I-SITE
UNIVERSITÉ
LILLE NORD-EUROPE

Transition(s)

[Chapter 1]

November 2020

The aim of this “Transition(s)” magazine, the first chapter of which we present here, is to put into perspective the emblematic actions of the Lille Nord-Europe Excellence Initiative, which, through the integration of Research, Academic Programmes, International Projects and Valorisation, justify the construction of a future Experimental Public Establishment (EPE).
Its structure, bringing together the current Université de Lille and four schools (Centrale Lille Institut, Sciences Po Lille, ENSAPL and ESJ), in partnership with the CNRS and Inserm, the Inria Lille Nord-Europe centre, the Lille University Hospital and the Institut Pasteur de Lille, will enable the Lille site to position itself as a spearhead on the theme of global transition.

This work has been carried out with the financial support of the French government within the framework of the Programme d’Investissements d’Avenir (Future Investments’ Programme) (I-SITE ULNE / ANR-16-IDEX-0004 ULNE) managed by the French National Research Agency (ANR).
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Editorial

Putting into perspective the emblematic actions **of the Lille Nord-Europe Excellence Initiative**

Régis Bordet
MANAGING DIRECTOR OF THE I-SITE ULNE FOUNDATION

Our societies are facing a turning point on a technological, economic, health, social and environmental level. These issues are particularly significant in our Region, an area of economic, social and ecological transition on a par with its important industrial and mining past. The Rev3 project, supported by all the institutional, academic and economic players of the Region, is the striking symbol of this. All these upheavals question not only our knowledge and its practical applications, but also our ability to transmit them, by highlighting their complexity.

On the basis of this regional diagnosis, the public players in charge of higher education and research in the metropolitan area have their full part to play in responding to these challenges, whether through the penetration of new understanding in the sphere of education, participation in the public debate and the clarification of public policies, or by contributing to the life of the city, whether institutional or not, by developing socio-economic outlets for the products of their research or by setting up concrete demonstrators of innovative organisations, including on its campuses.

This justifies the fact that the Lille Nord-Europe Initiative of Excellence, the I-SITE label awarded to the Lille site in February 2017, has chosen to promote "A university for global transition". The project takes an integrated approach to all the dimensions of this complex issue, with the aim of becoming one of the European universities of excellence in 2030, while at the same time building an identity linked to its history and territory. The EPE (Etablissement Public Expérimental "Université de Lille"), which is due to come into being on 1 January 2022, therefore intends to be fully involved in this turning point, by putting its profound organisational transformation at the service of a better understanding of the global nature of this phase of systemic transition initiated at the European level, which is being accelerated in the context of the health crisis we are currently experiencing. This ambition should lead to the generation of courses of action to reinvent progress, using the metropolitan and regional ecosystem as a laboratory for observation and experimentation.

Based on its sixty or so research units and their very favourable appraisal, the Lille Nord-Europe Excellence Initiative has increased the density of its

"The attractiveness of our metropolis and the competitiveness of its economy are based on a top level university, a vector of technological and social innovation, an inspiration to guide our public policies and a stimulus for its inhabitants."

Damien Castelain,
president of the MEL

scientific fabric by supporting the consolidation of four themes of excellence called "hubs": Precision healthcare; Changing planet; Human-friendly digital world; Changing cultures, societies and practices, directly aligned to the theme of global transition. The hubs serve to differentiate the Lille site and promote interdisciplinarity and the link between research and training. They are based on a dozen or so research clusters. Forming partnerships with companies and the socio-professional world and grounding itself in international networks are also among the priorities of the Lille initiative.

This densification of the scientific fabric is worked in with a complete reform of graduate programmes undertaken along two main lines:

- The evolution of doctoral schools towards graduate schools for better movement between master and doctorate, and a greater opening towards the international and socio-professional world.
- The development of thematic graduate programmes linked to the four hubs, the specification of which is to offer a high level of training based on the highlights of our research. The development of academic programmes is accompanied by a transformation of teaching practices through the creation of the Lille Learning Lab, a support for innovative teaching projects and the availability of new teaching infrastructures in collaboration with foreign universities.

Thanks to its research and training activities, the EPE "Université de Lille" has to integrate scientifically, economically, socially, culturally and architecturally into the city, becoming its driving force. It is, in fact, the EPE that trains the future professional and managerial staff, that is at the source of innovations generating economic activity and that enlightens citizens with reliable data in order to avoid the excesses linked to ignorance, or even lies. This involves the co-construction of public policies with decision-makers from local authorities, based on scientific work generated within the university, as is already the case with the Métropole Européenne de Lille (MEL) and the Hauts-de-France Region. But the Lille site will only be able to achieve its level of ambition by developing its international hold, strengthening its cross-border network with the KU Leuven, and the universities of Ghent and Kent in particular, as well as by developing premium partnerships with prestigious universities, via international chairs and international associate laboratories.

In order to illustrate the challenges that the Lille Excellence Initiative wishes to take up in order to respond to the various transitions that impact its region, a series of conferences for the general public is being organised over the period 2020-2021. It will host experts in different specialisations to shed light on the debates surrounding transitions in its multiple facets, be they ecological, economic, technological, societal or other.

"It is logical and relevant that the higher education and research strategy of our region, embodied in particular by the Lille initiative of excellence focusing on transitions, is part of the same dynamic force as our project for a third industrial revolution in the Hauts-de-France."

Philippe Vasseur,
chairman of the Rev3 mission

DYNAMICS OF THE INITIATIVE OF EXCELLENCE

GLOBAL TRAN

4 THEMES OF EXC

PRECISION HEALTHCARE

- promoting systems biology and precision medicine;
- catalysing the digital revolution in biomedical research;
- optimising the impact for the patient and society.

CHANGING PLANET

- understanding and monitoring global changes;
- seeking alternative solutions to the exploitation of fossil resources;
- assessing the impact of global changes on Man, Earth and Societies.

4 GRADUATED

"PRECISION HEALTHCARE"

"SCIENCE FOR A CHANGING PLANET"

12 RESEARCH

PHENOTYPES MIXING STRUCTURED AND UNSTRUCTURED DATA
PHENOMIX

STUDY OF SENSITIVE MATERIALS
TEM-ASTER

INNOVATIVE MODELLING OF RADIONUCLIDE AEROSOLS OVERSEE
OVERSEE

MOLECULAR DESIGN FOR HEALTH

HEALTH & ENVIRONMENT

CATALYTIC RESOURCES AND THE BIO-ECONOMY
RECABIO

SITION
ELLENCE

HUMAN-FRIENDLY DIGITAL WORLD

- designing a digital world involving human and social sciences;
- creating innovative concepts to tame complexity;
- developing disruptive technologies for a society in transition.

CHANGING CULTURES, SOCIETIES AND PRACTICES

- analysing the organisational and institutional issues related to the historical transformation of cultures and societies;
- understanding the logics of inequality and forms of vulnerability in order to build a more inclusive world;
- seeing Europe as a laboratory for transitions (social, political, legal, economic, environmental...).

PROGRAMMES

"INFORMATION & KNOWLEDGE SOCIETY"

"CHANGING CULTURES, SOCIETIES AND PRACTICES"

CLUSTERS

DYNAMICS FOR DISRUPTIVE COMMUNICATIONS AND CONNECTIVITY
DYDICO

CHANGING INSTITUTIONS AND ORGANISATIONS

EUROPE: HISTORICAL CONSTRUCTIONS AND THE DYNAMICS OF TRANSITION

DIGITAL SYSTEMS FOR HUMAN KNOWLEDGE
DISYKNOW

ARTIFICIAL INTELLIGENCE AT THE SERVICE OF PEOPLE
HUMAIN@LILLE

VULNERABILITIES AND INCLUSION

Ecosystem

AN INITIATIVE OF EXCELLENCE THAT CONTRIBUTES TO THE DEVELOPMENT OF ITS REGION...

The Lille Nord-Europe Initiative for Excellence is part of the Hauts-de-France Region's strategy for specialisation in research and innovation, the training of young people in the Region and of those engaged in a professional activity who wish to refresh their knowledge, and the international visibility of the metropolis and the Region.

... with the socio-economic world for a region that creates value

The I-SITE and its consortium rely on an ecosystem made up of seven competitiveness clusters, the CCI and HDFID*, to mobilise and raise awareness among businesses. The initiative collaborates with the SATT** Nord and the network of accelerator-incubators (Euratechnologies, Eurasanté, Plaine Images, Cré'Innov...). Objective: to develop student entrepreneurship and the creation of start-ups by researchers or in connection with research, particularly in these strategic fields: "Artificial intelligence and data sciences at the service of people and industry", "Precision healthcare and medical devices", "Circular economy and the new functions of equipment" and "Food and functional ingredients". Still with SATT Nord, the I-SITE finances early research projects with a view to transferral to the socio-economic world (28 projects since 2018). Within this framework, it has initiated a specific action to develop returns on investment in the human and social sciences. In order to develop partnerships between research laboratories and companies, it co-finances, with the Hauts-de-France Region and the Lille European Metropolis, collaborative projects via thesis schemes in companies, industrial chairs and joint laboratories. Since 2018, over 40 companies have been involved in these projects.

40 COMPANIES IN THE REGION INVOLVED IN OUR SYSTEMS

3 MILLION EUROS INVESTED IN A LEARNING LAB

NEARLY **400** FUNDED MOBILITY GRANTS

... with academic programmes that promote pedagogical innovation and lifelong learning

With nearly 80,000 students, the Université de Lille and the Grandes Ecoles of the I-SITE consortium constitute one of the most important university sites in France. As a vital player in the local labour market, the consortium offers comprehensive and diversified academic programmes. Pedagogical innovation is a priority of I-SITE. Its actions in this area are part of a wider trajectory to co-construct the L5 (Lille Leuven Louvain learning lab). This project benefits in particular from the expertise of colleagues from KU Leuven, which is a world reference in this field. A chair dedicated to

"KU Leuven and its Kortrijk campus are looking forward to a particularly fruitful and mutually enriching collaboration in the field of educational technology as a driver of educational innovation. Whether it be multi-site teaching, collaborative approach or personalised learning, our joint activities will lead to concrete learning systems that are perfectly integrated into our academic programmes.".

Piet Desmet,
vice-rector of KU Leuven,
rector of Kulak

Collaborative study room at Lilliad.

"learning analytics" allows a professor from KU Leuven to develop the project. On the Lille site, the Lille learning lab, with a budget of around two million euros, will put forward a set of innovative measures to encourage the establishment of intensified, interactive and multi-site courses. Already established on the Pont-de-Bois campus, it will soon be deployed on the other campuses. The foundation also encourages the launch of innovative and ambitious projects led by teams of teachers and engineers from the university and schools in its consortium. In response to the challenge posed by the COVID-19 pandemic, the I-SITE will, for the start of the 2020 academic year, contribute 650,000 euros to the deployment of new teaching tools, making this constraint an opportunity to teach differently.

In the field of lifelong learning, the I-SITE supports the experimental project, 'University of work-linked training' which aims to amplify the relationship between university and business.

"Developing an ecosystem favourable to pedagogical innovation is at the heart of our project to create the Lille learning lab, which is divided into three areas: supporting teaching teams in the development of their teaching practices; creating places conducive to pedagogical experimentation; enhancing and recognising teachers' investment in this field."

Lynne Franjié,
vice-president for academic programmes at the Université de Lille

...with the means to strengthen its international influence and attractiveness

Thanks to the geographical location of the Lille site at the heart of Europe, the I-SITE project has enabled its establishments to strengthen their collaboration with universities of excellence in the cross-border region. A network called 3i (Interregional Internationalisation Initiative) has been set up with the University of Ghent, KU Leuven in Belgium and the University of Kent in the United Kingdom. Objective: to bring together the academic world, local authorities and the private sector to collaborate on challenges common to the different regions. In addition to existing double degrees, this partnership has fostered the emergence of new joint research projects, thanks to the funding of mobility grants for teacher-researchers, staff and students (340 grants in 2019-2020) and joint thesis grants (45 grants in 2018-2020). To further consolidate their cooperation, the Université de Lille and KU Leuven also signed a strategic partnership agreement in 2019.

Outside Northwestern Europe, the Université de Lille has created the InclusU consortium with seven European universities. This partnership, focusing on the issue of social inclusion and civic responsibility, has fed into the creation of the I-SITE hub, "Changing cultures, societies and practices". Beyond Europe, a representative office has been opened in Belo Horizonte (Brazil) to increase the visibility of the consortium. A second representative office should be opening soon in China.

"The 3i network enables the researchers of the I-SITE consortium to develop their expertise in collaboration with our partners in the cross-border region in order to respond to the challenges shared by the regions of Kent, Flanders and Hauts-de-France. Together, we will find solutions to serve the citizens."

Kathleen O'Connor,
coordinator for the development of international relations at the I-SITE ULNE foundation

Finally, the consortium is actively working to attract more international scientific talent (researchers and academics) and to improve their reception in France. Winner of a European H2020 project, the PEARL (Programme for EArly-stage Researchers in Lille) programme will enable the recruitment of around thirty international doctoral students on interdisciplinary research themes.

Further information on the 3i cross-border network: www.3iuni.eu; and on the PEARL programme: www.pearl-phd-lille.eu

*Hauts-de-France Innovation Development
**Société d'Accélération du Transfert de Technologies (Technology Transfer Acceleration Company)

In synergy with public policies

The I-SITE works on behalf of its founding members in close consultation with the Hauts-de-France Region and the MEL who are represented on the foundation's board of directors. They participate in the construction of its strategy. Their departments collaborate with the I-SITE team, communicating every month to coordinate their actions and produce significant changes. Given the large number of people that the consortium represents (over 7,000 staff), its research and development activities cover most of the areas of specialisation presented in the intelligent specialisation matrix and its regional diagram (SRI-SI). For its part, the MEL has played a major role in structuring the site by financing the research clusters in particular, essential tools for focusing research and technological innovation efforts, and the Lille Leuven Louvain learning lab, an emblematic pedagogical innovation project built with our partners from KU Leuven. In the field of health, its considerable support was decisive for the creation of the PreciDIAB National Centre for Precision Medicine for Diabetes headed by Professor Froguel.

Health

PROJECTS CENTRED ON PRECISION HEALTHCARE

Advances in biology, technology and information technology now make it possible to help develop more precise medical care. The Lille site participates in the deployment of precision medicine in the flagship topics of the health sector.

Diabetes and Precision Medicine

The Lille region is a major player in the fight against diabetes. Spearheaded by the European Genomic Institute for Diabetes (EGID), it has been awarded the label of National Centre for Precision Medicine on diabetes and obesity through the PreciDIAB project. Thanks to a new method for the detection and quantification at high throughput by mass spectrometry of hormones involved in diabetes (INS-SPECT project), Jean-Sébastien Annicotte's team at LABEX EGID hopes to be able to screen compounds to identify new drug candidates.

START-AIRR INS-SPECT Project, Institut européen de génomique du diabète (European Diabetes Genomics Institute- EGID)
Contact: Jean-Sébastien Annicotte

"The cooperation among our institutions in these large-scale projects for the region is a unique opportunity. It allows us to unite excellence at the service of patient care at Lille University Hospital."

Frédéric Boiron,
general director of the University Hospital (CHU) of Lille

Artificial intelligence at the service of precision

The Lille Health Data Warehouse (EDS) aims to be one of the main centres in France for the exploitation of big health data. The data submitted will be used for several purposes such as research, improving the quality of care and medico-economic analysis. This tool will contribute to the progress in medical knowledge, to the improvement of patient inclusion in clinical trials and to the strengthening of medical and strategic management. This strategic data will also help to improve the quality of care.
Thanks to the MD-PhD scheme implemented by the I-SITE, Arthur Lauriot dit Prevost, a paediatric intern, will be able to spend a year concentrating on his research work prior to becoming clinic chief. His project aims to use artificial intelligence to make health data (analysis and hospitalisation reports, mail, medical imagery, photos, etc.) readable and structured in a way that is difficult to use on a large scale in its current state.

Phenomix cluster
Contacts: Vincent Sobanski and Grégoire Ficheur

A graduate programme dedicated to precision health research

As part of the development of the Lille site's academic programmes, a specialised master's course known as the "Precision Health graduate programme" opened in September 2020. This interdisciplinary and international programme covers very fundamental aspects of precision healthcare, as well as the social issues it raises.

Contact: Anne Tailleux

Stimulating the discovery of drugs to fight infectious diseases

Thanks to the support of institutions, the Lille site has a chemical library of over 100,000 molecules with therapeutic potential. The modelling offered by artificial intelligence makes it possible to better identify target-molecule interactions whilst avoiding animal experimentation. Lille's health researchers are actively participating in the race for new medicines, particularly with regard to infectious diseases. The joint SmartLab team, co-financed with the help of the I-SITE, will promote the collaboration between the M2SV Unit and BioVersys for the development of treatments aimed at raising antibiotic resistance. This project has just been selected by the Inno-

"The Institut Pasteur de Lille, alongside its partners, is proud to contribute to the construction on the Lille site, of a centre of excellence in biomedical research on a European scale."

Xavier Nassif,
general director of the Institut Pasteur de Lille

vative Medicine Initiative (IMI) of the European Union. This capacity for innovation is now fully mobilised in the search for effective therapeutic approaches to fight COVID-19.

Joint team of SmartLab, Centre d'infection et d'immunité de Lille (Infection and Immunity Centre - CIIL) and Medicines and Molecules for Acting on Living Systems Unit (M2SV)
Contact: Nicolas Willand

Quickly diagnosing COVID-19 for fast treatment

CNRS silver medal winner Sabine Szunerits and her team at the IEMN are developing, in conjunction with David Devos at the University Hospital and with the help of the LICORNE cohort of patients who have had the COVID-19 infection, a rapid diagnostic tool using an immunological sensor approach, thanks to nanoparticles. The CorDial-S project, initially supported by the I-SITE via the two million euros made available to the Lille task force to fight COVID-19, has just been selected by the European Commission as part of the H2020 call for projects, the only project coordinated by a French institution.

CorDial-S, Institut d'électronique, de microélectronique et de nanotechnologie (Institute of Electronics, microelectronics and nanotechnology - IEMN) and Lille University Hospital (CHU)
Contacts: Sabine Szunerits and David Devos

For a precision cancer diagnosis

In France, cancer is the leading cause of mortality ahead of cardiovascular pathologies. The main locations are the lung, stomach, liver, colon and breast. The situation is dramatic in Hauts-de-France: the regional excess mortality rate for all cancers combined is around 25%, with premature morbidity 36% higher than the national average. Among the many projects funded in this area, the Snoopy intelligent sniffer project is led by Isabelle Fournier. The project aims to analyse volatile organic compounds using mass spectrometry to detect certain cancers. It has resulted in funding to develop this technology. The researcher also works with the cancer department of Lille University Hospital to guide surgery. Thanks to the real-time analysis of tissue micro-samples using mass spectrometry, the MSGUIDE technology helps rapid discrimination between cancerous and normal tissues, providing invaluable help when choosing the perimeter for excision, as well as in defining the cancer type.

Snoopy Prematuration Project, Proteomics, inflammatory response, mass spectrometry laboratory (PRISM)
Contact: Isabelle Fournier

Learning how to announce more precise diagnoses

In Lille, the Presage simulation centre supports medical students in the practice of the main medical procedures. These courses are aimed at paramedical professions and doctors practising in various specialities: surgery, gynaecology, obstetrics, anaesthesia, resuscitation, pneumology, general medicine, paediatrics, cardiology, etc. The announcement of the diagnosis becomes a challenge for health professionals who will be able to train before treating patients face-to-face.

High throughput screening for COVID-19

Thanks to the Lille chemical library and in partnership with Apteeus, a Lille-based start-up, the teams led by Jean Dubuisson and Benoît Deprez are repositioning existing drugs by testing them in vitro on both virological and tissue models. This project is already bearing fruit with the identification of a molecule which will enter clinical evaluation, thanks to the support of the I-SITE and the Lille task force fighting COVID-19.

ANTI SARS 2 project, Centre d'infection et d'immunité de Lille (CIIL) and the Medicines and molecules for action on living systems unit (M2SV)
Contacts: Jean Dubuisson and Benoît Deprez

Planet

UNDERSTANDING GLOBAL CHANGES AND PROVIDING SOLUTIONS

The Earth is undergoing a series of changes linked to planetary activity in itself, but also to human activity impacting the environment, ecosystems and society. Researchers at the Lille site benefit from state-of-the-art equipment and pool their expertise. Objectives: to understand and predict global developments, and to develop technologies helping to limit their harmful effects.

Understanding and modelling the bowels of the Earth

Our planet is constantly undergoing changes and deformations in its structure. They are responsible, for example, for volcanic eruptions and earthquakes on the surface. Understanding these complex phenomena allows for better preparation. The study of the earth's mantle is a real experimental challenge because the pressure and temperature conditions at these depths are very difficult to reproduce in the laboratory. With their first ERC Advanced Grant in 2012, entitled RheoMan, Patrick Cordier's team put forward a revolutionary approach based on multi-scale simulations that allow scientists to deduce from events and properties on a microscopic scale, the behaviours observed and felt on a human scale. With the ERC TimeMan, Patrick Cordier then turned his attention to the problem of time in the study of earth deformations. Combining digital techniques with experiments on a microscopic scale, the team is now able to observe dislocations of crystals using electronic microscopy on human time scales, whose translation to a macroscopic scale can be made on a geological time scale.

ERC Rheoman and Timeman, Materials and Transformation Unit (UMET) Contact: Patrick Cordier

Deciphering and predicting the evolution of plants

How do plants choose their breeding partners when they cannot move around? How can they recognise and avoid being pollinated by the pollen they themselves have produced, when they are generally hermaphroditic and therefore have both male and female sexual organs? The NOVEL project aims to understand the evolutionary processes and to identify the molecular mechanisms by which a genetic system at the heart of flowering plant reproduction (called "self-incompatibility") has been able to diversify dramatically since the emergence of flowering plants. It is based on the combination of different approaches, ranging from mathematical modelling of natural selection to experimental manipulation via the exploration of the dynamics of complex genomes.

ERC NOVEL, Evolution, ecology and paleontology laboratory (EEP) Contact: Vincent Castric

"The research carried out within the Planet hub is multi-scale: from the atomic nucleus to the earth's mantle; multidisciplinary: from chemistry to human and social sciences; multi-thematic: from the environment to energy; multi-techniques: from spectroscopy to catalyst reactors. Let's bet that discoveries and innovations will be just as plentiful!"

Lionel Montagne,
vice-president of research at the Université de Lille

Arabidopsis lyrata flower and genetic network for regulating dominance between self-incompatible alleles.

Better control of the nuclear risk

What happens to the radioactive elements in the event of an accident affecting nuclear facilities? This is the focal issue of the Oversee project. Based on globally unique approaches to multi-scale digital modelling, it aims to analyse how these elements are released into the atmosphere. For example, when there is a serious accident in a power plant such as Fukushima or Chernobyl; in spent fuel storage tanks or in fuel reprocessing plants where fires may break out in the reprocessing solvents. With its large nuclear stock (including the Gravelines power plant in the Hauts-de-France region) and the proximity of a reprocessing plant in The Hague, France presents a significant nuclear risk and volatile compounds could transport radioactive elements far beyond the accident site. Digital simulations of unprecedented sophistication will enable the Lille project to better understand the transport phenomena of these elements and to limit their health and environmental consequences.

I-SITE Oversee cluster, Laboratoire physique des lasers, atomes et molecules (Physics Laboratory of Lasers, Atoms and Molecules - PhLAM), Physical Chemistry of Combustion Processes and the Atmosphere Laboratory (PC2A), Unité de catalyse et chimie du solide (Catalysis and Solid Chemistry Unit - UCCS), Labex chemical and physical properties of the atmosphere (CAPPA) and CPER Climibio
Contact: Valérie Valleten

Towards a revolution in chemistry, the backbone of the circular economy

Thanks to original scientific approaches (hybrid catalysis, photo- and electro-catalysis, etc.), the research teams working on the RECABIO project are proposing new ways of exploiting alternative resources such as bio-resources or plant waste so that they can effectively replace the products produced by petro-resources. The approach is based on a strong collaboration between researchers in experimental sciences and in human and social sciences to develop new tools. Objective: to develop new solutions and evaluate their virtues (socio-economic and environmental impacts in particular) with regard to their technological advantages.

Cluster I-SITE Ressources: catalyses et bioéconomie (Resources catalysis and bio-economy - RECABIO), Unité de catalyse et chimie du solide (UCCS), Institute of electronics, microelectronics and nanotechnology (IEMN), Laboratory of electro-technology and power electronics (L2EP), Group of studies and research, interdisciplinary in information and communication (GERiiCO), Lille economy management (LEM)
Contact: Robert Wojcieszak

Mastering energy with batteries and miniaturised super capacitors for the electronics of the future

Connected watches, drones, micro sensors... more and more miniature objects are emerging. They are capable of interacting in a network (Internet of Things) to capture information in the environment and respond to needs in the fields of health, the environment or the industries of the future. In order to make them self-sufficient in power, there are major scientific and technological challenges in developing the miniaturisation of electrochemical energy storage and substantial performance improvements. The teams in Lille are currently developing new, original and efficient micro storage devices. In particular, two miniaturised devices, Li-ion micro-batteries and 3D super micro-capacitors, complement the energy storage micro-source built into connected objects. The VERMINE 3D project uses the third dimension to artificially increase the surface of the micro-devices without increasing the surface footprint. This technological revolution represents a real paradigm shift in the field. It should enable energy density never before achieved, opening the door to the energy autonomy of miniaturised communicating electronic components of the future.

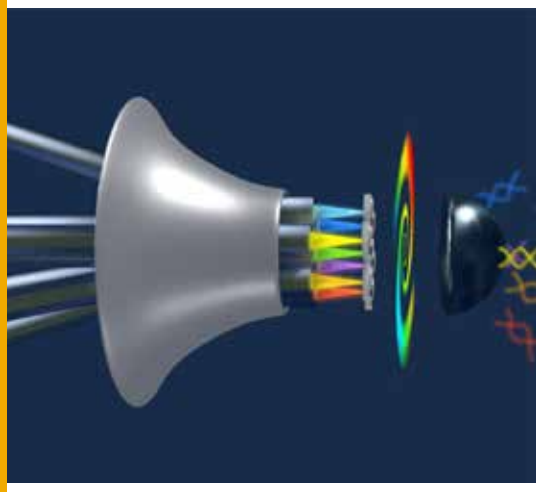
Project START-AIRR VERMINE 3D, Unité de catalyse et chimie du solide (UCCS), Institute of Electronics, microelectronics and nanotechnology (IEMN)
Contact: Christophe Lethien

Mesocentre used for computer modelling.

Digital

TOWARDS A DIGITAL WORLD AT THE SERVICE OF SOCIETY

The digital world is transforming life in society, both individually and socially. In this context, researchers are developing disruptive digital technologies (hard and soft) by integrating advances in research in the humanities and social sciences.



Networks of the future

The production and exchange of data is at the heart of our modern societies, where increasingly mobile users and intelligent objects need to be connected. Current communication networks are close to their limits. Radically new solutions have to be developed for tomorrow's connectivity, both for the transmission and the processing of data. This requires multi-scale communication infrastructures: this is the objective of the Dydico cluster. Over long distances, these infrastructures will use multi-core or multi-mode optical fibres. For short distance connections, they will use ultra-high frequency wireless links in the TeraHertz (THz) range. As such, in 2018, the Lille site set a record for transmission (100 Gbit/s). An ongoing project aims to directly drive an array of THz transmitters via a multi-core optical fibre (see illustration), which would be a world first. The cluster benefits from the fact that Lille is the only French site with both a large nanotechnology centre and an optical fibre manufacturing plant. It also participates in a joint laboratory with Prysmian/Draka, the world leader in optical communication cables, and is supported by partnerships with Nokia and Alcatel Submarine Networks. At the user level, the multiplication of connected objects and the requirements of low latency and data security necessitate the use of systems that mimic the human brain (neuromorphic calculation) for local and secure data processing.

Cluster I-SITE Dynamics for disruptive communications and connectivity (Dydico), Institute of Electronics, microelectronics and nanotechnology (IEMN), Laboratoire physique des lasers, atomes et molécules (PhLAM), European Centre for Mathematics, Physics and their Interactions (Labex CEMPI), Équipex Flux et Excelsior Contact: Marc Lefranc

The topology for the creating of electronics using light

Today's requirements for processing and transporting data are increasing exponentially. However, the performance of today's electrical circuits is tending to peak. To go further, one of the avenues explored by physicists is the replacement of electric currents with light or other electromagnetic waves, for example in the THz range. Another very promising approach is based on "topological metamaterials", in which these waves propagate without loss and are insensitive to disturbances. The emergenTopo project combines these two approaches by exploring new avenues in topological photonics, and is spearheading a nascent Lille community grouped around the topological control of waves.

Cluster I-SITE Dynamics for disruptive communications and connectivity (Dydico), ERC emergenTopo, Physics Laboratory of Lasers, Atoms and molecules (PhLAM)
Contact: Alberto Amo

Artificial intelligence for analysing complex systems

The HumAIn@Lille cluster brings together research excellence in statistical modelling and machine learning to explore complex systems, with applications in biology, astrophysics and chemistry. The approaches developed in Lille make it possible, in particular, to effectively test whether a model correctly reproduces experimental data (for example, the electrical activity of heart cells) or to better analyse this data (for example, to determine in detail how a pair of black holes generating gravitational waves rotates, or to understand the functioning of areas housing stellar nurseries based on observations from radio telescopes). The ambition is to design AI that is accepted and integrated into human society, providing decisions and predictions that are easily understood by its users and obey ethical and legal rules.

Cluster I-SITE HumAIn@Lille, IA Baccarat and Sherlock Chairs, ERC BlackJack, Lille Centre for Research in Computer Science, Signal and Control (CRIStAL), European Centre for Mathematics, Physics and their Interactions (Labex CEMPI)
Contact: Olivier Colot

"The regional academic players are grouped around the humAIn alliance to structure and boost research in artificial intelligence across the region, integrating interdisciplinary research based on all the research laboratories of the Region."

Mireille Régnier,
director of the Centre Inria Lille Nord-Europe

History of algorithmic tissue reconstruction from the 16th century

In June 1520, the meeting between King François I and the British sovereign Henry VIII and their courts was the occasion for a display of unprecedented luxury, emblematic of the splendours of the Renaissance. Tournaments and dismounted combat, wrestling matches, feasts, balls and masquerades followed one after the other, with music as a backdrop. To celebrate the 500th anniversary of this event, which will leave a lasting impression on memories on both sides of the Channel, the digital Cloth of Gold Camp project has undertaken to reconstruct it in 3D. The aim is to show people what happened and to re-enact it for the public through an interactive visual mediation tool. It is the opportunity for ambitious collaboration between the human and social sciences; for the analysis of historical sources on material culture; and for computer modelling, in particular the optical rendering of precious ancient fabrics, mixing gold and silver threads.

Cluster: I-SITE Digital systems for Human Knowledge (Disyknow), Project I-SITE VALO SHS, Institut de recherches historiques du septentrion (IRHiS), Equipex IrDIVE, CPER Mauve
Contact: Isabelle Paresys

Analysing visual perception to develop artificial retinas

The precise mechanisms of human vision are not well known. Detailed understanding is a major challenge in creating artificial retinas for the visually impaired. The Disyknow cluster project is developing a new experimental approach coupling two types of devices. The first one uses the most precise system in the world to study the stimulation of each individual photoreceptor (rods and cones) of the retina, based on an adaptive optics scanning laser ophtalmoscope (AOSLO). At the same time, the second study will show how the image is subjectively perceived in the brain, using innovative psychophysical methods. At the same time, low energy consumption neuromorphic integrated circuits are being developed from solutions inspired by living organisms. Thus, start-up Axorus, developed out of the IEMN laboratory, incubated at Eurasanté and supported by SATT Nord, is developing an artificial retina based on electronic neurons, with the ambition of restoring the visual acuity of people suffering from retinal diseases.

Cluster: I-SITE Digital systems for Human Knowledge (Disyknow), ANR DEBORRA, Cognitive & Affective Sciences Laboratory (SCALab), Institute of electronics, microelectronics and nanotechnology (IEMN), équipex IrDIVE
Contacts: Bilge Sayim, Virginie Hoel, Alain Cappy

Human and social sciences

CHANGING CULTURES, SOCIETIES AND PRACTICES

The Université de Lille and the Grandes Ecoles of the Lille area are mobilising their skills and knowledge in the human and social sciences to promote an understanding of the changes that mark cultures, practices and societies. Objectives: to seize opportunities more effectively, but also to measure and control risks.

Cross-border cooperation supporting social inclusion

The Franco-Belgian Interreg project, I SAID, promotes the inclusion and self-determination of people with intellectual disabilities. It aims to identify the facilitators and obstacles they encounter in life, to develop response strategies in consultation with players in the field and to disseminate them through the training of the professionals concerned. It participates in the construction of innovative and integrated solutions within the regions involved (Hauts-de-France and Wallonia).

Project I SAID Interreg France-Wallonie-Vlaanderen, Laboratoire psychologie: interactions, temps, émotions, cognition (Psychology Laboratory: interactions, time, emotions, cognition - PSITEC)
Contact: Yannick Courbois

Lifestyles, quality of life and inequality in Europe

In Europe, work on inequality and class difference is experiencing a revival, but is often confined to national areas only. Co-financed by I-SITE and the Maison Européenne des Sciences de l'Homme et de la Société (European Centre for the Humanities and Social Sciences - MESHS), the QUALIEUROPE project studies social inequalities at European level and their repercussions on the lifestyle and quality of life of workers. It employs a multi-factorial analysis of inequalities in terms of wealth, access to culture, health and public transport, quality of the environment, foreign language skills, participation in community and political life, etc. It draws on the major European statistical surveys which provide a detailed analysis of the inequalities in the quality of life and work in Europe. The project mobilises research teams in ten European countries.

Project I-SITE SHS QUALIEUROPE, Centre d'études et de recherches administratives politiques et sociales (CERAPS) and Centre lillois d'études et de recherches sociologiques et économiques (CLERSÉ)
Contacts: Étienne Pénissat and Manuel Schotté

"Building on their critical tradition and their openness to interdisciplinarity, the human and social sciences of the Lille site are mobilising to understand our present and imagine our future, to identify the processes of vulnerability that weaken individuals and threaten social ties, and to build more inclusive societies on the scale of our Region, Europe and beyond."

Philippe Sabot,
vice-president of research in charge of the humanities and social sciences sector at the Université de Lille

Words as a trigger for change

The NeoLog project is carrying out a linguistic analysis of gender markers in the English language in order to identify the logics of exclusion and inclusion at work in its efforts to renew itself. The study looks at the social and cognitive impact of the appearance of new gendered words in English.

I-SITE SHS NeoLog Project, Laboratoire Savoirs, Textes, Langage (STL)
Contact: Maarten Lemmens

Questioning membership in the European Union

Membership in the European Union is a topical issue at a time when, for the first time in the history of European integration, a Member State has left the Union. However, the question of membership in this international organisation does not exclusively concern States. There are also issues of concern at the level of the European regions, particularly in the cross-border areas such as the Lille site. Finally, the disenchantment that people seem to feel with the European project also raises the question of EU citizenship. Awar-

ded by the European Union, the Jean Monnet Chair, obtained by the researcher Elsa Bernard, will support research and take it to an international level, as well as strengthen and diversify training on these issues.

Jean Monnet Chair, Laboratory Centre for Law and Legal Perspectives (CRDP)
Contact: Elsa Bernard

A historical understanding of change: the archaeological and historical signs of Christianity

The DANUBIUS programme, jointly funded by the I-SITE and the ANR is looking at the spread of Christianity in one area of the Roman Empire (Lower Danube), during the transition between Antiquity and the Middle Ages. It brings together historians, archaeologists and geographers from several European and North American countries. The work involves the use of computer technologies, in particular geographic information systems (GIS). The archaeological and historical signs of Christianity in the Late Antique Lower Danube are geo-located and compiled on a platform. This cartography will feed the historical analysis of the different aspects of the phenomenon under study, while offering a free online working tool to the whole scientific community.

Project I-SITE EXPAND Danubius, Laboratoire histoire, archéologie et littérature des mondes anciens (Laboratory of history, archaeology and literature of ancient worlds - HALMA)
Contact: Dominic Moreau

"The Hauts-de-France Region is both creative and fragile, rich in its industrial history and cultural heritage and an exceptional site for analysis, reflection and experimentation in the human and social sciences. Research in Lille is taking root in this area but is also working to better understand the challenges of a changing world and to define the conditions for a more inclusive society."

Nil Toulouse,
vice-president of research in charge of the law, economy and management sector at the Université de Lille

"The strength of Lille's research on European and international issues is the strength that comes from a metropolis where borders, traffic and exchanges are a daily and inescapable reality."

Pierre Mathiot,
director of Sciences Po Lille

The Trend(s) industrial chair to support changes in the distribution sector

The distribution sector in the Lille metropolitan area and the Hauts-de-France Region is undergoing profound changes. To respond to the urgency of the situation, the Trend(s) chair, launched in November 2019, is supported by an inter-disciplinary and international research team, and brings together three major retailers (Boulanger, IDKids and Leroy Merlin) around four lines of research: the functions of the brick and mortar shop in an omnicommercial environment; new business models and emerging markets; the (re)legitimisation of the sector and the players in distribution in the face of consumer distrust; the organisational and cultural transformation of companies. The chair aims to produce and disseminate the knowledge co-produced by this ecosystem, using an innovative and collaborative methodology. It is supported by the MEL, the I-SITE and the PICOM by Cap Digital competitiveness cluster.

Trend(s) Chair, Lille school management research centre (LSMRC)
Contact: Isabelle Collin-Lachaud

A CONSORTIUM, INCUBATOR OF THE "UNIVERSITÉ DE LILLE - 2022"

The Lille Nord-Europe Excellence Initiative, led by a foundation and labelled I-SITE in February 2017 within the framework of the Investments for the Future Programme, supports the creation, on 1 January 2022, of an Experimental Public Establishment which will be named "Université de Lille" and which will bring together the current Université de Lille, Centrale Lille Institut, Sciences Po Lille, the École Supérieure de Journalisme de Lille and the École Nationale Supérieure d'Architecture et Paysage de Lille.

By strengthening the links with national research organisations (CNRS, Inserm, Inria), the University Hospital (CHU) and the Institut Pasteur de Lille, the other schools on the site, as well as with many players in the socio-economic world and by participating in a cross-border university network (KU Leuven, University of Ghent and University of Kent), the ambition is to create an internationally recognised university, capable of ranking among the top European universities.

Structuring and strategic actions

With a budget of 15 million euros per year, the Excellence Initiative directs its funds towards structuring and strategic actions, notably around the development of research, and support for training and innovation in education. It also provides financial support for the international development of the Lille site and for actions linked to the socio-economic world.

"For Centrale Lille Institut, the Experimental Public Establishment, 'Université de Lille', will be an opportunity to develop its international ambition."

Emmanuel Duflos,
director of Centrale Lille Institut

"For the past two years, the management the of I-SITE has been working to convince the University and the Schools of the need to create an Experimental Public Establishment in Lille. This is an essential step in the confirmation of the label of excellence. I am delighted that the institutionsare now actively working towards this goal."

Gilberte Chambaud,
president of the I-SITE ULNE foundation

"The creation of the Experimental Public Establishment, 'Université de Lille', will be in line with our values, particularly inclusion, and will be at the very foundation of our excellence."

Jean-Christophe Camart,
president
of the Université de Lille

190
COMPANIES THAT SUPPORT THE PROJECT

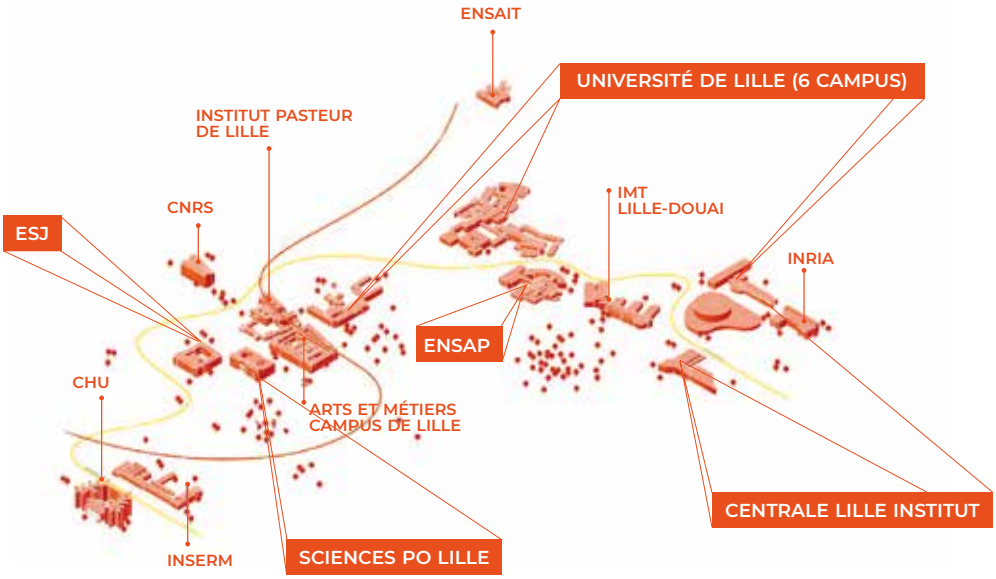
150
NATIONALITIES

2,100
PHD STUDENTS

70
RESEARCH UNITS

80,000
STUDENTS

3,500
RESEARCHERS



Our founding establishments

Université de Lille, Centrale Lille, École Nationale Supérieure des Arts et Industries Textiles, École Nationale Supérieure de Chimie de Lille, École Mines-Télécom Lille-Douai, Sciences Po Lille, École Supérieure de Journalisme, École Nationale Supérieure d’Architecture et de Paysage de Lille, Arts et Métiers Campus de Lille, CNRS, Inserm, Inria Lille Nord-Europe, CHU (university hospital) de Lille and Institut Pasteur de Lille.

THE MEMBERS OF THE EPE

Centrale Lille Institut, ENSAP, ESJ, Sciences Po Lille, Université de Lille.

Our founders

I-SITE
UNIVERSITÉ
LILLE NORD-EUROPE