

ANNUAL REPORT 2015

LUXEMBOURG
INSTITUTE
OF SCIENCE
AND TECHNOLOGY

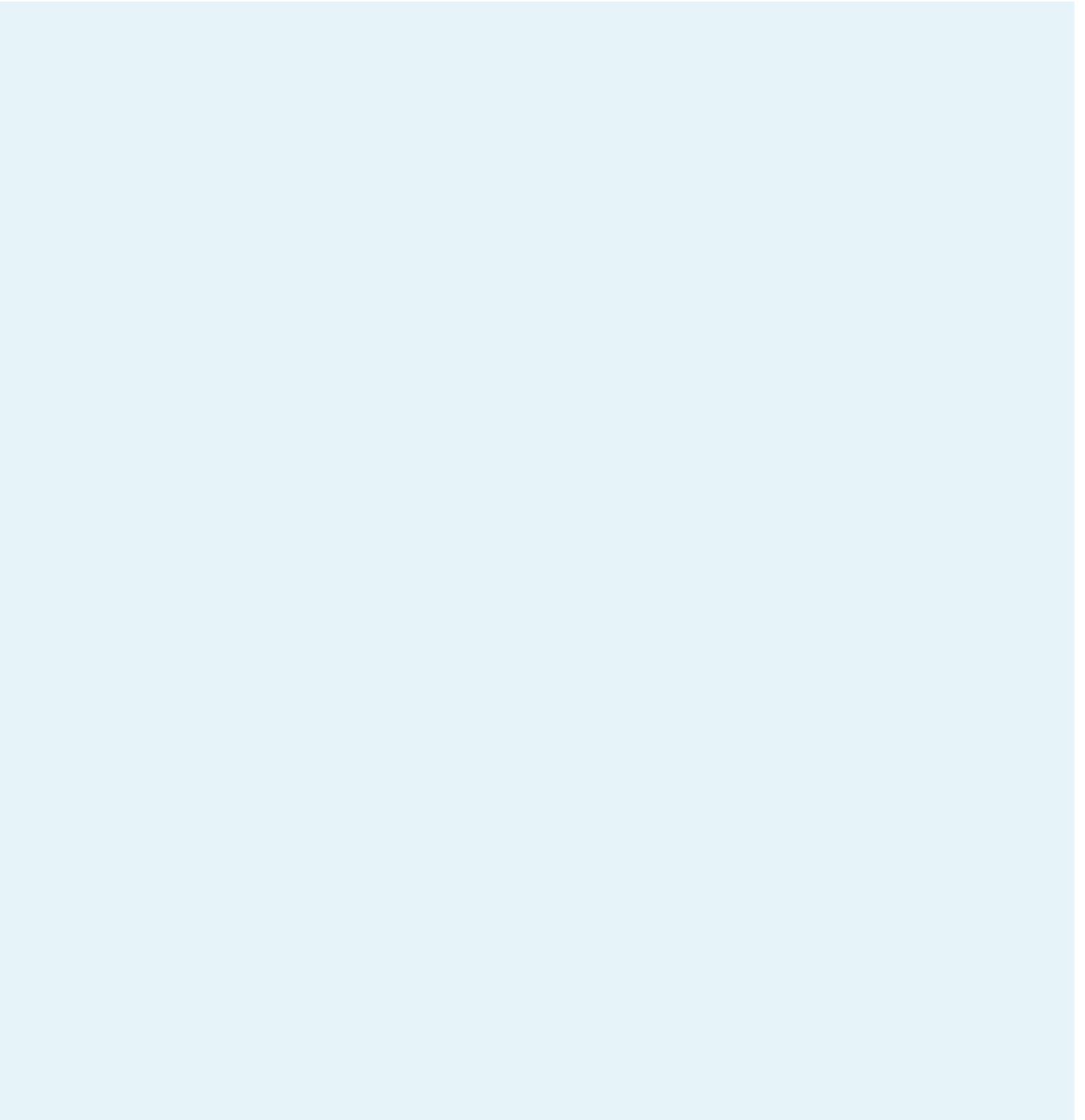






TABLE OF CONTENTS

Editorials	3
Strategy and mission	6
Programmes	9
Smart Cities	10
Smart Space	12
Smart Manufacturing	14
Smart Finance	16
Research and technology	18
Research departments	19
Infrastructures and technology platforms	22
Patents	24
Cooperation and partnerships	26
National cooperation	27
Public-private partnerships	28
International cooperation	29
Review	30
Scientific excellence	31
Publications and visits	32
Awards and recognitions	33
Doctoral theses	34
Annual financial statements	36
Balance sheet	36
Profit and loss statement	37
LIST at a glance	38



FOREWORD FROM THE CHAIRMAN OF THE BOARD OF DIRECTORS

Dear partners,

On 1 January 2015, the public research centres Gabriel Lippmann and Henri Tudor merged to become the Luxembourg Institute of Science and Technology (LIST). The objective was to refocus their RDI activities on the development of technologies and to align these with Luxembourg's priorities of economic and industrial growth. A successful wager, as you will read in this first annual report.

We have gone from transformation to implementation. This is confirmed by LIST's 2015 results. The scientific indicators of the Performance Contract signed between LIST and the Government were significantly exceeded during 2015, while additional efforts are to be made so that our results in terms of contract research match our ambitions. We are confident that we can attain our goals of scientific and technological excellence in 2016. Cross-sectoral programmes, as well as the technology platforms that we are currently developing, will be key to achieving it.

This transition will not, however, happen without some kind of regeneration – new vision, new RDI topics, new organization, etc. – which has needed, and in 2016 still will need, time and many resources to reach the maturity and the excellence that we strive to.

A year of transition, 2015 was also a year of two distinct phases. While the first five months was a period of expectation, the arrival of the new Chief Executive Officer, Prof. Dr Gabriel Crean, created real momentum that helped with the rapid implementation, by mobilising national and international partners in less than six months, of two major projects of primary importance for Luxembourg: the National Composite Centre – Luxembourg and the European high-performance computing project.

These are impressive results in a short space of time, which point to a bright future for LIST!



Georges Bourscheid
Chairman of the Board of Directors



FOREWORD FROM THE CHAIRMAN OF THE BOARD OF DIRECTORS

Dear Government ministers,
Dear Luxembourg stakeholders,
Dear public and private partners,
Dear colleagues,

It was an honour to have been appointed as the first Chief Executive Officer of LIST in January 2015. Since arriving in Luxembourg in May 2015, it has been an equal privilege to have the opportunity to work with so many talented people at LIST, in the Luxinnovation and Fonds National de la Recherche Government agencies, in several Government ministries, in Luxembourg industry and finally with our partners, both public and private, across Europe. With all your expertise, creativity, local knowledge and ambition, we will develop LIST over the coming years into a research and innovation engine for the Luxembourgish economy and society.

Already LIST has and is showing, that putting together more than five hundred of the most brilliant engineers, scientists, technologists, researchers, administrators and managers can both stimulate and accelerate the innovation fabric and industrial development of Luxembourg. This has and will continue to be achieved through the quality of our research, the ability to align our research and innovation strategy with Government priorities, the originality of our intellectual property and the rapidity of our technology transfer to our industrial partners. You will find many examples within this first annual report.

Our scientific and technological research reputation is the bedrock of our credibility and attractiveness to our industrial and academic partners, to our public stakeholders and the broader Luxembourgish society. In this report you will see that LIST, in our chosen fields; is publishing in the best science and technology journals in the world; has received considerable recognition in the scientific community along with many academic prizes, and last but not least, is preparing the future through a large cohort of over 72 doctoral students, of whom twenty doctoral candidates successfully defended their thesis in 2015. Our scientific and technological knowledge is anchored firmly in the three research departments of LIST.

This report also highlights our increasing engagement with, and support for, Luxembourgish and European industry. This has and will continue to require significant efforts in order to achieve the ambitions of our stakeholders. Several concrete steps have been taken: the establishment of a Technology Showroom on the ground floor of the Maison de l'Innovation to showcase our scientific and technological developments to industry and civic society; increasing our patent filings by over 40% in areas of strategic interest; the organisation of tech-days with Luxembourg industry along with an intense engagement by LIST staff on visits to both large and SME industry; and finally, initiating the development of major technological platforms of national interest to accelerate research into prototypes. The first of these national technology platforms hosted by LIST will be the National Composite Centre – Luxembourg in new facilities in Hautcharage. Working together with the Luxembourgish Government, LIST will bring the very best of its talent and ingenuity to focus on providing our national industry with the technology, software, services and prototypes that they need to accelerate products to market.

In parallel, we are taking first steps to offer integrated LIST global solutions to our public and private partners, taking advantage of the multidisciplinary competences and technologies developed in the three research departments. In short, LIST is developing programmes around key strategic challenges, by combining multiple sciences, technological innovations and technology building blocks from across LIST into unique and compelling offerings, creating significant additional value to

our partners. The first snapshot of these embryonic programmes in the areas of smart cities, smart space, smart manufacturing and smart finance, are detailed in this report.

Finally, it is not sufficient that LIST organises internally through its smart programmes the creation of integrated solutions for our partners; we must also be capable of collaborating, cross-fertilising and integrating research knowledge and intellectual property from our research partners in Luxembourg and beyond. I am therefore pleased to report that we have increased both the scale and depth of our research collaborations within the Luxembourg research community; first and foremost with the University of Luxembourg, but equally with the Luxembourg Institute of Health and the Luxembourg Institute of Socio-Economic Research. We have also started to selectively reach out to the very best universities and research technology organisations in Europe and worldwide to both strengthen our research excellence and to attract the very best research staff and doctoral students from around the globe.

In conclusion, I must reiterate a statement that I have continuously made since my arrival in Luxembourg in May 2015, that a LIST research technology organisation that is best in class, that supports Luxembourg and European industry, that can underpin Luxembourg's societal ambitions, that provides increasing opportunities for all its staff and students, in state-of-the-art research and technology platform environments, is an exciting challenge that cannot be created overnight. It will take time! It is a process that will require a common spirit of purpose and determination within LIST, in the broader research and innovation community in Luxembourg and continuing support from our policy makers and partners. I look forward to working with all the wonderfully talented staff and students of LIST, my executive management team, our Board and stakeholders, along with our public and private partners to achieve our ambition and that of Luxembourg.



Professeur Dr Gabriel M. Crean
CEO LIST



LIST is a public Research and Technology Organisation (RTO). It develops advanced technologies and innovative, competitive solutions in response to the key needs of Luxembourg and European companies in industries as diverse as energy, mobility, finance, logistics, space, construction, agriculture, or manufacturing production. LIST's innovations also meet a number of challenges that our society as a whole and our citizens in particular are and will be facing, particularly in the areas of the environment, security, education, culture, sustainable development, and the effective use of resources.

MEETING THE CHALLENGE OF ECONOMIC, INDUSTRIAL AND SOCIETAL NEEDS

TO BE A POWERHOUSE OF NATIONAL AMBITION IN TERMS OF INNOVATION

LIST's strategic priorities have been identified in order to strengthen the Luxembourgish Government's strategy of economic diversification and smart growth as described in the "National plan for smart, sustainable and inclusive growth". In order to do this, its structure is based on a matrix pattern in which the three technology departments (materials science and technologies, information technologies, and environmental technologies) develop the expertise, know-how, and technological building blocks to support four sectorial and cross-disciplinary programmes dedicated to cities (Smart Cities), to space (Smart Space), to finance (Smart Finance), and to industry (Smart Manufacturing) (see pages 10-17). These programmes will enable LIST to combine its technological innovations in strategic sectors through "comprehensive and global LIST services" offered to its customers, whether public or private. They also support national efforts to transform Luxembourg into a "Smart Nation".

In March 2016, the 2014-2017 Performance Contract between LIST and the Government was amended. Public funding has increased from 154 million Euros to 158.6 million Euros, an increase of 4.6 million Euros, intended to fund, among other things, sector programmes.

STRENGTHENING SYNERGIES WITH THE STAKEHOLDERS OF INNOVATION

As a driver of diversification and growth, LIST clearly positions itself as a force for technological development and transfer, on the boundary between basic research and practical application. It develops, matures, and conceptualises technological innovations up to the prototype and testing phases. To do this, LIST maximises synergies with the stakeholders in Luxembourg innovation including:

- multinational industrial companies, industrial clusters and small and medium-sized businesses (SMEs),
- agencies that fund and promote innovation such as the National Research Fund (FNR) and the National Agency for Innovation and Research (Luxinnovation),
- various Luxembourg ministries,
- research institutes such as the Luxembourg Institute of Health (LIH) and the Luxembourg Institute of Socio-Economic Research (LISER),
- and the University of Luxembourg.



TO PROVIDE ADVICE AND EXPERTISE FOR NATIONAL POLICIES

LIST's mission is also to provide support, through innovation and research, for the definition, implementation and assessment of national policies. LIST therefore provides its know-how and expertise to the the Ministry of Sustainable Development and Infrastructure (MDDI) in matters relating to industrial emissions, climate change, renewable energy, air emissions, water resources management and biodiversity. It manages, in particular, on behalf of MDDI and the Ministry of the Economy, the REACH & CLP Luxembourg Helpdesk (www.reach.lu), which helps companies to comply with European REACH and CLP regulations. In addition, LIST is collaborating with the Foreign Ministry on a set of projects relating to the development of technology transfer to foreign countries. LIST is also supporting the Ministry of Agriculture in its approach and strategy favouring more sustainable, precision agriculture. Finally, LIST participated in different trade missions organised by the Chamber of Commerce in Luxembourg's partner countries in order to promote excellence in research and innovation.



Carole Dieschbourg, Minister of the Environment, and Gabriel Crean at the signing of the three-year agreement with the MDDI.

STATUS, OBJECTIVES AND MISSIONS OF PUBLIC RESEARCH CENTRES

(Extract from the law on the organisation of public research centres of 3 December 2014)

Art. 2. Public research centres

- (1) Public research centres instituted and organised by this law are public research, development and innovation institutions and are endowed with a legal personality.
- (2) They benefit from scientific, administrative and financial autonomy and act outside of any purpose of profit.
- (3) Public research centres are placed under the auspices of the minister who has Research in the public sector under his or her portfolio, hereinafter referred to as "the minister".

Art. 3. Objectives

- (1) Public research centres are for the purpose of undertaking research, development and innovation activities in order to promote the transfer of knowledge and technology, and undertake scientific and technological cooperation at national and international levels.
- (2) Research, development and innovation in public research centres take place within the framework of the policy defined by the Government and with respect to the programmes defined by the national research fund created by the amended law of 31 May 1999 on creating a national research fund in the public sector.
- (3) Public research centres set their research, development and innovation objectives in their multi-year programme set out in Article 19.

Art. 4. Missions

- (1) As general missions, public research centres:
 - a) develop and undertake oriented basic research and applied research activities, and necessary support for research, development and innovation activities;
 - b) carry out transfer of knowledge and technology to the public sector and the private sector.

(2) As part of accomplishing their missions, public research centres are urged to:

a) stimulate and undertake research, development and innovation activities in order to maintain and develop their science and technology expertise;

b) carry out national and international contract research activities with organisations, establishments, companies, and research, innovation and development institutions as well competitive research, via national, European or international research, development and innovation programmes;

c) promote the scientific, economic and socio-economic valorization of their research, development and innovation results and the deployment of new economic activities;

d) conduct studies and provide expert assessments and consultancy during the implementation of new technologies, products, processes and services based on their oriented basic research and applied research;

e) contribute to research staff training through the supervision of PhD students and participation in doctoral schools as well as promote the mobility of their research staff;

f) contribute to learning and updating lifelong knowledge in areas that are important to their expertise;

g) contribute to the development of scientific culture;

h) contribute through their research, development and innovation activities to the definition, implementation and assessment of national policies.

(3) Other missions likely to facilitate the achievement of the purpose specified in Article 3 may be granted to public research centres by agreement with the Government.

TO BE A POSITIVE DRIVING FORCE FOR INDUSTRY AND INNOVATION IN LUXEMBOURG

LIST, together with its various institutional and private partners, also actively contributes to the reindustrialisation of Luxembourg. Indeed, the last thirty years have been marked in Europe by a massive outsourcing of numerous production activities to Asian countries and, with this, research and development activities. However, innovation is the key element and differentiator of competitiveness and of sustainable and inclusive growth. It has, in fact, been shown that the regions that are heavily investing in innovation are also those that have the highest growth and economic resilience, the lowest unemployment rates, and the highest quality of life. With this in mind, LIST is not only active in building long-lasting partnerships with the key economic players in Luxembourg in order to consolidate their local presence, but is also developing a strategy of cooperation across Europe and worldwide in order to enhance Luxembourg's visibility, industrial appeal and welcome.

PROMOTING LUXEMBOURG AS A TESTBED FOR EUROPEAN INNOVATION

Luxembourg benefits from considerable assets that place it at the forefront of Europe's most innovative countries. It has a dynamic economy with strong finances, it is politically stable and pro-active, it has modern and connected infrastructure, a growing multicultural population, a varied industrial fabric, and research organisations with high potential, of which LIST is the cornerstone. Moreover, Luxembourg stands out because of its central European location and single-scale factor, from city neighbourhoods to the countryside. Consequently, at a time in which the greatest innovations need a testing and experimentation ground before being put into operation on a wider scale, Luxembourg offers unique possibilities for rolling out innovative products and services, which enable them to be tested out under real-life conditions and on various levels. As a major Luxembourg player in sectors such as FinTech, advanced materials, sustainable building, the deployment of smart grids, high-performance computing, and digital strategy, LIST contributes, with its local and also European partners, to making Luxembourg a vast experimental and testing laboratory for their products and services.

An example of this is the European project Horizon 2020 SUCCESS aimed at improving building logistics in urban areas and for which Luxembourg serves as a pilot site for testing the different solutions and validating their results with Luxembourg, French, Italian, and Spanish partners.



At the launch of the Technology Showroom, HRH Grand Duke Henri (2nd from the right) and Prime Minister Xavier Bettel (2nd from the left), together with François Bausch, Minister of Sustainable Development and Infrastructure (1st from the right) and Gabriel Crean, CEO of LIST (middle) tested the SMART CITY LOGISTICS demonstrator.



PROGRAMMES

In the near future, two thirds of the world's population will be living in cities. Luxembourg will not be free of the resulting problems in terms of environmental impact or population. With the aim of thinking ahead and finding innovative and sustainable solutions, Luxembourg has made Smart Cities one of its priority areas by favouring funding of a certain number of national initiatives. Luxembourg has been specifically investing in digital technologies in a significant way for more than a decade, particularly in the storage and exploitation of data related to the management of cities and which are vital elements in the development of solutions in terms of Smart Cities. To this end, Luxembourg has just launched, in partnership with France, Italy, and Spain, the high-performance computing project for Europe (see page 22). Coupled with the strong skills developed in Luxembourg in certain fields such as mobility, construction, energy, and water management, these digital infrastructures will enable the country to develop sustainable solutions and dedicated services for the management of major cities. They also contribute to the promotion of Luxembourg's excellence at the forefront of European innovation.

SMART CITIES

LIST AND SMART CITIES: 4 MAJOR THEMES

MOBILITY

LIST is developing technologies to reduce road-traffic congestion and to offer quicker, greener, and less expensive mobility options.

These technologies are aimed at public authorities, both national and local, and at transport communities, logistics operators, transportation service providers, and commercial operators.

CONSTRUCTION

LIST's goal is to enable key players in the construction industry to make significant savings throughout the entire life cycle of a building project thanks to new technologies or new materials.

LIST's solutions affect all the key players in the construction industry, including project managers, contractors and building firms.

ENERGY

LIST offers companies that produce or consume energy, as well as energy distributors, solutions that enable them to better predict and manage peak consumption, to reduce the need for expensive infrastructure expansion, and to improve service quality and customer satisfaction.

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 unions.

OUR PARTNERS

- VOLVO
- CITY MOV
- ENOVOS
- ADMINISTRATION DE LA GESTION DE L'EAU
- SALES-LENTZ
- ADMINISTRATION DE L'ENVIRONNEMENT
- PAUL WURTH
- GTM BÂTIMENT-VINCI
- NATURHOME
- VILLE DE LUXEMBOURG
- BENG ARCHITECTES ASSOCIÉS
- ADMINISTRATION DES SERVICES TECHNIQUES POUR L'AGRICULTURE (ASTA)
- ARCELOR MITTAL
- CONVIS
- SYNDICAT INTERCOMMUNIAL DE DÉPOLLUTION DES EAUX RÉSIDUAIRES DU NORD (SIDEN)
- SYNDICAT INTERCOMMUNIAL DE DÉPOLLUTION DES EAUX RÉSIDUAIRES DE L'OUEST (SIDERO)
- EUROPEAN INVESTMENT BANK
- CYBERCULTUS
- CHAMBER OF AGRICULTURE
- SUDSTROM
- PWC

SOME ACHIEVEMENTS

Mobility

Optimising logistics locations

LIST has developed a Geographical Information System (GIS) for logistics. This tool is used to determine the optimum location for areas of cargo, storage, parking, charging stations for electric cars, new railway stations, charging stations at bus stops, etc. It integrates and synthesises dynamic and big data from different sources, generates possible scenarios taking into account the multimodal dimension, simulates scenarios, and shows the optimal locations. It also makes it possible to visualise solutions and check the impact of any decisions taken.



Construction

Evaluating the added value of a BIM approach

In the field of Building Information Modelling (BIM), LIST, together with its French partners, has developed for the Architecture Urban Building Plan (Puca) a method and computer tools for evaluating the return on investment of a BIM approach in a construction project. In fact, BIM processes and technologies are increasingly being used, but their added value is not yet proven. BIMetric is intended for project managers, operators, architects and engineers, as well as for building firms.



Energy

Predicting the production of photovoltaic panels

PV-Forecast is a real-time dynamic forecasting model for the energy production of all of the photovoltaic panels located throughout Luxembourg, up to three days in advance. It thus helps to maintain the network's long-term stability and to facilitate both the smart powering of energy networks and the marketing of this "green" energy. The model has been developed with the financial support of the Fondation Enovos.



Water

Water resource management

LIST has developed a smart control system for water stocks. The system is based on the real-time demand for drinking water rather than, as is traditionally the case, on all storage reservoirs being completely full whatever the demand. It also includes a global approach to storage with each reservoir being managed based on the status of all the reservoirs in the network. Finally, it takes account of forecast scenarios in terms of water consumption, rainfall etc.



"The partnership with LIST has helped us to integrate advanced algorithms for processing data collected by Foobot, our connected device for monitoring ambient air quality."

Inouk Bourgon
CTO of Airboxlab

"LIST has helped us to streamline our production process and to develop a planning system tailored to our needs."

Olivier LOUIS
Deputy CEO of Naturhome

Since the creation of SES in 1985, the space industry has grown exponentially in Luxembourg. Today, Luxembourg has over 30 companies in the space industry located across its territory covering a wide range of activities: technological development, the design and integration of micro-satellites, terrestrial infrastructure development, and support services. Luxembourg has been a member of the European Space Agency (ESA) since 2005, and is one of the largest financial contributors per capita, evidence of the government's willingness to invest strategically in the development of the space industry.

However, to remain competitive, the Luxembourg space sector must be more innovative than its competitors in terms of new materials, new products and new services, and most importantly must seize the opportunity offered by space data for developing its offering. ESA's launch of Sentinel satellites, whose sensors systematically gather a considerable amount of environmental data with unprecedented levels of temporal resolution and spatial precision, holds enormous potential.

SMART SPACE

LIST AND SMART SPACE: 3 MAJOR THEMES

PRECISION AGRICULTURE

LIST is providing tools and data to optimise agricultural management, particularly crops, based on earth observation data combined with data obtained from drones and terrestrial data.

RESOURCE MANAGEMENT AND NATURAL RISKS

Thanks to the integration of satellite, airborne, and field-based satellite imaging data, LIST offers solutions in the field of resource management and natural risks, in particular, flood management.

HIGH PERFORMANCE MATERIALS

LIST offers new solutions in terms of the development of materials that meet the requirements of the space industry, particularly in terms of (multi-)functionality, lightness, and sustainability.

OUR PARTNERS

- AUREA IMAGING
- AIRBUS DEFENCE AND SPACE
- CNES
- CONVIS
- GEOVILLE
- LUXSPACE
- CYBERCULTUS
- THALES ALENIA SPACE
- TERRASPHERE
- HITEC LUXEMBOURG
- GVSELUX
- EARTH LAB
- SES
- LUXEMBOURG SPACE CLUSTER
- GREENVISION
- ESA
- TELOPS-CANADA
- AEROVISION BV

SOME ACHIEVEMENTS

Precision agriculture

Imaging by drone, an attractive opportunity for applications in viticulture

LIST participated in a study at Trier University (Germany), which aimed to probe the relevance of the use of multi-spectral and multi-angled imaging from a drone in a Luxembourg vineyard. The specific aim was to compare working methods and physiological variables of plants, such as chlorophyll and nitrogen content or the yield. The study was able to highlight that the soil tillage method significantly affects canopy reflectance, that the differences are clearly visible on the images and that drone imaging is therefore fully suitable for applications in viticulture.

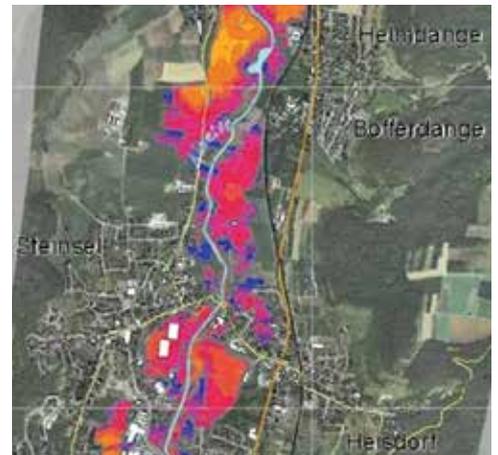


Resource management and natural risks

Flood management via satellite

LIST has developed several methods and technologies for managing floods via satellite: a method of mapping flooded fields from radar satellite images; a method of assimilating information from remote sensing in hydraulic models in order to increase the reliability of forecasts; "iGUESS" software that allows satellite data, data collected in the field, and the results of forecasting models to be integrated and analysed on a common platform; and a tangible table device that makes it possible to simulate different scenarios and to make group decisions.

These methods and technologies form a genuine crisis centre for the prevention and management of floods. The crisis centre makes it possible to consult rainfall recordings from the last few hours, soil moisture, changes in water level, and river flow measurements by using both satellite images and data collected on the ground such as urban characteristics. All this information is automatically integrated into prediction models and then viewed on a tangible table.



High performance materials

Functional coatings for space

LIST has developed a black coating which offers significant advantages compared to those currently available on the market. This nanocomposite coating is particularly interesting for the space industry, where the reduction of stray light is an important prerequisite for astronomical instruments. The process in place for this application is compatible with both current manufacturing technologies and developing ones such as 3D printing.



Manufacturing companies must currently overcome many challenges. They must remain innovative in an increasingly competitive economic environment, produce at increasingly lower costs, and have ever shorter time-to-market and delivery times. They need to develop new products and associated services, and understand new business models. They must manufacture with the lowest possible impact on the environment and natural resources, integrate digital technologies to enhance yield and manufacturing processes, and, of course, comply with increasingly strict environmental regulations. LIST's activities from the "Smart Manufacturing" programme are intended to support Luxembourg's industry of the future.

SMART MANUFACTURING

LIST AND SMART MANUFACTURING: 3 MAJOR THEMES

COMPOSITE MATERIALS

LIST is developing renowned expertise in composite materials and will be the operator of the National Composite Centre – Luxembourg (NCC-L), created at the end of 2015 with the support of the Ministry of the Economy, the Ministry of Higher Education and Research, the National Research Fund, and Luxinnovation (see page 22). LIST's activities will take place at two levels. The aim will be to develop industrial technological innovations in order to provide or anticipate solutions related to industrial challenges as well as to develop expertise and know-how in supporting the development of prototypes and demonstrators by the implementation of joint pilot lines with manufacturers. This will focus on four areas: the synthesis and formulation of composite materials, production and implementation processes for composites, the physico-chemical and thermo-mechanical characterisation of composite materials, including long-term performance monitoring, and the modelling of these multi-functional and heterophased materials, including the simulation of production processes. There will be a particular emphasis on nanocomposite and nanohybrid materials, resulting from the combination of nanotechnology and polymer science/engineering. The exploitation of bio-renewable resources will be considered for the production of sustainable materials in close connection with the circular economy.

ADDITIVE MANUFACTURING

LIST is creating new additive manufacturing opportunities for companies. This consists primarily of offering new additive manufacturing solutions using expertise in advanced materials and particularly in composite materials, in Life Cycle Analysis, in risk management and nano-toxicity management, in powder engineering, and in post-processing. These skills hold strong potential for the emergence of many solutions based on additive manufacturing. It is also developing styling models using design by optimising the geometry and the inherent properties of objects.

INDUSTRY 4.0

LIST offers solutions that are related to the digital organisation and management of processes and data associated with the value chain in the manufacturing sector. On this topic, LIST is working with Business Federation Luxembourg (FEDIL) to roll out "Manufacturing 4.0" in Luxembourg industry.

OUR PARTNERS

- UNILEVER
- GOODYEAR
- EURO-COMPOSITES SYSTEMS
- ROTAREX AUTOMOTIVE
- PERFORMANCE FIBERS
- ARCELOR-MITTAL
- PAUL WURTH
- DUPONT DE NEMOURS
- TOYOTA
- DELPHI
- SAINT-GOBAIN
- IEE
- CARLEX GLASS LUXEMBOURG
- L'ORÉAL
- NESTLÉ WATERS QUALITY ASS. CENTRE
- GUARDIAN LUXGUARD
- CIRCUIT FOIL LUXEMBOURG
- TARKETT
- SANDVIK
- CERATIZIT LUXEMBOURG

SOME ACHIEVEMENTS

Composite materials

Towards stronger bioplastics

LIST has developed a new method for combining polylactic acid (PLA), a bioplastic used in packaging or as a protective plastic (cases for laptops or mobile phones) with acrylonitrile butadiene styrene (ABS) in order to design a reinforced material. This approach has been limited up until now because PLA and ABS do not mix, as with water and oil. Adding cardanol, a natural component of cashew-nut husk oil, allows these two plastics to be combined. PLA mixed with ABS via the method developed by LIST is stronger and more flexible and could replace other convenient petroleum-based plastics.



Additive manufacturing

A bisphenol A-free coating

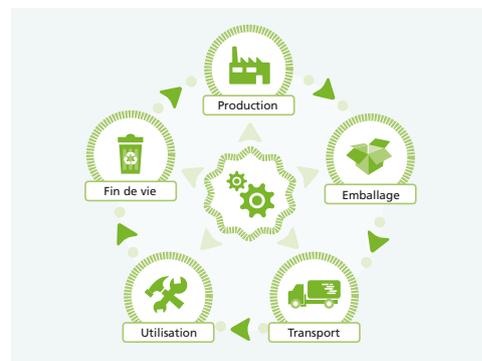
LIST has developed a new coating to replace those using bisphenol A as a base. This is a well-known endocrine disruptor whose use in coatings, for example inside the metal cans of fizzy drinks, has become increasingly controversial. The new coating developed by LIST is based on the use of cardanol, a natural component derived from cashew-nut husk oil, in the form of resin. This resin is reinforced by newly synthesised molecules at LIST, which are found in vanilla, cloves, or in other derivatives from lignin. This strengthening enables improved mechanical properties and impervious new coatings.



Industry 4.0

Additive manufacturing and eco-design

LIST has developed, in the framework of a European project, a tool that enables companies in the engineering sector, of which there are many in the Greater Region, to calculate the environmental impact associated with additive manufacturing technologies, as part of an eco-design approach; additive manufacturing and eco-design are two catalyst approaches for innovation and competitiveness. The tool is based on the development of a specific version of the ECOPACT software developed by LIST in partnership with Luxinnovation. ECOPACT allows companies to calculate the environmental impact of the life cycle of their processes and/or products in order to identify processes and/or materials with the strongest impact at each stage of the life cycle, the first step in an eco-design approach.



“Zeiss has benefitted from a fruitful collaboration with LIST for the last 5 years. Through this cooperative effort we have been able to extend the capabilities of our product, the ORION NanoFab Helium Ion Microscope. This allows us to introduce new analytical capabilities to complement the existing imaging capabilities. The outcome of this collaboration is an integrated, market ready solution for both the scientific community and for industrial research and development.”

Michael Steigerwald

General Manager, Carl Zeiss Microscopy, IMIC

FinTechs present many challenges, but also real opportunities, which Luxembourg should tackle in order to support its financial sector in its digital transformation. In order to remain competitive, Luxembourg should concentrate its resources on areas where it offers clear advantages that will help to position it as Europe's most reliable and innovative FinTech ecosystem.

Two areas of focus are particularly interesting. The first is creating a smart regulatory environment based on innovative technology, which can adapt to new risks associated with the introduction of new technologies in close to real-time and which represents a good compromise not only between regulation and innovation, but also between regulation and implementation costs. The second is the improvement of advice in departments dealing with companies and users via the exploitation of mass data. The European high-performance computing project (see page 22) coordinated by Luxembourg, in partnership with France, Italy and Spain, will contribute, amongst other things, to developing new applications and new services in the financial sector.

SMART FINANCE

LIST AND SMART FINANCE: 2 MAJOR THEMES

CREATING A SMART REGULATORY ENVIRONMENT (REGTECH)

The RegTech programme involves developing a technological platform that will allow all the key players in finance to innovate in disruptive or ongoing ways while effectively aligning these new financial products and services to regulatory frameworks which themselves are constantly evolving. On one hand, thanks to efficient tools and methods, key financial players will be able to demonstrate that their products and services comply with national and European regulations. On the other hand, regulators will be able to implement regulations closer to reality on the ground by best using the information provided by FinTech stakeholders and information related to new risks.

IMPROVEMENT OF PRODUCTS AND SERVICES THROUGH EXPLOITING BIG DATA

In this new work stream, LIST will develop tools, practices and technologies that will allow companies operating in FinTech to collect and use data at all times as a planning and consulting tool. The first results are expected in 2016.

Solutions developed by LIST are aimed at banks, investment firms, insurance companies, professionals in the financial sector (PSF), support PSF, consulting companies, and audit firms, etc.

OUR PARTNERS

- INSTITUT LUXEMBOURGEOIS DE RÉGULATION (ILR)
- POST GROUP
- LABGROUP
- SCORECHAIN
- COMMISSION NATIONALE DE LA PROTECTION DES DONNÉES (CNPD)
- COMMISSION DE SURVEILLANCE DU SECTEUR FINANCIER (CSSF)
- EUROPEAN INVESTMENT FUND (EIF)
- EUROPEAN BUSINESS RELIANCE CENTER (EBRC)
- ASSOCIATION DES BANQUES ET BANQUIERS LUXEMBOURGEOIS (ABBL)

SOME ACHIEVEMENTS

Creating a smart regulatory environment (RegTech)

TISRIM

LIST has developed TISRIM, a tool which enables companies and organisations to analyse and manage information security risks more easily, more efficiently, and more independently. The tool is based on standard ISO/IEC 27005 and is aligned with relevant international best practices. It is aimed at consultants who have to perform risk assessments for their customers, as well as at internal risk-assessment managers who have to assess and manage risks for their company or organisation. Finally, the tool can also be used to prepare for ISO/IEC 27001 certification.

Creating a smart regulatory environment (RegTech)

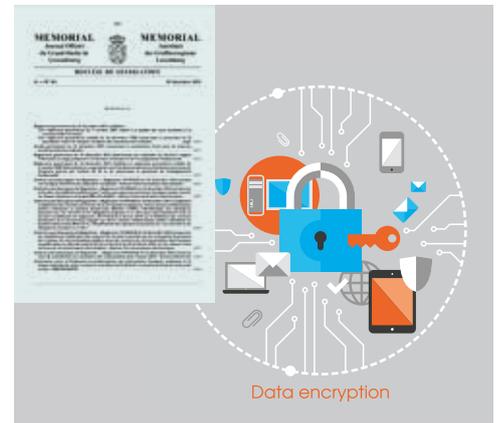
Complying with European recommendations on telecommunications

The TISRIM risk-assessment tool has served as the basis for the design of security and integrity assessment and management software for telecommunications networks, TISRIM Telco. Developed with the Luxembourg Institute of Regulation (ILR), TISRIM Telco is modelled on business processes and IT architecture specific to telecommunications companies and allows for quick, easy and robust risk assessment. It forms part of a continuous improvement approach to communications security by protecting networks and users against service interruptions and security breaches. It also enables compliance with European recommendations on telecommunications security. In December 2015, assessment using TISRIM Telco was integrated as a prerequisite in the Grand-Ducal regulations on the notification of security measures to be taken by telecommunications companies.

Creating a smart regulatory environment (RegTech)

Risk management through models

The approach used for telecommunications regulation and based on business-architecture and risk-management models, has been used, in partnership with the Commission for the Supervision of the Financial Sector (CSSF), to regulate support for the Professionals of the Financial Sector (PSF). This project has helped to validate the risk-management approach using industry models developed by LIST, an approach which can now be applied to all sectors involved in risk management.





**RESEARCH AND
TECHNOLOGY**

“ENVIRONMENTAL RESEARCH AND INNOVATION” (ERIN)

The ERIN department consists of 170 researchers and engineers in the fields of life sciences, environmental sciences and information technology, and it provides the necessary interdisciplinary knowledge and skills to confront the major environmental challenges our society is facing: mitigating climate change, ecosystem resilience, sustainable energy systems, efficient use of renewable resources, environmental pollution prevention and control, etc. In 2015, the ERIN department implemented its “smart green vision”, which is aimed at searching for scientific excellence in order to understand complex environmental and biological systems and their interaction with the technosphere, for the purpose of accelerating innovation towards the sustainable management of natural resources while integrating developments in ICT technology. The department is thus positioned as an important contributor for implementing LIST’s “Smart Cities”, “Smart Space” and “Smart Manufacturing” programmes, as well as for implementing the Luxembourg government’s strategy in the area of circular economy.

HIGHLIGHTS OF 2015

- Launch of 25 competitive projects, including 7 as part of European programmes and 3 collaborative projects.
- Numerous scientific support activities, in particular for the Ministry of Sustainable Development and Infrastructure and the Ministry of Agriculture, Viticulture and Consumer Protection
- 170 scientific publications in international journals, including 100 with an impact factor greater than 2
- Supervision of numerous PhD students, 7 of whom successfully defended their thesis in 2015
- Filing of 8 patent applications

LIST’s activities are based on the expertise and excellence of its three technology departments. They actively contribute to achieving LIST’s objectives through the development of a strong technological foundation and the consolidation of collaborative activities and partnerships by benefitting from significant investment in technology infrastructure and platforms. Particular attention is given to the promotion of know-how and expertise.





“IT FOR INNOVATIVE SERVICES” (ITIS)

The ITIS department highlights IT as a vehicle of transformation and innovation in organisations. The priority areas of application are aligned with the “Digital Lëtzebuerg” national strategy: finance, construction, logistics and mobility. Aspects of regulatory compliance are also dealt with in an interdisciplinary way. Thus the department actively contributes to the implementation of LIST’s “Smart Cities”, “Smart Finance” and “Smart Manufacturing” programmes. ITIS’s multidisciplinary team is able to understand the different areas of an organisation (infrastructure, processes, people and business) and can develop IT solutions which enable the analysis and transformation of an organisation. This expertise covers the areas of decision support tools, business modelling and data analysis (‘Business Analytics’).

HIGHLIGHTS OF 2015

- Participation in various European projects;
- Coordination of two major H2020 projects;
- Filing of four patents;
- Granting of 155 paid licences relating to ITIS’s assets;
- Transfer of activities in the construction sector to an IT service provider;
- As part of one of the patents relating to geolocalisation inside buildings based on WiFi, an FNR POC project was accepted;
- Very actively involved in the organisation of the European Data Forum (EDF) 2015 conference held on 16 and 17 November 2015 in Luxembourg (711 participants and 43 speakers);
- Identification of a strategic partnership with the Center for Business Analytics of Singapore National University.

“MATERIALS RESEARCH AND TECHNOLOGY” (MRT)

The activities of the MRT department revolve around two thematic pillars: nano-materials and nanotechnology, and sustainable composite materials. A central laboratory pools all of its cutting-edge equipment in order to have manufacturing processes for composite materials, polymers, thin film, nanomaterials and functional devices. Thus the department contributes significantly to the implementation of LIST’s “Smart Cities”, “Smart Space” and “Smart Manufacturing” programmes.

HIGHLIGHTS OF 2015

- Strengthening of industrial partnership activities and promotion of technological research;
- Cooperation with several stakeholders in industrial research in Luxembourg, including Goodyear, Arcelor Mittal, Codipro and International Laquers;
- International influence was increased through several significant bilateral research contracts, including those with Sandvik (SE), Aixtron (DE), Toyota (JPN), and Zeiss (US);
- Filing of 14 patents;
- Contribution to the setting up of the National Composite Centre – Luxembourg (NCC-L) (see page 22);
- Numerous scientific publications with high impact (i.e. Nature Physics) and an increasing number of invited presentations at international conferences;
- Consolidation of the competitive project portfolio through the launch of 5 projects in the FNR-CORE programme and two projects in the H2020-ITN European programme.



In an increasingly competitive industrial environment, technological infrastructure support provides strong added value in terms of competitiveness. Such infrastructure provides companies with a combination of know-how, methods, expertise, tools and equipment for accelerating the development and maturation of products and services intended to be brought to market. As a Research and Technology Organisation (RTO), LIST is able to offer its industrial partners unique environments and opportunities for cooperation in order to create value for their products. These devices allow efforts made by public and private investment to be shared, leading to reduced R&D costs and investment risks, but also accelerated processes for bringing products to market. This gives a real competitive advantage to LIST's partners and also constitutes an appeal factor for Luxembourg through the emergence of a national environment of innovation, which is conducive to economic opportunities that create wealth and employment.

In the design and implementation of technological infrastructures, LIST places emphasis on a collaborative approach, focusing on the valorisation of industrial value chains and multi-stakeholder synergies. This strategy was initiated in 2015 in two large-scale projects, firstly the establishment of the National Composite Centre – Luxembourg with several industrial partners, and secondly equipping Luxembourg with a high-performance computer and its networking through strategic partnerships with France, Italy and Spain.

INFRASTRUCTURES AND TECHNOLOGY PLATFORMS

NATIONAL COMPOSITE CENTRE – LUXEMBOURG

From September 2016, LIST will house on its premises the National Composite Centre – Luxembourg (NCC-L). This technology platform has been formed from the pooling of resources and skills in the field of composites amongst the key players in Luxembourg's private and public sectors. Composites are found, for example, in the automotive, aeronautics, electronics, telephony, sports and medical sectors. The aim of the platform is to further boost the development and processing of innovative materials in Luxembourg, thus generating new jobs in industry. The NCC-L will focus on two major areas: firstly, nanomaterials and nanotechnology; and then sustainable materials closely linked to the circular economy. Together with manufacturers, it will lead research and innovation projects to develop pre-commercial industrial applications.

Directed by Prof. Dr Philippe Dubois, the NCC-L will involve some 60 people when fully operational. It will be funded by public and private funds, to the amount of €100 million over five years, 11.5 million of which will be allocated to equipment and infrastructure.

HIGH-PERFORMANCE COMPUTING

The Luxembourg government, supported by LIST and Luxinnovation, launched together with France, Italy and Spain an "Important Project of Common European Interest" (IPCEI) to strengthen Europe's capabilities in high-performance computing. Currently, the global ranking of high-performance computers is dominated by China and the United States. Europe still remains in the race, subject to substantial investments. These investments are strategic because high-performance computers are used by an increasing number of government agencies, universities, research centres, and industrial companies and for a growing number of applications in fields as diverse as security, healthcare, energy, water resources, mobility, climate, finance, space, agriculture, and manufacturing production. In all of these areas, Luxembourg wants to strengthen its industrial development and operational capabilities. To do this, and with the support of LIST and Luxinnovation, Luxembourg is coordinating the IPCEI initiative with its partners with the primary objective of agreeing, by September 2016, on a common road map.



1. Announcement of the establishment of the NCC-L by Marc Hansen, Minister for Higher Education and Research (2nd from right), Francine Closener, Secretary of State for Economy and Gabriel Crean, CEO of LIST. (18 December 2015)
2. Prof. Dr Philippe Dubois, Scientific Director of NCC-L
3. The European Commissioner Günther Oettinger announced the HPC project at the EDF conference held in Luxembourg on 16-17 November 2015.

OUR TECHNOLOGY PLATFORMS

“Materials characterisation and testing” platform

A unique set of skills and equipment combined in one platform for the testing and advanced characterisation of materials: molecular analysis, elementary and isotopic analysis, surface analysis, structure, morphology and topography, mechanical trials and accelerated ageing, fire testing, thermophysical analysis.

Main customers: companies in the manufacturing, construction, packaging, automotive, aeronautics, cosmetics and medical sectors



“Innovative processes for industry” platform

Cutting-edge expertise and equipment available to companies looking to innovate in developing their processes. All the components of the industrial manufacturing process are taken into account for an integrated solution. From development of materials to characterisation, the laboratory deals with manufacturing techniques and machine modifications.

Main customers: industrial companies from every sector and their equipment manufacturers



“Integrative biology” platform

High-level expertise and fully-equipped laboratories for genomics, transcriptomics, metabolomics and proteomics

Main customers: manufacturing companies, agri-food industries, pharmaceutical companies, universities, biotech companies



“Ecotechnologies” platform

A set of fully automated bioreactors and pilots of different scales to optimise bioenergy production and wastewater treatment processes, including online analytical sensors for measuring water and gas quality.

Main customers: organic waste management companies, biogas producers, water treatment plants, agri-food industries, hospitals



“Development of Technologies around Connected Objects” platform

A set of skills and technologies around connected objects including natural interfaces, 3D printing, sensors and artificial intelligence, enabling designers to translate their ideas for new products and services with a specific focus on group decision-making, solving complex problems, skills assessment, and collaborative design.

Main customers: companies and organisations in the construction sector, logistics, mobility, healthcare, and IT professionals



PATENTS: WITHOUT PROTECTION, RESEARCH EQUALS PHILANTHROPY!

LIST clearly positions itself as a driver for technological development and transfer, on the boundary between research and industrial application. In this context, the protection of intellectual property has a key role to play. Without protection, research equals philanthropy. Studies shows that countries with a strong policy in terms of intellectual property protection are those who, in turn, benefit from a richer economic development as well as a vibrant labour market. Moreover, the appeal of the patent portfolio of a country for foreign investors is self-evident. This is why it is important for Luxembourg to have a vigorous policy to protect public intellectual property, especially in the areas in which the country wants to diversify and expand its economy. LIST, for its part, protects its high-potential results. The number of patent applications continues to increase. The most promising technologies include:



THE INACTIVATION OF ANTIBIOTICS PRESENT IN WASTE WATER

LIST has developed a degradation and inactivation process for antibiotics in waste water using immobilised enzymes on functionalised supports. If we compare this to competitor technologies, the patented process can significantly improve the inactivation of antibiotics.

Potential applications: wastewater treatment, particularly from hospitals
Filing number: EP15079606



HYDROPHOBICITY OF LONG HEMP FIBRES

This biotechnology enables hydrophobic properties to be given to long hemp fibres (Cannabis sativa L.).

Potential applications: replacement of fibre glass in the manufacture of composite plastics, particularly used in the automotive industry
Filing number: LU92825



BUILDING SITE MANAGEMENT

LIST has developed an equipped method that allows for the improved control and supervision of a building project, specifically in a safer and more automated way through the smart management of tasks and resources. The goal is to allow stakeholders in construction to increase their performance.

Potential applications: construction sector
Filing number: EP15188830



AUTRES DÉPÔTS

- LU92716
- LU92827
- EP15188741.1
- LU92895
- LU92836
- LU92794
- LU92793
- US14/984,532
- LU92758
- LU92779
- LU92906
- LU92920
- LU92783
- LU92784
- LU92857
- LU92763
- LU92828
- LU92921

THE APPROVAL OF PEER TRANSACTIONS

LIST has developed a method allowing parties to authenticate each other without needing to connect to a third-party authentication service. This method allows, for example, two smartphone users to be authenticated directly using only their devices (without the need of an Internet connection) and to be able to use services in full security.

Potential applications: transport (multimodal transport management), finance (financial-transaction management), etc.

Filing number: EP15203228

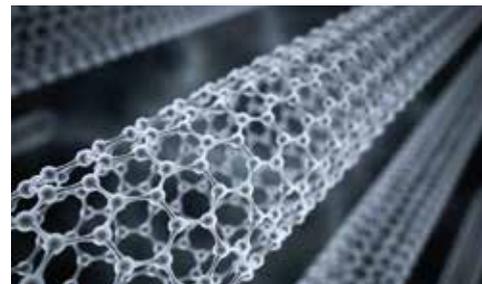


NEW BIPHASIC COMPOSITE MATERIALS CONTAINING CARBON NANOTUBES

The new biphasic composite materials, developed by LIST as part of a continued partnership with Goodyear and co-funded by the National Research Fund (FNR), contain carbon nanotubes to strengthen the structure of the material.

Potential applications: emergence of new composite materials, with improved wear and tear and better maintenance of their mechanical properties over time.

Filing number: EP15173720 and EP15173721

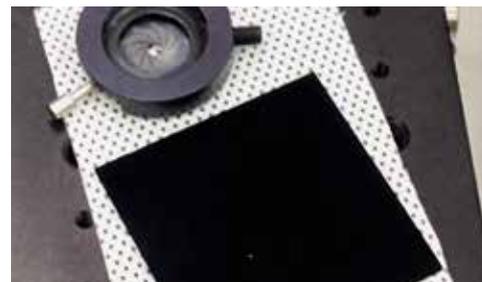


NEW CERAMIC COMPOSITE MATERIALS CONTAINING CARBON NANOTUBES

In partnership with the European Space Agency (ESA), LIST has developed new ceramic composite materials containing carbon nanotubes. These new composites have better-performing optical properties than the black materials available today.

Potential applications: Smart Space and optical systems for space applications.

Filing number: LU92757





COOPERATION AND PARTNERSHIPS

COLLABORATING WITH ALL THE STAKEHOLDERS INVOLVED IN RESEARCH AND INNOVATION IN LUXEMBOURG

University of Luxembourg

17 research projects are currently being carried out in partnership with the University of Luxembourg, including 3 funded by the Horizon 2020 programme. The European project EJD FUNMAT aims to set up a joint European PhD programme in the field of research on functional materials. The aim of the European project GETUI, meanwhile, is to investigate the use of gestures in interactions with tangible user interfaces in the framework of the computer-assisted assessment of collaborative and complex problem-solving skills. Finally, the third European project TARGET is the joint exploration of the use of augmented reality technologies in training security and emergency officers, such as police officers and firefighters, in improved crisis management. Furthermore, contacts were made with the University for establishing not only a shared doctoral school but also a joint training programme for PhD candidates belonging to Luxembourg research institutions, including LIST.

Luxembourg Institute of Socio-Economic Research (LISER)

The partnership with LISER was strengthened in 2015 with the launch of a new major project. The CONNECTING project, co-funded by the FNR, aims to use consequential Life Cycle Analysis (LCA) for assessing multimodal mobility policies.

Luxembourg Institute of Health (LIH)

LIST and LIH had several meetings to discuss common work streams, particularly biomedical ones. Indeed, some of LIST's specialised skills, such as big data management or pseudonymisation, are skills that will help strengthen this partnership.

Technoport®

LIST is a member of the Board of Directors of the high-tech business incubator Technoport®. This involvement is an integral part of LIST's strategy in terms of valorisation of project outcomes. It allows LIST's researchers who want to start a business from the results of their research to assess the viability of their business project. Young entrepreneurs therefore benefit from tailored coaching on all aspects of business creation and can take advantage of Technoport®'s many partner networks.

Luxinnovation and clusters

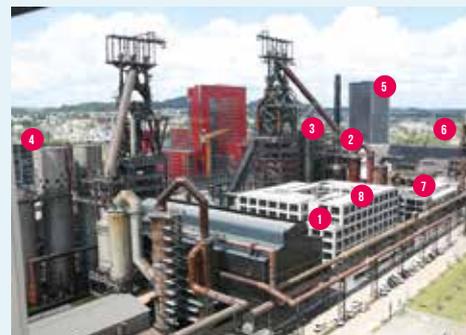
LIST is working closely with Luxinnovation and industrial clusters to implement sustainable partnerships with companies. Meetings and working groups were held throughout the year in order to align strategies. In addition, LIST participated at the "Business Meets Research" initiative organised by Luxinnovation in 2015. This has led to some 80 entrepreneurs being welcomed to LIST. Finally, the two partners are working together on the large Europe high-performance computing project (see page 22).

National Research Fund (Fonds National de la Recherche – FNR)

The partnership was extended by ten new projects in 2015, thus bringing the number of LIST projects co-funded by the FNR up to 64. In addition, LIST has actively participated in different research promotional activities organised by the FNR and aimed at a young audience, such as the "Science Festival" and the "Researchers at School" initiative.

This partnership with all the stakeholders of research and innovation in Luxembourg was strengthened in particular by the stakeholders being located on a single site, the Belval Innovation Campus, encouraging strong momentum from the design phase through to the implementation of various initiatives.

In 2015, LIST strengthened its partnership with all the stakeholders of research and innovation in Luxembourg: the National Research Fund (FNR), Luxinnovation, industrial clusters, Technoport®, the Luxembourg Institute of Health (LIH), the Luxembourg Institute of Socio-Economic Research (LISER), and the University of Luxembourg, in order to jointly support efforts to implement projects, programmes and initiatives in the field of research and innovation.



1. LIST
2. Fonds National de la Recherche (FNR)
3. Luxembourg Institute of Socio-Economic Research (LISER)
4. ILNAS
5. Université du Luxembourg
6. Luxembourg Institute of Health (LIH)
7. TECHNOPORT
8. LUXINNOVATION

One of LIST's missions is to support Luxembourg's industrial ecosystem through public-private partnerships. To this end, LIST has multiplied its partnerships with SMEs and big groups. In 2015, 60% of the contracts that were signed were with European and Luxembourg companies. To implement these lasting partnerships, LIST is working closely with the Luxinnovation agency and with clusters.

LEGEND 1

- Companies
- Universities
- Public institutions
- Research centres
- Federations and associations
- Other

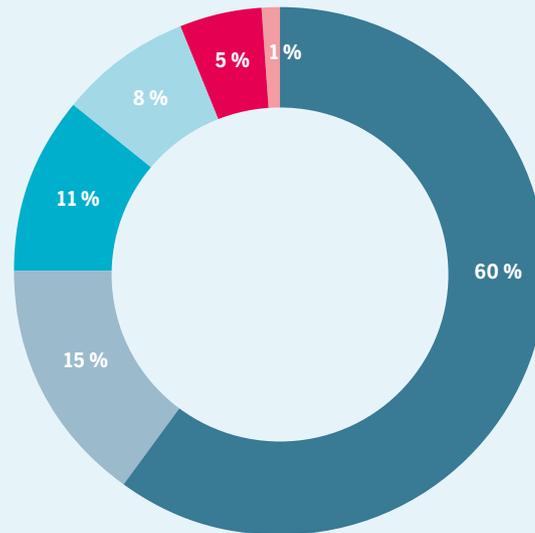
LEGEND 2

- Manufacturing production
- Information technology
- Construction
- Healthcare
- Water
- Energy
- Space
- Mobility, Transport & Logistics
- Finance
- Other sectors

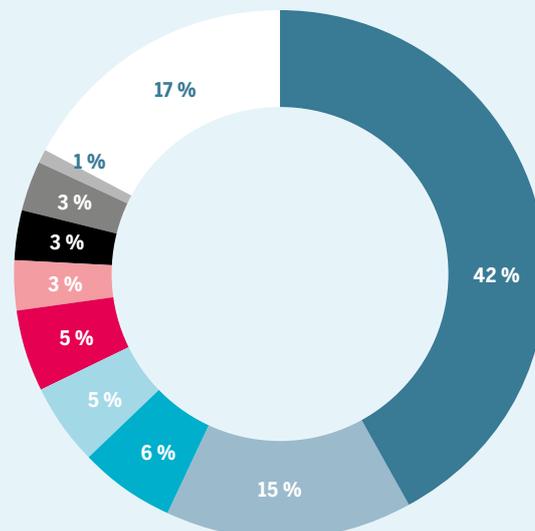
PUBLIC-PRIVATE PARTNERSHIPS

SUPPORTING LUXEMBOURG'S INDUSTRIAL ECOSYSTEM

1. DISTRIBUTION OF CONTRACTS SIGNED IN 2015 BY TYPE OF PARTNER



2. SECTOR COVERAGE OF THE CONTRACTS SIGNED IN 2015 WITH COMPANIES



PROMOTING “MADE IN LUXEMBOURG” INNOVATION

GEOGRAPHICAL DISTRIBUTION OF INTERNATIONAL CONTRACTS SIGNED IN 2015



One of LIST’s objectives is to support and promote “Made in Luxembourg” innovation by developing its European and international dimension. Within Europe, LIST is also an active member of several European networks, including the European Association of RTOs (EARTO, www.earto.org), whose annual conference it hosted in 2015. LIST’s CEO, Prof. Dr Crean, is a member of EARTO’s Executive Board. LIST would like to develop its cooperation and interaction with other European RTOs. It should be noted that half of LIST’s activities are at a European level.

EUROPE

- | | |
|-----------------|----------------|
| Finland | France |
| Sweden | Czech Republic |
| Great Britain | Austria |
| Ireland | Switzerland |
| Denmark | Italy |
| Germany | Spain |
| The Netherlands | Portugal |
| Belgium | Cyprus |

WORLD

- | | |
|--------|-------------|
| USA | Japan |
| Brazil | Australia |
| | New Zealand |

A PRESENCE ON ALL FRONTS

27, 28 AND 29 APRIL 2015

The 2015 EARTO-EIRMA conference was held in Luxembourg on LIST's initiative, and brought together more than 250 participants from 21 countries, including around 40 industrial groups and around 50 RTOs. (photo from left to right: Marc Hansen, Deputy Minister for Research, Georges Bourscheid, Chairman of LIST's Board of Directors, and Gabriel Crean, CEO of LIST).

21-22 MAY 2015

80 entrepreneurs met with LIST researchers as part of the "Business Meets Research" initiative.

29 JULY 2015

LIST welcomed a delegation from the Ministry of Agriculture, chaired by Fernand Etgen, Minister of Agriculture (7th from the right). The collaboration focused on the valorization of plant biomass for producing biomaterials and bioenergy, as well as on crop protection and precision agriculture.

SEPTEMBER 2015

30 members of COREPER (Committee of the Permanent Representatives of the Governments of the Member States in the European Union) visited LIST's Technology Showroom.

30 OCTOBER 2015

The eSanté agency and LIST signed a partnership agreement for the transfer and operation of a medical-practice management software product, GECAMed, as part of the pilot phase of the deployment of the Shared Care Record. (Photo from left to right: Eric Dubois, Director of LIST's "IT for Innovative Services" department, and Hervé Barge, Director of the eSanté agency).

16 NOVEMBER 2015

LIST welcomed Andrus Ansip, Vice-President of the European Commission responsible for the "Digital Single Market" (Photo from left to right: Jean-Paul Zens, Media and Communications Department of the Ministry of State, Mario Grotz, Ministry of the Economy, Gabriel Crean, LIST, Andrus Ansip, European Commission, Gaston Schmit, Ministry of Research, and Jean-Paul Schuler, Luxinnovation)

16-17 NOVEMBER 2015

The 2015 European Data Forum (EDF), co-organised by LIST at the Luxembourg-Kirchberg Conference Centre, attracted more than 700 professionals from around the world.





**SCIENTIFIC
EXCELLENCE**

LIST's goal of serving Luxembourg's economic development goes hand in hand with a requirement for high scientific quality. In 2015, the scientific excellence indicators contained in the Performance Contract signed with the state were significantly exceeded, demonstrating that an RTO like LIST that is primarily geared towards applied research and technological development can, at the same time, contribute significantly to the production and transfer of high-level scientific knowledge and thus to the international influence of Luxembourg's scientific community.

PUBLICATIONS AND VISITS

LIST'S SHOWCASE OF SCIENTIFIC EXCELLENCE

SCHOLARLY PUBLICATIONS

In 2015, LIST's researchers published 188 scholarly articles with an impact factor equal to or greater than 2 in international journals and conference proceedings. Some publications were of particular note.

- Dr Emmanuel Defay, a researcher at LIST, is the co-author of an article which appeared in the March 2015 issue of the prestigious journal *Nature Physics*. Entitled "Too cool to work", the article, which was co-authored with Xavier Moya, Volker Heine and Neil D. Mathur, deals with the energy efficiency of elastocaloric, magnetocaloric, and electrocaloric effects, which are currently being investigated in an increasing number of prototypes of cooling devices without refrigerant gas. This research could have a huge impact on our future domestic fridges.
- The results of the SYSBIONAMA project, co-funded by the FNR, were published in the journal *ISMEJ* (Multidisciplinary Journal of Microbial Ecology) of the Nature Publishing group. Co-funded by the National Research Fund, the SYSBIONAMA project analyses microbial communities using state-of-the-art molecular biology technology in order to develop predictive models and thus monitor and move ecosystems in the right direction.
- Two researchers from LIST, Dr Antonino Marvuglia and Dr Enrico Benetto, together with Prof. Beniamino Murgante of the University of Basilicata (Italy), were invited to contribute articles in the special issue of June 2015 of the *Journal of Environmental Accounting and Management*. Dealing with the topic of calculation algorithms for sustainability assessments, the special issue presented research showcases connecting different research communities, especially geo-informatics, environmental informatics, and Life Cycle Analysis (LCA).
- The article co-authored by Dr Jenny Renaut from LIST and entitled "Animal Board Invited Review: Advances in Proteomics for Animal and Food Science" was selected as the article of the month by the prestigious scientific journal *Animal*.
- The publication "Disease Severity Estimates – Effects of Rater Accuracy and Assessment Methods for Comparing Treatments" published in *Plant Disease* in August 2015 and co-authored by Dr Philippe Delfosse, a researcher at LIST, was singled out by the American Phytopathological Society (PSA) for its groundbreaking content.
- Dr Youssef Habibi was invited with other researchers from Norway, Argentina and Sweden, to contribute to a special issue on bionanocomposites in the *Journal of Nanomaterials*.

The full list of all publications is available at www.list.lu/scientific-publications

Furthermore, many LIST researchers participated as members of editorial boards of scientific journals or of steering committees for international scientific conferences.

SCIENTIFIC VISITS

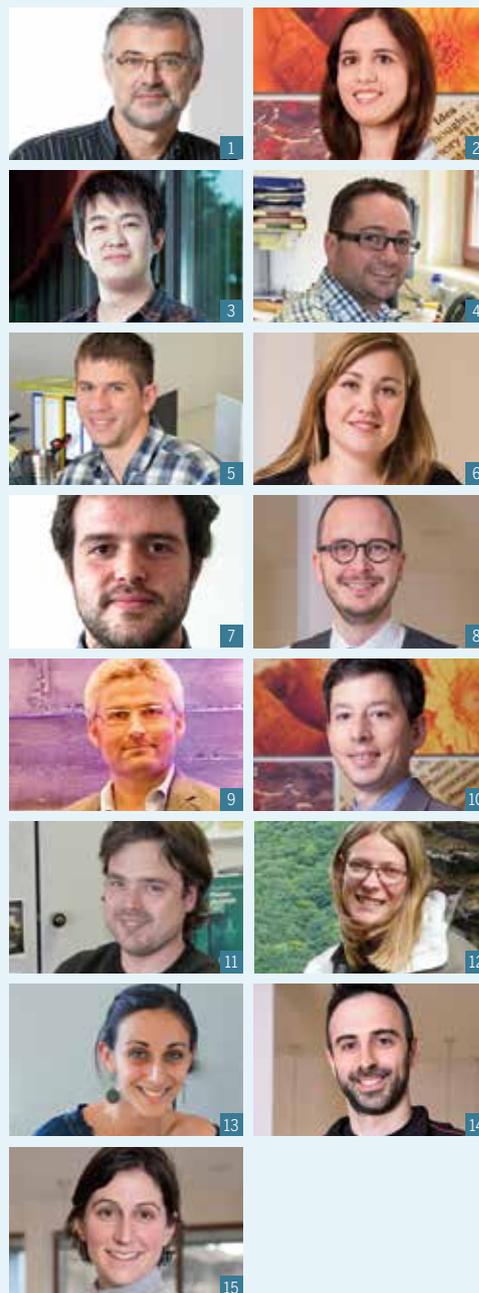
The hosting of 6 scientific visitors demonstrates the positive dynamic of LIST's academic network. The scientific visitors came from the Ecole Centrale de Paris (France), Wuhan University (China), the University of Cambridge (UK), the University of Technology of Sydney (Australia), the University of Western Australia, and the University of Trier (Germany).

In addition, 3 researchers from the Centre were hosted on scientific visits by the following institutions: the Fondazione Edmund Mach Research and Innovation Centre (Italy), the Carnegie Mellon University (US), and Wuhan University (China).

AWARDS AND RECOGNITIONS

- 1 **Dr Patrick Choquet**, group leader of the Materials Research and Technology (MRT) department, was jointly awarded with Prof. Katja Heinze of the University of Mainz, the interregional research prize for his work in the field of smart food packaging, co-funded by the FNR's CORE programme.
- 2 **Dr Ioanna Lykourantzou**, a researcher in the IT for Innovative Solutions (ITIS) department, received the "Honorable Mention" prize at the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing, which was held in San Francisco from 27 February to 2 March 2015.
- 3 **Dr Fan Xu**, a PhD student and then a researcher in the MRT department, received the 2014 award for the best PhD thesis completed abroad by the Chinese government in March 2015. The thesis focused on the digital study of instability patterns of film-substrate systems.
- 4 **Dr Christian Penny**, a researcher in the Environmental Research and Innovation (ERIN) department, was awarded the prize for the 2014 Best Short Paper at the annual general meeting of the Luxembourg Medical Sciences Society on 25 March 2015.
- 5 **Guillaume Nataf**, a PhD student in the MRT department, won an award for his paper entitled "Defects at domain walls in magnesium-doped lithium niobate" at the E-MRS (European Materials Research Society) 2015 Spring Meeting in Lille in May 2015.
- 6 **Blandine Fauvel**, a PhD student in the ERIN department, was awarded with the student prize at the "My thesis in 180 seconds" competition in Lorraine.
- 7 **Benoit Othoniel**, a PhD student in the ERIN department, won a prize for the best oral presentation at the World Conference on Natural Resources Modelling, which was held in Bordeaux from 29 June to 1 July 2015.
- 8 **Alexandre Bertrand**, a PhD student in the ERIN department, won the 2nd prize at the 8th SET Plan (Strategic Plan for Energy Technologies) Conference for his work on the integrated and multi-objective optimisation of regional energy systems. The conference was held on 21-22 September in Luxembourg.
- 9 **Andreas Arens**, a researcher in the ITIS department, was awarded the "Patient Experience" prize on behalf of the WikiFood research team on 6 October 2015 during the 2015 Luxembourg Healthcare Summit. Wikifood is a platform aimed at allergic patients.
- 10 **Dr Marcin Seredynski**, a researcher in the ITIS department, is one of co-winners of the "Best Technical Article" prize awarded during the ITS World Congress, which took place from 5 to 9 October 2015 in Bordeaux. His publication focused on public-transport cooperatives.
- 11 **Dr Sébastien Cambier**, a researcher in the ERIN department, was awarded the prize for the best ecotoxicology poster on 26 November 2015 at the BelTox and INVITROM Joint Symposium held in Antwerp.
- 12 **Barbara Glaser**, 13 **Joana Corte-Real** et 14 **Dario Torregrossa**, PhD students in the ERIN department, were acknowledged for their work at the first ERIN PhD-Day held at LIST on 11 December 2015.
- 15 **Anna Scaini**, a PhD student in the ERIN department, won the student video contest of the American Geosciences Union for her contribution 'Drawing a life though a river' at the 2015 AGU General Assembly. The conference was held from 14 to 18 December 2015 in San Francisco.

LIST's staff have won several awards during this past year. Below is a selection:



In 2015, LIST provided, in partnership with the University of Luxembourg and foreign universities, the supervision of 72 PhD candidates. 20 PhD candidates successfully completed their doctoral theses in 2015:

OUR STRENGTH, OUR PEOPLE

The performance and recognition of LIST relies on the skills, experience and drive of our employees. They are the backbone of our institute!



1 | team made up of multiple competencies: IT specialists, experts in material science, in environmental innovation and management, engineers, physicists, chemists, mathematicians, agronomists, architects etc.

DOCTORAL THESES

Dr Kodjo ATTIPOU

University of Lorraine: "Plissement et flambage dans les tapis de sols" (viva took place on 4 December 2015)

Dr Dieter DE SMET

Lappeenranta University of Technology (LUT): "Innovation Ecosystem Perspectives on Financial Services Innovation" (viva took place on 8 December 2015)

Dr Ricardo FERNANDEZ GONZALEZ

University of La Laguna (Spain): "Synthesis, Assembling and Validation of Solid Oxide Fuel Cell Units" (viva took place on 31 July 2015)

Dr Jay FRENTRESS

Oregon State University: "The Role of Near-stream Zones on Flow, Chemistry and Isotopic Composition at the Headwater Scale" (viva took place on 8 December 2015)

Dr Anastasia GEORGANTZOPOULOU

University of Wageningen: "Effects of Silver Nanoparticles and Ions and Interaction with First Line of Defence" (viva took place on 6 February 2015)

Dr Laura GIUSTARINI

University of Trier: "Integrating Remote Sensing Information from SAR Sensors and Hydraulic Modelling" (viva took place on 5 November 2015)

Dr Elio GOETTELMANN

University of Lorraine: "Modélisation de processus métiers sensibilisés aux risques et déploiement en confiance dans le cloud" (viva took place on 21 October 2015)

Dr Xavier GOUX

University of Lorraine: "Influence des différents facteurs opérationnels sur la structure des communautés microbiennes impliquées dans le processus de digestion anaérobie" (viva took place on 18 December 2015)

Dr Florian HILT

University of Toulouse: "Développement de revêtements phosphorés à propriétés retardatrices de flammes synthétisés par polymérisation plasma à la pression atmosphérique" (viva took place on 16 April 2015)

Dr Christian KÖHLER

University of Luxembourg: "The Influence of Macro-substrates and Conditioning on Pharmaceutical Removal Rates by Moving Bed Biofilm Reactors" (thesis held on 5 October 2015)

Dr Carine LALLEMAND

University of Luxembourg: "Towards Consolidated Methods for the Design and Evaluation of User Experience" (viva took place on 12 May 2015)

Dr Youri MARTIN

Université catholique de Louvain: "Predicting Future Species Distributions: from Correlations toward a Better Understanding of Underlying Processes" (viva took place on 22 October 2015)

Dr Frédéric MAYER

Université catholique de Louvain: "Biomethane Yield of Energy Crops and Prediction of the Biochemical Methane Potential (BMP) with Near Infrared Spectroscopy (NIRS)" (viva took place on 27 February 2015)

Dr Kaddour RANI

University of Lorraine: "Stratégies d'optimisation sur les protocoles en scannographie pédiatrique" (viva took place on 14 December 2015)

Dr Vincent ROGE

University of Strasbourg: "Etude, fabrication et caractérisation de nanostructures catalytiques de type ZnO/SnO₂ intégrées à des membranes modèles pour la dépollution de l'eau" (viva took place on 24 September 2015)

Dr Dimitrios SALAMPASIS

Lappeenranta University of Technology (LUT): "Trust-embedded Open Innovation: Towards a Human-centric Approach in the Financial Industry" (viva took place on 16 November 2015)

Dr Moustapha SARR

University of Lorraine: "Etude, synthèse et élaboration de nanocharges biphasées, nanotubes de carbone/diatomées pour l'amélioration des propriétés physiques de nanocomposites à matrice polymère" (viva took place on 24 June 2015)

Dr Qian SHAO

University of Strasbourg: "Coupling Fluid Flow, Heat and Mass Transfer with Thermo-mechanical Process: Application to Cracked Solid Oxide Fuel Cell" (viva took place on 24 March 2015)

Dr Christelle TCHALLA

University of Lorraine: "Modelling and Simulations of Inter-and Intralaminar Failures in Composites Materials" (viva took place on 19 September 2015)

Dr Dirk van der LINDEN

Radboud University Nijmegen: "Personal Semantics of Meta-concepts in Conceptual Modeling-Languages" (viva held on February 13 2015)

collaborators | **577**

64 % men

women **36 %**

72 | PhD students allowing LIST to stay strongly connected to the academic world

80 %

researchers and innovation specialists

Approval of accounts

The accounts have been audited by PricewaterhouseCoopers, statutory auditors, and approved by the Board of Directors on 21 April 2016.

The unabridged financial report is available on www.list.lu (in French).

The 2014 figures are the aggregated figures of the former public research centres Henri Tudor and Gabriel Lippmann.

BALANCE SHEET AS ON 31 DECEMBER 2015

Assets (in Euro)	2015	2014
Fixed assets		
Intangible fixed assets	190,047.32	201,906.25
Concessions, patents, licences, trademarks and similar rights and assets	190,047.32	201,906.25
Tangible fixed assets	13,250,243.57	16,478,836.75
Land and buildings	2,747,521.77	3,409,639.91
Technical facilities and machinery	9,175,286.87	11,421,557.22
Other fixtures and fittings, tools and equipment	725,539.78	568,581.85
Payments on account and tangible assets under development	601,895.15	1,079,057.77
Financial fixed assets	872,716.17	888,980.57
Shares in affiliated undertakings	513,550.45	527,564.85
Amounts owed by affiliated undertakings	359,165.72	359,165.72
Capitalized loans and receivables	0.00	2,250.00
Total fixed assets	14,313,007.06	17,569,723.57
Current assets		
Debtors	24,389,610.97	25,020,302.08
Trade receivables	5,697,123.39	5,116,070.91
Other receivables	18,692,487.58	19,904,231.17
Transferable securities	0.00	3,070,900.00
Cash at bank and in hand	50,824,160.88	38,390,017.01
Total current assets	75,213,771.85	66,481,219.09
Prepayments	357,271.35	394,301.53
Total assets	89,884,050.26	84,445,244.19
Equity & Liabilities (in Euro)	2015	2014
Capital and reserves	65,751,395.99	61,782,472.38
Capital contribution	25,196,617.51	25,196,617.51
Profit or loss brought forward	36,585,854.87	34,254,885.89
Profit or loss for the financial year	3,968,923.61	2,330,968.98
Provisions	605,845.18	351,620.91
Provision for taxation	436,809.16	351,620.91
Other provisions	169,036.02	0.00
Liabilities	22,748,451.13	21,401,156.57
Payments received on account of orders where not separately deducted from inventories	15,377,776.49	13,666,473.27
Trade creditors	1,805,046.36	2,584,794.06
Tax and social security debts	2,387,742.98	1,686,413.26
Other creditors	3,177,885.30	3,463,475.98
Deferred income	778,357.96	909,994.33
Total liabilities	89,884,050.26	84,445,244.19

PROFIT AND LOSS ACCOUNT FOR 2015

Charges (in Euro)	2015	2014
Consumption of goods, raw materials and consumables	3,498,444.32	5,238,790.01
Other external charges	10,331,685.21	11,307,428.92
Staff costs	41,414,498.40	43,749,917.77
Value adjustments in respect of non-financial assets	3,439,741.75	3,703,594.35
Other operating charges	1,017,540.08	553,847.98
Value adjustments and fair value adjustments in respect of financial assets	34,014.40	565,985.60
Interests and other financial charges	60,158.46	10,326.31
Extraordinary charges	0.00	2,328,949.41
Profit for the financial year	3,968,923.61	2,330,968.98
Total charges	63,765,006.23	69,789,809.33

Income (in Euro)	2015	2014
Net turnover	7,044,909.05	7,697,958.17
Other operating income	56,511,363.71	59,858,838.23
Income from financial fixed assets	0.00	221,952.48
Income from financial current assets	0.00	30,496.59
Other interests and financial income	208,733.47	49,387.98
Extraordinary income	0.00	1,931,175.88
Loss for the financial year	0.00	0.00
Total income	63,765,006.23	69,789,809.33

LIST IN NUMBERS

(situation on 31.12.2015)

100

| projects are carried out with international partners

8

| ministers trust us

43

| multinationals use our expertise

20

| European programmes co-finance our research activities

LIST AT A GLANCE

BOARD OF DIRECTORS



Photo from L-R: Georges Thielen, Nicolas Gengler, Eva Kremer, Diane Wolter, Georges Bourscheid, Hubert Jacobs Van Merlen, Léon Diederich, Isabelle Kolber, Marie-Christine Mariani, Amal Choury.
absent: Gaston Schmit

Georges Bourscheid

Chairman of the Board of Directors

Hubert Jacobs Van Merlen

Vice-Chairman of the Board of Directors

Amal Choury

Member, CEO of eKenz

Nicolas Gengler

Member, Professor at the University of Liège

Isabelle Kolber

Member, Head of Laboratory at SEBES

Eva Kremer

Member, Deputy Director of SNCI

Marie-Christine Mariani

Member, Director of MCM Steel

Georges Thielen

Member, Manager at the Goodyear Innovation Center Luxembourg

Diane Wolter

Member, former philanthropy advisor at the Banque de Luxembourg

Léon Diederich

Government Commissioner, Principal Government Counsellor at the Ministry of Higher Education and Research (until April 2015)

Gaston Schmit

Government Commissioner, Principal Government Counsellor at the Ministry of Higher Education and Research (from May 2015)

MANAGEMENT



Prof. Dr Gabriel Crean
Chief Executive Officer



Jean-Luc Pitsch
Chief Financial and
Administrative Officer



Dr Fernand Reinig
Chief Human Resources Officer

DEPARTMENTS AND PROGRAMMES



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



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



Prof. Dr Jens Kreisel
Director, Materials Research and
Technology (MRT)



Dr Aziz Zenasni
Director of Programmes

39

nationalities work
together to advance
innovation

188

scientific
articles were
published in
2015 with an
impact factor
of 2 or more

+ 37%

of patents
were filed
in 2015

IMPRESSUM

Editor

Luxembourg Institute of Science and Technology

Layout

Vidale-Gloesener

Photographic and iconographic credits

LIST, Christian Aschman, Liz Hacken, the Belval Fund, the Ministry of the Economy

© LIST, Esch-sur-Alzette | June 2016

