409,996.78
on formation expenses, and intangible and tangible fixed assets	-5,027,135.13	-4,250,069.78
on current assets	-	-159,927.00
Other operating expenses	-1,385,839.17	-752,394.19
Other interest and financial income	22,353.17	24,264.23
derived from affiliated undertakings	-	-
other interest and financial income	22,353.17	24,264.23
Value adjustments in respect of financial fixed assets and in respect of transferable securities held as current assets	6,561.11	-109,173.36
Interest and other financial expenses	-12,212.91	-6,933.24
concerning affiliated undertakings	-	-
other interest and financial expenses	-12,212.91	-6,933.24
Profit after income taxes	4,197,363.89	5,452,878.56
Profit or loss for the financial year	4,197,363.89	5,452,878.56



## REFERENCED PROJECTS:

- **5G-MOBIX:** 5G for cooperative & connected automated MOBility on X-border corridors, project co-funded by the European Commission's Horizon 2020 Programme
- **AskREACH:** Enabling REACH consumer information rights on chemicals in articles by IT-tools, project co-funded by the European Commission's LIFE Programme
- **BioVim:** Monitoring of pests and development of eco-friendly crop protection strategies in viticulture, project co-funded by the Wine Institute (IVV)
- **FEDER-DAP:** Data Analytics Platform, project co-funded by the European Regional Development Fund (ERDF)
- **FOCALIDS:** Space Deployable 1-Dimensional Focal Plane Detector for Magnetic Sector Mass Spectrometer, project co-funded by the Luxembourg National Research Fund (FNR)
- **HYDRO-CSI:** Doctoral Education unit in hydrological sciences, project co-funded by the Luxembourg National Research Fund (FNR)
- **LIFANA:** Lifelong Food and Nutrition Assistance, project co-funded by the European Active Assisted Living Programme (AAL)
- **MASSENA:** Materials for Sensing and Energy Harvesting, project co-funded by the Luxembourg National Research Fund (FNR)
- **PriSe:** Printed Temperature and Strain Sensors, project co-funded by the European Space Agency (ESA)
- **SENSECO:** Optical synergies for spatiotemporal SENSing of scalable ECOphysiological traits, project co-funded as part of a European Cooperation in Science and Technology (COST) initiative
- **SWAM:** Smart Waste Collection Systems, project co-funded by the Luxembourg National Research Fund (FNR)
- **TARGET:** Training Augmented Reality Generalised Environment Toolkit, project co-funded by the European Commission's Horizon 2020 Programme
- **VitalizeMe:** Further development, validation and commercial exploitation of an advanced alveolar *in vitro* model for the prediction of respiratory sensitization, project co-funded by the Luxembourg National Research Fund (FNR)

Find out all about these projects and many more on our website:

[www.list.lu/en/projects](http://www.list.lu/en/projects)

## IMPRESSUM

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Luxembourg Institute of Science and Technology

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