2017-EFFORTS CROWNED WITH SUCCESS

2017 saw many of our projects flourish, facilitated by fewer financial management constraints. We have become better organised, produced research that is as valuable as ever and have been in greater demand, particularly by the socio-economic world. These favourable conditions have reinforced our influence in France and abroad. They have also helped us forge new partnerships.

Within the framework of the Future Investments Programme, we obtained the certification of the I-Site FUTURE, which is a sign of the recognition of the scientific and institutional excellence of the project to create an establishment that we are jointly undertaking with our neighbouring partners: UPEM, ESIEE Paris, EAVP, IGN and ENPC. To accompany this merger process, which will help us all to develop, the first seminars aimed at achieving mutual understanding were held. These periods of discussion between staff were a genuine success.

They reflect a shared desire to step up cooperation in order to build a university with an international profile in the areas of the city and the transport of the future. For example, this project has enabled us not only to develop new multidisciplinary training courses at all levels, but also to undertake the first joint research work between the various I-Site laboratories.

Our contract-based research activity has grown significantly.

Our activity in 2017 was also notable for the start of work on the Transpolis innovation platform and the completion of work on the Sense-City Facility of Excellence, SI Research, our tool for collecting and sharing information about our teams’ output, has been deployed in all our departments and laboratories. Some important projects for the Institute have also been successfully launched, for example the Goals and Performance Contract (COP) 2017 - 2021 as well as our four unifying projects. Following the example of the "R5G" project, these scientific leadership set-ups developed by our researchers have made it possible to envision new cross-cutting and interdisciplinary research in the laboratories of our five departments. It is part of an approach to coordinate and organise our research activities in order to better respond to major societal issues in the fields of transport, mobility, safety, planning and the environment.
— In what framework did you collaborate with IFSTTAR?

Jean-Marc Zulesi: In September 2017, the Ministry of Transport launched the Assises de la mobilité, a National Mobility Consultation. The aim was to provide input for the draft Mobility Policy Act (LOM) which will be put before the Cabinet in the first half of 2018, and which will lay down the government’s transport strategy over the next ten years. In both Salon-de-Provence and the Paris region, IFSTTAR researchers made an active contribution to the Mobility Consultation. They participated in themed round tables and workshops dedicated to innovation for cleaner, more supportive and more connected mobility. On this occasion, they engaged in discussions not only with other researchers but also with elected representatives, business and start-up leaders, representatives of associations and trade unions, and users.

— What future mobility issues were discussed during the Mobility Consultation?

J.-M. Zulesi: We need to be able to offer our fellow citizens transportation and infrastructure that is more efficient and safer, while optimizing land-use planning and the protection of our regions. For my part, I am convinced that the solutions to these challenges will come more from innovation than from the construction of new infrastructure. Even more encouragement must be given carpooling, autonomous vehicles, car-sharing and intermodality, as well as active modes such as cycling. At the end of the Mobility Consultation, on December 13, 2017, I officially submitted my report detailing thirty-five concrete proposals to this effect to the Minister of Transport. These included, for example, the creation of a “Mobility and Innovation” platform open to all public and private stakeholders, and the opening-up and exploitation of data to facilitate traffic flow and carpooling, while respecting the rights of users. These proposals should all contribute to creating a flexible legal and regulatory framework that fosters future technological developments.

— What struck you about IFSTTAR’s contribution to this consultation?

J.-M. Zulesi: IFSTTAR’s contribution was valuable in several respects. Thanks to their expertise, its researchers approach problems pragmatically, from a scientific perspective and on the basis of their field experience. The ideas and solutions they propose are central to innovation. I am thinking in particular of their research on smart cities and embedded sensor networks, capable of identifying the overloaded vehicles that cause the most damage to roads. We can also mention the modulation of tolls according to vehicle occupancy rates, or the creation of special car-pool lanes. On the whole, IFSTTAR recommends that the public authorities should strengthen and expedite their involvement in the governance and planning of transport, so that innovative mobility solutions can be included in transport and travel plans as of now.

Innovation is essential for the future of mobility.
Let's Hear From

What is the significance of IFSTTAR for your association?

Anne-Marie Herbourg: Through its strategic and technical support, IFSTTAR is a valuable ally for ADtech. Its activities are in perfect harmony with the sectors of activity we are involved in, for example the road as a means of implementing intelligent mobility, development, urban logistics, etc. Its activities provide our elected representatives with a decision-making tool that enables them to meet the expectations of users, who are increasingly demanding high-quality services. In a context where local authorities are facing severe financial constraints, IFSTTAR’s expertise and responsiveness are essential for prioritising investments. Thanks to its international and multidisciplinary approach, the Institute also helps us to deal with cross-cutting issues such as infrastructure safety, resilience and efficiency, spatial planning and the protection of regions, etc. Applied research on these topics is crucial for us as infrastructure managers. Finally, IFSTTAR also helps to maintain the technical skills of local government officials by providing the Road Technical Days, training courses, networks, tools, etc. This contribution is essential for local and regional authorities.

What do local and regional authorities expect from the Institute’s expertise?

A.-M. Herbourg: How can we improve the maintenance and safety of France’s 400,000 km of county roads? How can we make arriving in a built-up zone more seamless? How can we make our roads intelligent using roadside sensors or smartphones? IFSTTAR is currently studying all these questions. Its findings should help local authorities optimize the operation, management, maintenance and conservation of their assets. We are particularly interested in the experiments conducted at Sense-City and Transpolis. Moreover, on the same journey, users travel on a municipal road, followed by a county road and then a suburban road... Without being aware of it, they expect the same level of service on each. We need to take on board this route-based approach which requires shared expertise or even common governance, as IFSTTAR does when it considers changes in behaviours for example. The Institute’s work encourages us to change the way we think.

What is your strategic thinking currently focusing on?

A.-M. Herbourg: One topic where much is at stake is the sustainability of infrastructure. Research on the analysis of cracked wearing courses, on the combined effects of freezing and thawing on pavements or on the monitoring of engineering structures will help to identify and implement the most appropriate responses. The 5th Generation Road also raises major questions, especially with the advent of autonomous vehicles and their impact on operating modes: safety-based approaches, improvements in road markings, etc. Consideration must also be given to safety - accidents are less of an infrastructure problem than a behavioural one – and natural risks. With climate change, we are witnessing an increase in the number of events that impact infrastructure and mobility: landslides, floods, violent storms... Without forgetting the issues related to platooning, to the recycling of asphalt millings, to air quality... We expect a lot from IFSTTAR's research on these major topics for the future.

Anne-Marie Herbourg, Chair of the Association of the Technical Directors of Metropolises, Départements and Regions (ADtech)
2017 HIGHLIGHTS

JANUARY

- **23-27 January**
  SUP&R International Training Network European research Project “Sustainable Pavement and Railway”.
  Find out more...
  SUP&R ITN

- **24-25 January**
  The Intelligent Mobility Encounters at the Belfroi de Montrouge.
  Find out more...
  Les rencontres de la mobilité intelligente

- **25-26 January**
  Find out more...
  JTR 2017

- **26 January**
  25 years of CLORA.
  Find out more...
  Clora

- **31 January**
  Visit by Stéphane Beaudet, Vice-Chairman of the Ile-de-France Regional Council with responsibility for transport and Jean-Jacques Barbaux, President of the Département Council of Seine-et-Marne (77).

FEBRUARY

- **1 February**
  Eiffage Infrastructures has signed a new framework contract for scientific collaboration with IFSTTAR.
  Find out more...
  Framework contract with Eiffage Infrastructures

- **7 February**
  Bron National Scientific Encounters (Lyon)
  Can we recycle the city?
  Find out more...
  Can we recycle the city?

- **8 February**
  Differing perspectives on. Culture, sciences and areas Conference cycle “Sensitive urban mapping”.
  Making the invisible visible.

MARCH

- **Until 5 March**
  Exhibition. Urban changes, the city belongs to us! The LVMT presented an interactive mock-up for calculating CO2 emissions at the Cité des sciences, Paris.

- **9 March**
  Conference “Recycling concrete in concrete, quite naturally”.
  Find out more...
  Recycling concrete in concrete, quite naturally

- **14 March**
  Knowledge encounters “Outside the walls” Eco-neighbourhood projects in France.
  Find out more...
  Eco-neighbourhood projects in France
15 March
Information and discussion day “The contribution of regenerating agents to the recycling of asphalt mixes”.
Find out more...
Information and discussion day

20-22 March
DG2017: 5th conference: ‘Driver Distraction and Inattention’
Find out more...
DG2017

28 March
Mobilite@VEDECOM: Opening of the Satory test track in Versailles.
Find out more...
Mobilite@VEDECOM

27 April
Differing perspectives on: Culture, sciences and areas Conference cycle “Sensitive urban mapping”. Alternative and artistic cartography.

MAY

4-5 May
International Workshop on Communication Technologies for Vehicles.
Find out more...
The International Workshop

11 May
Mobility in the smart city “The City of the Future” event on the Descartes campus.
Find out more...
Mobility in the Smart city

10-12 May
Acoustics and Vibrations Technical Days.
Find out more...
Les JTAV 2017

18 May
Bron National Scientific Encounters Around the theme “Dreaming the city, dreaming the world”.
Find out more...
Patrick Chamoiseau and Michel Lussault

18-19 May
French language transport socioeconomics seminar. Organised jointly with the Ministry for an Ecological and Solidary Transition.
Find out more...
Transport policies and decision support

29-31 May
ITS-Telecommunications in Warsaw.
Find out more...
ITS-Telecommunications

MAY - JUNE

29 May to 2 June
1st European Pavement Friction Workshop.
Find out more...
1st European Pavement Friction Workshop

31 May to 2 June
ITF 2017: IFSTTAR at the International Transport Forum
Find out more...
ITF 2017
JUNE

- 2 June
ERC Vespa: creation of a new joint research team (IFSTTAR/Agrocampus Ouest) dedicated to the role of plants in urban areas.
Find out more... Vespa

- 6 June
Differing perspectives on: Culture, sciences and areas. Conference cycle “urban mapping”: Planned or improvised cities?

- 13 June
Seminar of the International Associative Laboratory (LIA) with Sherbrooke University “LIA Ecomaterials”.
Find out more... LIA Ecemat meeting

- 14-16 June
Find out more... The JOA 2017

- 19-22 June
ITS, Intelligent Transportation Systems World Congress, Strasbourg.
Find out more... ITS European Congress

- 29 June
INNOV’DAY RAIL: a day of meetings devoted to the future of railway research.
Find out more... Innov’Day Rail

SEPTEMBER

- 11-15 September
LABEX WEEK 2017, the 3rd international conference of the Urban Futures Labex
Find out more... LABEX WEEK 2017

- 13 and 14 September
Find out more... 1st Franco-Japanese workshop

- 18-21 September
Find out more... IPIN 2017

- 19 September
The National Mobility Consultation: helping to reinvent mobility.
Find out more... Les Assises nationales de la mobilité

- 24 September
Nantes Digital Week Public presentation of the NoiseCapture application.
Find out more... Noise-Planet NoiseCapture app

- 29 September
Future-oriented workshop on automated mobility.
Find out more... Future-oriented workshop on automated mobility
OCTOBER

2-4 October
UHPFRC 2017: 3rd international symposium on Ultra High Performance Fibre-Reinforced Concrete in Montpellier.
Find out more...
UHPFRC 2017

7-15 October
26th Science Festival
Find out more...
26th Science Festival

10 October
Knowledge encounters associated with the Fête de la Science: “Mobility and digital (r)evolutions”.

16-17 October
30th edition of the JCartier encounters: Mobility in all its forms for the benefit of local authorities and citizens.
Find out more...
30th Edition of the JCartier encounters

24 October
Signing of a cooperation agreement with RTRI (Railway Technical Research Institute).

NOVEMBER

15-16 November
TAP 2017: International Transport and Air Pollution Conference.
Find out more...
TAP 2017

15 November
Signing of a framework agreement between the World Bank and IFSTTAR on pollutant emissions from transport.
Find out more...
World Bank and IFSTTAR on pollutant emissions from transport

21 November
Knowledge encounters “Digital technology for sustainable cities? Sense-City, an example of a reduced-scale digital city”.
Find out more...
Digital technology for sustainable cities?

23-24 November
Géorail: First international symposium on the geotechnical issues facing railways, Paris.
Find out more...
Géorail 2017

23-24 November
FUTURE Days: co-building the city of tomorrow.
Find out more...
FUTURE Days

27-29 November
8th Sound environment consultation.
Find out more...
8th Sound environment consultation.

DECEMBER

4 December

5 December
The SmartR project, steered by the École Polytechnique, the CNRS and IFSTTAR, selected by the Paris-Saclay SATT.
Find out more...
The SmartR project

6-7 December
Mutual understanding seminar at IFSTTAR’s Champs-sur-Marne site for the members of the future Gustave Eiffel University.
Find out more...
Mutual understanding seminar clip

8 December
Closure of the collective expert appraisal on Urban Land Uptake (Artificialisation des sols) jointly led by INRA and IFSTTAR.
Find out more...
Urban Land Uptake

13 December
Closure of the National Mobility Consultation.
Find out more...
Les Assises nationales de la mobilité
THE TRANSPORT MINISTRY CALLS ON IFSTTAR

In addition to its active participation in each of the six thematic working groups that met between October and December 2017, IFSTTAR responded to a request from the Transport Ministry to organise two important events: a workshop on urban logistics and a round table on the International Day of the Mobility Consultation (Assises de la Mobilité). IFSTTAR’s proposals for the Mobility Consultation belong to three main categories: planning, which sets out a vision of the state of the transport system in the long term; support and economic incentives; regulation and supervision, which includes transport safety. These proposals were presented by the Institute’s representatives in each of the six thematic working groups. Olivier Bonin (AME-LVMT) for “More supportive”; Nicolas Hautière (COSYS) and Thierry Kretz (MAST) for “More sustainable”; Rochdi Trigui (AME-LTE) and Guillaume Uster (COSYS-ESTAS) for “Cleaner”; Anne Aguiléra (AME-LVMT) for “More connected”; Dominique Mignot (TS2) and Philippe Vézin (TS2) for “Safer”; Laetitia Dablanc (AME-SPLOTT) and Jean-Patrick Lebacque (COSYS-GRETTIA) for “More intermodal.”

Digital technology offers new opportunities. Transport systems, travel practices and mobility policies are undergoing many changes and will continue to do so in the future. IFSTTAR rallied its network for the international day on 24 November, which brought together around 500 people. Led by Anne Aguiléra, a team from the LVMT jointly managed research unit organised a round table on the theme “Digital technology, new mobility practices and the concept of Mobility as a Service (MaaS)”. The participants included an advisor to the Finnish Minister of Transport and an official from the Singapore Land Transport Authority. Discussions focused on the nature of the innovations generated by digital technologies and on the role of public authorities in promoting their emergence, development and inclusion within sustainable mobility policies. Virginie Boutueil, Gaëlle Lesteven and Marianne Thébert of LVMT are unanimous: “Despite the differences in the territorial, cultural, political or economic context, the discussions have shown that current developments and the challenges that face local and national public authorities take very similar forms in many countries, both in the North and the South.” As requested by the Minister for Transport, the material gathered during the conference will be used as input for the draft Mobility Policy Act (“LOM”). Through its participation in working groups, Innovation workshops and various Mobility Consultation events, IFSTTAR has been particularly active and conspicuous in its public policy support role. This work is continuing in 2018, at the instigation of the DGITM, as a qualified member of the group drafting the Mobility Policy Act.

We brought together a large amount of input from researchers from IFSTTAR departments within a limited timeframe. The results of several years of collective research on these issues are clear: there is not one form of sustainable mobility but several, depending on the users, their characteristics and the situations in which they find themselves, as well as the different types of area...

COPRINNE BLANQUART,
Director of the AME Department

In parallel with these groups, periods were set aside for speaking and debate, for example the themed workshop on urban logistics on 17 October in Paris, organised by IFSTTAR and chaired by the Deputy Valérie Lacroute. “Promising avenues have been explored for promoting innovative urban logistics solutions,” explains Laetitia Dablanc. This researcher is particularly pleased that the organisation of last mile logistics has been considered, as this is a real challenge for urban planning and space management policies at the different territorial scales. “The question of harmonisation and making sure that regulations are clearer for freight transport professionals has emerged as a key issue”.

Find out more...
The FUTURE initiative, led by the Université Paris-Est, is a project that brings together seven members and associates of the Université Paris-Est (UPE) community: IFSTTAR, UPEM, ESIEE Paris, EAVT, EIVP, IGN and ENPC. These partners are part of the I-SITE FUTURE consortium and are signatories to the agreement with the Agence Nationale de la Recherche, the main agency for higher education and research in the Future Investments Programme.

Accredited in February 2017 for a period of 10 years, FUTURE starts with a 4-year probationary period. Focused on the theme "the city of tomorrow", its scientific programme will be accompanied by the creation of an institution capable of implementing its strategy in the long term, with regard not only to research, training, support for economic development and public policy, but also partnerships and resources. This institution will be a university of a new type in France, made up of a national research institute (IFSTTAR), a university (UPEM), a national school of architecture (École d’Architecture de la Ville et des Territoires (EAVT) in Marne-la-Vallée) and two engineering schools (ESIEE Paris and the École des Ingénieurs de la Ville de Paris (EIVP)). The IGN will endeavour to improve ties between ENSG-Géomatique and the new establishment, while the École Nationale des Ponts et Chaussées will be linked to it through an agreement.

The aim of the university project is to create an internationally recognised institutional tool on the topics of transport, the city and urban planning. This specialization does not exclude any discipline, either now or in the future. A strong disciplinary base must ensure the excellence of research within our specialised themes and provide a foundation for the development of other themes in the medium term. This also applies to training, in addition to the priorities that are specific to it, i.e. the professional training dimension, pedagogical innovation and links with professions in the public or private sector. Geographical ties are addressed in two interlinked ways:

- the intake will include students from the area who have just finished secondary education, with the setting up of courses that will be demanding in terms of content and also support to help them achieve success;
- the expansion of existing facilities in France to bolster the research, training and partnership network on the topics covered by the university. These topics are often at the core of the questions posed by the public authorities, and advising public authorities at all levels (central government, Europe, local authorities) is considered equally crucial for the future university as transferring its research results to industry.
2017 PRIZES FOR PHDS

AME

SPLOTT
François Bahoken
Thesis prize awarded by the journal M@ppemonde.
Find out more

LVMT
Richard Zelezny
2017 Aydalot prize for the best thesis, awarded by the ASRDLF (French Language Association for Regional Sciences).
Find out more

SPLOTT
Françoise Bahoken
Thesis prize awarded by the journal M@ppemonde.
Find out more

GEOLOC
Nicolas Antigny, Myriam Servieres and Valérie Renaudin
2nd best paper at the 2017 IEEE IPIN conference.
Find out more

SII
Antoine Cринiere and Jean Dumoulin
Best paper award, 2017 SPIE Thermosense 2017 (SPIE = International Society for Optics and Photonics)
Find out more

COSYS

LEOST
Virginie Deniau
elected international vice-chair of Committee E of URSI (International Union of Radio Science)

SII
Vincent Le Cam
Vinci 2017 prize for innovation (regional “Processes and Techniques” prize)

COSYS (LISIS) + MAST (EMMS+SMC)
Aghiad Khadour, Gonzague Six, Marc Quiertant, Sylvain Chataignier, Jean-François David, Richard Michel, Yannick Falaise and Bruno Godart
Awarded the 2016 Cerema prize in the innovation category.
Find out more

Anne Ruas
ICA Honorary Fellowship (ICA: International Cartographic Association)
Find out more

LICIT
Ludovic Leclercq
Grant Mickle Award from the TRB (Transportation Research Board)

SII
Antoine Cринiere and Jean Dumoulin
Best paper award, 2017 SPIE Thermosense 2017 (SPIE = International Society for Optics and Photonics)
Find out more

GERS

SV
Elif Oral
CCR Prize (Caisse Centrale de Réassurance) “CAT NAT”

GEOEND
Céline Filippi
Best paper at the “Near Surface Geoscience Conference” - September 2016, Barcelona, Spain.
MAST

NAVIER + EMMS
Astrid Billon
Silver medal in the SMABTP Thesis Competition.

NAVIER
Romain Mesnil
Hangai Prize awarded by the International Association for Shell and Spatial Structure

Jules Thiery
Thesis prize from Université Paris-Est in the category Science, Engineering and the Environment, for his work on transfers of liquid in nano-porous media.

Sébastien Brisard
2017 Jean Mandel Prize for Mechanics (LMS, Polytechnique-ENSMP).

Philippe Coussot
Weissenberg Award from the European Rheological Society.

Lionel Du Peloux, Frédéric Tayeb, Olivier Baverel, Jean-François Caron
"Best Paper Award" from the journal Structural Engineering International.

LBMC
Anicet Le Ruyet
Best paper award "John W. Melvin Student Paper Awards", at the "Stapp car crash conference"

MIT/LAMES
Marion Lambert
Best poster prize at the 7th International EATA Conference (European Asphalt Technology Association), Zürich, Switzerland.

TS2

LBA + LMA
Hedi Hamdane
Prize awarded by the Abertis International Chair for transport infrastructure management, in the "Road Safety" category.

LBA
Manuel Taso
AMU (Aix-Marseille Université) Thesis prize.

TS2/Various units
Catherine Gabaude, Martine Hours, Bernard Laumon, Jean-Louis Martin, Dominique Mignot
Interior Ministry Bronze Medal (for Road Safety)

LMA
Hugo Loeches De La Fuente
Young Researchers Award ECTRI-FEHL-FERSI, 8th Young Researchers Seminar 2017, 16-18 May 201, Berlin, Germany.
SCIENTIFIC LIFE: RESEARCH AND EXPERTISE
These issues were defined by the new Goals and Performance Contract (COP 2017 – 2021) which came into force in 2017. Themes 1 and 2 extend the challenges of the 2012 scientific strategy on mobility and infrastructure, and challenges 3 and 4 on the environment and regions are refocussed within the same theme which deals with the protection and development of regions. In addition to the three scientific themes, the 4th theme aims to encourage and promote scientific excellence and technology transfer within the institute.

THEME 1
EFFECTIVE TRANSPORT AND SAFE TRAVEL

Goal 1: Improving the reliability of passenger and freight transport for all modes and purposes, with well-managed costs and externalities.
Goal 2: Enhancing the safety and ergonomics of transport, for mobility that is stress-free and respectful of human life.
Goal 3: Making progress with regard to multimodal, intelligent, clean and seamless systems and services.

THEME 2
MORE EFFICIENT AND RESILIENT INFRASTRUCTURE

Goal 4: Modifying infrastructure, at the lowest possible cost, in response to climate change and new operating and maintenance requirements.
Goal 5: Helping to build a circular construction economy by increasing the use of renewable materials and alternative biomaterials.
Goal 6: Developing new generations of transport and energy production infrastructure that take account of the energy transition.

THEME 3
PLANNING AND PROTECTING REGIONS

Goal 7: Foreseeing natural and climate risks in order to improve the resilience of cities and regions, reduce their vulnerability and protect the population.
Goal 8: Understanding, evaluating and streamlining the interactions between infrastructure, transport services and planning policies, as well as their impacts on the environment and the population.
Goal 9: Helping to implement sustainable regional planning, especially in urban areas.

THEME 4
FOSTERING AND PROMOTING SCIENTIFIC EXCELLENCE AND TECHNOLOGY TRANSFER

Goal 10: Creating conditions that foster excellence in research.
Goal 11: Sharing scientific and technical output, knowledge and know-how.
Goal 12: Increasing the Institute’s contributions to innovation.
Internal changes in its research structures are an integral part of the life of a research institute to better adapt to scientific issues while taking into account the ambitions and desires of the staff working in the laboratories.

An emerging Simu&Moto research team (Simulators & Motorcycles) was created in 2017 within the TS2 department with as its main topic the simulation of motorised two-wheeler driving. The team is currently concentrating on formalising its scientific project, which could eventually be integrated within an existing laboratory or jointly-managed research unit.

The GEOLOC laboratory which conducts research and expert appraisals on geolocation methods and systems has migrated from the COSYS department to the AME department. It has upgraded its scientific project to respond not only to the technological and societal challenges linked to the digital transition and greater connectivity for all transport stakeholders, but also to accommodate changes in mobility practices and vehicles. It is thus moving closer to the uses of mobility.

Within the MAST department, a new laboratory EMGCU (Testing and Modelling for Civil and Urban Engineering) was set up at the start of 2018 as a result of the merger of two laboratories covering similar scientific themes: EMMS (Testing and Modelling of Materials and Structures) and SDOA (Safety and Durability of Bridges). This merger gave rise to discussions held throughout 2017 in order to finalise the scientific project for the new single laboratory. EMGCU focuses its activity on engineering structures and all aspects related to their aging: the development of diseases and understanding of the processes that lead to disorders (cracking, etc.), estimating their lifespan and managing their lifecycle optimally.

Cooperation with external partners also helps to structure research activities. It is encouraged where it is scientifically relevant and speeds up the creation of teams that possess the necessary skills to tackle emerging scientific problems. IFSTTAR creates various forms of partnership. In 2017, a Joint Research Team (ERC) was set up in collaboration with Agrocampus Ouest bringing together the Water and Environment Laboratory (LEE) in Nantes (GERS Department) and an Angers-based laboratory, the Physical Environment of Horticultural Plants (EPHOR). This ERC will go under the name of VESPA (City Water Soil Plants Atmosphere), and is the first research team to deal with plants and soils in urban areas. In addition, a ninth jointly-managed research unit was created with CEREMA in the area of environmental acoustics, confirming long-standing collaborations between the teams. A project for a UMR was also presented for evaluation by HCERES in the field of psychology. This UMR would be formed by a merger between the Mobility and Behaviour Psychology laboratory (LPC, AME department) and the Laboratoire Adaptations Travail-Individu (LATI) at the University of Paris Descartes.

The launch of four unifying projects aims to encourage cross-disciplinary and interdisciplinary research within the Institute in the laboratories of its five departments. It must also make IFSTTAR’s presence felt on current issues with high stakes for society.

> **The Ville 2050** unifying project focuses on the design of tomorrow’s sustainable and “liveable” cities, in particular in the context of climate change and the energy transition and in order to meet the targets set for 2050 to limit the environmental impacts of cities. How can we work towards mobility for all, towards a city that consumes little energy and resources and has a small environmental footprint, which at the same time is adaptable and resilient?

> **The Mobility and Digital Transitions** unifying project focuses on the ongoing digital transitions that have already had major consequences in the field of mobility and will continue to do so in the future. It deals with the emergence of digital technologies for connected mobility, aiming to show how it is possible to study mobility from the digital perspective and consider how stakeholders and areas are addressing the opportunities opened up digital technology.

> **The Virtual traveller** unifying project aims to simulate human behaviour in order to predict the impacts of tomorrow’s mobility. The simulations it performs take in new traffic regulations, increasingly delegated driving aids and autonomous vehicles, but also individuals’ reactions and behaviour in the face of these new vehicles and facilities.
The Infrastructure for the energy transition energy unifying project deals with adapting infrastructure to climate change, extending its lifespan, monitoring it and making it more "intelligent", reducing maintenance costs and preserving assets.

In 2017, kick-off seminars were held for each of these projects. These seminars brought together a large number of participants and enabled the various teams to discuss their work and consider new common approaches. They are led by teams of three researchers and the progress of the work is consolidated by an operational committee.

In addition to unifying projects, the scientific directorate encourages important research collaborations with partners, network leadership and targeted initiatives by young researchers or emerging research topics. In 2017, 11 targeted initiatives, 3 research collaborations and 1 networking action were launched. That same year, 4 network leadership initiatives, 5 targeted initiatives and 7 research collaborations were concluded with 5 seminars to present the work.

— IFSTTAR IS PUTTING IN PLACE DEDICATED POLICIES TO SUPPORT ITS RESEARCH ACTIVITIES

**IFSTTAR** is implementing dedicated policies to support its research activities, which are in line with the major research priorities at national and European levels.

**DIGITAL POLICY**
To respond to the issues resulting from the digital transformation of research activities, several practical support projects for research structures have been carried through. The establishment of a centralized computing and storage centre for the entire Institute now offers new possibilities for the development and hosting of data or applications. Similarly, the development of a research data management policy aims to assist the modification of practices to comply with new data requirements (laws and regulations, cybersecurity, etc.).

If we look at a more precise level, that of travel simulation activities, the existing operational organisation has been revamped and a project to overhaul software tools is ongoing.

**OUR POLICY FOR CAPITALISING ON OUR RESEARCH**
This has led to the implementation of the "IS Research" tool. Designed to meet the needs for capitalising on information about research projects and expertise, it avoids the fragmentation, or even the loss, of information, reduces the number of internal audits conducted into our laboratories, streamlines data collection and validation channels, and finally presents information that is distributed across various applications in the information system in an intuitive and standard form (financial information, time spent). The system was deployed in early 2017 in all our departments and laboratories. In a year, 500 files were submitted, bringing the total number to 1200. Each contains between 10 and 100 items of data: title, type, summary, related projects, funders, stakeholders, opinions, documents...

"SI recherche" was constructed in agile mode by a group of future users from the Institute’s laboratories and management departments, in continuous dialogue with the in-house development team.

**SCIENTIFIC AND TECHNICAL INFORMATION POLICY**
This is part of a national initiative for open science which is accessible to all researchers. To encourage direct communication between researchers, IFSTTAR is actively seeking open access distribution for its publications. Thus, the order of July 31, 2017 for dissemination and free access (http://www.IFSTTAR.fr/ressources-en-ligne/nos-politiques-de-diffusion-de-connaisances/documentation-scientifique-et-technique/) is in compliance with the provisions of Article 2 of the Digital Republic Act codified in Article L533-4 of the Research Code. This Article gives researchers the opportunity to disseminate the final version of their manuscript once it has been accepted for publication and specifies the terms and conditions for so doing. By this order, IFSTTAR has introduced a depositary requirement and confirmed its decision to gather together all its scientific literature in its local institutional open archive (http://mads-externe.IFSTTAR.fr/). This archive, which is interfaced with the national open archive HAL and the European OpenAIRE platform, can also be consulted in the HALIFSTTAR series (https://hal.archives-ouvertes.fr/IFSTTAR). In line with this policy and with the concern to combat the pricing increases and models that are imposed by the major Anglo-Saxon publishers, IFSTTAR was the second signatory of the Jussieu Call for Open Science and Bibliodiversity (http://jussieucall.org/index-FR.html).

This call, the result of an initiative by a French group representing researchers and scientific publishing professionals, is aimed at scientific communities and research institutions. It advocates open access to scientific publications to encourage bibliodiversity and innovation that is not restricted to a single approach based on the transfer of subscriptions towards APCs ("Article Publishing Charges").

— RETURN TO CONTENTS —
doctorate can be the stepping stone to an academic career. But internationally, and for a very wide range of professions, the PhD is increasingly becoming a pre-requisite for entering the jobs market at a very high level, since it is recognised as a high-level course that teaches students to cope with the complexity of a subject over a significant period of time. Employability is often facilitated by a thesis topic related to the socio-economic needs of companies or local authorities. A significant number of PhDs at IFSTTAR are conducted within the framework of CIFRE (Industrial Agreements for Training through Research), which allows a company to hire a doctoral student who will occupy a central position in a research partnership with a public laboratory, with the financial support of the Ministry of Higher Education, Research and Innovation. IFSTTAR actively participates in the CIFRE forum (http://www.anrt.asso.fr/fr/forum-cifre-7825). PhDs can bring new types of expertise into laboratories while at the same time taking part in the training of doctoral students via the doctoral schools in IFSTTAR’s partner universities. Between its creation in 2011 and the end of 2017, IFSTTAR trained 575 PhDs. Their employment ratio (for both fixed-term and permanent contracts) after one year is 90% for those who gained their PhD in 2016. It is over 93% for those who gained their PhDs in previous years. In 2017, IFSTTAR awarded 25 doctoral contracts, which represents a financial commitment of €2.5 million. In addition, 12 doctoral contracts were signed with an external employer. Work has started on 14 CIFRE theses, 8 research contract theses, 5 theses on fixed-term contracts (including two theses that are jointly supervised with Canada) and one ITPE4A thesis. In total, work on 65 theses has got under way in the Institute’s laboratories or jointly managed research units! At the other end of the process, 75 theses were defended in 2017.

INTERNATIONAL AND NATIONAL NETWORKS

IFSTTAR takes part in networks in order to benefit from scientific synergies in a variety of research areas.

INTERNATIONAL PARTNERSHIPS

These grow and become stronger over time. They are now implemented through bilateral partnerships with organisations (research institutes, universities, ministries, private operators such as the World Bank for air pollution) in 18 countries. The resulting activities take different forms that nurture research and its exploitation. In particular, they enabled 32 foreign researchers to join IFSTTAR in 2017. In 2017 the most extensive and diverse activities were with Japan thanks to numerous partnerships, notably with the PWRI (Public Works Research Institute), the PARI (Port and Airport Research Institute), and the universities of Tokyo, Kyoto and Kwansei Gakuin. A fouryear framework agreement was signed with RTRI (Railway Technical Research Institute) providing a framework for researcher mobility and facilitating the joint publication of collaborative work. Several scientific events were held in 2017, notably the Concrack scientific seminar (MAST department) in Tokyo on 24-26 April on the occasion of the publication in English of the revised version of the recommendations of the Japan Concrete Institute (JCI), the France-Japan scientific seminar on psychology (social, cognitive and ergonomic) applied to transport (steered by COSYS) and a week of discussions on natural disaster reduction from 2 to 6 October 2017 organised by the French Embassy in Tokyo. At the European level, IFSTTAR teams responded to the H2020 calls for projects and achieved the excellent success rate of 22%. Through these projects, the Institute is diversifying its partners and continuing to build its activities on two pillars of the Framework Programme: “scientific excellence” and “responding to societal challenges”. A dozen influential contributions for the next European framework programme have thus been coauthored by the researchers involved at different levels of working groups, and expert groups and at the institutional level.

NATIONAL PARTNERSHIPS

IFSTTAR engages in various forms of partnership in order to harness scarce expertise and anticipate future needs. These partnerships do not necessarily take the form of jointly managed research units or joint teams. They may also be set up by an agreement or framework contract,
making it possible to maintain contacts between research teams with the same scientific interests. With this in mind, the framework agreement with MétéoFrance was extended at the end of 2017 and regular meetings are held for those involved, who include CEREMA, BRGM and INERIS. Within a more institutional setting, IFSTTAR plays a leading role in the Allenvi Research Alliance for the Environment, in particular with regard to the urban environment and mobility, and is involved on a long-term basis in developing scientific policies for each of its sites. The year 2017 was marked by the selection of the I-Site Future project for the Marnela-Vallée site but also by the I-Site Next projects in Nantes and the I-Site and IDEX developments in Marseille, Lyon and Lille, in which IFSTTAR is a partner.

An agreement has been signed with the DGITM (French General Directorate for Infrastructure, Transport and Maritime Affairs at the Ministry for an Ecological and Solidary Transition) to the tune of €110k to support research projects of direct interest to the MTES. The DSR (Road Safety Commission) financed 4 projects in 2017 and issued a call for projects in November 2017. Research results are shared within the framework of the Scientific and Technical Network during discussion days, such as the technical road days, and other similar events on bridges, geotechnical engineering, noise and vibrations as well as the transport and trip study days.

In 2017, transfer seminars were organised to facilitate links between researchers and research users, in particular the Ministries’ Directorates-General. Seven “meetings” that took very different forms were organised, in small groups to discuss an issue in greater depth or in larger seminars. They focused on the reliability of transport systems (with the DGITM and DST), living with autonomous vehicles (DGITM), the mobility consultation as well as eco-materials and bio-sourced materials (DGALN: Directorate General for Planning, Housing and Nature) or pollution (DGEC: Directorate General for Energy and Climate) and the sound environment consultation (DGPR: Directorate General for Risk Prevention).

Support for public policies also relies on external demands and opportunities. For example, in collaboration with INRA, the Institute has conducted a joint study on urban land uptake (ESCO artificialisation des sols) at the request of MTES, ADEME and the MAA (Ministry of Agriculture and Food). Support for public policies can also take more ad-hoc forms, for example the participation of numerous researchers and engineers from IFSTTAR in the National Mobility Consultation, or in the public debates organised by the National Commission for Public Debate (CNDP). One example is the two researchers from IFSTTAR who took part in the public debate on the projects to extend the port of Dunkirk. An action plan has been approved in order to consolidate, clarify and coordinate our activities in support of public policies. In 2017, it led to practical information (dates, procedures) being posted on the Intranet for project leaders wishing to submit their projects to ministries. Our survey of actions in support of public policies using the SI Research tool is under way and this information will eventually be made available on the Institute’s website.

On 24 October 2017 the Managing Director of IFSTTAR signed a 4-year framework agreement with the RTRI.
As IFSTTAR is an applied research institute, partnerships with the socio-economic world are part of its DNA. These partnerships are necessary for the practical application of research results in ways that meet the challenges posed by the economic fabric and provide the resources needed to develop its activities. Two departments support researchers and their partners in these partnerships. One team (“BAC”) computes estimates and monitors expenditure statements, and has considerable expertise in invoicing for challenging partnership financing such as European projects (7 new European contracts notified in 2017). Another (AMP) supports the setting up of projects, seeks to maintain links with our partners and assists the Departments in their strategy of partnership with the socio-economic world.

A CONTINUOUS INCREASE IN THE AMOUNT OF REVENUE GENERATED BY PARTNERSHIPS WITH THE SOCIOECONOMIC WORLD

IFSTTAR has significantly increased its internal resources as a result of research contracts, and these reached the sum of € 18.1 million in 2017 € 6.5 million more than in 2013. It should be noted that the number of contracts has slightly decreased, but thanks to a more strategic approach to partnerships, their unit value has increased. This year also saw an increase in the types of contracts that are the most “profitable” for the establishment (bilateral contracts with companies and cost-controlled partnership contracts). An example of this is the I-Street project - “The road of the future” call for projects in the PIA4 programme managed by ADEME. This was set up in collaboration with the major partners in the sector, namely EIFFAGE, OLIKROM and TOTAL, and for which IFSTTAR receives funding to the tune of € 3.6 million.

See 2017 contracts, page 51

ENCOURAGING WELL-STRUCTURED, LONG-TERM PARTNERSHIPS WITH INDUSTRY

Partnerships with major players in the field are the subject of framework contracts. These simplify and speed up the creation of partnerships by providing a general legal framework for the creation of contracts. These contracts are monitored and managed by a scientific team and a business developer. To date IFSTTAR has signed 14 framework contracts with the main groups in the transport, infrastructure and energy sectors. IFSTTAR continues to be actively involved in forums for discussions between private and public stakeholders. In 2017, 6 FTE (Full Time Equivalent) posts were made available to the following PIA establishments VEDECOM, SystemX, Rateniun, and Efficacity.

In order to assist the Departments in their partnership strategy, an annual roadmap is prepared jointly between the support services concerned (AMP) and the Department directors to move from “reactive” contractualization to the qualitative planning of the envisaged partnerships, and to extend our customer portfolio.

ACTIVE PARTICIPATION IN STANDARDISATION ACTIVITIES

As part of its public policy support remit, research results in the field of standardisation are also shared with the socio-economic world through participation in standardisation committees. A representation database has been created which lists all our experts who are actively involved in standardization activities. In 2017, 51 experts participated in 67 committees, one third of them at European or international level.

REACHING OUT TO SMES

IFSTTAR’s Goals and Performance Contract includes a commitment to collaborate with stakeholders of all types, including those who are less well integrated in the transport R&D sector. The “Innov’day” formula, which had been acclaimed by the SMEs who took part in the event, was repeated in 2017, this time with rail as its theme. It provided SMEs with networking opportunities and exposure. Some events are planned for 2018 in collaboration with the competitiveness clusters to enable SMEs to discover the research opportunities IFSTTAR can offer them.

FUNDING NEW TEST PLATFORMS, AND MAKING THEM AVAILABLE TO INDUSTRIAL PARTNERS

The AMP team offers researchers support for the purchase of new equipment, which is often involves complex procedures in the case of one-of-a-kind platforms. In order to improve the transparency of these major facilities for our partners, work has been done to establish fair pricing for flagship platforms, such as Sense City.
RESEARCH ACTIVITIES THAT ARE OPEN TO SOCIETAL ISSUES

The research conducted at IFSTTAR responds to major societal challenges. It is therefore essential to disseminate the results to as many people as possible by providing reliable information that can stimulate dialogue between Science and Society.

The IFSTTAR collections were created 3 years ago and now give pride of place to digital publishing and open access. Of the 8 books published in 2017, 7 were released under open access and the number of digital publications we distribute now far exceeds those on paper, since digital publishing accounts for 65% of the activity of the IFSTTAR bookshop compared to 35% for paper.

IFSTTAR's science and society web space gives researchers the opportunity to present their work to the general public. In 2017, the “Scientific topic files” have been given a new look, and they are now freely accessible, in the form of interactive pdfs and booklets in French and English. We also produce promotional bookmarks and paper saucepans for a younger age group.

The autonomous vehicle was the subject of a scientific topic file “Sharing views on automated vehicles” released in 2017. This topic, as well as that of the 5th Generation Road, was at the heart of discussions with audiences from inside and outside schools during workshops organised in Bron and Provins.

Some new series of videos were introduced in 2017: “Sum up your thesis”, “Focus on research” and “Focus on equipment”. Sixteen new videos were produced this year to showcase the work of IFSTTAR researchers and PhD students. The complete “Focus on the profession” series is now available on IFSTTAR’s website in the “Careers at IFSTTAR” section.

In 2017, the major task of listing, digitizing and indexing the Institute’s Scientific Heritage Image Collection was undertaken. Seventy-six LCPC scientific films are now available on the internet through our video hosting platform. Launched in 2012 as part of a partnership between the municipality of Bron, IFSTTAR and ENTPE, the Bron National Scientific Encounters (RSNB) constitute an innovative and participatory project around the theme “Cities that are more sustainable, socially just and supportive to citizens”. In 2017, citizens were thus invited, during the knowledge encounters and the general discussion, to discover the challenges and alternatives that exist in urban areas as well as the potential impacts of digital technology on the city.

As part of a partnership between IFSTTAR, Arcadi Île-de-France and Université Paris-Est, a series of conferences-debates entitled “Sensitive urban mapping” was held at the Maison de la Poésie in Paris. On this occasion, players in the fields of scientific innovation, literary and artistic creation had an opportunity to meet one another and reflect on how they see the city of yesterday and today.

Find out more...

The “Focus équipement” videos
The IFSTTAR topic files

— FORWARD TO THE “FUTURE”

2017 also marks the beginning of a new process for IFSTTAR and its partners - the I-Site FUTURE project.

This will fundamentally change the establishment and its research: its institutional aspect includes the creation of the so-called Gustave Eiffel National University, which has the ambition of becoming a scientific leader in the field of urban research, based on the various IFSTTAR sites and their partnership dynamics, and on the institutional merger with an existing University (Université Paris Est Marne-la-Vallée), three engineering schools (EIVP, ESIEE and ENSG) and an architecture school (ENSAT). For IFSTTAR, this is a tremendous opportunity to work with other partners and in other disciplines, such as history and urban planning, on the sustainable development of regions and socially desired public policies.

Significant resources have been allocated to the project in order to support some twenty flagship initiatives. This resourcing will be maintained if the international committee set up by the General Secretariat for Investment is satisfied with the quality of the organisation in place. 2017 was marked above all by the launch of interdisciplinary calls for projects that generated a large number of high-potential responses and by a series of “Mutual Understanding Seminars” whose primary objective was to forge closer links between the research teams and support staff of the various institutions.
Mobility and safety issues, which are central to IFSTTAR’s research, are addressed by Theme 1. The aim is to achieve “efficient transport and safe travel”. The purpose of this theme is to encourage the development of ways of attaining land transport/travel capacities that meet society’s expectations, i.e. that are more reliable, more energy-efficient, safe and responsible, and suitable for all people and goods. Three topics were addressed in 2017: digital technology and mobility, road safety and the human consequences of accidents, the development of services and their uses.

Mobility systems are crucial for the functioning of modern societies, and they must become more energy efficient, more reliable and resilient while integrating technologically innovative components. They must also make the effort to understand the consequences of the automation of transport systems. 2017 was a particularly eventful year with the National Mobility Consultation. This demonstrated that IFSTTAR’s research preferences were very sound. The acceleration of innovation and the digital revolution was the subject of the More Connected Mobility workshop, where the results from 2017 were presented. The exercise of documenting the concerns of French people, innovative service offerings and stakeholder preferences provides a broad and comprehensive view of future avenues for research on mobility and its future.
DIGITAL TECHNOLOGY AND MOBILITY

Digital technology plays an increasingly vital role in mobility. This is why IFSTTAR has sought to coordinate and unify its energies through an internal multidisciplinary organisation which it has called a “unifying project”. Thus, in the field of mobility, two unifying projects have been launched “Mobility and the digital transition” and “Models of human beings: their impacts on tomorrow’s mobility”.

The Mobility and Digital Transition unifying project

The digital revolution is having a major impact on our mobility and transportation. This is underpinned by the increasing number of mobile terminals, connected equipment and new technologies that assist the movement of people, vehicles and goods. For public transport, real-time access to digital data makes it easier to find a route, consult timetables, choose a transport mode and purchase tickets. Such data can also be used to improve traffic conditions, enabling suppliers to adjust their transport services and improve maintenance and safety. The digital transition is also contributing to the rapid development of a collaborative mobility economy through service platforms that connect their customers directly to ride seekers, facilitating the sharing of vehicles (with or without drivers), bicycles or other means of transport. Connected vehicles now have on-board technologies that facilitate their movement on intelligent infrastructures that give priority to public transport, multi-occupancy vehicles or alternative routes. Digital technology is a new and indispensable tool for the future of mobility, and synonymous with progress and profound changes for all stakeholders: service users, local authorities, businesses and public transport services alike.

It is in this context as well as that of the many other practical projects being conducted at IFSTTAR on this topic that the unifying project “Mobility and Digital Transitions” was born. To date, 11 laboratories from the three departments (COSYS, TS2 and AME) have expressed an interest in participating in this project which comprises three components: connected mobility, the use of digital technology to study mobility, and stakeholders and areas faced with the opportunities offered by digital technology.

Proceedings of Mobility and Digital (R)evolutions

The observation of customs and practices is made possible by massive data collection. The strengths and potential of digital technology and its ability to change mobility patterns are of interest to researchers in the human and social sciences. The journal Netcom has devoted a special issue to this subject. This issue describes some of the papers presented at the 15th conference of the Spatial Mobility and Social Fluidity (MSFS) group which belongs to the International Association of French-speaking Sociologists (AISLF). Entitled “Mobility and Digital (R)evolutions”, this conference took place on 8 and 9 November 2016 in Marne-la-Vallée and was organised under the aegis of the Urban Futures Labex, the Île-de-France Region and IFSTTAR. While the term “mobility” was understood in a broad sense referring to the introduction of novel conceptual and empirical approaches to mobility in the social sciences, the selected papers focus more specifically on trip-making, both from the standpoint of individual practices and the transport systems used.

In all, 9 papers, which explore three lines of thought, are featured in this issue. Their aim is to examine the innovative (or not) strengths and potential of digital technology. The first focuses on the potential and limitations of new digital data for mobility analysis. The second and third lines of thought consider how digital technology transforms travel practices. However, while the second targets new mobility services, the third focuses more on a set of practices.
European grant: the Smartwalk project for more precise geolocation

The development of navigation systems has benefited greatly from technological advances. Their reliability is essentially due to the precision of the geolocation on which they are based. Today, thanks to the Smartwalk project, pedestrians can benefit from the progress, especially indoors where satellites are not accessible. This project, which has been awarded the Marie Curie European individual grant, has led to the invention of new approaches to localization in order to measure and analyse indoor personal mobility.

The research has developed algorithms for locating pedestrians using sensors that are built into connected objects. The calculation is done autonomously (with no reliance on terrestrial radio telecommunications networks) and complies with European regulations concerning the privacy of traces. A quaternion attitude filter and a multimodal statistical model of hand accelerations are used to estimate the direction of walking (which differs from that of the sensor) to within less than 20° over a walking distance of 1 km. Cross-disciplinary work (engineering, cognitive and legal sciences) has explained why, after 10 years of research, no universal walking navigation system has been adopted. Two innovative devices have also been developed: ULISS and PERSY, which are freestanding units that record GNSS satellite and magnetic signals.

The results from Smartwalk have enabled the AME GEOLOC laboratory to collaborate with international groups in the navigation sector. They have also led to two patents and new projects on personal mobility.

The H2020 project: Roll2Rail

Adapting the rail system to automation, particularly in open environments, is an important challenge and requires localization, traffic management and information exchange functions to be performed in normal and degraded mode. The train of the future will have to provide better operational reliability and reduced life-cycle costs. The information and communication sciences are central to these challenges. The Roll2rail project (“New dependable rolling stock for a more sustainable, intelligent and comfortable rail transport in Europe”) is in line with this goal. This H2020 project aims to revolutionise railway rolling stock. This is one of Shift2Rail’s flagship forerunner projects for the innovation program. IFSTTAR has been instrumental in the transition from the wired train-borne TCMS (Train Control Management System) to a wireless network, based on a backbone network using LTE eNodesB and Wi-Fi access points in the railcars. RAMS and cyber security properties were also investigated, using the IEC 62443 cyber risk analysis method and in-depth threat and vulnerability analysis. The three studied cases concerned passenger Wi-Fi, the control/command system for opening/closing trainset doors and the CCTV system. IFSTTAR also worked on the analysis of train-to-train propagation channels in the 5.8 GHz and 60 GHz ranges for virtual coupling applications.

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INTERNATIONAL CONFERENCES

Still on the subject of digital technology and Big Data, we should point out that the COSYS GRETTIA laboratory organised a special session at the ESANN’2017 conference on Artificial Intelligence (AI) and massive urban data. In the field of innovative methods combined with new technologies, the COSYS ESTAS laboratory organised the international conference on rail transport RailLille2017. IFSTTAR’s involvement in the organisation of these international events enhances its profile.

ESANN’2017

As part of this international conference, COSYS GRETTIA organised a special session entitled “Processing, mining and visualizing massive urban data”. This session was devoted to the visualization and processing of large volumes of data in order to develop decision support tools for mobility services and, more broadly, in relation to the city of tomorrow. The conference brought together participants from the academic and industrial sectors to interact and present the latest advances in methodology and applications in the field of Data Analytics.

RailLille2017 Conference

2017 was memorable for the organisation of a major international event by the COSYS ESTAS laboratory: the “RailLille 2017” conference which was held from 4 to 7 April. This was the 7th edition of the IAROR (International Association of Railway Operations Research). This association brings together the academic and professional expertise in railway research. It promotes innovative methods (theoretical approaches and technological development) which increase the flexibility, performance and punctuality of the rail system.

The conference was attended by a record 212 participants from 21 countries. The majority (61%) of the participants were from academia, but there were also many representatives from transport operators (25%) and consultancies (13%). Various topics were addressed in lectures given by invited speakers. These included capacity assessment, line planning, the optimisation and robustness of schedules or train movements, operational traffic management, and taking passengers into account in the design of transport plans, etc.

The lectures attracted nearly 70 participants. An ESTAS laboratory paper on the optimisation of traffic planning during track maintenance works was awarded first place among the best ten that were presented. The papers in question were published in the journal Computers & Operations Research.

ESANN’2017 program

RailLille2017 Conference
FUI AWARE project: cameras to provide better all-weather visibility

The automotive industry has not been left behind in the quest for automation. This involves various phases of technological development in the context of increasingly sophisticated delegated driving systems. The FUI AWARE project aims to guarantee all-weather road visibility by means of increasingly effective sensors. The road and air transport modes are tackling the same problem, which is, by 2018-2019, to have aid systems capable of perceiving the environment and detecting all local movements, whether of moving objects or vulnerable users. This detection must work under all weather conditions, especially in so-called degraded situations such as at night, or in fog, snow or rain. A survey of present-day ADAS (Advanced Driver Assist Systems) shows that technological solutions based on visible light cameras, radar or lidar meet the functional need for detection under favourable conditions, chiefly during the day. Under degraded conditions, these solutions have some limitations and provide less reliable detection. However, reliability is essential for safety.

The benefits of combining a colour camera and an infrared thermal camera to better detect obstacles (vehicles, pedestrians or animals) in poor weather have been demonstrated, thanks to several series of video captures made under various conditions, in the CEREMA Clermont-Ferrand fog tunnel at Col de la Fageole, and on open roads in Ile-de-France. Data from video synthesis has also been used. Different types of video stream processing developed for visible light and that are useful in driving aids have been evaluated and in some cases modified by different project partners so they can process thermal infrared images. A patent for the work carried out by the COSYS LEPSIS laboratory within the framework of the project is under consideration. The autonomous vehicle, whether for the transport of people or goods, will evolve in the coming years and lead to new forms of mobility: autonomous mobility.

The large number of industrial, economic, societal, environmental and ethical challenges associated with the development and deployment of automated mobility, the fact that we must face all these challenges simultaneously and the fact that they have an impact on the daily lives of individuals, the strategies of businesses, the equilibrium of areas and governance issues, prompt us to take an interest in this issue as of now and define rules to ensure that the rights and safety of transport users are respected. This is the objective of the future-oriented workshop on automated mobility led by DGITM’s Intelligent Transport Team.

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Future-oriented workshop on automated mobility

Launched by the Ministry for an Ecological and Solidary Transition, this future-oriented workshop aims to tackle “autonomous mobility” with a broad, interdisciplinary, cross-sectoral approach, following a systems approach that will be organised around in three areas: changes to society and lifestyles, changes to areas and changes to mobility. This is the framework within which IFSTTAR, one of the instigators of the initiative, is beginning to conduct research. The Workshop sets up productive collaborative processes that will provide input for regular meetings. A first demonstration took place on 2 May 2017. It made it possible to lay the foundations for collective, long-term work.

Vision 2016 - International Conference Night Drive Tests and Exhibition, 7p, 2016. “All-weather vision for automotive safety: which spectral band?”

AWARE Consortium:
- Valéo, automotive sector,
- Safran-Sagem, aeronautics and system architecture,
- Lac, cost optimization,
- CEA-Leti Ulis, detection and sensor technologies,
- Oktal et Oktal SE, simulation technologies,
- Nexyad, signal processing,
- Ifsttar et Cerema, characterising degraded conditions using cameras and field tests.

Find out more...
ROAD SAFETY AND THE HUMAN CONSEQUENCES OF ACCIDENTS

Even if driving automation has, in the long term, the potential to reduce the number of accidents caused by unsatisfactory driver behaviour, there is still a long way to go. The signs of a worsening road safety situation require us to conduct further detailed analysis of the causes of accidents and analysis of injury mechanisms. Here again, data are essential for assessing situations and devising solutions. The Rhône Register, created in 1995, still remains a powerful research tool for monitoring road trauma victims and better understanding the link between accidents and trauma, as was investigated in the analysis of cranioencephalic traumas.

Analysis of cranioencephalic traumas

Cranioencephalic traumas are one of the leading causes of death or disability in industrialized countries. Road traffic accidents are responsible for one third of head injuries of all severity levels combined (Scholten, 2014) and this proportion rises to half for severe head injuries (Masson, 2001). The frequency and severity of these traumas has prompted the French Public Health Commission to consider the issue and fund a study to provide a more accurate description of cranial trauma injuries. It was possible to conduct this study thanks to the Rhône Register which was set up by UMRESTTE in 1995. It is the only French database that provides a detailed description of injuries regardless of the severity of the trauma. The aim was to take stock of the analyses already carried out on the Register and to describe brain injury casualties in terms of the frequency, impacts, demographic characteristics, circumstances, nature and severity of the injuries. Of the 80,542 victims identified in 2005-2014, the Register included 4913 head injuries. The average annual incidence was 28.5/100,000, and higher among males (43/100,000 versus 15/100,000 for females). Head trauma victims were mainly motorists (36%) followed by motorcyclists (24%), pedestrians (17%) and cyclists (17%). While the number of head injuries among motorists has halved since 2005, more remains to be done for vulnerable road users. A report has been sent to the French Public Health Commission (Santé Publique France) and a poster has been accepted at the EuroEpi2018 Congress to be held in Lyon from 4 to 6 July.

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**CHUT: better understanding skin injuries in order to propose design improvements for passenger compartments**

As can be judged from the research mentioned above, describing the consequences of an accident in terms of injuries provides great benefits.

Pursuing the same objective, the targeted initiative “CHUT: Characterisation of Haematomas among Transport Users” aims to quantify the stresses that may cause bruising or haematomas. It is based on a digital model of the skin. This research aimed to develop a tool to predict the risks of injury from minor injuries. CHUT was led by the Biomechanics and Impact Mechanics Laboratory in the TS2 department over the 2016-2017 period. The research team consisted of K. Bruyère (Senior Researcher), M.-C. Chevalier (Research Engineer), S. Nicolle (Lecturer) and M. Ottenio (Lecturer). Their objective was to launch research that would eventually lead to the development of a tool for predicting injury risks from minor injuries, such as bruising. At present, there is no reliable tool for predicting this type of injury. Nevertheless, such injuries occur frequently among the users of “soft” transport modes. To determine the mechanical criteria that are just sufficient for bruising to occur, an ex vivo experimental dynamic compression protocol was devised for the upper limb. “Revascularisation” of the limb, without which no bruising can occur, was then attempted, but without complete success. For the time being, applying static pressure is the adopted method. In parallel with this experimental approach, a multilayer digital model of the skin (dermis and hypodermis) with capillaries was developed to simulate at the local level what happens during an impact on the zone in question and thus determine the maximum stresses/deformations applied to the capillary walls. An experimental campaign was carried out to characterise the mechanical properties of isolated capillaries in order to determine their breaking point.

**DALVAR: description of the associations between the Injuries sustained by road traffic accident casualties**

In 2017, the data from the Rhône Register was exploited for a second time in order to study the injuries sustained by road accident casualties. When the emergency services arrive at an accident scene, it is important for them to assess as accurately as possible the severity of the injuries sustained by each casualty in order to improve their care and refer them to appropriate hospital facilities. It was shown that the injury association profiles differ according to the type of user (cyclist, motorist, motorcyclist or pedestrian). The DALVAR targeted initiative has allowed a number of instructions for the care of the injured to be defined. Diagnosing the injuries sustained by accident casualties is challenging because the injuries are usually closed (as opposed to the injuries sustained by victims of stabbing, for example), particularly when internal organs are impacted.

We can therefore try to predict their presence based on other injuries that have been sustained. One way to approach this is to describe the associations between different injuries among casualties. These associations may depend on the circumstances of the accident, in particular the type of user (motorist, pedestrian, cyclist, etc.). Thus, to study the associations between injuries among traffic accident casualties, it seems quite appropriate to consider the population of casualties as a set of strata defined by the circumstances of the accident. The Dalvar targeted initiative simultaneously estimated several graphical models, each describing the conditional independence relationships among a set of variables in a given stratum. The preliminary findings using data from the Rhone Register made it possible to study the association profiles for the injuries sustained by road accident casualties, according to the type of road user: cyclist (vélo), motorist (voit), motorcyclist (moto) and pedestrian (piet).
THE DEVELOPMENT OF SERVICES AND THEIR USES

Digital technology has had a profound impact on the mobility ecosystem. New research and expert appraisal partnerships with innovative start-ups have been created and are set to expand. The work carried out together by IFSTTAR and the start-up Karos (short distance carpooling) is a good illustration of this new type of partnership.

KAROS: understanding practices in order to optimise intelligent carpooling

The start-up Karos is developing a predictive carpooling service based on machine learning techniques for automatically learning the travel habits of drivers and passengers in both time and space. All of a user’s trips are used to build a predictive model to estimate future trips and provide carpooling opportunities. Using a set of methodologies, the research aimed to study how Karos’ service could match the real practices of commuters. More precisely, traces of practices were analysed to study the identified carpooling opportunities, compare the successful and unsuccessful opportunities and deduce the factors of success. In addition, 22 in-depth interviews were conducted with car-poolers. They allowed us to identify the obstacles and levers with regard to use. The results have been converted into developments for the Karos application. They highlighted, for example, the role of instant messaging in transforming a simple carpooling opportunity into an actual carpool trip or the importance of offering opportunities that strictly follow the usual route used by future car-poolers.

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The Altaroad start-up

In 2017, the intelligent road project based on NANOASPHALT patented nano-sensors (managed by Bérengère Lebental) took shape with the creation of the start-up Altaroad, which is now incubated at AGORANOV in Paris and has a team of 4 full-time experts working on the project. The start-up follows a "lean" approach and is being co-created with its first customers. This means it can simultaneously optimise its technology, algorithms and implementation methods to create an optimal service that will, for example, be able to detect the footprint or weight of a specific vehicle, to conduct traffic management in the Smart City, to identify the areas of the infrastructure that require maintenance, or to quickly detect high-risk situations such as ice, wrong-way driving, or poor lane-keeping by an autonomous vehicle.

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B+R: promoting the bicycle as a feeder mode to railway stations

Digital technology should not make us forget that mobility remains a question of physical movement. Active modes, including cycling to stations, are beneficial for mobility. IFSTTAR’s expertise was also sought in this area for the B+R project on the use of the bicycle as a feeder mode with bicycle parking in stations.

In order to relieve congestion in station park-and-ride facilities (P+R) and to attract new passengers, SNCF Mobilité is seeking to encourage the use of the bicycle as a feeder mode with bicycle parking in stations.

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SNCF entrusted leadership of the “B+R” project to the consulting firm Sustainable Mobilities, which called on IFSTTAR’s expertise to offer the following to SNCF’s B+R project leaders:

> a method for dealing with B+R in house;
> materials for convincing the relevant officials in the regional and local authorities (arguments and keys to success);
> instruments for assessing the need, estimating the potential, prioritizing stations on a regional scale and sizing the facilities.

Many schemes of this type have already been introduced in several regions of France, often with success. The objective of the “B+R” project was to build on current trends and the available knowledge in order to create tools that present the arguments and methodology for the SNCF Mobilité staff who will be rolling out the B+R schemes in the regions.

In terms of arguments, we know, for example, that getting a regular passenger to switch from the car to the bicycle to go to the station represents a socio-economic saving of around €2000 (Predit VERT project, IFSTTAR 2015), or that one new person takes out a Regional Train seasonal ticket for every 5 to 8 additional bicycle parking spaces (ADEME study, 2016).

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Instant deliveries

Another major challenge is the mobility of goods. IFSTTAR’s research on urban logistics for the new “instant deliveries” urban logistics mobility services which are characterised by almost instantaneous deliveries. They can be defined as urban home delivery services that are available within two hours of ordering, using smartphone applications to connect auto-entrepreneurs on bicycles, restaurants or parcel shippers and consumers. After an initial survey conducted in December 2016, a second was undertaken from January to March 2018. It consisted of a 38-item questionnaire that was administered either face-to-face or by telephone on the personal circumstances (age, educational level, place of residence, etc.), the occupational circumstances (type of platform for which the courier works, working hours, pay, etc.) and working conditions and difficulties encountered when carrying out the tasks. The consultants 6T were commissioned to help design and conduct the survey.

Laetitia Dablanc

SPLOTT is studying the operation of the new urban logistics mobility services which are characterised by almost instantaneous deliveries. They can be defined as urban home delivery services that are available within two hours of ordering, using smartphone applications to connect auto-entrepreneurs on bicycles, restaurants or parcel shippers and consumers. After an initial survey conducted in December 2016, a second was undertaken from January to March 2018. It consisted of a 38-item questionnaire that was administered either face-to-face or by telephone on the personal circumstances (age, educational level, place of residence, etc.), the occupational circumstances (type of platform for which the courier works, working hours, pay, etc.) and working conditions and difficulties encountered when carrying out the tasks. The consultants 6T were commissioned to help design and conduct the survey.

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Transpolis

Transpolis is a major facility that is currently being built in order to conduct full-scale testing of innovative solutions for new forms of urban mobility. After 9 years of preparation, this platform is beginning to take shape when seen from above. Today, we can discern the outlines of the so-called Urban System district around its forty or so buildings as well as the two test tracks and the three impact zones belonging to the Security and Safety subgroup, and, between the two, the curves and intersections of the Architecture and Comfort zone. The buildings at the entrance to the platform have already been built, with the long reception complex where Transpolis will set up its offices alongside an area set aside for IFSTTAR and visitor reception, as well as the metal structure of the workshop where the vehicles will be prepared for the tests.

Seen from the sky, one can now understand that this platform covers 80 hectares, which is 1200 m long and 900 m wide, will allow us to adopt a systems approach to the topics to be addressed, with the possibility for research or industrial development teams to have all the facilities and resources that are usually distributed between several sites at the same location.

A crucible for innovation, a research space for urban transport, a site for full-scale tests or a certification facility for road safety barriers, for example, the platform located at Les Fromentaux will at last take its place in the international scientific landscape to meet the expectations of its designers and those who will join them.

Both data and innovation are at the heart of Theme 1’s research. New societal demands are being expressed, supported by new technologies and the new services they allow to be deployed. However, they must not overshadow the issues of security and social equality that are also of concern to IFSTTAR.
Increasing the efficiency and resilience of infrastructure entails facing new scientific challenges linked to adapting to climate change and responding to the energy, environmental and digital transitions.

Following on from the previous COP, this second theme aims to provide effective solutions to the maintenance, reliability and durability problems posed by ageing infrastructure. For example, the award of the CEREMA prize for the “Clerval VIPP (independent-span post-tensioned prestressed beam)” project is an acknowledgement of the quality of IFSTTAR’s work in the analysis and certification of a repair method for a common type of structure whose ageing is a critical problem on the national road and motorway network. At the end of 2017, the completion of several theses on the durability of traditional or innovative cementitious materials and the assessment of reinforced concrete led to significant progress in methods for evaluating structures, optimising maintenance and preventing deterioration. This work has contributed to a comprehensive revision of French and European standards.

The implementation of a circular construction economy and sustainable management of natural resources requires the use of recycled materials and biomaterials as well as improved life cycle assessment (LCA) techniques. Within the framework of the Energy Transition Law, an agreement with the DRI (Directorate for Research and Development) at the MTES was signed in 2017 to manage the FastCarb project which receives support from IREX. This project brings together some twenty institutional, industrial and research partners. Its goal is to use recycled concrete aggregate as a carbon sink in order to reduce the CO2 footprint of concrete, improve its recycling and make it possible to incorporate a greater percentage of this material in concrete.

2017 was also marked by the launch of research projects on emerging themes such as the digital transition of infrastructure and the impact of climate change on engineering structures and transport infrastructure. These include the launch of large-scale European H2020 projects such as ENSEMBLE, which contains a WP led by IFSTTAR to study the impact of platooning on infrastructure, traffic flow, road safety and the organisation of logistics. Another European project is PANOPTIS which is concerned with the monitoring and maintenance of transport infrastructures using representative digital models calibrated with data from surveillance, performed in particular by drones. This project also includes a climate change adaptation component.
ADAPTING INFRASTRUCTURE

The main body of research concluded in 2017 is aimed at adapting infrastructure to climate change and new operating and maintenance requirements at the lowest possible cost, through better knowledge of the ageing mechanisms of structures and the development of improved monitoring, evaluation and maintenance methods.

SUP&R ITN: an international project to increase the lifespan of bridges

The European SUP&R ITN project has helped develop innovations intended to extend the lifespan of infrastructure without decreasing its structural reliability. This project was concluded in 2017 and enabled IFSTTAR to take on 3 PhD students and release 6 publications and a software package for road and rail applications.

Coordinated by the University of Nottingham (UNOTT), the SUP&R ITN project (The Sustainable Pavements & Railways Initial Training Network) was submitted in 2013 in response to the FP7 PEOPLE ITN call for projects. It has made it possible to recruit 13 PhD students and 3 post-docs on topics related to the design, construction, maintenance, sustainability and environmental assessment of road and rail infrastructure. The main partners working with UNOTT were the Universities of Palermo, Dublin, Huelva and Granada, and the companies SACYR, REPSOL, Irish Rail and URS. IFSTTAR worked on the road component with a PhD student focusing on the durability of low-temperature asphalt mixes incorporating recycled materials (MAST/MIT) and on the environmental assessment component with a postdoctoral researcher working on life cycle analysis tools (AME/EASE). The total budget of the project was €4 million of which IFSTTAR received €0.5 million. The MAST/MIT laboratory also temporarily took on 3 PhD students on the resistance to cracking of mixes made with plant-based binders, warm mix binders and the modelling of rubberized mixes for railway applications. Launched in October 2013, the project was terminated in October 2017. The provisional output statement reports 50 publications including 6 from IFSTTAR as well as environmental assessment software (the SUP&R ITN MCDA Tool), all available on the project website.

Structure and themes of the SUP&R ITN project.
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DEDIR: from Design to the Sustainable Maintenance of Road Infrastructure

DEDIR (IFSTTAR/CEREMA) is a pivotal research project that has contributed to the development of new high-performance instrumentation and non-destructive testing methods, which are essential for improving the diagnosis and the well-considered maintenance of the road network. DEDIR is jointly led by IFSTTAR and CEREMA, with the goal of optimising the use of the resources available for the maintenance and preservation of road assets. Organised around seven topics, this research programme covers a wide spectrum of topics and has generated several types of deliverable: models, methodologies, software, demonstrators, and articles. New models for predicting pavement damage (cracking) have been developed, and new methods for testing and diagnosing pavement structures have been investigated. Simpler and more modern surface testing devices have also been developed and are attracting great interest within the highways industry. Network management is made easier by new operating and database management software. With regard to pavement reinforcement, the use of geo-grids in structures was tested and evaluated on the circular test track. A more accurate characterisation of heavy goods vehicle traffic and its impact on pavements was also carried out. These new methods and the associated software were presented at IFSTTAR’s Nantes site on 17 May 2018.

Some of these activities will be continued within the framework of various projects or partnerships such as the national DVDC project (pavement lifespan) or various agreements with the highways industry (managers, contractors, etc.).

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The Clerval VIPP beam project

In the field of engineering structures, the CEREMA award was given to the “Clerval VIPP beam” project on the analysis and certification of an effective repair method for a widespread type of structure whose ageing is critical.

Several theses on the durability of traditional or innovative cementitious materials and on the electrochemical and mechanical analysis of reinforced concrete have resulted in significant progress for the corrosion assessment of reinforced concrete structures and their reinforcing bars as well as the optimisation of maintenance. The new methods for preventing damage feature in French and European standards, and in recommendations published in 2017 for preventing the internal sulphate reaction in concrete, with a new performance test that targets hydrogen sulphide attack in wastewater treatment plants.

COST-GPR TU 1208: civil engineering applications of Ground Penetrating Radar

The diagnosis of ageing infrastructure and the development of innovative non-destructive testing methods were central to the research carried out with the European Commission’s support in the framework of the COST GPR TU 1208 action. This action focused on the exchange of scientific and technical knowledge on Civil Engineering Applications of Ground Penetrating Radar (GPR). The action aimed to set up and reinforce working links between universities, research institutes and industry in the field of GPR. It brought together some 150 institutions from 28 member countries.

The covers four areas:
> radar instrumentation,
> civil engineering applications,
> the modelling, processing and inversion of radar signals,
> synergy between different non-destructive testing methods for civil engineering.

The action has produced a large body of publications and other output: 16 training courses, 38 short scientific visits, 2 books, 4 guides, 1 catalogue, 125 papers in peer-reviewed scientific journals and 472 papers at international conferences. The action also led to the creation of the TU1208 GPR association and a scientific journal Ground Penetrating Radar - ISSN: 2533-3100.

IFSTTAR was involved in this action through the participation of three researchers, one of whom was X. Derobert, who co-led COST Axis 2 and the writing of 3 technical guides on the detection of underground networks in urban sites, the non-destructive testing of flexible pavement structures and the use of radar technology to assess concrete structures.

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DEVELOPING THE CIRCULAR ECONOMY

IFSTTAR is participating in the development of the circular construction economy by proposing alternative materials that are innovative or recycled, particularly due to the recycling of deconstruction materials and the in-situ recycling of soils, particularly in urban areas. Four projects on these topics came to an end in 2017: BioRePavation, Recybétton, the reuse of urban soils in road construction and Terra-Nova.

The BioRePavation project (November 1, 2015 - April 30, 2018)

BioRePavation set out to make pavements more environmentally friendly. The idea behind the project was to use “biosourced” binders while reusing high proportions of materials recovered from end-of-life roads. BioRePavation was led by IFSTTAR and brought together 6 European and American partners from the industrial and public research sectors. The project received €1.3 million in European funding.

Three innovative solutions based on biosourced materials and recycled mixes (50%) were tested. Some were close to being launched on the market, while others were at an earlier stage of development. The evaluation was carried out mainly through a full-scale test using IFSTTAR’s circular test track. This large facility can replicate 10 years of truck traffic in one month. The experimental pavements were instrumented with a large number of sensors to monitor their behaviour: deformation, temperature, humidity, etc. A life cycle analysis and laboratory measurements of fumes emissions were also carried out.

The results from this full-scale test are outstanding. After 30 months of teamwork formulating materials, designing structures and applying over a million loads, it was proven that the proposed concept is not only industrially feasible but also provides very durable materials. Indeed, BioRePavation’s innovative mixes perform better than the best material used in Europe (EME2). After application of the equivalent of 1.9 million reference French axle loads (130 kN), some sections have not yet exhibited any distress, which will lead IFSTTAR to continue loading beyond 1.9 million load applications.

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The re-use of urban soils in road construction

Funded by the FNTP (a partnership between Eiffage and RAZEL BEC), a project on the reuse of urban soils came to an end in 2017 with the defence of Katia Bellagh's thesis (IFSTTAR/ESITC). An environmentally-friendly characterisation method, derived from that used to sort aggregates, was proposed in addition to the range of geotechnical tests in order to describe the shared properties of these soils. These operational conclusions will inform the drafting of a technical guide for the re-use of excavated soils with low contamination levels that covers both geotechnical and environmental requirements (the reuse methodology and assistance in defining appropriate limits). Two urban soils from the Paris region, with varied histories and from distant sampling sites, were compared and found to be surprisingly similar in their geotechnical class, mineralogical nature and chemical composition. The research also showed that the contaminants present in the tested urban soils had little or no effect on their geotechnical behaviour. The soils were deemed acceptable for use as backfill or as a capping layer from the point of view of mechanical performance or suitability tests for treatment with lime (1%) or hydraulic binders (5%). The factors that prevent the reuse of soils on environmental grounds have been shown to be the presence of sulphates with fluorides and antimony (with the soluble fraction). Finally, leaching, percolation or monolithic immersion tests revealed that treatment with lime or hydraulic binders has an impact on the release of pollutants in the soil - some elements seem to be stabilized while others are released in greater quantities.

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The RECYBETON National Project: recycling of concrete

The RECYBETON National Project has been completed. Its aim was to boost the recycling of concrete by analysing the compatibility of its components and promoting their use at construction sites. With the participation of 43 partners and a budget of €4.8 million, this project was led by IREX with the support of MTES and had as its objective the use as constituents of new concrete of all the aggregates obtained from deconstruction concretes, including the fine fraction. Thus, ultimately, all the materials obtained from deconstruction would be recycled as raw materials in cement production. Through the MAST department’s MIT and GPEM laboratories, IFSTTAR has been heavily involved in this large-scale project, both for the recycling processes and the characterisation of the concretes obtained. Research conducted in the framework of RECYBETON has been deployed in the ANR project ECOREB (ECOconstruction for Concrete Recycling) in the context of 3 themes: water and recycled materials, the study of the mechanical behaviour of materials derived from recycling, and the durability of such materials. A day during which the results of the National Project were presented was held on 9 March 2017 and the scientific results will be shared at the "4th International Conference Progress of recycling in built Environment" on 11 and 12 October 2018 in Lisbon and during the ECOREB day on 15 May 2018.

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Find out more...

RECYBETON National Project
Joint research between IFSTTAR and CEREMA has also explored ways of recycling new materials and improving construction techniques, both for earthworks and building construction.

Terra-Nova: recycling new materials and improving construction techniques, both for earthworks and building construction

The results of the former ORSI Terra-Nova, which is a major research partnership between IFSTTAR and CEREMA, allows better practical exploitation of local marginal materials (soils that are too dry, dredging sediments, demolition materials, slightly contaminated urban soils or borderline soils) and encourages their reuse in currently limited settings by defining appropriate rules, as well as an analysis framework and methods.

In terms of structures, the Terra-Nova research project supplements the existing rules of best design practice and lays down certain design rules in the following areas of earth constructions:
- embankment slopes,
- fill adjacent to engineering structures,
- infrastructure subgrades in general,
- adaptation of earthworking techniques to extreme climatic conditions,
- earth construction for buildings,
- urban soils.

An event was held to present the results on 28 May 2018 at IFSTTAR’s Nantes site.

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Clay and straw mortar wall made with a mixer which reduces the water requirement during manufacture and speeds up the process.

© Erwan Hamard / Ifsttar-MAST-GPEM
NEW TRANSPORT INFRASTRUCTURE AND ENERGY PRODUCTION

Faced with the challenges of new forms of mobility, innovation is emerging in the infrastructure for transport and energy production and storage. With the support of the European Commission, the CEDR and the FEHRL, a roadmap on the future of transport infrastructure has been developed within the framework of the FORx4 project (Forever Open Road, Rail, River and Runway), and more specifically the FOX and USE-IT projects, presenting a vision of the construction and adaptation of these infrastructures to future mobility, intermodality and climate change. Officially launched at TRA 2018 in Vienna, this roadmap proposes an intermodal R&D environment and ethos and research avenues for construction, testing, maintenance and recycling.

The FOX project: Forever Open infrastructure across all transport modes – Road map

The goal of the FOX project is to develop an intermodal R&D environment and ethos to meet future transport and connectivity requirements for people and goods. This project addresses the different phases of the transport infrastructure life cycle, namely construction, testing, maintenance and the end of the life of materials (recycling). It deals with road, airport, rail and waterway infrastructure. Initially, FOX built a network of researchers and practitioners working on the different modes of transport, sharing their views and a common technical ethos. In the second phase, the project developed roadmaps to encourage innovation and the development of intermodal research, as well as to assess its short-, medium- and long-term potential. The project began with a review of the current state of knowledge and advanced practices for all aspects of the transportation infrastructure life cycle. It aimed to highlight the problems associated with each method or technology. The most promising methods for intermodal development were then identified and analysed. The third step was to develop a roadmap for future research, development and implementation initiatives across the four transport modes.

The 5th Generation Road

The 5th Generation Road (R5G) is made up of technological building blocks preparing for the future, which takes in positive energy, thermal or electric, instrumented and communicating roads... IFSTTAR is contributing to the development and construction of the R5G demonstrators for the I-Street project, responding to the call for projects of the “Road to the Future” Future Investments Programme (PIA) financed by ADEME, as part of a consortium with Eiffage and TOTAL. Three large demonstrators are currently deployed: on the IFSTTAR circular test track in Nantes (2017), in the framework of the Sense-City EQUIPEX (2017) and on the RD 199 county road in Marne-La-Vallée (ongoing). What is special about this new generation of roads is the way the built environment and the road infrastructure interface with each other in order to optimize the system for the benefit of urban users. These demonstrators help optimize energy interchanges between roads and nearby buildings, mitigate noise and pollution, reduce the heat island effect, and manage stormwater. In addition, R5G is diversifying into regional projects with the deployment of innovative energy and mobility solutions.
The cable fatigue test bench finds a second youth

The cable fatigue test bench is able to perform full-scale tests on civil engineering cables or tubular engineering structures. This type of test is essential in order to validate any innovative technical solution and make sure of the product’s durability/integrity under real operating constraints. This facility is the only one of its kind in France, and one of only three in the world. It was acquired by IFSTTAR in 1989 and completely refurbished in 2017. In the past it was used exclusively for fatigue tests on the cables and anchorages of prestressed, suspension and cable-stayed bridges to certify their stay systems for use in France and abroad (the Rion-Antirion and Millau bridges, etc.), but it is now also used for offshore installations. New partners are interested in the full-scale behaviour of technical solutions for offshore operations or the prevention of seismic risks. The cable and its anchorages are placed under static tension and then subjected to cyclic force. The forces applied vary from a few percent to 80% of the breaking force. Acoustic sensors are used to detect and locate any failures that occur during the test. The latest changes to the facility enable complex fatigue tests to be carried out by combining tensile and bending forces.
Current events constantly remind us that we have to cope with extreme natural and climatic events that are dangerous for the population and destructive for infrastructure. Climate change is marked by an increase in the intensity and frequency of these events. Our regions must adapt to prevent and foresee these hazards. In addition, mobility generates externalities (air, soil and water pollution, noise, undesirable impacts on spaces and biodiversity) that should be avoided, mitigated or offset. This is the challenge facing the development of urban areas: reconciling the growing need for space, mobility, supply and energy with the need to protect the population and the environment from pollution and natural or malicious hazards.

IFSTTAR makes an important contribution to research on these issues. In order to better prevent and foresee natural hazards and environmental damage, the Institute’s research deals with the prevention of natural hazards, noise pollution, pollution of urban areas or the air and water, floods, extreme heat events, energy management and urban development. It is conducted by multidisciplinary teams working in partnership with other public institutions.
The FUI Newton: a method for forecasting the settlement caused by the excavation of urban tunnels and the influence of presupport

E. Bourgeois (COSYS-LISIS) in collaboration with Solétanche-Bachy

The conventional method of tunnel boring - i.e. without using a tunnel boring machine - is versatile, flexible and well suited for dealing with short distances or exceptional situations. Tunnelling with tunnel boring machines and the settlements it causes are still the subject of some uncertainty. These topics were addressed by the FUI Newton project.

Managed by Solétanche Bachy (2012-2017), the aim of this project was to improve tunnelling methods and the techniques used to reinforce the neighbouring soil. In addition, settlement monitoring and inspection systems were revamped in order to develop methods for verifying the design as the works progress.

The soil reinforcement methods which proved to have good potential included "bolting" and the installation of an "umbrella vault" consisting of tubes positioned above the keystone. Together with the project partners, IFSTTAR has added two new features to the CESAR professional software package: a new behaviour law for the computation of settlement, developed by N. Gilleron (as part of a CIFRE thesis with Egis) and new ground-bolt interaction models, developed by the Centre de Géosciences at the Fontainebleau École des Mines.

In addition, Ittech, the distributor of CESAR-LCPC, has developed a professional software package known as C-Newton. This automates data preparation, execution of the calculations and exploitation of the results with a specific application to settlement problems. A second thesis (C. Klothe) performed complete three-dimensional modelling of tunnel excavation with the "bolts" and "umbrella vault" while complying with the real geometry of the support. This work also proposed an original model of the settlement compensation process based on "cuffs" placed around the tubes of the umbrella vault. The results were used to validate the modelling decisions made for the C-Newton software.

Discrete numerical analysis of the risk of subsidence and swelling associated with underground cavities

Doctoral thesis by Y. Ikezouhene (GERS-SRO) conducted in partnership with INERIS.

Over time, underground cavities undergo ageing and several types of damage may occur. Pre-existing underground operations, sometimes made up of one or more levels, were probably not designed with long-term stability in mind. The mechanisms involved can cause two types of surface problems: subsidence or roof collapse. These can cause serious damage to structures and infrastructure on the surface but also jeopardize the population’s safety. Yaghkob Ikezouhene’s thesis aimed to study the swelling of rock and model the propagation of roof collapse in the overburden in order to rank the parameters linked with this phenomenon.

Numerical modelling using the discrete element method (DEM) was used to analyse the instability of underground quarry roofs. A Rock Mass Discretization Program (RMDP), which is the pre-processing module of the STTAR3D software, and a code to calculate the expansion coefficient of the debris from the collapse have also been developed. Validation on a real case - La Brasserie quarry - was performed.

Yaghkob Ikezouhene’s thesis aimed to study the swelling of rock and model the propagation of roof collapse in the overburden in order to rank the parameters linked with this phenomenon.

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FORESEEING NATURAL AND CLIMATE RISKS

In 2017, IFSTTAR’s output for this goal was particularly extensive on the themes of land movements and the climate in urban areas. Land movements pose a significant threat to the population and infrastructure. The topics presented below relate to collapses of underground cavities, settlement during the excavation of urban tunnels, rockfalls and earthquakes.

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“Characterisation and design of rock structures” (CADOROC)

A CEREMA – IFSTTAR (GERS-SRO) joint research project, which is linked to the national C2ROP project (Rockfalls, Rock Risks and Protection Structures) in which EDF is a partner.

The CADOROC research operation, which lasted four years, aimed to better characterise rock masses and to optimise the design of rock structures (by providing rock shed protection systems) in order to assess their durability. The results of this project made a contribution to the C2ROP National Project launched one year later. This operation, which was divided into four parts, took account of: the characterisation of changes in rock masses and rock hazards; the characterisation of the weathering of the interfaces between rock and structures; the design and modelling of rock structures; and finally, the evaluation of the durability of rock shed protection systems. The results led to the drafting of a technical guide on the design of rock anchorages.

Five doctoral theses shed light on a number of points such as:

> the analysis of thermal variations on rock instabilities;
> the behaviour of the passive anchorages secured to the rock whose heads are subjected to tensile and shear stresses;
> modelling of netting screens;
> the behaviour of sands under low speed impact loading - with application to the design of soil layers protecting structures from rock impacts;
> characterisation of the strength and shear behaviour of the interfaces between concrete and bedrock in hydraulic structures.

A seminar to present the results was held on 10 October 2017 in Aix-en-Provence. In France, as elsewhere in the world, seismic risk is a major concern that requires us to acquire greater knowledge about the phenomena, how to predict them and how to better withstand their destructive impacts. The project with the University of Rio de Janeiro and Petrobras studied slope stability. Y. Abboud’s PhD focussed on the contribution of a 3D macro-element in the CESAR software to model the seismic behaviour of shallow foundations.

Seismic stresses pose a significant risk to the stability of offshore installations with potentially dramatic environmental and economic consequences. In 2015, the “Earthquakes and Vibrations laboratory”, the Federal University of Rio de Janeiro and the oil company Petrobras signed a research partnership agreement to study the seismic stability of offshore slopes on the Brazilian coast. The aim of the project was to evaluate the amplification of the seismic signal in clay masses taking the form of slopes with different gradients. An experimental programme was set up to study different slope geometries, with a low gradient or in the shape of a canyon. The project was completed in 2017.

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Seismic stability of offshore slopes: a project led by the “Earthquakes and Vibrations” laboratory (GERS) in collaboration with the University of Rio de Janeiro and Petrobras.
Development of a 3D macro-element for analysing the seismic behaviour of shallow foundations
Thesis by Youssef Abboud (GERS-SV) completed in the framework of a research contract between IFSTTAR and EDF-CEIDRE.

This thesis involved developing alternative methods for the justification of seismically loaded shallow foundations as part of France’s new seismic zoning system that came into force in 2011 in the aftermath of the Fukushima disaster. A model based on the macro-element concept was developed to study the soil-structure interaction (SSI) taking into account the various non-linearities. Its formulation is based on the theory of elastoplasticity and refers to the applicable standards (Eurocodes 7 and 8). The various plastic mechanisms (punching, overturning and sliding) are combined within the framework of multi-mechanism theory and their parameters are defined from tests, in the laboratory or in situ, or from numerical simulations under static conditions. The computation costs are reduced because the non-linearities related to the soil-structure interaction are concentrated at specific points in the computation model. The advantage of the macro-element lies in the fact that it is formulated in terms of stresses and strains. This facilitates its use for the justification of foundations (bearing capacity, sliding, debonding, settlement, displacement, distortion and rotation). Implemented in the CESAR LCPC finite element code, the macro-element is able to simulate the static and seismic behaviour of a shallow foundation. Thus, it makes it possible to carry out parametric studies of the seismic response of structures and to analyse the static and seismic behaviour of real structures. Parametric studies, carried out on a structure using a large number of real seismic signals, have highlighted the practical capabilities of the macroelement.

HyClAuU: learning from hydrological and climatic processes to improve urban planning
An IFSTTAR-CEREMA research partnership.

Led by K. Chancibault (IFSTTAR) and J. Bouyer (CEREMA), the HyClAU research partnership has provided us with a better understanding of the hydrological and climatic issues facing urban areas in order to help them better adapt to global climatic and demographic changes. Launched in 2014, it achieved three objectives:

- Measurement techniques and data were used to better describe how urban areas affect their environment: data analysis was carried out to link the level of vegetation with latent heat flux (evapotranspiration); a local evapotranspiration measurement method was improved; urban indicators based on very high resolution satellite data (70 cm) were defined; and lastly, temperature differences according to the classification of neighbourhoods were calculated using mobile measurements.
- Developments have allowed us to improve the way hydric and climatic processes are represented in models in order to make better use of nature-based solutions: improvement of soil-network flow processes in a hydro-energetic model; development of automatic reconstruction of sanitation networks with a small amount of urban data; better representations of green roofs, valleys and street trees in models.
- Climate projections (DRIAS) were studied and analysed and specific indicators were developed to raise awareness of heatwave risk.

The main findings of the project were presented at a special event held in Nantes on 29 November 2017.
UNDERSTANDING, ASSESSING AND MITIGATING IMPACTS ON THE ENVIRONMENT AND THE POPULATION

Air pollution and noise are the two main transport externalities with proven adverse health impacts. Although considerable progress has been made in recent years to limit vehicle emissions, much remains to be done and our cities regularly experience pollution peaks.

When it comes to pollution, it is important to better characterise the pollution emitted by vehicles, but also to consider its ultimate fate in the soil and water. In order to acquire a shared perception of the problem, researchers from several IFSTTAR laboratories joined forces for an in-house network leadership initiative on pollutants moderated by Mathieu Goriaux and Yao Liu. This initiative made it possible to set up an information exchange network on methods for measuring pollutants in water, the air and the soil. The principal results obtained by teams from several laboratories and the wide variety of pollution fields investigated were presented at a seminar organised on 13 June 2017 in Nantes. With regard to atmospheric pollutant emissions, IFSTTAR continued its efforts to characterise the regulated or unregulated pollutants emitted by vehicles. In particular, the Institute has studied the impact of different types of engine technology and driving on emissions of unregulated pollutants. The EMI 2-4 study, for example, focused on the emissions of two-wheelers and light motorized quadricycles, which have so far been poorly regulated and little studied. The fate of these pollutants is also the subject of important research: changes in the concentration of particulates, PAHs (polycyclic aromatic hydrocarbons) and atmospheric mercury as one moves away from the infrastructure; the deposition of platinum in the urban environment as well as mercury and palladium in roadside ecosystems. The characterisation of pollutants in urban stormwater requires research into the sampling method and the ranking of the ever-increasing number of substances to be analysed. The development of urban gardens on land that has been slightly contaminated by previous activities also raises the question of the characterisation of pollutants in soils.

The EMI 2-4 project: analysis of the emissions from motorised two-wheelers and quadricycles

ADEME, programme CORTEA.

The pollutant emissions from motorised two-wheelers and quadricycles are still insufficiently known and regulated. The pollutant emission ceilings set for their type approval were overdue or even absent for diesel-powered quadricycles until 2017. Their engines consequently lack catalytic converters, EGR valves or particle filters. The EMI 2-4 project updated the real emissions data for motorised two-wheelers on the basis of new data on unregulated compounds and, for the first time, assessed the pollutant emissions of diesel-powered light quadricycles. Tailpipe emissions were measured on three light motorised quadricycles for two regulatory driving cycles and one real-life cycle developed by the LTE, as well as on four scooter models tested during three driving cycles on the UTAC-CERAM dedicated test facility. For all the vehicles, gaseous pollutants - including many unregulated compounds - as well as particulate matter by mass and number were monitored.

In the case of two-wheelers, the study confirmed that the two-stroke engine is responsible for extremely high hydrocarbon pollution, or total HC, with an emission factor of more than 10 g/km (1,000 times higher than that of a recent petrol car). This type of engine also emits very large amounts of benzene, toluene (more than 3 g/km) and aldehydes.

Quadricycles also pollute more than current diesel cars under the same urban driving conditions: the quantities of CO emitted are 2 to 5 times higher and up to 14 times higher in the case of the direct injection model. The respective factors for HC emissions are 4 to 6 and up to 50 for the direct injection quadricycle. Lacking filters, the three quadricycles also had high particulate emissions, equivalent to Euro 0 to Euro 2 diesel cars (1990-1995). Direct injection is only better in terms of NOx emissions, but with a less favourable NO2 ratio, which is the most harmful of the relevant oxides of nitrogen.

In the future, further assessments will be needed to measure the impact of the more stringent regulatory limits that came into force in 2017 (Euro 4).

Testing a motorised quadricycle on LTE measurement facility.

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Noise is also a major environmental problem. A recent study commissioned by ADEME estimated the social cost of transport noise at over €20 billion per year. For several years, IFSTTAR has been developing models to predict noise, its emission at source and its propagation. More recently, assessment tools have been developed, particularly in order to produce noise environment maps.

NoiseCapture: a smartphone application for noise environment mapping

NoiseCapture is being developed jointly with the CNRS as part of the European ENERGIC-OD project that is co-financed by the GEOPAL programme. This Android application can perform geo-localised measurements of sound levels in outdoor environments. The collected data is transferred anonymously to a server that aggregates the contributions of all users to create maps. These maps can be viewed in real time on a dedicated website, and are the outcome of acoustic and geographical analyses. While for the time being they provide information only on the instantaneous sound environment, the maps will eventually provide the public and communities with access to acoustic indicators that show noise exposure. The application was the subject of several presentations at the Consultation on the Quality of the Noise Environment that was held in Paris in 2017.

Find out more... NoiseCapture application

The GRAFIC project: detailed continuous mapping of sound quality in urban locations and on urban journeys

ADEME, Arnaud Can, UMRAE, in partnership with Université de Cergy-Pontoise, University of Gand, Bruitparif and The Paris City Authorities.

The development of decision support tools and tools for characterising urban noise environments, which are consistent from a qualitative point of view, is a major challenge. The goal of the GRAFIC project was to combine two recent innovative approaches in order to provide ways forward for achieving the continuous mapping of urban noise environments that is coherent from the perceptual and physical points of view: mapping of noise levels which is based on mobile data and the characterisation of noise environments from the perceptual point of view.

New methods for mapping noise levels, based on geo-referenced mobile measurements, have recently been developed. They have the advantage that they consider all sound sources, provide very high spatial resolution coverage, and reduce mapping costs. In addition, recent work has shown that, as well as characterising physical noise levels, it is necessary to develop tools that place greater emphasis on the qualitative aspects of noise environments, as these cannot be merely be considered from their energy dimension. The aim is to take better account of people’s exposure and discomfort in the presence of noise.
Supporting Sustainable Development

Urban areas are complex not only because of the large number of issues they face, but also due to the need to take account of the interactions between them. Urban spatial planning therefore requires collective thinking, with multi-disciplinary approaches that exploit a wide variety and a large quantity of data. IFSTTAR is actively involved in responding to this challenge through its involvement in networks and the production of tools to address this complexity.

Collective expert appraisal on urban land uptake
INRA-IFSTTAR

In the public debate, urban land uptake is considered to be the main cause of the “disappearance” of agricultural or natural land. The government therefore wishes to implement measures to reduce this destruction of agricultural and natural areas. To support this public policy initiative, a survey of the current state of knowledge on the measurement of urban land uptake, its determinants and its impacts was commissioned jointly from INRA and IFSTTAR by the Ministries of Ecology and Agriculture and ADEME. Some fifty experts from various research organisations, including 13 from IFSTTAR, worked for two years with an INRA-IFSTTAR project team to carry out a collective scientific appraisal. Reducing the impacts of urban land uptake to some extent amounts to building more sustainable cities through technological innovations (infrastructure, buildings, vehicles) but it also requires trade-offs between conflicts of use in terms of land management, and possibly the creation of fiscal instruments to encourage well-considered densification or even fostering coordination at the appropriate territorial scales in order to optimise land management. It ended on 8 December 2017. A summary is available on the INRA website.

Sense-City: the mini-city for tomorrow’s city

The massive deployment of sensors for energy efficiency, pollution and innovative materials.

Seven organisations (IFSTTAR, ESIEE, CSTB, Université Paris-Est, LPICM UMR 7647 Ecole Polytechnique-CNRS, INRIA and Université Paris-Est at Marne-la-Vallée) have joined forces to form the Sense-City consortium within the framework of PIA 1 for the creation of a facility of excellence for the city of tomorrow: Sense-City. Located on the Descartes campus in Marne-la-Vallée, the Sense-City facility of excellence consists of a climatic chamber and two miniature cities. A large 3,200 m² climatic hall is able to simulate rain and fine weather in order to study the urban metabolism and improve the city of tomorrow. It is capable of reconstituting a specific climate from -10°C to 40°C, from 30 to 95% humidity as well as the sun and rain. As it is mobile, it can move onto one mini city or the other depending on the planned experiments. The mini-cities are parts of cities that are built for limited periods of time in order to study certain urban elements. Each is equipped with sensors connected to a data system that stores the measurements that will be analysed by researchers and engineers depending on their scientific interests. Occupying the middle ground between a clean room and a living lab, Sense-City enables a large number of scientific experiments to be carried out in a controlled environment in order to improve our knowledge of sensors, communications networks, water, air and soil pollution, energy losses, heat exchanges, street furniture for urban monitoring, the properties of new materials with regard to pollution and heat, and the benefits vegetation brings to the city.
The Proteus project: the digital city and water quality

Drawing on the experimental possibilities offered by the "Sense-City" EQUIPEX, the main objective of the Proteus project is to produce smart, energy-efficient sensors for monitoring water quality in drinking water and wastewater networks. This €3.9 million H2020 project brings together the following stakeholders in the sensor value chain: IFSTTAR, ESIEE Paris, Easy Global Market SAS et PONSEL MESURE SAS (France), UNI-NOVA, SMAS Almada and Unparallel Innovation (Portugal), WINGS ICT Solution (Greece) and the University of Perugia (Italy). Proteus has helped improve the measurement of a number of chemical and rheological parameters through the use of microfluidic and carbon nanotube sensors. Trials are conducted in the Sense-City drinking water circuit to test and improve the prototypes. As far as the hardware is concerned, several different carbon nanotube sensors have been developed to monitor temperature, pressure, flow, conductivity, pH, chlorine and chlorides. A chip has been designed to retrieve data from these sensors. Lastly, software has been developed to upload the data into an information system. With respect to the detection of chemical elements, the experiments are promising; they prove that nanotube-based sensors are sensitive to chlorine, chlorides and pH. On the energy front, experiments are being carried out to recover energy from the stream of water to power the sensors and data uploading. The results show that it is necessary to top up the energy produced by the water stream by means of a solar panel in order to ensure optimal operation.

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In parallel with the environmental issues that face us, another major area of intervention for IFSTTAR is the impact of logistics and mobility on the urban metabolism. The Institute’s research aims to improve the chain that runs from the sensor to the decision support tool.

The activities of the TerriTAP network

A methodology for quantifying incoming and outgoing flows of materials at the scale of an urban project has been developed by SPLOTT. It enables us to evaluate the nuisances associated with worksite flows by, for example, developing scenarios for optimising the metabolism. Between 2014 and 2017, the TerriTAP network initiative - Territories Transport Public Action - brought together researchers and practitioners in planning and urban development for a series of meetings. The main topics addressed were urban and transport planning, parking, urban rail planning, urban transport safety, the management of staff mobility and regional logistics. The meetings made it possible to compare the scientific work and the analyses of the practitioners with a view to mutual enrichment.
KEY FIGURES
CONTRACTS IN 2017

- **€15.6 million**
  Revenue in 2017 from contracts for research (excluding the Sense-City and Transopolis projects)

- **€18.1 million**
  Total value of orders notified in 2017

- **163**
  Orders notified in 2017

**Goals for research contracts**
As at 31/12/2017

- **Goal 1**
  Increase internal resources via research contracts

- **Goal 2**
  Give preference to developing research contracts that generate profits

- **Goal 3**
  Developing links with the world of industry

**I-Street**
Success in July 2017 of the I-Street project financed by ADEME to the tune of €3.7 million.

**Sense-City**
Revenue of the Sense-City project in 2017: €142k, out of total funding from the ANR of €8.99 million.

**Transopolis**
Agreement on the part of the Lyon area local authorities to provide the project with €9.3 million of funding

- **134**
  Contracts completed in 2017

- **16**
  Contracts in 2017 which received more than €200k of aid: 1 BPI, 1 ADEME, 3 ANR, 3 DAC, 3 Industrial, 5 European

- **400**
  Ongoing contracts

- **55**
  Ongoing H2020 contracts including:
  - 8 contracts signed in 2017 for a value of €2,063,886
PHD ACTIVITIES

In 2017 IFSTTAR passed the milestone of 500 PhDs!

575 theses defended since IFSTTAR’s creation which include 75 theses defended in 2017, with a median research duration of 3.32 years and 9 Accreditations to direct research awarded in 2017.

Number of theses defended by theme:

<table>
<thead>
<tr>
<th>Theme 1</th>
<th>Theme 2</th>
<th>Theme 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>EFFICIENT TRANSPORT AND</td>
<td>MORE EFFICIENT AND RESILIENT</td>
<td>PLANNING AND PROTECTING REGIONS</td>
</tr>
<tr>
<td>SAFE TRAVEL</td>
<td>INFRASTRUCTURE</td>
<td></td>
</tr>
<tr>
<td>22 PhDs</td>
<td>31 PhDs</td>
<td>22 PhDs</td>
</tr>
</tbody>
</table>
Employment rate of PhDs after 5 years, according to type of contract and sector.
(Response rate 97%)
HUMAN RESOURCES

1,052
IFSTTAR staff
Amounting to 1,026 full-time equivalent posts of which
810.6 are permanent posts

627
men

425
women

Gender distribution of staff by category
As at 31/12/2017

Distribution of staff by average age
As at 31/12/2017

Permanent
men

Non-permanent
men

Permanent
women

Non-permanent
women

29 years old

48 years old

47 years old

31 years old

Permanent Contract
16
men

Senior Technician
6
men

Permanent Contract workers
216
men

Contract workers
119
men

186
women

92
women

40
women

1
woman

7
men

79
staff

189
staff

536
staff

350
men

97
men

39
men

186
women

92
women

40
women

1
woman
Distribution of permanent staff by site
As at 31/12/2017

Number of physical employees
As at 31/12/2017

Staff by research theme

<table>
<thead>
<tr>
<th>RESEARCH THEME</th>
<th>Subsidy</th>
<th>Internal resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theme 1: Efficient transport and safe travel</td>
<td>€18,749,844</td>
<td>€2,299,144</td>
</tr>
<tr>
<td>Theme 2: More efficient and resilient infrastructure</td>
<td>€14,874,093</td>
<td>€932,085</td>
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<tr>
<td>Theme 3: Planning and protecting regions</td>
<td>€21,985,726</td>
<td>€1,068,521</td>
</tr>
<tr>
<td><strong>ALL RESEARCH ACTIVITY</strong></td>
<td><strong>€55,609,663</strong></td>
<td><strong>€4,299,750</strong></td>
</tr>
</tbody>
</table>

€4,475,516
Action for the entire institution including the promotion of research

€14,887,267
Support functions
IFSTTAR’S PARTICIPATION AND REPRESENTATION

A survey of IFSTTAR’s participation and representation in external organisations in connection with research and its applications, in France and internationally.

In 2017, a survey of IFSTTAR’s participation and representation in external organisations in connection with research and its applications, in France and internationally, was performed and formalised in an interactive database within the Institute. For the most strategic of these, approximately 400 staff members were commissioned (more than half of all those listed). Figure 1 shows the distribution of these commissions by type of organisation and Figure 2 by geographical zone.
Revenue and expenditure exclusive of depreciation.

Breakdown of revenue (executed budget)

- 15.9% contracts and support for research activities
- 3.3% from the commercialisation of research activities and service provision
- 2.1% other subsidies and products

Total revenue in 2017: €105,241,945

Proportion of the Institute’s internal resources and subsidy for public service responsibilities

- Internal resources: 21.3%
- Subsidy for public service responsibilities: 78.7%

Breakdown of expenditure by research theme

- 37% Planning and protecting regions
- 29% More efficient and resilient infrastructure
- 34% Efficient transport and safe travel

Total expenditure in 2017: €104,789,258

Breakdown of expenditure

- 23% Support functions
- 68% Activities of research units
- 9% Action for the entire institute
ORGANISATION
LOCATION OF THE LABORATORIES

BELFORT
Bâtiment F
Rue Thierry Mieg
Belfort Technopôle
F-90010 Belfort
Tel.: +33 (0)3 84 58 36 00
Research Laboratories:
LTE/TEMA/Fédération FCLAB

BORDEAUX
Cerema DETER Sud-Ouest
rue Pierre Ramond - CS 60013
F-33166 Saint-Médard-en-Jalles Cedex

GRENOBLE
Maison des géosciences
1381, rue de la Piscine
F-38400 Saint Martin d’Hères
Research Laboratory:
ISTerre

LIÈGE - VILLENEUVE-D’ASCQ
20, rue Elisée Reclus
BP 70317
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Research Laboratories:
ESTAS, LEOST

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Fax: +33 (0)4 72 37 68 37
Research Laboratories:
RRO, LICIT, LBMC, LESCOT,
UMRESSTTE, LTE, LEPIS, UMRAE

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Research Laboratories:
ESTAS, LEOST

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LBA, LMA

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Fax: +33 (0)2 40 84 59 99
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MIT, LAMES, GPEM, SMC, GéoEND, GMG,
EE, GEOLOC, MACSI, SII, EASE, UMRAE

SALON-DE-PROVENCE
304, chemin de la Croix Blanche
F-13300 Salon-de-Provence
Tel.: +33 (0)4 90 56 86 80
Fax: +33 (0)4 90 56 25 51
Research Laboratories:
LEPSIS, LMA

VERSAILLES - SATORY
25, allée des Marronniers
F-78000 Versailles
Tel.: +33 (0)1 30 84 40 00
Fax: +33 (0)1 30 84 40 01
Research Laboratories:
TEMA, LIVIC, LEPSIS, GRETTIA
GOVERNANCE

ORGANISATIONAL CHART OF THE BOARD OF DIRECTORS as at 31/12/2017

Representatives of the State
Ministry of public works:
- Serge BOSSINI (full member), Ministry for an Ecological and Solidary Transition
- Jean Philippe TORTEROTOT (deputy member), Ministry for an Ecological and Solidary Transition

Ministry of transport:
- Christine BOUCHET (full member), Ministry for an Ecological and Solidary Transition
- Xavier DELACHE (deputy member), Ministry for an Ecological and Solidary Transition

Ministry of the environment:
- deputy member being replaced
- Thierry HUBERT (deputy member), Ministry for an Ecological and Solidary Transition

Ministry of research:
- Frédéric RAVEL (full member), Ministry of Education, Higher Education, Research and Innovation
- Philippe TOUSSAINT (deputy member), Ministry of Education, Higher Education, Research and Innovation

Ministry of higher education:
- Alain BERNARD (full member), Ministry of Education, Higher Education, Research and Innovation
- Éric CHARRON (deputy member), Ministry of Education, Higher Education, Research and Innovation

Ministry of the budget:
- Anne-Sophie ANBAR (full member), Ministry for Action and Public Accounts
- Charlotte SAULNERON-SAADOU (deputy member), Ministry for Action and Public Accounts

Ministry of industry:
- Franck TARRIER (full member), Ministry of the Economy
- Catherine BELLANCOURT (deputy member), Ministry of the Economy

Ministry of health:
- Ghislaine PALIX-CANTONE (full member), Ministry of Solidarity and Health
- deputy member being replaced

Ministry of the interior:
- Manuelle SALATHE (full member), Ministry of the Interior
- Pierre VAISS (deputy member), Ministry of the Interior

Ministry of defence:
- Hisham ABOU-KANDIL (full member), Minister for the Armed Forces
- Deputy member being replaced

Qualified dignitaries
- Marie-Claude DUPUIS, RATP
- Anne-Marie HERBOURG, ADTech
- Pierre IZARD, SNCF
- Carole LE GALL, Engie
- Yves METZ, Ingerop
- Guy SIDOS, Vicat
- Jacques TAVERNIER, Usirf

Representatives of the staff
SUD Recherche EPST-Solidaires:
- Christine BUISSON (full member),
- Maryse BASSEPORTE (deputy member)

SUD Recherche EPST-Solidaires:
- Christophe GRANSAERT (full member),
- Philippe BON (deputy member)

UNSA:
- Laurent LEOUC (full member),
- Franziska SCHMIDT (deputy member)

CGT:
- Paul MARSAC (full member),
- Nathalie BOTTICCHIO (deputy member)

The Chairman of the Scientific Board, the Managing Director, the Scientific Director, the budgetary control authority and the accounting officer attend the meetings in an advisory capacity.
ORGANISATIONAL CHART OF THE SCIENTIFIC BOARD
as at 31/12/2017

Scientific and technical dignitaries
Ministère chargé de l’équipement:
- Sylvain ALLANO
  The Daffodile Company
- Brigitte BARIOL-MATHAIS
  FNAU
- Bénédicte BUCHER
  IGN
- Pierre-Étienne GAUTIER
  Systra
- Corinne GENDRON
  Université du Québec à Montréal (Canada)
- Antonio GOMES CORREIA
  Universidade do Minho (Portugal)
- Catherine JACQUARD
  Fondasol
- Corinne LARRUE
  Université Paris-Est Créteil
- Barbara LENZ
  DLR (Allemagne)
- Catherine PEREZ
  Agència de Salut Pública de Barcelona
  (Espagne)
- Stephen PERKINS
  OCDE
- Jean-Éric POIRIER
  Colas
- Souheil SOUBRA
  CSTB
- Catherine TRUFFERT
  Iris Instruments - BRGM

Representatives of the Staff
CFDT
- Alexandre de BERNARDINIS (full member),
- Fabrice VIENNE (deputy member),
- Pierre-Olivier VANDANJON (full member),
- Étienne LEMAIRE (deputy member)
CGT
- Divitha SEETHARAMDOO (full member),
- Jean-Michel FOURNIAU (deputy member)
Sud Recherche EPST-Solidaires
- Karine BRUYERE (full member),
- Neila BHOURI (deputy member),
- Sébastien AMBELLOUIS (full member),
- Juliette KAUV (deputy member)
Unsa
- Lamine DIENG (full member),
- Malal KANE (deputy member)

Discover the Organisational chart of IFSTTAR

GO TO THE INTERNET WEBSITE
<table>
<thead>
<tr>
<th>SIGLES</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADEME</td>
<td>Agence de l'environnement et de la maîtrise de l'énergie</td>
</tr>
<tr>
<td>AISLFL</td>
<td>Association Internationale des Sociologues en Langue Française</td>
</tr>
<tr>
<td>Allenvi</td>
<td>Alliance nationale de recherche pour l'environnement</td>
</tr>
<tr>
<td>AMP</td>
<td>Appui aux montages de projets</td>
</tr>
<tr>
<td>ANR</td>
<td>Agence Nationale de la Recherche</td>
</tr>
<tr>
<td>ARCADI</td>
<td>Arcadi Île-de-France is a public body for achieving cooperation in the performing and visual arts in Île-de-France (EPC)</td>
</tr>
<tr>
<td>B+R</td>
<td>Bike and Ride ou Bicyclette Relais</td>
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<td>Parc relais, parking relais, P+R ou stationnement incitatif</td>
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