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IFSTTAR was born on 1st January 2011, the outcome of the merger of INRETS and LCPC. It is Europe’s largest research institute for cities and regions, transportation and civil engineering. As a fully-fledged research institute, IFSTTAR serves society and citizens and therefore has the task of generating the knowledge needed to resolve the issues facing society.

IFSTTAR thus occupies a primary position as a partner in the areas of transport, mobility and planning, from the first stages of research to application of the results to the social and economic spheres to bring about social and industrial innovation, which demonstrates the application of our findings to society as a whole and the relevance of our knowledge.

Looking at our first year of activity, it seems that much still remains to be built and consolidated. Nevertheless we have come a long way, and we are very proud to be able to present you with this survey of our activity in this emblematic year which, as you will see, has been so rich in achievements.

2011 has been a year of intense activity for us, from the creation of the new governance bodies to mobilization for our internal re-organization, from our highly successful research to our participation in the Future Investments Programme (PIA) which has resulted in some major achievements. To this we should add the renewal of our quality certification, a favourable AERES appraisal of our research structures and a consolidation of our European and international position.

Above all, 2011 was marked by the steps we took collectively to sketch out the future of our institution and achieve both internal cohesion and clarity for the outside world. These are the issues covered by the Institute’s large-scale strategic projects, namely, Imagine IFSTTAR, the scientific strategy, and the goals and performance contract.

The first sets out to motivate all the Institute’s staff in order to create a plan for the Institute that is built on agreement about its new raison d’être.

From the scientific point of view, IFSTTAR is engaged in the effective introduction of interdisciplinary approaches, building on the wide range of disciplines covered by the two original Institutes. In this connection, the Scientific Directorate of IFSTTAR, in conjunction with our partners, has launched a collective review to examine the scientific strategy that will best meet society’s expectations. This process of transformation will continue in 2012 with the finalization and implementation of the Institute’s scientific strategy which will govern its activities over the next 10 years and provide the basis for the goals and performance contract to be signed with the government.

We take this opportunity to pay tribute to all those working at IFSTTAR, whether researchers or support service staff for their involvement and efforts in this collective construction process.

Enjoy your read!

Hubert du Mesnil
President of the IFSTTAR
Board of Directors

Hélène Jacquot-Guimbal
Managing Director of IFSTTAR

2011, THE CREATION OF IFSTTAR
EUROPE’S LARGEST RESEARCH INSTITUTE FOR CITIES AND REGIONS, TRANSPORTATION AND CIVIL ENGINEERING.

EDITORIAL
Hubert du Mesnil
Hélène Jacquot-Guimbal
### KEY FIGURES 2011

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### SITES

**7 main sites:** Lille-Villeneuve d’Ascq, Lyon-Bron, Marne-la-Vallée, Marseille / Salon-de-Provence, Nantes-Bouguenais, Paris, Versailles-Satory.

IFSTTAR also has the following secondary sites Belfort, Grenoble, Nice, Le Grand-Quevilly and Clermont-Ferrand
THE CREATION OF IFSTTAR

IFSTTAR, French Institute of Science and Technology for Transport, Development and Networks was created by the merger of INRETS and LCPC. Decree N° 2010-1702 of 30 December 2010 created the French Institute of Science and Technology for Transport, Development and Networks (IFSTTAR).

Statute

A national public scientific and technical establishment has been created known as the "French Institute of Science and Technology for Transport, Development and Networks" (IFSTTAR), to be overseen jointly by the Ministers with responsibility for sustainable development and research. Its head office is to be in Marne-La-Vallée (Paris region).

Role

IFSTTAR’s role is to carry out and commission, direct, lead and appraise research, development and innovation in the areas of urban engineering, civil engineering, and construction materials, natural hazards, the transportation of persons and goods, systems and means of transport and their safety, infrastructure, and investigate their uses and impacts from the technical, economic, social, health, energy, environmental and human points of view.

THE INSTITUTE’S PRINCIPAL AIMS ARE:

1. To carry out fundamental and applied research, perform methodological studies and develop tests and prototypes;
2. To conduct all types of expert appraisals and advisory work in the fields mentioned in the above paragraph;
3. To implement a scientific and technical information policy and disseminate the knowledge gained, in particular through publications, technical regulations and standards;
4. To pursue a policy to exploit the results of its scientific and technological research, in particular by means of technical support, technology transfer and certification tests;
5. To play a role in training by and for research and both vocational and in-service training;
6. To help to export its expertise and the techniques it develops and gain better international exposure for them. This role is, in particular, focused on assisting its supervising ministries, other administrations and the organizations associated with them, local and regional authorities, European and international institutions, professional bodies, firms and users’ associations.
Armand Jung: We interviewed several of the Institute’s experts, and 18 of their scientific colleagues took part in the roundtables, for which IFSTTAR helped us choose the issues. The experts who took part provided extremely valuable additional insights during the debates. We also asked the Institute to summarize the recent international scientific literature dealing with the analysis of road risk factors, and the evaluation of the measures that have been implemented to reduce the number of accidents. Their expertise and responsiveness enabled the 28 researchers to complete this important task in under two months.

Philippe Houillon: The mission worked for five months. Almost 170 persons appeared before us during over 60 hours of hearings: these included researchers, doctors, road users’ associations, vehicle manufacturers, associations of road casualties. We also organized twelve roundtables on different aspects of road safety. Last, the mission travelled to a vehicle and equipment test site at Monthéry and to Brussels where we took stock of European regulations. We used the considerable amount of information we gathered to make the most comprehensive survey possible of the current state of knowledge. IFSTTAR’s contribution to this work was a fundamental one, providing a sound basis for our analysis of the situation. This is borne out by the fact that our report quotes large sections of the IFSTTAR study.

WHAT ARE THE RECOMMENDATIONS OF YOUR REPORT WHICH WAS ISSUED IN OCTOBER 2011?

A.J.: Early on in our work we came to see that no single measure would be able to produce significant results on its own, a view IFSTTAR shares. To achieve a lasting reduction in the number of road fatalities we can’t rely on a few flagship measures as in the past with compulsory seat belt wearing and the increase in the number of radar speed control traps. Nowadays we need to conduct a systems analysis based on a series of measures targeting all sections of society.

P.H.: To bring about a lasting reduction in road deaths, our report makes 39 proposals under ten headings. These include the widespread introduction of LAVIA – the French Intelligent Speed Adaptation system – as original equipment on production vehicles, a ban on the use of present-day hands-free mobile phone kits, etc. Some have already been adopted by the government, for example the obligation to have a breathalyzer in the vehicle. By the year 2020 these 39 recommendations could reduce the number of road deaths to 2000 from their present level of about 4000.

WHAT PROMPTED THIS FACT-FINDING MISSION?

P.H.: It was set up on 24 May 2011, because of a specific political situation. In April 2011, the statistics showed an interruption, even a sudden reversal, in the overall downward trend in road traffic accidents. The number of road deaths had, in fact, increased by 20% compared with April 2010 after a 10% increase in the first quarter of 2011. The Government therefore announced the removal of the warning signs before radar speed cameras, an increase in the number of radar speed cameras and a ban on in-vehicle devices that warn drivers about them.

A.J.: Many people thought the government was trying to “trap” them, and a genuine clamour ensued. In order to re-open dialogue, there was a need to include all the stakeholders in a detailed analysis of the causes of road traffic accidents in order to re-gain our bearings. This is why the National Assembly set up this fact-finding mission. At the time, the Prime Minister stated that no changes to legislation or regulations would be made until the mission’s conclusions were known.
Barbara Lenz: Our research covers the transport of people and freight. Analyzing them allows us to develop transport demand models and build forecasting scenarios. The latter are extremely useful for testing the effectiveness of different technologies and the political measures that are put in place or recommended in order to limit transport demand in the long term. We therefore provide technical support for a variety of projects generated by German Ministries in the area of transport and mobility. The analysis it conducts means DLR can help develop appropriate research strategies in the sphere of transportation, which is our core activity.

WHAT ARE YOUR LINKS WITH IFSTTAR?

B. L.: INRETS asked me to spend two months in Paris in 2003, and this year marked the beginning of increasingly strong collaboration, which currently focuses on freight transport and which IFSTTAR will continue with equal intensity in the future.

Since August 2011, we have been hosting a young researcher from SPLOTT in Berlin who is working on a comparative study of French and German approaches to business organization and distribution. This highly innovative work fills a gap in research. When she leaves Berlin in July 2012 she will be joined in France by a post-doc from our institute in order for them to continue the work together, this time in France.

Complex freight transport issues require long-term research. This area of research is becoming increasingly crucial in view of the fact that business trips and freight movements account for 40% of traffic in urban areas. In the short term, we will continue our analytical work in this area and, in the longer term, attempt to build Europe-wide scenarios. A Franco-German (or rather an IFSTTAR/DLR) seminar to be held in September should allow us to identify other areas for collaboration.

HOW CAN WE MAKE MOBILITY MORE PEOPLE-FRIENDLY?

B. L.: European cities must find answers to the major challenges set out in the European Union white book on urban transport which are covered by legislation.

The legislative framework may stimulate changes in behaviour. If we just think about freight transport in Germany, one of the most appropriate measures is without doubt the extension of the “Maut” tax. This has been levied since 2005 on vehicles of over 12 tonnes using the motorways and is due to be extended to the entire national network of four lane roads from August 2012. This measure is expected to provide strong encouragement for continual improvements in freight transport efficiency. People-friendly transport is everybody’s concern!
2011 saw the creation of IFSTTAR. It was therefore extremely eventful for the Institute, as can be judged from this section which presents IFSTTAR in its setting.

The year was marked by three particularly emblematic features: one is IFSTTAR’s participation in the Future Investments Programme and the other two are the outcome of the merger between the former INRETS and the former LCPC, i.e. the creation of a new scientific strategy and the development of a project for the Institute, “Imagine IFSTTAR”.

The Institute’s partnerships and collaborative activities have increased and been consolidated at regional, national and international levels.

In 2011, we can thus mention participation in 17 Future Investment Projects at IFSTTAR’s various sites, involvement in 61 European projects, the defence of 74 doctoral theses and 7 accreditations to supervise research (HDR), the renewal of the Institute’s ISO 9001 certification for its quality assurance system, 23 awards for its researchers, participation in 11 new projects in the framework of the 2011 call for proposals for the 7th FPRD...

The transformation is under way!

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Since 1 January 2011, IFSTTAR, which was created by the merger of LCPC and INRETS, became a new key player on the international scene in the fields of transport, infrastructure, natural hazards and urban issues.

This new scientific and technological establishment brings together multidisciplinary teams with the ability to develop a systems research approach in order to meet the challenges facing society, considered from the technical, economic, social, health, energy, environmental and human points of view.

Much ground has been covered since this date, thanks to the work of all the teams that have been brought together to form the new Institute. The support services and governance bodies have been restructured while maintaining an outstanding level of success in calls for projects and preparing its scientific strategy and the project for the Institute. The governance and consultative bodies were almost complete with the appointment, in the early summer, of the staff representatives on the Board of Directors – which also had a new chair – and the Scientific Board. Then, in early autumn, the election of the professional representatives was held.

"COMING TOGETHER IS A BEGINNING, STAYING TOGETHER IS PROGRESS, AND WORKING TOGETHER IS SUCCESS."
HENRY FORD (1863-1947)
The future of IFSTTAR is being shaped collectively

Developing its scientific project has led the Institute to re-examine research issues in the French context (National Strategy for Research and Innovation, National Strategy for Sustainable Development ...) and the European context (Framework Programme for Research and Development...). At the end of the process, transforming these issues into research topics provided the foundation of the project. The first stage of the updating and knowledge-sharing process for these issues consisted of mutual understanding seminars. Five such meetings were organized ending in the summer of 2011. They provided an opportunity for staff to meet and swap ideas around a scientific topic in order to develop an overall view, make a diagnosis and identify possible areas for research by highlighting possibilities for synergy, potential linkages, and opportunities for working together in the future.

The research structures college, which is a genuine debating forum with almost 80 members, took part in this first phase, supported by contributions from nine multi-disciplinary discussion groups. The first project was set up at the end of 2011 and draws on IFSTTAR’s strong points and the added value resulting from its creation. Apart from its coverage of a wider range of topics, what is characteristic of IFSTTAR is its multi-disciplinary systemic approach. This major quality, which is essential for studying fields as complex as cities and environmental protection, is the guiding principle of the project.

Another collective creation, the “Imagine IFSTTAR” project for the Institute was launched in 2011 to provide IFSTTAR with a shared vision of its social utility. Its goal is for all the scientific and operational departments to work together around a common core. It will reflect the discussions within the hundred-strong committee made up of the Institute’s and units management, set out the organization’s goals and the action plan for achieving them.

From the national to the international level

At the national level, 2011 was a very good year judging from the number of projects IFSTTAR has been involved in that have received accreditation during the first wave of calls for proposals for the Future Investments Programme. The teams are still active in 2012 and many projects have been submitted.

At international level, the Institute’s profile and influence continue to grow, a testimony to the recognition of the Institute’s expertise and scientific excellence. Further proof is provided by its active presence at major events and the fact that it has organized some of the most important global meetings. Chief among these is the TRB (Transportation Research Board) annual meeting which is an unrivalled forum for transportation issues. In addition, the Nord-Pas de Calais region hosted the World Congress on Railway Research, and the Lyon region held the European Congress on ITS (Intelligent Transport Systems). The year came to a close with the World Road Congress in Mexico City, where the Institute’s researchers won first prize in the framework of the European Forever open Road project.
Future Investments Programme (PIA)
The reasons for a success

Its 17 selected projects\(^{(1)}\) give IFSTTAR a strong presence in the Future Investments Programme. The Institute is involved in 5 laboratories of excellence (Labex), 4 facilities of excellence (Equipex), two technology research institutes, 4 institutes of excellence on zero carbon energy (IEED), 2 technology transfer acceleration companies (SATT) and 1 initiative of excellence (IDEX). This success was the result of strong motivation on the part of the Institute’s teams in response to the PIA calls for projects, at a time the Institute was undergoing major internal changes. IFSTTAR’s strong regional presence was a key factor in this success, as it facilitated the preparation of proposals with close links to the regional dynamics created by Research / Academic Clusters (PRES) and Competitiveness Clusters. All IFSTTAR’s sites are involved in PIA projects, as 7 of the projects involving IFSTTAR are in Île-de-France (the Greater Paris Region, 5 are in Rhône-Alpes, 2 are in Provence - Alpes - Côtes-d’Azur, 2 in the West and 1 in Nord-Pas-de-Calais.

The research issues that are tackled by the winning projects involve many fields and varied disciplines. In a way, the scope of the PIA projects cover the range of the Institute’s activities comprehensively: transportation, the environment, natural hazards, sustainable constructions, planning and urban issues... which are approached from a variety of angles that bring into play mathematics, physics, medicine, economics and the life sciences.

Clearly, IFSTTAR has comprehensively adopted the PIA procedure and the implementation of the 17 winning projects should have a powerful knock-on effect on all the Institute’s activities in the coming years.

\(^{(1)}\) Including all the projects submitted in 2011 and accepted in 2011 and early 2012.

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A ten-year scientific strategy

The review of the Institute’s scientific approach must prepare the Institute to consolidate its positions with regard to its areas of excellence, foresee developments and take up a position on new challenges. The new issues include the need for sustainable development and responses to climate change and population ageing, which are areas where we must develop research approaches that are more systemic and multidisciplinary and that give complexity a central place. The scientific strategy review which got under way in early 2011 and the mutual understanding seminars identified IFSTTAR’s strengths and added value, not only in terms of themes, approaches and methods, but also in the interplay between disciplines and the consideration of human factors. In addition to these seminars, a large number of discussions were undertaken with the laboratories in order to specify the principal research issues for the next ten years. These were then discussed with the Institute’s governance bodies (the Board of Directors, Scientific and Technical Board) and our external partners.

Following these discussions, IFSTTAR’s scientific strategy was finalized, around the following four tasks:

- **Task 1**: Analysis and innovation for sustainable and responsible mobility.
- **Task 2**: Constructing, deconstructing, preserving and modifying infrastructure efficiently and sustainably.
- **Task 3**: Climate change, natural hazards and environmental and health impacts in man-made environments.
- **Task 4**: Designing and planning sustainable cities and regions: systemic and multi-scale approaches.

By their very nature, these tasks cut across disciplinary boundaries and illustrate how IFSTTAR’s research addresses societal issues. The tasks may also evolve over time. While IFSTTAR’s first goals and performance contract imposes these tasks for the medium and long terms, those that follow it will enable the Institute to update its scientific strategy as societal and scientific concerns change.

Last, in order to develop its research activities and adapt them to the issues, needs and priorities that have been identified above, in 2011 IFSTTAR conducted an in-depth review of the resources, tools and policies that need to be introduced, consolidated or modified. The changes in question will be introduced as research directions are modified in order to make sure the new scientific strategy is adequately resourced.

A project for the Institute: A human adventure

In early 2011, the Managing Director of IFSTTAR decided to initiate a process of consideration with a view to developing a project for the Institute, Imagine Ifsttar, along the same lines as a company project. The fundamental aim is to forge a common culture within IFSTTAR, which is essential if it is to perform its role successfully.

The project has three goals:

- To create a vision that is shared by all the staff of the new organization created by the merger.
- To undertake the transformations that are necessary for it to perform its role more effectively and integrate better in its scientific, technological and societal environment.
- To lead its entire staff in a “human adventure” which will give meaning to their professional activities.

The first phase of the process involves drafting the project, which is a document setting out IFSTTAR’s ambitions. This took up the whole of 2011 and will continue into 2012. Gradually, by a process involving concentric circles and successive improvement of the project, all the Institute’s staff came to be involved thanks to an approach that encouraged their active participation. The management committee officially launched the process in May 2011. Next, meetings of all the representatives of the Institute’s management were held in June and November 2011. Between these collective meetings, the teams met for working sessions in order to determine the future organization of the Institute in a collegial manner. The second phase of the project will get under way in 2012 when an action plan for achieving the goals of the Imagine IFSTTAR project will be implemented.

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KEY DATES 2011

1. JANUARY 1ST: Creation of IFSTTAR

2. JANUARY 23RD-27TH: IFSTTAR involved in the 90th Annual Meeting of the Transportation Research Board (TRB) in Washington

3. JANUARY 27TH: Creation of the Albertis / ENPC / IFSTTAR Research Chair

4. FEBRUARY 8TH: Organization of the "Roads Plenary Session" in Nantes

5. MARCH 22ND: Launching of the “mutual understanding” seminars in order to develop the Institute’s scientific strategy

6. APRIL 18TH: Signing of a memorandum of understanding with the Minister of Infrastructure and Transport of Congo-Brazzaville

7. APRIL 18TH: IFSTTAR pays homage to Professor Olivier Coussy by organizing, with École des Ponts ParisTech, an international symposium at Marne-La-Vallée entitled “Mechanics and physics of porous solids”

8. FROM 10TH TO 15TH MAY: Predit Crossroads Event in Bordeaux

9. MAY 23RD: IFSTTAR present at the World Congress on Railway Research in Lille

10. MAY: Launching of the Institute’s Imagine IFSTTAR project
JUNE 6TH  IFSTTAR actively involved in the 8th ITS Europe Congress on Intelligent Transport Systems in Lyon
FROM 8TH TO 10TH JUNE  IFSTTAR organizes the 4th congress of ARPenv, an Association for Research in Environmental Psychology
JUNE 16TH AND 17TH Meeting of the German and French Roads Directors
JUNE 20TH 1st meeting of the IFSTTAR Board of Directors and election of the new Chair, Hubert du Mesnil, Managing Director of RFF
JUNE 23RD Election of staff representatives to IFSTTAR’s governance bodies
JUNE 23RD Parliamentary Meetings on Roads and Road Safety
FROM 29TH TO 30TH JUNE IFSTTAR organizes the “Engineering Structures Plenary Session” with SÉTRA in Marseille
JULY 6TH Signing of the partnership agreement between IFSTTAR and the Jean Rouxel Materials Institute (IMN)
JULY Creation of the IFSTTAR Research and Discussion Groups (GERI)
SEPTEMBER 2ND Signing of the IFSTTAR/ANDRA partnership agreement to coordinate research on the underground storage of radioactive wastes
SEPTEMBER 9TH Signing of the Charter to make expert appraisals available to the stakeholders of civil society
SEPTEMBER 28TH Inauguration of the Futurs Urbains Laboratory of Excellence
FROM 29TH TO 30TH SEPTEMBER IFSTTAR takes part in the 24th Entretiens Jacques Cartier in Ottowa (Canada)
FROM 26TH TO 30TH SEPTEMBER IFSTTAR present alongside MEDDTL at the World Road Congress in Mexico City
OCTOBER 20TH Professional elections to the Institute’s consultative bodies
1. IFSTTAR HAS “ISO 9001” CERTIFICATION (SINCE OCTOBER 2002)
Certification renewals were awarded in 2005, 2008 and 2011 for its quality management system in the 5 activity areas of research, development, studies and expert appraisals, certification, and testing for civil engineering materials and structures, geotechnical engineering and natural hazards, the environment and transport infrastructure operation.

2. IFSTTAR HOLDS ACCREDITATION FROM “COFRAC TESTS” IN ACCORDANCE WITH THE ISO 17025 STANDARD
This relates to the 7 following testing programmes:
- prog. no. 3: Tests on hydraulic concrete and its components (CPDM/Paris),
- prog. no. 5: Tests on concrete reinforcement (SMC/Nantes),
- prog. no. 29-1: Tests on metal materials, mechanical testing (SMC/Nantes),
- prog. no. 8: Tests on asphalt mixes and their components (MIT/Nantes),
- prog. no. 23: Tests on rocks and aggregates (MIT/Nantes),
- prog. no. 86: Tests on asphalt mixes and their components (MIT/Nantes),
- prog no. 105: Tests on special products intended for hydraulic concrete structures (CPDM/Paris),
outside the programmes: Mechanical testing of structures in crashes STAT ROUTE (UNEX/Bron).

3. IFSTTAR HAS BEEN AWARDED ACCREDITATION BY “COFRAC INDUSTRIAL PRODUCT CERTIFICATION”, IN ACCORDANCE WITH THE STANDARD EN 45011 (SINCE MAY 1ST 2006)
For the EC marking of aggregates (Directive 89-106: “Construction Products”), notified body No. 1165 according to the “2+” system for audits of plant production control in aggregate quarries.

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Due to its links with LCPC, IFSTTAR inherits a long tradition of “quality assurance” going back to the 1980s. LCPC was the first, and for many years the only, EPST with ISO 9001 certification for its quality management system.

In particular:
- In 1979, LCPC was one of the 5 laboratories that set up the RNE which became COFRAC in 1994.
- After a call for tenders, LNE won the public contract and replaced the LRQA as the ISO 9001 certifying body for the October 2011 renewal audit.

IFSTTAR’s 3 quality qualifications
A first accreditation for UNEX at Bron

Ten months after the LCPC/INRETS merger, UNEX (Experimen- tnal Testing Unit) was awarded its first “COFRAC tests” accreditation for mechanical strength tests on structures during a crash. This project had been run for more than a year by Patrick Joffrin, the unit’s director, and Sophie Serindat, its quality correspondent. The COFRAC appraisal was conducted in 2 stages by 2 auditors, one for quality, the other for technical aspects. At their request, a “crash” test was carried out on the day of the audit.

Extension of ISO 9001 certification to LIVIC in Satory

Among the goals set for the Quality Delegation by the Managing Director, Hélène Jacquot- Guimbal, is for ISO 9001 certification to be eventually extended to the quality management systems of every IFSTTAR site.

With this end in view, LIVIC began to formalize its operation by drafting a MOU with numerous appendices. Its status as a jointly-managed unit (until the creation of IFSTTAR) had led to the drafting of notes that described the procedures in place in the former INRETS and the former LCPC. Several tools were implemented in order to achieve traceability and archival storage, including a Wiki and a control chart for monitoring project revenue and expenditure. Straightforward realistic procedures were specified and applied for monitoring the measurement devices. The EREFIN indicators were introduced as a means of measuring and improving quality.

The initial audit was added to the renewal audit for the Paris and Nantes sites in October 2011.

The favourable report of the LNE auditors granted certification to LIVIC from 21 December 2011. This will remain valid until 31 October 2014, as for the other certified IFSTTAR sites, Paris and Nantes...
PRIZES AND AWARDS

As is the case every year, many IFSTTAR researchers have received awards for their research work

Fanny MALLARD and Amandine FARGIER (doctoral students - IM)
2011 “Young Professionals” prize from the French Committee of PIARC for “A method for evaluating the effects of road projects on ecosystems for the development of a planning tool”.

Farah HOMSI (IFSTTAR research fellow - IM)
First prize for theses done at Ecole des Ponts ParisTech for her thesis “Submerged instrumentation of cementitious materials using ultrasonic carbon nanotube transducers”.

Bérengère LEBENTAL (MACS)
First prize for theses done at Ecole des Ponts ParisTech for her thesis “Submerged instrumentation of cementitious materials using ultrasonic carbon nanotube transducers”.

Judith PRINCETON (GRETIA)
First prize for the best paper and best presentation at the Young Research Seminar in Copenhagen.

Nicolas CHEIFETZ (CIFRE VEOLIA – GRETIA)
Prize for the best presentation at the IFSTTAR doctoral workshop.

Philippe COUSSOT (Researcher at the Navier Laboratory)
DARGELOS prize 2011 (awarded by the Association of former students and graduates of the École Polytechnique) for his work on the rheophysics of complex fluids.

Jean-Pierre MEDEVIEILLE (Deputy Managing Director)
CERTH (EKETA) Jury prize, from the Centre for Research and Technology Hellas for his contribution to the European Research Space in the field of transport.
Anne-Catherine RODRIGUEZ
2010-2011 University Prize organized by the General Council of the Val-de-Marne Département.
Equal second prize for her doctoral thesis “Women HGV drivers - life history and relationship to their job of an increasing proportion of the labour force in a changing occupation”.

Nicolas ROUSSEL, Mickaël THIERY, Guillaume HABERT, Patrick BELIN (MIT)
First prize in the 2011 Eugène Freyssinet awards for their research “Towards capture of the CO2 in demolition concretes”.

Émilie MASSON
(CIFRE ALSTOM - IFSTTAR/LEOST)
Winner of the S2I Poitiers doctoral school prize for her thesis “Study of the propagation of electromagnetic waves in curved tunnels with non-rectilinear cross-sections for metro and railway applications”.

Jean-François NICOLAS (intern - GER, Earthquakes and Vibrations Group)
École Polytechnique prize for a mechanics research project “Propagation of seismic waves in soils: a fractional derivative model”.

Joël YERPEZ (MA) and Marina HUGUES (Jonction consultancy)
Special prize awarded by the Charles Parey jury of the French Committee of the World Road Association (FC - PIARC) for their paper “Feeling claimed priority and reaction time, analysis of accidents at intersections”.

18 PRÉDIT RESEARCH PROJECTS AWARDED PRIZES AT THE BORDEAUX CROSSROADS EVENT FOR RESEARCH AND INNOVATION IN LAND TRANSPORT:
6 of these involved teams from IFSTTAR, 2 overseen by IFSTTAR, and 4 partnerships.

ENERGY AND ENVIRONMENT - TECHNOLOGIES PRIZE:
“STEEM: Tram system with maximized energy efficiency” coordinated by Alstom transport - partnership with LTN.

PRIZE FOR TRANSPORT SYSTEM QUALITY AND SECURITY:
“SURTRAIN: Surveillance of transport systems by analysis of images and sound” (coordinated by Eolane - partnership with LEGOT).

PRIZE FOR QUALITY AND SECURITY OF TRANSPORT SYSTEMS - KNOWLEDGE:
“CESIR - A: combination of studies for health and road safety - matching national databases” (coordinated by INSERM - participation of UMRESTTE).

PRIZE FOR MOBILITY IN URBAN REGIONS:
“The coherent city” (managed by LVMT - Marie-Hélène MASSOT and Jean-Pierre ORFEUIL).

PRIZE FOR TRANSPORT POLICY:
“Outlook for the sustainable financing of public transport” (managed by LET - partnership with LVMT).
PARTNERSHIPS AND JOINT VENTURES

By exploiting the links it has forged with the major players in all aspects of transport-related expertise the Institute is setting out to develop an effective collective discussion process that is in line with the expectations of the public and industry. This enables it to apply its knowledge, heighten its profile and engage in action.

ROAD INFRASTRUCTURE

IDRRIM shows the way

IFSTTAR was one of the founding members of the Institute for Roads, Streets and Infrastructures for Mobility (IDRRIM) which was set up on 19 January 2010. IFSTTAR makes a significant contribution to its operation, playing an active role in its different bodies. IFSTTAR thus performs the secretariat functions of the bureau, which is a governance structure that assists the Chair Yves Krattinger and the Managing Director Marc Tassone, and the Institute is also present on most of the eight operational committees. Of these, the Opinion and Methodology Committees deserve a special mention. These committees were formerly members of the now defunct CFTR (French Committee for Road Engineering Techniques) whose work IDRRIM is continuing. The CFTR was responsible for creating most of France’s technical culture for the construction and maintenance of land transport infrastructure. This provides IFSTTAR with a way of promoting its findings and an opportunity to develop partnerships at the national level.

Within the Methodology Committee, the National Pavement Surface Characteristics group and its sub-groups on Skid resistance, Noise and Evenness (the last two managed by IFSTTAR) have reference status at national level in their respective areas. In its role as a founding member, IFSTTAR has asked IDRRIM to share responsibility for organizing and leading the “Roads Plenary Session” (JTR) as from 2011. IFSTTAR also helped IDRRIM draw up the programme for its first national congress which is to be held in Lyon in October 2012, alongside the Interoute et Ville exhibition. With other bodies such as the French National Committee of PIARC, IFSTTAR has also decided to let IDRRIM take advantage of its international presence in order to extend awareness of IDRRIM beyond France’s borders.

THE ENVIRONMENT

AllEnvi, a long-term Adventure

The National Alliance for Environment-Based Research (AllEnvi), which was set up in 2010 by the Minister for Higher Education and Research, brings together the expertise of research institutes, universities and engineering schools in the area of the environmental sciences. The aim is promote a coherent multidisciplinary approach to the four major sustainable development challenges, namely, food, water, climate and land use. IFSTTAR is one of the 15 founding members of this alliance which has 27 institutional members and a total of 20,000 scientists. After a first year devoted to setting up its thematic working groups and management structure, the Alliance began to operate at a more regular level in 2011. In March 2011 its priorities for environmental research were suggested to ANR for the 2012 schedule. In addition to the regular work of the thematic groups, the second half of 2011 was given over to preparing the 1st AllEnvi Forum which is to be held in the first quarter of 2012. As well being on the steering committee, IFSTTAR takes part in 5 of the 11 thematic working groups (climate, water, hazards, cities and mobility, and environmental assessment).
ENERGY AND TRANSPORT

IFSTTAR continues to play an active role in ANCRE

Since 2010, IFSTTAR has been running the working group on “Energy and Transport” (GP6), which is part of the National Alliance for Coordinating Energy Research (ANCRE), a body that was set up at government request in July 2009. Beyond its founding members (CEA, CNRS and IFP), ANCRE has extended partnerships with the French public sector research bodies that deal with energy-related issues, including IFSTTAR, in order to identify and ultimately overcome the main stumbling blocks, be they scientific, technological, economic or societal. This task involves, among other things, analyzing the strengths of French research entities by creating a detailed overview and proposing research programmes (from fundamental research to producing actual demonstrators) to overcome the difficulties.

In all, over 500 experts were invited to participate in the nine thematic groups, five of which were devoted to energy sources (energy from biomass (GP1), fossil fuels and geothermal sources (GP2), nuclear power (GP3), solar power (GP4), marine, hydroelectric and wind power (GP5)). Three other groups focused on end use (transport (GP6) supervised by IFSTTAR, buildings (GP7) led by the CSTB, and industry and agriculture (GP8) led by CNRS). The last group, (GP9), is more interdisciplinary and is involved in forecasting and summarizing the findings.

Group GP6, led by IFSTTAR, employs a two-pronged approach, i.e. by sector and by discipline. Nearly 80 IFSTTAR scientists provide their expert knowledge on vehicles, motor and engine technology and energy and its use across all transport sectors: road, maritime and river, rail, and air. By the end of 2010, GP6 had released an initial summary report with a series of recommendations on difficulties or technologies that merit further study, with projects for demonstrators. It also produced a preliminary skills map.

Work continued in 2011, and a number of the group’s scientists have helped draw up the numerous proposals that have been put before the bodies responsible for funding research and future investment. This primarily involved internal combustion engines, electric and hybrid motors and transport-related aspects for both persons and/or freight, essentially in the road and rail sectors. With the exception of air transport, a very large proportion of GP6’s work has been based on output by PREDIT working groups and, as such, provides a valuable complement to the research in question.

SUSTAINABLE URBAN PLANNING

A dominant role in the activities of IRSTV

The Urban Scientific and Technical Research Institute (IRSTV) brings together some twenty laboratories from 13 research and higher education establishments in western France. The research teams are working together to investigate cities and the urban environment with the goal of developing methods and tools for sustainable urban planning. IFSTTAR plays a major role, taking part in many research projects that involve a large number of bodies, in some cases as leader, in particular the Nantes Area Urban Environment Observatory (OVENU). This observation unit conducts long-term monitoring of water, pollutant and energy flows in a variety of media (air, water, soil ...). It also conducts urban remote sensing in order to monitor several catchments in the Nantes conurbation.

In the area of urban microclimatology, the GER unit studies suburban catchments, models moisture transfers between different parts of the urban environment (atmosphere, soil, hydrological networks, vegetation and the built environment) and analyzes the operation of techniques that provide an alternative to stormwater collection.

In the case of urban soils (SOLURB), GER’s research focuses on how the nature of urban soils affects water and pollutant transfer. In the case of urban background noise, IM is working on the development of sound propagation models that take account of urban forms and the interactions between sound and the urban environment.

In 2011, an ADEME project (SITERRE), in which GER is taking part, was launched. This deals with the creation of urban soils with innovative materials instead of topsoil and quarry aggregate. The year also saw the completion of the ANR-sponsored AVUPUR project on the hydrological modelling of suburban catchments. GER also helped organize the CNRS urban environment course that was held in La Rochelle from 19-23 September 2011.

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CLOSE
REGIONAL TIES

IFSTTAR intends each of its sites to become a focal point for expertise, a melting pot where individuals meet, ideas are spread, and actions are set up, working with regional players through partnerships in order to develop safe and sustainable mobility. The Institute maintains a large number of fruitful ties with business interests and academia at both local and regional levels.

Paris Region
(Île-de-France)

IFSTTAR’S HEAD OFFICE IS SHORTLY TO MOVE TO MARNE-LA-VALLÉE, TOGETHER WITH SOME RESEARCH TEAMS STILL TO BE DECIDED
The Marne-la-Vallée site is changing very fast with the construction of the Bienvenüe building to accommodate part of IFSTTAR in the very near future. The Cité Descartes site will have the potential to house 1500 researchers, engineers and doctoral students from research bodies, higher education establishments, institutes and Paris-Est Marne-la-Vallée University which are located there. This grouping will form the Paris-East Science and Technology Cluster which is part of Paris-East University and will work closely with the Advancity competitiveness cluster. This will constitute one of the world’s largest multidisciplinary centres for teaching, research and innovation on urban issues.

AT THE END OF 2012 IFSTTAR WILL RELOCATE TO MARNE-LA-VALLÉE.”

AN IMPORTANT CENTRE FOR TEACHING AND RESEARCH ON ALL URBAN THEMES
As a founding member of Paris-East University, IFSTTAR is active in the research units and the doctoral schools of the PRES (research and academic cluster).

The Abertis-ENPC-IFSTTAR chair, which was created in January 2011, carries out training and research in the area of the management of transport infrastructure and targets students, researchers, teachers and professionals working in the field. The chair is responsible for the first Albertis prize for transport infrastructure management.

IFSTTAR is also very active in the creation of the new western PRES known as UPGO which stands for Paris Grand Ouest University. It brings together the Universities of Cergy-Pontoise
and Versailles-Saint-Quentin-en-Yvelines, IFSTTAR and eight other research organizations and higher education establishments. VeDeCoM is one of the flagship projects of the new PRES.

**URBAN RESEARCH IN THE PARIS REGION IS MAPPING OUT THE FUTURE**

In 2011, the Future Investments Programme continued to rally the research units in the Paris region around projects whose funding had already been found or was being negotiated. One of these, the Sense-City Equipex, led by IFSTTAR, sets out to use sensor networks to monitor urban areas closely. A miniature test city will be constructed at the CSTB site in the Cité Descartes in order to anchor this city from the start. Several of the participants city will be installed.

The NanomagesX Equipex, which is managed by the Navier Institute (a Marne-la-Vallée research unit which is jointly run by CNRS, ENPC and IFSTTAR), aims to construct and operate a 3D imaging line chief to study the structure of new materials in the SOLEIL synchrotron.

No less than 5 IFSTTAR research units are involved in another Future Investments Programme, the Futurs Urbains Labex. This project will develop an interdisciplinary approach in urban contexts by coordinating high quality research with the ability to conduct in situ trials at the Descartes Cluster in Marne-la-Vallée. The Efficacity project aims to find ways of reducing energy consumption by implementing the technology, services and design evaluation tools developed by its industrial and academic project partners.

The Institute also participates, with Paris-East University, and the Sorbonne Paris Cité, in the Technology Transfer Acceleration Committee (SATT) Ile-de-France Innov.

**GREATER INVOLVEMENT IN THE COMPETITIVENESS CLUSTERS**

A second proposal for an IDEED(1), VeDeCoM2, has been extensively reworked by the 42 partners (which include Renault, PSA, Valéo and IFSTTAR). The themes to be covered by the future institute which is to bring together 200 researchers at Versailles-Satory, have been modified more comprehensively: vehicle electrification, the delegation of driving tasks (to the point of automation), new transport systems and services with a proposal for a utilization laboratory in which IFSTTAR will be very much involved.

As part of the “Vehicles of the Future” programme which has Mov’eo support and certification, the LTN teams at Satoy have submitted a proposal known as Mov’eo TREVe with a view to creating the facilities and regulations needed to conduct comparative tests and evaluate charging systems for electric vehicles and chargeable hybrid vehicles. The consortium includes Renault, Schneider and 6 other partners and aims to use the Satoy site to set up test facilities whose reference status will be recognized by the entire electric vehicle sector.

Another proposal, SYSMO 2015, which has been certified by Mov’eo and Sytematic, and which involves IFSTTAR teams from Satoy and Marne-la-Vallée, has been submitted in response to an ADEME call for expressions of interest for new transportation systems. The proposal is to develop techniques, systems and knowledge for multimodal information systems, car-sharing with automatic vehicles and, more recently, systems for major transport hubs.

The Institute is heavily involved in the governance of the Advancy cluster, chairing the scientific board and the Mobility certification committee and leading its strategic policy committees. The Institute’s teams are continuing their involvement in setting up projects that are certified by this cluster, for example, NEWTUN (interactive pre-retaining for tunnel boring) and REPTILES(2) (rehabilitation of drinking water pipes). (1) Institutes of Excellence on Zero Carbon Energy.

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**THE FUTURE INVESTMENTS PROGRAMME BOOSTS PARTNERSHIPS**

The development of proposals for Future Investment Projects has boosted partnerships between academia (PRES, Universities, Engineering Schools), and other public establishments (CEA, CNRS, CSTB, IFREMER), and the industrial sector (ALSTOM, EADS, DCNS, STX). Two of these projects, in which IFSTTAR was involved, the Jules Verne IRT in the Pays-de-la-Loire and the France Energies Marines IED in Brittany, will end positively with concrete achievements in 2012. However, although the IC-Ouest IDEX, backed by the UNAM(3) PRES in the Loire valley and the UBE(4) PRES in Brittany, was not selected by the General Commission for Investments, it did succeed in initiating closer inter-regional ties between universities in Brittany and Pays-de-la-Loire which all the participants are keen to continue.

**A UNIFYING FORCE FOR RESEARCH IN THE REGIONS**

IFSTTAR’s desire to develop partnerships with the Universities in the Pays-de-la-Loire region takes varied forms, which the Institute has maintained and extended in 2011. This has allowed IFSTTAR to participate actively in the region’s various research coordination bodies (CCRDT, Observatoire Régional de La Recherche …) and

(3) Nantes-Angers-Le Mans University. (4) The European University of Brittany.
BRINGING ABOUT THE SUSTAINABLE CITY

The strong involvement of the IFSTTAR teams at Bron and Grenoble in the Future Investments Programme was crowned with many successes in 2012-07-22. These include OSUG@2020 (the Grenoble Centre for the Sciences of the Universe), PRIMES Physics, Radiology, Medical Imaging and Simulation), the IVTV (Engineering and ageing of living tissues) Equipex, Resif Core (Seismological and Geodesic network) and the CeLyA (Lyon Acoustics centre) Labex. Its 150-strong staff, which include 61 researchers, make CeLyA one of Europe’s largest centres for acoustics research.

The LICIT research unit has also been contacted to provide additional expertise in the area of transport for the IMU (Intelligence on Urban Worlds) Labex.

A STRONG PARTNERSHIP WITH THE LUTB COMPETITIVENESS CLUSTER

The ambitious project to set up a shared platform of test facilities for public transport known as TRANSPOLIS, in which IFSTTAR plays an active role through the LUTB competitiveness cluster, has continued to move forward. A joint subsidiary has been set up with the industrial partners in LUTB (Renault Trucks, Colas, Aixam, Vibratex, Eve system and the Alcatel group). This subsidiary should provide some of the investment needed for the project (other investments are managed by IFSTTAR) and oversee the project as a whole.

In order to raise the profile and increase the effectiveness of transport research in the Rhône-Alpes Region, the teams at Bron have undertaken a large number of initiatives, some of them, like the LUTB “Think Tank”, are highly innovative. Their participation in the CMRT (Combined Transport Research Centre) and the Rhône-Alpes PST is also noteworthy. Together, these activities help to increase the number of partnerships either between the Lyon-based academic transport research units or between MEDDTL’s departments and public establishments that focus on expert appraisals and research.

ENHANCING THE PROFILE OF REGIONS

In addition to the Institute’s role in the various coordination structures and its participation in joint research projects, IFSTTAR’s organization of national and international technical and scientific events in the regions helps develop the profile and influence of those regions where IFSTTAR has sites.

For example, in 2012 the traditional national Roads Plenary Sessions (JTR), which have been held in Nantes in early February for over twenty years, will be held alongside several other events prepared by a number of local players. These include the 2012 International Acoustics Congress and the LCA 2012(5) and IWAGPR(6) international seminars.

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PRIORITY TO EXCELLENCE
The Accident Mechanisms research unit (MA) and the Laboratory of Biomechanics and Applications (LBA) both received “A” ratings in the AERES evaluation. Their research, which is complementary and interdisciplinary, is concerned with analyzing accidents, from causation to remediation. Since 2010, LBA has had improved test facilities and a dedicated 950 m² building for impact testing.

In 2011, there has been an increase in activities aimed at consolidating the centre’s local and regional ties. The strong involvement of the teams at Marseille and Salon-de-Provence in calls for tenders for Future Investments has borne fruit. They will therefore take part in the Aix-Marseille University (AMU) A*MIDEX initiative of excellence via which AMU hopes to gain a place in the top 20 research institutes in France and the top 100 in the world. At the same time, the launch of the PACA-Corse SATT in which IFSTTAR is a partner is expected to provide a genuine stimulus to local research.

Set up by 10 research establishments that hold shares in it and two others that do not, the PACA Corsé SATT will promote the activities of the region’s 6000 or so life sciences researchers.

IFSTTAR also obtained joint funding from the FUI and the Region and certification of its Risk Management and Regional Vulnerability competitiveness cluster for the REMOTE project in partnership with ONERA, EGIS, one SME, as well as the Lyon and Mediterranean CETEs. The project will last 30 months in all and its main goal is to show the capabilities of a radar demonstrator for monitoring unstable natural sites and sensitive structures.

TRANSPORT AND HEALTH: A UNIFYING FORCE FOR RESEARCH AND DIALOGUE IN PACA
The partnerships with Aix-Marseille University have been considerably strengthened. The arrival of surgeons who specialize in abdominal and digestive surgery and the integration of the team from the Otology, Neuro-otology and Microendoscopy unit have strengthened expertise and opened up new possibilities. One example is a joint project with the Institute of Movement Sciences to develop a physical and virtual simulator for neonatal resuscitation and the Centre for Magnetic Resonance in Biology and Medicine to study and model the spinal cord.

The project for a “Humans in Transport” Labex, which was unfortunately not selected, nevertheless made it possible to strengthen ties with the Institute of Movement Sciences, the Centre of the Psychology of Language Knowledge and Emotion and the ONERA Control, Simulation and Flight testing” Research Unit (PSEV).

The centre’s teams have also been involved in research with Décathlon and Strasbourg University on cyclist head injuries with a view to improving helmet design as part of the MEDDTL/DTI funded Bicytête project.

OUTSIDE THE REGION
These regional ties have also made it possible to support international activities:

- Joint organization of the 2nd Simbio-M International Conference on Simulation for Biomechanics.

- Development of a spinal biomechanics research platform that is jointly run by France and Quebec. The understanding between IFSTTAR and the Polytechnic of Montreal also brings in the Montreal École de Technologie Supérieure and the Sainte Justine and Sacré Cœur teaching hospitals. It has resulted in exchanges between the researchers and a number of jointly supervised doctoral theses.

- Organization of the 3rd International French Language GERI COPIE conference. The title of the conference was “The quality and safety of pedestrian travel: factors, issues and new measures.”

- Launching of a research programme with the Centre for Automotive Safety Research (CASR) at Adelaide University (Australia) with a view to evaluating pedestrian-oriented driving aids in real situations.

(7) Research unit that is jointly managed with the Université de la Méditerranée, which will be part of the future Aix-Marseille University.
(8) Provence-Alpes Côte-d’Azur – Corsica.
(9) Technology Transfer Acceleration Company.
(10) IFSTTAR Research and Discussion Group on the Behaviour of Pedestrians in their Environment.

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AN IMPORTANT AND EMBLEMATIC PROJECT FOR IFSTTAR

2011 ended with the involvement of regionally-based transport research teams in three candidates for the Future Investment Projects, two with Labex status and one IRT\(^{(1)}\). Only one of these, the Railénium IRT bid, which was backed by the I-Trans Competitiveness Cluster and the Lille Nord-de-France PRES and 18 industrial partners, was to win.

Railénium’s main goals are: to enhance the life cycle of railway infrastructure (increasing track service life by 30% and track capacity by 20%) and to achieve the rapid international success of its new products. The issues involved are crucial for the future of rail transport. The Railénium IRT is spread over two sites, a principal site at Valenciennes and a secondary site at Villeneuve d’Ascq. IFSTTAR will mainly be involved at the second site.

This ambitious project involves the construction of a dedicated test loop for rail infrastructure and its environment. This major facility is supported by a technological research, training and commercial development and promotion structure whose task is to exploit the innovations generated by the project’s industrial and academic expertise and know-how and which will ultimately employ 200 researchers, engineers and technicians.

The quality of the bid is primarily due to a long period of collegial activity involving laboratories in the North of France and Picardie and industry, which has been encouraged by considerable support from local and regional government. In addition, due to lucky timing, the newly formed IFSTTAR was able to enrich the project with knowledge of two areas: civil engineering and soil mechanics on the one hand and intelligent communication systems applied to traffic safety and security on the other.

STRENGTHENING REGIONAL PARTNERSHIPS: THE FOUNDATIONS OF QUALITY IMPROVEMENTS

The teams at Villeneuve have maintained and increased their strong involvement in setting up projects with their partners from industry and academia, and in the scientific governance bodies with which they work: the scientific boards of partner establishments, the I-Trans Competitiveness Cluster, the SPI doctoral school, the CISIT-CPER programme, and regional consultation bodies. The validity of these partnerships is demonstrated by the involvement of our researchers in university teaching and the supervision of a regular flow of doctoral students (16 out the 110 persons working at the site in 2011).

Regional ties, which are not an end in themselves, help to create a dynamic which enhances individual and collective profiles and recognition. The activities of the teams that work at the site are therefore far from restricted to local partnerships, but extends to many national operations: the CORRIDOR project sponsored by ANR-TTD which was selected in November 2011 and the SYSTUF project sponsored by AMI-ITS. At the international level, it is also worth mentioning the work of ERRAC-Roadmap in the area of rail transport and many European projects from the 7th FPRD: SecureMetro, MODSAFE, On-Time, RESTRAIL, GALOROI, QUALISAR, SATLOC, TRENDS and SECRET.

\(^{(1)}\) Technological Research Institute.
THE INTERNATIONAL STAGE

The Institute's international activities focus on setting up cooperation with institutes of excellence, participating in international networks, building the European Research Space and consolidating its influence.

IFSTTAR's international influence

At the European level, IFSTTAR has maintained its leadership role in 2011 by participating in many new 7th FPRD projects. This achievement confirms the validity of its systems of active support for its research teams, particularly, through its subsidiary ERT, and above all its strategy of participating in European associations such as ERTICO(1), ECTRIP(2), FEHRL(3), and FERSI(4). In addition, in 2011, IFSTTAR conducted a review of its European influence. This has been approved by its Board of Directors and consolidates this defining approach.

The Institute is therefore in a good position for its input concerning Horizon 2020, which is to be the next Framework Programme for Research and Development (FPRD) starting in 2014, to be heard and passed on.

2011 also provided the opportunity to organize the participation of the French partners in the Urban Europe Joint Programming Initiative, and to finalize one of the three roadmaps of the Forever Open Road which is the European counterpart of the 5th Generation Road. Also worth mentioning is the election of Dominique Mignot, IFSTTAR’s Deputy Scientific Director, to the FERSI board.

The European “Transport Research Arena” (TRA) conference, which France will host in 2014, is another key operation in IFSTTAR’s international activities. The Institute was asked by the Ministry of Sustainable Development to coordinate the conference and has spent a year creating dialogue with all the stakeholders in this event that sets out to be at the centre of multimodal innovation in Europe. Furthermore, TRA 2014 has already attracted the attention of several international partners (the TRB WIT committee(5), THE PEP(6) and the ITF/OECD JTRC(7) which are thinking of taking part.

At the international level, the Institute has continued the same strategy that concentrates on OECD countries and seeks shared scientific excellence. In this context, the Institute has organized bilateral scientific seminars with Quebec, Germany, the United States and Japan and has implemented its strategy to encourage the international mobility of researchers. The Institute takes advantage of the working groups organized by the ITF/OECD joint transport research centre and continues to play a major role in PIARC. IFSTTAR’s expertise has also been recognized in targeted countries such as Cameroon with regard to road safety.

(1) European Road Transport Telematics Implementation Co-ordination Organization.
(2) European Conference of Transport Research Institutes.
(3) Forum of European National Highway Research Laboratories.
(4) Forum of European Road Safety Research Institutes.
(5) Transport Research Board Committee on Women’s issues in Transport.

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IFSTTAR benefits from the wealth of European experience accumulated by INRETS and LCPC and has consolidated its position within the European Research Space. Its long-term support for European Associations and its contacts with the Commission have enabled it to launch new European projects and receive funding.

Following the 7th FPRD call for proposals in 2011, IFSTTAR took part in 17 new projects, coordinating two of them. Since the programme was launched in 2007 the Institute has thus been a stakeholder in no less than 61 projects, mostly on the themes of “transport” and “information and communications technology”, allowing it to enhance its profile within Europe and obtain €2,511,649 of additional European funding in 2011.

These successes are partly due to the Institute’s work within European associations. Its activities within ERTICO, a European coordination platform for promoting and implementing intelligent transport systems, took concrete form in 2011 with the Institute’s participation in the ITS Europe Congress which was held in Lyon on 6-9 June and by its collegial participation in several strategic European projects including SATIE, Instant Mobility (a public-private partnership on the Internet of the future) and the i-Mobility (formerly e-Safety) network on intelligent transport systems for persons and goods.

As the driving force behind the creation of the future European transport research alliance via the European Commission-backed DETRA project, IFSTTAR plays a vital role in leading virtual networks and centres of excellence: Humanist (HUMAN centred design for Information Society Technologies), ISN (Integrated Security Network), EURNEX (European rail Research Network of Excellence), Nearctis (Network of Excellence for Advanced Road Cooperative traffic management in the Information Society), VPH (Virtual Physiological Human), HYCON2 (Highly-complex and networked control systems). In-house initiatives to support the participation of the Institute’s researchers in European projects have been boosted. These take the form of targeted information, specific recommendations, interpretation and assistance, that are disseminated, in particular, at specially organized discussion and information workshops. The Institute’s subsidiary ERT has helped put together several successful bids and provides valuable management assistance for European projects.

IFSTTAR has also been actively involved, both directly and through its networks, in preparatory work for the coming Horizon 2020 FPRD by responding to national and community calls for proposals and publishing a number of position papers aimed at institutions and its partners. It has made sure that all its research activities are well integrated within the future programme.

Since 2010, AllEnvi has given IFSTTAR with the responsibility of overseeing French participation in the Urban Europe joint programming initiative on sustainable cities. The Institute plays an important role on the initiative’s management committee and has also set up a French “mirror group” with members drawn from MESR, MEDDTL, ANR, ADEME and CNRS. Finally, IFSTTAR has expanded its bilateral collaboration activities, with European countries, above all with Germany, primarily BAST, a German counterpart, as part of the Forever Open Road project.

The European stage, a major influence and contribution to cooperation

An international presence marked by excellence, exchanges and solidarity

IFSTTAR’s many existing links with centres of excellence in the United States such as the Universities of Berkeley, Penn State and Virginia Tech have been strengthened. The long-term visits by two of our researchers to Californian Universities are among the outstanding events of the year.

This collaboration covers extremely varied fields, from civil engineering to logistics and the organization of freight transport, from transport applications of cognitive science to numerical models of the human body for passive safety.

The partnership with the federal administration’s Highways Research Centre for civil engineering has continued. During the TRB annual conference, IFSTTAR also played an active part in the Franco-American workshop on the role of

Our researchers present abroad

The mobility of IFSTTAR’s researchers reflects its strategy of influence which depends on their participation in the major international conferences on transportation research, the TRB conference and the World ITS Congress.

IFSTTAR also encourages its researchers to take up medium- and long-term assignments in partner institutes abroad, particularly in North America (United States and Canada) and Europe (Germany and Switzerland).

Every year, IFSTTAR acts as host to some twenty experienced researchers (other than doctoral students and researchers on fixed-term contracts) from institutes with which it has longstanding cooperative research links.

168 ASSIGNMENTS COMPLETED OUTSIDE THE EU, 8 OF WHICH WERE MEDIUM OR LONG DURATION (6 MONTHS AND OVER) BY:

- Laetitia Dablanc (United States)
- Kostas Chatzis (United States)
- Laurent Terral (Quebec)
- Minh Tan Do (United States)
- Julien Lardy (United States)
- Benoit Matthern (United States)
- Marion Bost (Switzerland)
- Corinne Blanquart (Germany)

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International visits and delegations

In 2011, IFSTTAR welcomed 85 foreign visitors from administrations, research laboratories and universities etc. in 14 countries.

The aim of these delegations was to raise their awareness of IFSTTAR’s knowledge and expertise in its areas of competence (pavements, road safety, engineering structures, etc.).

IFSTTAR also organized meetings of working groups from several European associations and programmes (REFINE, ERA-NET ROAD, CEDR, FEHRL) in which more than 120 representatives from Europe took part.

This very large number of visitors bears witness to our Institute’s renown.

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public transport in creating sustainable communities where people enjoy living. Cooperative actions with Japan had to be modified after the March 2011 earthquake and the Institute demonstrated its solidarity with its Japanese partners by, among other things, the launch of the ANR-backed ONA-MAZU project which deals with the quantitative assessment of the nonlinear response of soils during earthquakes. The annual Franco-Japanese workshop on intelligent transport systems was held in Tokyo in October 2011 after a meeting with Kyoto University.

Particular importance is given to partnerships with Canada and Quebec, and IFSTTAR cooperative projects between France and Quebec have been funded for 2011-2012. A number of ties with the Ecole Polytechnique de Montréal and other scientific partners in Quebec have been strengthened in order to set up a project on post-accident spinal injuries during the 24th Entretiens Jacques Cartier (which took place in Quebec and Montreal).

A symposium that brought together researchers from IFSTTAR and its Australian partners was held in Brisbane in September 2011 and a meeting between MIROS (Malaysian Institute for Road Safety) and the Institute took stock of cooperation projects between the two bodies in Malaysia, including training in the use of driving simulators.

Its activities in Sub-Saharan Africa have included the setting up of a twinning arrangement between France and Cameroon under the umbrella of the OECD and with support from the World Bank. The aim is to develop a road safety information system that is built around an accident database. A collaboration agreement has also been signed with the Republic of Congo’s Minister for Infrastructure and Civil Engineering that provides for the Institute to give its support and technical assistance for work on the Congolese national road network.

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THE JTRC GETS READY FOR ACTION
The activities of the Joint Transport Research Centre which is run by the OECD International Transport Forum (ITF) have been planned every two years since 2006. IFSTTAR has researchers on its management committees and working groups who take an active part in deciding on the priorities for research policies.

In the case of the activities for 2010-2011, they took part in the work of 7 of the 9 working groups, on the themes of pedestrian safety, urban space and health, powered two-wheeler safety, assessment of the effectiveness of road safety measures, long-life pavements, adapting infrastructure to extreme weather conditions and climate change, international transport research documentation (TRID database); road safety data, optimising financial resources for road operation, maintenance and development, and cyclist safety.

Preparatory work for the 2012-2014 programme started in 2011 and the decisions will be made on the basis of proposals from JTRC members, including those from IFSTTAR. In this connection, a roundtable is due to be organized on limiting mobility, with IFSTTAR’s participation, in November 2012.

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It was too good an opportunity to turn down! In January 2011, straight after finishing my doctorate ("Analysis and modelling of the impact of weather on road traffic", defended in December 2010), I joined the brand new Smart Transport Research Centre at the Queensland University of Technology in Brisbane, Australia. Edward Chung, the founding head of the centre, offered me a position as a post-doc, an opportunity I owe to the strong links my laboratory (LICT) developed with him when working on European projects.

This was a thrilling year in which I encountered a new culture and new ways of working and learnt to work with private sector partners and manage projects as the Smart Transport Research Centre is unusual in being partly funded by the private sector, in particular IBM, Thales, Brisbane City Council and motorway concessionary companies. The Centre’s aim is to imagine the travel of the future and reduce the costs of traffic congestion. In this area, Australia can teach us a great deal and it is a fascinating continent for experiments as more than 90% of its population are urban dwellers.

The country’s cities are expanding rapidly − Brisbane’s population is expected to grow from 3 to 5 million by 2035. Reducing congestion is a major issue in Australia and my laboratory was the first centre that carries out research into traffic modelling to be jointly funded by the private sector. In Brisbane I also worked in partnership with the public transport authority, Translink, on setting up a project to improve their user journey planner. In terms of applied mathematics, which was my original discipline, this involved developing algorithms to compute the shortest path from point A to point B under a set of constraints of varying complexity.

The climax of this adventure was the Franco-Australian symposium that I organized in September 2011: 10 IFSTTAR researchers met 10 researchers from all over Australia in Brisbane. Although I’m back at LICIT now, I still have a foothold in Australia, as an associate researcher at the Smart Transport Research Centre.
A new institute needs new communication vehicles

In 2011, priority was given to in-house communication with the launch of the in-house newspaper, ICUBE. This monthly newsletter is intended just for the Institute’s staff and research teams. Its goal is to foster mutual understanding and provide the basis for a common culture. Communication with our partners has not, however, been neglected and we have created new publications covering news, research, expert appraisals and jobs in the Institute. Two types of newspaper for an external audience have been created: a six-monthly electronic newsletter and a more detailed quarterly printed newsletter. These go under the name “Trajectoire” (Trajectory in English) – a reference to IFSTTAR’s core area of activity.

In 2011, IFSTTAR also published a brochure and its first annual report which brought together the annual reports of INRETS and LCPC in a single document.

The IFSTTAR brand: a new identity to display

The birth of IFSTTAR involved the creation of a new visual identity and required a complete overhaul of its communication vehicles. Press relations have also received special attention in order to increase the Institute’s renown and heighten the profile of our research.

Events

IFSTTAR takes part in many national and international exhibitions and events. Its research teams also regularly organize seminars, conferences and symposiums etc. To communicate with the general public, schools and doctoral students, IFSTTAR took part in:

- The “Nuit des Chercheurs” in September (this is an annual evening encounter between the general public and the research community),
- The 20th “Fête de la Science” in October,
- The CIFRE forum in December.

The Web

IFSTTAR had a website from the first of January, at the address www.ifsttar.fr. Temporarily, the site directs those seeking information about the laboratories and research units to the old LCPC and INRETS web pages. The project to create a new website has been launched. At the same time, a complete overhaul of our Intranet sites is in progress. This should be finished at the end of 2011 with the setting up of the IFSTTAR staff Intranet site.

“Fête de la science” at the IFSTTAR site in Bron.
Papers given at International meetings

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PAPERS GIVEN IN 39 COUNTRIES
The primary task facing IFSTTAR’s doctoral training system in the first year of its existence was to merge the recruitment and supervision practices of the two original institutions. The scientific directorate has produced a number of information notes on these issues (defining an IFSTTAR doctoral student, recruitment procedure, supervisory procedure, reproduction of theses).

What is an IFSTTAR doctoral student?

The first information note collectively established a definition of an IFSTTAR doctoral student that includes the specific cases of the UFRs, external funding, multiple locations, etc. An IFSTTAR doctoral student must satisfy five basic criteria. As far as the recruitment procedures for doctoral students who are financed by the Institute are concerned – and ignoring previous procedures – from 2011, IFSTTAR merged practices to create a common two-stage procedure for selecting topics then candidates. The Scientific Directorate oversees the first stage, which takes place at the beginning of the year and, in principle, selects a higher number of thesis topics than there are doctoral contracts. The candidate selection phase follows. This involves an interview and is run by an ad-hoc commission that is freshly appointed each year. The doctoral contract, an employment contract which is practically unique to IFSTTAR doctoral students was also merged. This contract provides for systematic re-evaluation of the student’s grant in the 3rd year and possibilities for teaching and industrial experience throughout the student’s doctoral training. Ties with the principal doctoral schools have been strengthened due to the presence of several colleagues on their boards, which helps to encourage links between the PRES and the Institute and provides a number of teaching opportunities for our doctoral students. Doctoral students are monitored by means of two progress reports (after 1 and 2 years) which may be followed by interviews. In their second year, doctoral students can present their findings at doctoral workshops which some laboratories organize for broad disciplines. One example is the STICSPI doctoral workshop organized by LEOST in Villeneuve d’Ascq on...
7 June 2011 which gave 17 doctoral students an opportunity to present their work, those organized by units (on 27 September in the case of MACS and on 27 October in the case of IM), that organized by partner associations such as the AFITL, e.g. the 16th workshop for doctoral students engaged in transport research held in Lyon on 28 June 2011. In future years such workshops will be available to all second year doctoral students whatever their discipline.

An increasing role for external funding

At the same time, funding from external sources (CIFRE, MEDDTL, ANR contracts, FUI, ADEME, EU, etc.) is increasing. Sixty percent of new theses are externally funded. This trend, which is in no way exclusive to IFSTTAR, requires a higher degree of coordination with the Directorate for Partnerships and Resources which oversees the contracts which may receive thesis funding. Coordination with MEDDTL also needs to be consolidated as does that with the principal industrial firms who ask us for scientific support for CIFRE theses (in the form of framework agreement, for example). This initial coordination guarantees the Institute will provide effective scientific supervision of the doctoral research.

A bright future

Our monitoring of the 2010 cohort of PhDs (71 in all) graduating from the Institute confirms the impression that those benefiting from doctoral training at IFSTTAR find themselves in a very good position.

At the beginning of 2012, i.e. slightly over a year after defending their thesis, 90% of our PhDs had found a job. 46% of these were permanent, 20% in the private sector and 26% in the public sector (university, EPST, engineering schools, EPIC, RST). The temporary jobs were mainly as Temporary Teaching and Research Assistants and post-docs in France and abroad. 8.5% of those awarded PhDs in 2010 are still looking for work and we have no information about the remaining 1.5%.

Last, 2011 also saw the setting up of a new association of IFSTTAR doctoral students, RaDi. It is part of the Institute’s Committee for Social, Sporting and Cultural Activities and its role is to support doctoral students throughout their time at IFSTTAR by representing and assisting them when they have formalities to perform and organizing friendly gatherings for them. The RaDi supplements the Joint Advisory Committee which was also set up in 2011.

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To respond to issues with a major societal impact, research goals must not be too narrow and compartmentalized and there must be a firm commitment to systemic, multidisciplinary, approaches, which are necessarily complex. Throughout the year, our researchers and staff have therefore engaged in a large number of discussions and an in-depth review in order to develop, collegially, a research strategy for the next ten years with 4 Research Orientations. The process also considered the resources, tools and policies to be consolidated, reoriented or implemented in order to enhance the Institute’s research and adapt it to concerns, needs and priorities. This high level of mobilization on organizational aspects did not prevent IFSTTAR from conducting research at a very high level in 2011. It should be pointed out that one of the major strengths of IFSTTAR’s research was already the way disciplines are combined (SPI, STIC, SHS and SDV) and the systematic consideration of human factors. These features are already discernable in the survey that follows, which has been conducted for each Research Orientation in turn. Research Orientations 1 (Mobility, the environment and energy) and R (Ageing, hazards and nuisances) deal with consumption and environmental impacts at various scales. Research Orientations 2 (Quality, safety and optimization of transport systems) and S (Improving road safety and modernizing transport infrastructure) focuses on the organization of transport systems and infrastructures. Research Orientation S places the emphasis on safety-related aspects of transport research, which are also covered by Research Orientation 3 (Accident studies, biomechanics and health). Finally, Orientation W (Conserving energy and natural resources) targets current concerns in the area of construction.

SCIENTIFIC AND TECHNICAL ACTIVITIES

Dominique Mignot
Deputy Scientific Director

Henri Van Damme
Scientific Director
Research Orientation W deals with a number of topics that have been highlighted by the Ministry of the Environment, Sustainable Development, Transport and Housing in order to meet the challenges posed by the Grenelle Environment Summit. Capturing and storing the CO₂ in deconstructed concrete, along with developing hydraulic binders with lower CO₂ emissions, developing bituminous products or substitutes for them that consume less energy, optimizing the transport of materials (aggregates, fill), making use of the near-surface geothermal potential, using the road to collect energy, converting the vibrational energy in structures into electricity or assisting the expansion of wind farms by establishing rules for the design of their foundations are all areas in which IFSTTAR and the RST are working to meet the next decade’s challenges.

One of these research projects, capturing the atmospheric CO₂ trapped in demolition concrete, won IFSTTAR first prize in the Eugène Freyssinet awards in September 2011. This prize is given to young engineers who have made a practical contribution to sustainable development in the area of construction. A wide range of other activities also focus on conserving resources. These include: the rational use of quarry materials, recycling road materials and deconstructed concrete, reducing water consumption and recycling industrial wastes or by-products. IFSTTAR is also interested in the promising new fields of biosourced and natural construction materials, for example using microalgae as an alternative to asphalt.

This work sets out to achieve the best technical and economic compromise and reduce the environmental impact of the techniques under investigation. A comprehensive response to construction issues is therefore favoured, with an evaluation of the environmental footprint of civil engineering and the incorporation of environmental parameters in the design of both road or rail projects. As construction is truly an art, IFSTTAR has made a contribution to an artistic project which will draw to a close in May 2012 with an exhibition at the École des Beaux-Arts in Paris.
The environmental balance sheet of roads
Innovative low temperature coating technology

IFSTTAR is studying possible improvements in construction standards prior to their implementation in partnership with public sector project managers and infrastructure owners active in the area of roads (SETRA, Département General Councils) and a number of road construction companies.

The aim is to optimize the environmental balance sheet of roads. Reducing the consumption of resources – aggregate, binders and energy – is of prime importance in this area, and has been particularly studied, with specifications (a recycling rate between 10 and 35%) and measurements relating to a variety of impacts such as the greenhouse effect, acidification and eutrophization. In the case of pavements, these coating techniques provide substantial environmental benefits (several tens of percent) for several indicators, placing innovation in the area of materials and their manufacture at the centre of environmental optimization.

This research combines two aspects that complement each other, full-scale trials and impact modelling. This enables our environmental evaluation to quantify the most important parameters on the basis of data from a dedicated construction site and take account of this in future calculations that pertain to the different phases of the life cycle of infrastructures.

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Compacted fibre-reinforced concrete of high-traffic pavements
The fatigue test track

For more than a decade various techniques for recycling asphalt planings have been tested, including treatment with hydraulic binders.

In this case, the addition of a small amount of metal fibre reinforcement substantially improves the mechanical performance of the material, giving a new life to asphalt that is suffering from fatigue. This technology, which is known as FRCC (Fibre-Reinforced Roller Compacted Concrete) is covered by a European patent. The four-year ANR Recyroute, which got under way in April 2008, sets out to assess the environmental and economic performance of FRCC made with new aggregate or asphalt planings that have been treated with a hydraulic binder as a composite material for high traffic pavements.

(1) The €M 2.3 ANR Recyroute project brings together three partners from the private sector (EIFFAGE Travaux Publics, APRR and CTI), and four partners from the public sector –IFSTTAR, CETE Ile-de-France, ENTPE and the City of Paris. It has been certified by the Advancity Ville et Mobilité Durables competitiveness cluster.

» Construction of RECYROUTE structures on the Ifsttar pavement fatigue carousel.
Concrete
The goal: 100% recycling

In the context of urban renovation, we must expect a large increase in the volume of deconstructed concrete, more than it will be possible to consume in pavement sub-bases. We therefore need to find other ways of recycling these waste materials, in particular as aggregates for use in concrete.

IFSTTAR was already aware of this as early as 2008, even before the national Recybéton project got under way in 2012, when at its instigation Duc Tung DAO began work on a CIFRE-sponsored doctoral thesis. This thesis, which was defended in 2012, was co-funded by all the major players in the sector: the Technical Association of the Hydraulic Binder Industry (ATILH), Cimbéton, the National Association for Ready-Mixed Concrete (SNBPE), the Association of Expert Contractors for the Concrete Pavements and Ancillaries (SPECBEA), the National Union of Aggregate Producers (UNPG). The Paris Airport Authority was also involved in the project.

This doctoral work improved our understanding of the way recycled concrete aggregate affects the in-service performance of concrete. It also linked the in-service properties of the recycled aggregate to the properties of the source concrete. This two-pronged approach provides a way of optimizing the design of concrete that contains recycled concrete and investigating the possibility of multi-recycling concrete (a succession of several recycling cycles).

One application of this work, at Roissy airport, was to recycle 100% of the deconstructed material from concrete slabs and re-use it in situ.

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Eight pavement structures have been tested under more than 2 million heavy loading cycles on the IFSTTAR circular fatigue test track (equivalent to 20 years of life with HGV traffic of 210 vehicles per day. These included 6 FRCC® structures, one ERTALH structure (Recycled Mix Treated with Hydraulic Binder) made with gravel and one asphalt structure that served as a control. The experiment, which ended in 2011, showed that in general the tested structures performed very well. The project also includes a very comprehensive programme of laboratory tests and the construction of projects at real sites. It is hoped that the project will lead to the development of a design procedure for these innovative pavement structures with a view to their operational implementation.

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» Deconstructing concrete slabs at Roissy airport. As part of doctoral research these slabs were 100% recycled in a slab with the same functional performance.
Algoroute
Algae take over the road

With its partners IFSTTAR is developing a “plant-based” polymer in order for roads to be ready for the post-oil age and ease the transition towards a carbon-free economy.

The Algoroute project is concerned with a new renewable source of plant material, microalgae. In 2011 it was selected for research support in the framework of the “scientific challenge” call for projects organized by the Pays-de-Loire region. Work on a doctoral thesis in this topic started at IFSTTAR in October 2010.

Growing microalgae has the major benefits of giving very high yields and not competing with plant production for human consumption. The Algoroute project partners (GEPEA, AlgoSource Technologies) are currently engaged in studies to produce a biofuel and foodstuffs. However, the economic and environmental viability of these applications depends on the ability to make use of the byproducts, which Algoroute also sets out to do. The project harnesses a range of expertise that is present in the Pays-de-Loire region, from academic laboratories, IFSTTAR, CEISAM, GEPEA and the firms AlgoSource Technologies and Alpha Biotech.

The goal is to be able to produce a hydrophobic viscoelastic binder from substances present in microalgae. This binder must be able to give cohesion to a granular structure while withstanding local mechanical or thermal stresses. This “plant-based” polymer could replace oil-derived asphalt in road mixes.

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Growing microalgae at Alpha Biotech (Asserac, Département 44) and the first coated material made with microalgae extracts.

> 3.3 m² of bituminous mix.

ZOOMING IN ON ...

Fine art and asphalt

For her final year project at the École Nationale des Beaux Arts in Paris, Pauline Tamisier, wished to feature an object made with an asphaltic mixture. The “Materials for Transport Infrastructure” Group which is part of the Materials Unit (MAT) rose to the challenge of manufacturing it (IFSTTAR / Nantes Centre), linking up with an age-old tradition going back to the ancient Far East where asphalt was used to make works of art.

The result was a work of art “Sans titre, 2011”, and the artist graduated with the congratulations of the Jury and the right to take part in the “Nomadic Geographies” exhibition to be held from May to July 2012 at the École Nationale des Beaux Arts in Paris.

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Designing wind turbine foundations
The standards are at an advanced stage

The recommendations for the design, construction and testing of wind turbine foundations were published in 2011. This 113 page document, which is shortly to be published in English, is the outcome of more than four years of collective activities that started in 2007. The work in question, which was undertaken by the CFMS (French Committee for Soil Mechanics and Geotechnical Engineering) and directed by Patrick Berthelot of the Bureau Véritas, brought together a number of professionals working in the field (technical supervisor, consultancy firms, foundation contractors, wind turbine manufacturers) and researchers – including several from IFSTTAR.

The is a concise reference document for these structures which have been subject to technical supervision since 2008 (for towers over 12m) and have been defined as facilities that are classified on environmental protection grounds (ICPE) since 2010. It includes a chapter on loading

Trapping the CO₂ in demolition concrete
Changing a defect into a quality

The invention of concrete almost goes hand in hand with the principle of recycling and the use of recycled aggregate in new concrete. But this is very much hampered by the poor quality of aggregate obtained from demolition. This absorbs a large amount of water in an hour or so. The fluidity of concrete made with recycled aggregate therefore diminishes a great deal while it is being transported to the worksite.

However, although the carbonation reaction is harmful during the lifetime of a reinforced concrete structure, it can be put to good use in order to trap CO₂ when the structure is demolished. The effectiveness of the capture procedure is assessed by modelling the diffusion of CO₂ through a granular bed of crushed concrete coupled with the carbonation of each grain. This modelling makes it possible to optimize waste treatment conditions.

In connection with this, a 3-year research project (CRAC – Carbonated Recycled Aggregates for Concrete) was launched in January 2010. After validating our model in the laboratory, in 2011 we showed that this type of treatment was capable of capturing between 20 and 30 kg of CO₂ per cubic metre of concrete, depending on the quality of the cement paste that is attached to the aggregate. Our research has also shown that this process modifies porosity. The aggregate that is obtained absorbs less water, but does so more rapidly, making it more suitable for conventional concrete manufacture.

In September 2011, this work won first prize in the Eugène Freyssinet awards which is given to young engineers who have made a practical contribution to sustainable development in the area of construction.

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» A stockpile of demolished concrete awaiting recycling.
cases and design stresses (limit state stresses, verification of design criteria), a chapter on geotechnical engineering and design parameters (minimum survey, geotechnical data and geotechnical model). Another deals with the different types of foundation that are possible (gravity base, gravity base on soils that have been strengthened with ballasted columns or rigid inclusions, pile foundations, composite foundations). This chapter is based on recent recommendations for ballasted columns (CFMS, 2011) and rigid inclusions following the National ASIPI Project (Soil Improvement by Rigid Inclusions) in which IFSTTAR took part, in particular by conducting reduced-scale centrifuge model tests.

CO₂ sequestration in Coal seams
Molecular simulation comes to our assistance

In order to mitigate climate change, the world’s experts agree that we need to halve greenhouse gas emissions, mainly CO₂, by 2050. Awaiting the massive exploitation of renewable energy sources which have no greenhouse effect, a bright future seems to be in store for the geological sequestration of CO₂ in coal seams, which is one of the principal techniques that can help reduce the problem. But in order to implement this emerging technology we have to understand the complex processes at work.

Pilot projects have shown that reservoir permeability is reduced subsequent to CO₂ injection due to swelling of the coal because CO₂ is adsorbed preferentially to the methane (CH₄) which is naturally present in the seam. In spite of the extremely small size of its pores, frequently less than a nanometre, coal can absorb large amounts of gas. This is explained by the forces of interaction between the gas molecules and the solid which, at this scale, become greater than those which result from gas pressure. These forces depend on the nature of the gas that is present in the coal, in this case CH₄ or CO₂.

By applying molecular-scale simulation and studying macroscopic poromechanical behaviour, Laurent Brochard has studied, with Massachusetts Institute of Technology (Roland Pellenq), the close coupling that exists between adsorption and strain. New constitutive equations for microporous media have been developed. These equations have been validated then calibrated for geological conditions by molecular simulation.

The study will continue in 2012 in the Navier Laboratory (a research unit that is jointly run by IFSTTAR, École des Ponts ParisTech and CNRS), in the form of theoretical and numerical modelling of the coal seam (S. Nikoosokhan’s doctoral research) and experimental studies (post-doctoral research by N. Espinoza on the adsorption of CO₂ in coal under triaxial loading), in collaboration with Total.

Theses

Quentin Barral, NAVIER
Superimposition of orthogonal flows in complex fluids: setting up the experiment, application to suspensions and yield stress fluids (02/12/2011)
– Sebastien Brisard, NAVIER
Morphological analysis and numerical homogenization: application to cement paste (05/01/2011)
– Laurent Brochard, NAVIER
Mechanics and absorption: Application to the swelling of coal during geological carbon sequestration (31/10/2011)

Coralie Brumaud, MAT
Microscopic origins of the rheological consequences of adding cellulose ethers to a cementitious suspension (14/10/2011)
– Jean-Francois Camenem, MAT
Influence of particle shape on the structure of dense granular stacks (09/12/2011)
– Duc Tung Dao, MAT
100% recycling of pavement concrete (10/10/2011)
– Thanh Toan Le, MAT
A geolocalized technique for evaluation the integration of road projects within areas and the selection of alternations (12/10/2011)

Jose Munoz-Castelblanco, NAVIER
Hydromechanical behaviour of a natural loess (29/03/2011)
– Firas Sayed Ahmed, NAVIER
Prestressing of Ultra-High Performance Fibre-Reinforced Concrete (UHPFRC) with Carbon Fibre Composite Materials (CFCM) (15/12/2011)
– Fabien Szmykiewicz, GER
Evaluation of the mechanical properties of soil-mixing material (04/10/2011)
This research deals with analyzing and modelling the links between transport systems, transport (persons and goods), public policies and urban and regional dynamics. It relies on qualitative and quantitative analysis involving large databases. In particular, new technology (GPS, mobile telephones, automatic ticketing) provide an increased mass of data on transport practices and the performance of transport networks. We investigate both travel practices and innovations (transport modes and services for mobility).

The aim is to gain information on which to base a reflection on the transition towards lifestyles, production systems and technical systems that are more sustainable from the environmental, social and economic standpoints. To this end, our analyses that deal with electric and hybrid vehicles, and new transport systems are both technical (the design of components, overall management of energy) and socioeconomic (market potential, perception, expectations and the acceptability of the different solutions). The research conducted in this Orientation also analyzes travel costs in relation to the budgets of households and firms, (particularly with regard to the transportation of their production), access to resources, jobs, services and labour, etc.) and sociospatial inequalities as well as disabilities that reduce mobility. The safety and security of transport systems and travel practices are also included in the process of reflection.

Last, this orientation investigates public policies with regard to transport and, more broadly, spatial planning. The areas that are investigated include the consideration and implementation of the different aspects of sustainability in these policies, links with the general public, and the appraisal practices implemented by the public authorities.

Research Orientation 1 brings together the activities of four IFSTTAR research units (DEST, LTE, LTN-Satory and SPLOTT) and one jointly managed unit (LVMT). Three goals that were part of the INRETS four year plan for 2010-2013 have been taken on board: observing and analyzing travel and areas; evaluating transport systems and their organization in order to reduce the energy consumption and environmental impacts of vehicles.

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How households are adapting to rising fuel prices

The considerable rises in fuel prices since the beginning of the years 2000 have prompted more in-depth analysis of the (variable) impacts this has had on household car ownership and use.

A CERTU study on travel in the period 2000-2010 summarizes the research started at INRETS in 2009 and completed in 2011 into the way households adapted to fuel price rises during the period 1999-2008. The research team has also investigated the specific impact of price volatility.

What has emerged is that these price rises have led to a substantial reduction in the distances travelled by car. As a consequence, although the number of cars continues to increase, overall traffic levels in France have remained constant since 2005. Another long-term effect is that vehicle manufacturers and consumers are tending to favour more economical models, particularly diesel. The price sensitivity of households to fuel prices is greater when the rise lasts for some time (after 2004) and when prices are volatile (the large increase in mid-2008 which was followed by a collapse).

Apart from this overall impact, when households are monitored over a several years, certain vulnerable groups stand out: the poorest individuals and those who live in the least dense zones cannot reduce their mileages because they have no alternative. A sudden price rise like the one in 2008 (when almost half of all motorists reported driving less) amplifies these impacts: some individuals, who were thought to be incapable of reducing their mileages, still manage to restrict their car use even more drastically. But how? Gaining a clearer picture of these groups and how their behaviours change would allow us to design compensatory social measures (fuel cheques, re-evaluation of the per-kilometre tax deduction, etc.) that target them. All topics that are worth studying...

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Storing energy in hybrid vehicles

Accelerated ageing

IFSTTAR played an active role in the Simstock project which was completed in 2011 and financed by ADEME to the tune of €2M. For three years, the 15 project partners from industry and academia mounted a large-scale experimental operation and developed joint protocols and a common methodology to investigate the ageing of the batteries and supercondensers used in hybrid vehicles.

A great deal is at stake here, as if these vehicles are to become acceptable and widely used we must improve forecasting of the performance and lifetime of the on-board energy storage systems used in these complex technologies.

Accelerated ageing tests were conducted for us to develop ageing models and build up a large database on the ageing of the batteries and supercondensers under experimental conditions which although simplified are nevertheless representative of use in a hybrid vehicle. The influence of utilization parameters (temperature, current amplitude, exchanged charge and variations in state of charge) has been demonstrated and led to the development of ageing models which have the potential to be implemented in energy simulation tools for vehicles.

The project partners are planning to continue their research by extending it to cover real loading conditions (real current profiles, rest periods and temperature variations). Studies of battery ageing are faced by the rapid development of technologies which are not yet industrially mature and the complexity of the mechanisms that are at work during real use. In addition, it is not possible to extrapolate directly to the conditions of “electric vehicle” or “hybrid vehicle” use. Plenty of work remains to be done!

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Carbon taxation in France
Do we need a completely new approach?

Has carbon taxation in France been a failure compared to elsewhere in Europe? Is it appropriate for road freight transport? The study performed by IFSTTAR has reached a clear verdict and demonstrated that the introduction of the carbon tax in the 2010 finance bill was ill-conceived, particularly for road freight transport, and this was partly responsible for its withdrawal.

The successive legal measures that have been proposed seem to have treated road freight transport less well than other sectors, in particular agriculture. Several issues should have been considered at the outset: for example the specific characteristics, or even vulnerability, of freight transport, particularly in comparison with agriculture, and the potential effectiveness of the carbon tax in question.

There are several reasons for not introducing a tax of this type. In Sweden, which served as a model for the Rocard report which laid the foundations for the French carbon tax, the goal of modal transfer has not been achieved and CO2 emissions from road freight transport are continuing to rise. In France, the shippers who were questioned at the time explained that the increase in the cost of road freight transport as a result of the tax could only have a minor impact on their modal choices.

Our research has nevertheless concluded that it was reasonable to create instruments for combating carbon emissions, but not in the way that was envisaged by the 2010 bill. For example, a higher level of taxation could have created a genuine disincentive, counterbalanced by a compensation mechanism with macroeconomic benefits such as a reduction in employers’ social security contributions.

Electronic power components
Innovative indicators of ageing

Ageing occurs with use and the passage of time. The electronic power components (IGBT modules) used for electrical traction (for both trains and cars) are not immune from this rule.

They age mainly because the materials in them suffer from thermal fatigue caused by temperature variations which damage the material, sometimes to the point of failure. Component damage is monitored using parameters that are
The development of electric transport
Under the scrutiny of socioeconomic analysis

The City, Mobility and Transport Laboratory (LVMT) at Champs-sur-Marne on the Cité Descartes site is investigating the socioeconomic conditions for the development of electric vehicles (1).

It has emerged from this research that the first step is for a group of players to create a system, providing vehicles, recharging terminals and parking spaces. The scenarios for network development that are described in different countries resemble one another: a phase of technological innovation, followed by the conquest of niche markets (self-service, company fleets), then the gradual increase in use as a private vehicle. For a household, exchanging a conventional vehicle for an electric vehicle involves an initial additional outlay which must be compensated for by savings during use (cheaper energy): for this it is necessary to make a considerable number of fairly long trips (for example a commuting trip of about 30 km), but these must not be too long because of range issues. When other constraints are considered, for example leisure travel and the type of housing stock (which affects the installation of terminals) the potential for electric car use varies between 10% and 30% depending on the region of France.

Urban areas offer considerable potential for suitable vehicles that are lighter, smaller and slower and offer less protection. A bonus at the time of purchase will be necessary during the expansion phase. The cost for the public finances will be part of a series of tax effects and social accounts (industrial and service sector jobs), whose impact will vary considerably depending on the performance of the nation’s industry in the context of international competition.

(1) With several partners including Renault, EDF, Veolia and in association with the Electric Vehicle GERI (VE).
After its first year of activity in 2010, 2011 saw a greater focus on the goals of Research Orientation R. Work was concentrated on a slightly smaller number of operations, 19 as opposed to 23 in 2010, as many on-going research projects finished at the end of 2010.

In fact, this change made it possible to rebalance the research conducted in the 4 sub-areas covered by Orientation R, including Goal 6 “Studying and mitigating the impacts of climate change”, which had not been the subject of formalized research since the start of the contract. Three research projects, all part of Goal 4, “Extending the service life of structures” finished at the end of 2011 after making important contributions to knowledge. The project “A performance-based probabilistic approach to the service life of reinforced concrete structures” improved our understanding of the propagation of corrosion in reinforced concrete structures and our ability to estimate the residual service life of a structure with corroded reinforcement.

The project on the characterization of embedding concrete using non-destructive techniques came to a close with the development of new techniques for measuring the density of pavement surface layers. The project on “The management of structural hazards” led to the development of new techniques for monitoring the structural health of engineering structures.

The launch of the project “Mitigating the impact of climate change on transport”, that comes under goal 6 of the four-year plan was one of the most important operations of 2011. It sets out to identify how infrastructure is affected by climatic parameters such as frost, particularly freeze-thaw cycles, the increase in mean temperatures and temperature variability, moisture transfer within pavements and the impact of UV radiation on the ageing of asphaltic mixes.

This operation will run in the period 2011-2014 and is expected to propose appropriate design systems for infrastructure.
Embedding concrete
Nondestructive tests

The ageing of the national stock of structures makes it vital to evaluate the condition of embedding concrete. The AI (Testing and Imaging) Group is involved in several research projects that aim to develop mechanical, electromagnetic and electrical nondestructive survey techniques.

The group’s most recent work has identified the linear trends that link composition and condition parameters (such as porosity, degree of saturation, compressive strength, chloride content, etc.) to physical measurements and observations. The research has shown that physical measurements are sensitive to most of the parameters that describe concrete, but to highly variable degrees, and some parameters may be confused with measurement biases. The physical measurements include electromagnetic and mechanical waves. The first of these mainly depend on the volumetric moisture content and nature of the aggregate and the second are governed by the material’s compressive strength and Young’s modulus. The different results also complement each other, as it has been observed that when several different measurements are made on a given homogeneous mixture (among those that have already been tested) it is possible to find the initial parameters from each.

The relationships in question are currently being validated in the framework of the ACDC and EVADEOS projects which are investigating their recalibration according to the type of structure which is tested and how gradients affect this type of non-destructive measurement.

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POLESUR
Preserving and managing urban soils

In order to limit urban sprawl, local authorities are increasingly faced by the need to redevelop sites that have potentially been contaminated by industrial and artisanal activities. To these concerns are added the risk that pollutants may be transferred into the soils as the result of the implementation of urban stormwater infiltration techniques.

In the Pays-de-la-Loire region, the desire to improve the protection and management of urban soils has prompted the Region to support for the POLESUR project (Pollution of water and soils in urban areas). This programme, which was backed by the region’s largest consortium in the area of urban soils (IFSTTAR, BRGM, École Centrale, École des Mines, Université, CSTB, Agrocampus Ouest), lasted 4 years and ended with a seminar on 7 and 8 December 2011.

The results, which bring together knowledge about pollutants, the infiltration characteristics of water retention ponds and the water treatment capacities of floating marshes, provide answers to concerns about the infiltration of stormwater and the environmental impact of derelict urban land. The project applied a multi-scale study methodology to evaluate the contaminant plume from an old landfill site for household and industrial waste in Nantes.

The consortium has now joined up with IRSTV (Institute for Research on Urban Sciences and Techniques) as a first step towards the creation of a national centre of expertise on urban soils in the Pays de la-Loire region.

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Public works
FURET minimizes nuisances

Road construction or maintenance works are necessary for the life of urban areas, but the resulting nuisances impair the quality of life for residents. In order to minimize these nuisances and improve the social acceptability of public works, IFSTTAR took part in the ANR-funded project FURET (Nonintrusive Urban Networks and Works).

The work, which was carried out by URAGIT (1) was concerned with defining the concept of nonintrusive worksites and designing and specifying decision-making aid systems to set out to reduce intrusion.

Two systems have been designed for two essential players with an involvement in nonintrusive urban works. The first is for those who manage public space and provides considerable stakes are associated with earthen hydraulic structures, be they for hydro-electric production, transport and tourism, or flood protection.

Effective diagnosis and monitoring techniques are therefore essential.

Electrical resistivity imaging (ERI) is very sensitive to soil state parameters and can make a valuable contribution to the diagnosis and monitoring of these structures. However, the adequacy and reliability of these techniques need to be further improved, while keeping costs down to a reasonable level, as the conventional (2D) technique tends to be unreliable.

A set of economically viable 3D tools and methodologies has therefore been developed in order to improve the reliability of the characterization of dykes, while retaining economic viability: modifying and optimizing the direct and inverse 3D problems, developing appropriate acquisition and processing strategies and using a maximum amount of previously collected data. In 2011, measurement campaigns were conducted on semi-controlled structures (at the CER in Rouen) and in-service structures.

Earthen hydraulic structures
3D monitoring

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(1) This work was done in close collaboration with the project stakeholders (IFSTTAR, EIVP, UVSQ, RATP, ÉGIS, LROP).
Monitoring structural health
A new health record

Civil infrastructure (bridges, buildings, networks etc.) is constantly and continuously subjected to aggressive environments, the ageing of its members or materials, or changing or exceptional operating conditions. These factors amplify the effect of the smallest error in design or construction or accidental damage that speeds up or sets off new types of structural deterioration. The result is a considerable reduction in durability and service life.

In order to evaluate the performance of structures more accurately, or at least obtain an opinion that is sound and objective, we therefore need to be able to characterize the real behaviour of the structure sufficiently precisely. This process of determining, monitoring and evaluating the serviceability of structures is the basis of the Structural Health Monitoring (S3) project.

The principal goal of S3 national research project, which ended in 2011, was to specify a comprehensive integrated design procedure for structural health monitoring for the diagnosis and appraisal of structures. The various stages of the project corresponded to a number of research and development requirements for information technology tools, experimental methods, analytical tools, application scenarios, and the drafting of recommendations. This project was made possible by funding from the Île-de-France Region and MEDDTL.

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Structural Health Monitoring on the bridge over the Adour in Bayonne (SNCF) – optical strand instrumentation.

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Reconstruction obtained using the 3D inversion approach on real data obtained from two lines of electrodes placed transversally and longitudinally to the dyke (at the EDF site).

Optical strand (in protective hose)

Recording of the passage of a double TGV trainset

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The major earthquake in Japan
Analyzing ground movements

On 11 March 2011, an Mw 9 earthquake struck the East coast of Japan. This was the strongest tremor that has been felt in the country and one of the largest earthquakes to have occurred since seismological measurements began.

Japan’s exceptional instrumentation system, consisting of roughly 1000 accelerometric stations on the surface (the K-NET network) and 700 seismograph pairs located on the surface and in boreholes (KiK network) meant that this large earthquake was the best recorded in the world, from distances that were close to the fault plane (40 – 50 km).

The recordings show that the strong movements lasted approximately 3 minutes, with a maximum ground acceleration value at sites near the fault plane that often exceeded 1g. This combination of factors led to the mobilization of interstitial pressure which was responsible for cyclic mobility and liquefaction at the regional level (Figure a). The ANR ONAMAZU project, which got under way in October 2011, brings together partners from France and Japan in order to conduct a thorough analysis of the ground movements that were recorded during the earthquake. This research involves IFSTTAR, BRGM, IRSN and CETE Méditerranée in France and DPRI, NIED and Shimizu Corp in Japan. The project began with the construction of a database containing accelerometer measurements from the mainshock and the aftershocks. This was used to compute, amongst other things, the response of the soil at station MYGH10 (Figure b), which shows that the medium did not return its initial state after the principal event. The intention is for the project now to conduct a fuller study of this phenomenon in order to calibrate constitutive models for soil under seismic loading.

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Reducing the seismic vulnerability of existing constructions

Reducing the seismic vulnerability of existing constructions is vitally important.

The use of bonded composites has become one of the standard techniques for strengthening reinforced concrete structures, in particular because they have many qualities and are simple to use. Carbon fibre based composites provide effective strengthening, acting as external reinforcing bars. However, we still lack knowledge about the behaviour of structures that have been reinforced in this way when they are subjected to external stresses (impacts, explosions or earthquakes). This observation was responsible for a major research project at IFSTTAR which set out to undertake experimental studies of the behaviour of reinforced concrete columns that have been strengthened with bonded composites and subjected to seismic-type stresses. The strengthening materials that are currently on the market were provided and installed by the project’s industrial partners (Freyssinet International et Cie and Vinci Construction France).

To operate with these systems, an innovative anchorage system was developed and validated by experiments at the Autun Département Laboratoire (CETE de Lyon). The columns were tested at the IFSTTAR structures laboratory in Paris. The reinforcement was bonded to the test specimens in a number of configurations in order to conduct a multicriteria evaluation of the effects of each of them. The performance of the tested reinforcement systems was confirmed, and in particular it was demonstrated that the new anchorage system considerably increases the effectiveness of flexural strengthening.

Gaining a detailed understanding of the effect of shear forces in heterogeneous plates poses many difficulties.

Although Reissner’s theory for homogeneous plates dates from 1945, it is still awaiting satisfactory extension to heterogeneous plates. Consequently, when we study stratified carbon fibre plates we are forced to use more complex models that are of little use to engineers.

By taking up Reissner’s work again, but applying it to a heterogeneous plate, we have shown that this model is not able to describe the effects of shear forces. In particular, the inclusion of additional variables is required. We have called the new model the Bending-Gradient model as it makes use of all the components of the gradient of the bending moment while the shear force only considers its divergence. Mechanical interpretation is nevertheless straightforward. In the case of a homogeneous plate, the bending-gradient model corresponds simply to Reissner’s original model. However, much better results were obtained when the model was applied to stratified plates under very general conditions.
the case of sandwich panels, we have demonstrated the validity of sandwich theory and provided effective tools for computing stiffness. Our findings will permit much more robust modelling of plates for structural members such as waffle slabs, orthotropic slabs and lattice structures.

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**A community software platform**
**All together with I-Simpa**

A community software platform that hosts numerical codes for computing acoustic propagation in 3D environments.

As part of its research into environmental acoustics, the EASE unit (part of the IM unit) has developed computing code for modelling the propagation of noise in 3D environments.

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**Colibri**
**A new device for dynamic pavement testing**

Dynamic pavement testing techniques can now take advantage of a new prototype, Colibri.

This device, which was developed by the network of Laboratoires des Ponts et Chaussées, is an example of the transfer of knowledge to the operational sphere, providing the highways engineering community with a robust freestanding device for analyzing short lengths of pavement. The device imparts a medium frequency impact to the pavement and measures the response using three accelerometers. The signals are analyzed in order to generate a map of the pavement structure that includes an indicator that shows the...
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Gwenaël Le Quilliec, MACS / SOA
Dynamic characterization of reference sands in the laboratory - Application to the seismic response of sand masses in centrifuge modelling (31/01/2011)

Malo Le Guern, MAT
Physico-chemical structure and resistance to cracking of asphalts (10/03/2011)

Gwenaël Le Quilliec, MACS / SOA
Physical and hydric characterization of rocks affected by production using SAGD, when steam is injected into heavy oil reservoirs (10/10/2011)

Influence of climate change and extreme conditions on fractured rock masses: role of fluids (H2O, CO2) in the weathering process (21/09/2011)

Raphaëlle Sadone, SOA
Behaviour of concrete columns with bonded composite reinforcement subjected to seismic type loading and analysis of some design rules (12/12/2011)

Ramzi Sahlaoui, NAVIER
Masonry walls with composite reinforcement: limit analysis and experimental study (12/07/2011)

Juliette Sohm, IM
Prediction the permanent deformation of pavement materials (17/03/2011)

Brahim Tali, NAVIER
Behaviour of the soil-structure interface under cyclic loading. Application to the design of deep foundations (14/02/2011)

Jonathan Tiveau, MAT
Long term properties of HDPE cable ducts for cable-stayed bridges (18/01/2011)

Nhu Cuong Tran, NAVIER
Development of a model for the concrete-steel interface at high temperature. Modelling of concrete structures exposed to fire (07/10/2011)

Stefano Dal-Pont, MAT
Experimental tools and numerical models for studying transfers: from the behaviour of porous media to that of crowds (01/12/2011)

Laurent Gallet, SOA
Cables in civil engineering. The importance of understanding and knowing their state of damage and protecting them (20/07/2011)

Frédéric Le Goll, NAVIER
Some contributions to the mathematical and numerical study of a number of multi-scale simulation models for materials (17/10/2011)

Guillaume Ovarlez, NAVIER
The rheology of granular pastes (26/05/2011)

Géraldine Villain, MACS
Towards an evaluation of concrete durability indicators for the laboratory and in-situ monitoring of deterioration (11/05/2011)
Research Orientation 2 is characterized by its major contribution to the VERONESE project, in particular by the introduction of collective actions involving such topics as green driving, the use of communication and positioning technologies and the development of simulation platforms. In 2011, the SERRES(1) and VERONESE(2) programmes continued to draw closer to each other, which has helped bring together the research teams from the two former institutes in order to tackle the issues of the sustainable management of road and rail traffic and user services, in the context of technical developments or the analysis of behaviours. Research Orientation 2 brings together the activities of five IFSTTAR research units (ESTAS, GRETTIA, LEOST, LESCOT, LPC) and three research units that are managed jointly with other bodies (LEPSIS, LICIT, LIVIC).

Many of the laboratories involved in this Research Orientation have taken part, through the NEARCTIS European network of excellence (overseen by IFSTTAR), in the development of converging inter-agency research programmes focused on “cooperative systems”. IFSTTAR has also been involved, in the framework of “Future Investments” in the creation of two Institutes: the IRT (Technological Research Institute) RAILENEUM which is backed by the Lille Nord-de-France PRES and the i-Trans competitiveness cluster, and the IEED VeDeCoM (Institute for Zero Carbon Communicating Vehicles and their Mobility) which is backed by MOVEOTEC and the MOVEO cluster in the Paris Region.

(1) Road Operating Solutions that take account of the Environment and Safety.

IFSTTAR’s laboratories are innovating all the time in order to make transport systems more environmentally friendly, safer and better suited to increases and changes in mobility. Automated driving systems, on-board road traffic incident detectors, increasingly sophisticated route analysis techniques, new materials, etc. – all in line with the principles of sustainable development.
Communication in a mobile environment
Progress towards interoperability

Enormous implications of road safety.

The ANR PLATA project (Programmable Telematics On-board Multistandard Radio Platform) sets out to implement a new multistandard radio telematics platform for the automobile sector based on emerging software radio technologies. The flexibility of this technology makes it possible to use different communications standards for vehicle/vehicle and vehicle/infrastructure communications. The ultimate goal is to provide Europe-wide interoperability between communication systems.

In 2011, a PLATA project demonstrator was developed. At the same time, a large number of simulations were performed, making it possible to evaluate the scaling-up process and the behaviour of the system with an increase in the number of equipped vehicles. The framework that has been put in place allows us to carry out realistic simulations of vehicle movement. For this purpose, a simulator - SUMO (Simulation of Urban Mobility) - was interconnected with the trajectory management functionalities in the OPNET network simulator. The result was that the trajectory and behaviour of each individual vehicle could be identified. The next stage will be to simulate communications with the OPNET software program. During trials we have simulated the movement of several hundred vehicles with the communications between them.

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Energy and planning railway timetables
A new timetabling criterion

The ESTAS research unit is specialized in rail-related themes and its expertise is widely recognized among its partners (SNCF, RFF) as a result of several projects (the national CIGIFRET project and the European ON-TIME project). In 2009, it began to take energy into account in its work on traffic management.

The research into optimizing timetable planning which has got under way since this decision therefore now includes energy as a criterion. Planning of this type depends, in particular, on train movement times allowing for disruptions and drifting, i.e. when the train moves under its own inertia with its motor turned off which leads to substantial savings. In 2011, ESTAS proposed a method that generated a variety of driving strategies using a number of speed profiles based on a trade-off between journey times and energy consumption. The method involves the multi-goal optimization of train movement and is based on evolutionary algorithms for the competitive optimization of energy consumption and journey times. For a given optimization task the decision-maker is presented with a set of distinct possible solutions and can then construct timetables that simultaneously meet passenger demand and take account of energy consumption.

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Example of TGV speed profiles for a 135 km journey: the red plot shows the minimized journey time and the green plot shows an alternative strategy which saves energy while slightly increasing the journey time.
Road traffic management
New techniques

The requirements of sustainable mobility are prompting road operators to test new road traffic management techniques. A new multicriteria approach for evaluating these, which is based on the level of service, was finalized in 2011.

During the day, a road operates with four possible levels of service: free flow, dense flow, capacity flow and saturated flow. The level of service is linked not only to the physical characteristics of the road and traffic demand, but also driving behaviours and the weather. The level of service concept can be used to evaluate the impact of traffic management techniques on congestion, the environment and safety. Variations in the total time spent driving under saturated conditions characterize how a traffic management measure affects congestion. Aggregating data on the basis of level of service is a more precise way of computing pollution and fuel consumption than the usual breakdown by mean vehicle speed bracket. Last, the rate of injury accidents on a network is related to the levels of service at the time. The methodology is undergoing validation for a number of variable lane allocation operations (for example the taxi lane on the A1 motorway). In addition, a network operation strategy selection tool, which takes the form of a catalogue of standard cases, is being developed. It can be used for the Paris region network to make decisions on the basis of the configuration of the infrastructure and the level of congestion.

The new approach can be integrated within traffic simulation tools in order to make a priori evaluations. It could also be used in traffic management centres for a posteriori evaluations. In addition, potential ways of improving the method have been identified, enabling it to be extended to the whole range of dynamic road traffic management operations.

Virtual reality driving simulation
Road safety on a headset

Driving simulators and test tracks, which are the two methods most commonly used today for testing and evaluating driving aid systems, are not completely satisfactory. Moving base simulator tests only generate sensorimotor feedback within a limited range, and test tracks can, in the case of certain situations, be dangerous for the driver.

As part of the PARTAGE project (ANR-VTT-09), IFSTTAR is proposing a new test mode for driving assistance that combines the advantages of simulators and real vehicles. The difficulty was resolved by using a virtual reality headset in a vehicle passenger compartment.

The vehicle positioning module uses the findings of the European CVIS project (Cooperative Vehicle-Infrastructure Systems) and the research carried out by Dominique Gruyer. In view of the constraints with regard to the positioning and orientation of the headset, the LIVIC unit developed a dedicated module. This was necessary because all the systems on the market have drawbacks in the context of this study: the need for all metal parts and the target to be a certain distance away, the need for lighting to be controlled and imperfect positioning depending on whether the systems rely on the investigation of the magnetic field, vision, inertia, or merging these. Since September 2011, we have been working with OKTAL (who are responsible for simulation and visual reproduction) to evaluate the operation of the headset in a vehicle owned by LIVIC. For this we have been using the Satory test track calibration zone and car park. This area has been digitized and a virtual zone has been constructed. This means the driver can drive within this area while having the impression of being in a residential area.

The initial results are conclusive. However, the positioning capabilities of the headset will need to be extended to allow large movements of the head.

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Modelling driver behaviours
Moving towards a virtual human

Driving a car is an extremely complex cognitive task and IFSTTAR has been working on it for several years. The research focuses on developing a model that is able to simulate the mental activities of a car driver on a computer, from perception through to action.

From 2008 to the end of 2011, in the framework of the European ISI-PADAS project, LESCOT and LIVIC have joined forces to install a version of the COSMODRIVE model on the SiViC virtual platform. COSMODRIVE is a cognitive model of the driver that is based on a dynamic “perception – decision – action” regulation loop, that is centred on the driver’s mental representation. In a way, this representation corresponds to the driver’s “awareness” of the situation.

The scientific and technical advances that have been made during the project mean COSMODRIVE can now drive a car in a virtual road environment, by using simultaneous synchronized SiViC simulations to simulate the external road environment, the driver’s mental representations and some decisions, as well as the visual strategies and driving manoeuvres that are implemented in order to move within the environment and interact with other users.

The modelling work has focused on simulating the adverse impacts of the driver being distracted (analysis of human error) in the context of potentially critical car following situations based on experimental data collected from drivers. In connection with this, one of the innovations of this research has been to use the same virtual environment as a mini driving simulator when collecting this data and then as a simulation environment for the COSMODRIVE model.

An electric Mini
The drivers’ verdict

IFSTTAR is carrying out the MINI E France study for BMW. This sets out to evaluate the level of acceptability of electric vehicles (EV) and how they modify the driving behaviours and travel practices of users.

A panel of 47 drivers, in two successive waves, were given the use of an electric MINI for a six month period from December 2010 to June 2011 and from July 2011 to December 2011. Data was collected by means of a set of questionnaires, focus groups, travel diaries and charging diaries. The aim was to reveal any changes in behaviours and attitudes during the time the subjects had the use of the electric vehicle (EV), comparing the data at the outset with that collected after 3 months and after 6 months.

It emerged that to begin with, the participants’ interest in this study and this type of vehicle was conditioned by their sensitivity to environmental issues and their attraction to the technology. It is certain that the limited range, regenerative braking and low noise level of this type of vehicle modified the users’ daily travel practices and behaviour. Some users began to drive in a way that used less energy, in particular as a result of the regenerative braking. They also chose their routes on the basis of the amount of energy they had left and favoured other modes of transport for long trips which are impossible by EV. Finally, they appear to drive more carefully to compensate for the vehicle’s silence, which 50% of the participants liked but saw as potentially dangerous.

Ultimately, it emerged that while most of the drivers were happy with the EV as it is able to satisfy 80% of their daily travel needs. However, its limited range and lack of room it are very negative factors which would prevent the MINI E from becoming the household’s main car.
Trams and road users
A dangerous mix?

The tram networks that are springing up in more and more cities on the grounds of sustainable development have a drawback – an increasing number of collisions between trams and other road users.

Two studies which were financed by the DGITM and completed in 2011 have examined the interactions between road users and trams, from the standpoint of tram drivers (Study 1) and of road users (Study 2). They both make recommendations for improving safety.

The main difficulties encountered by the tram drivers are due to antisocial behaviour, a failure to comply with regulations and poor concentration on the part of the other road users (motorists, pedestrians, the users of 50 cm³ motorized two-wheelers and cyclists).

In addition, 19% of road users are unaware of the priority rule for trams and do not see them as a potential danger due their low speed. This could partly explain their risky behaviour at locations of interaction with trams.

The situation calls for increased communication about the regulations that apply to tramways. In addition, an action plan that sets out to modify attitudes and subjective norms would be helpful. More broadly, in the current economic and financial crisis, it is essential to examine the collective dimension of safety and the energy-related and social implications of urban public transport policies.

MOCoPo
Traffic under surveillance

How can we forecast traffic congestion on motorways and measure how it will affect the level of pollution? This is the topic covered by the three-year PREDIT-funded MOCoPo research programme which got under way in 2011.

The first year of research has been devoted to collecting a large amount of data in the area near a highly congested motorway (the N87) in the Grenoble region. Pollution and extremely detailed traffic data were collected.

In order to measure the traffic, a helicopter was positioned for one hour above three zones on the N87 on five consecutive days. The resulting 15 hours of footage are currently being processed by software developed by the Delft University of Technology in the Netherlands. This outputs the longitudinal and lateral positions of all the vehicles on the lane more than 20 times a second by reidentifying vehicle trajectories over a length of 500m. The resulting data can be used to analyze car following behaviours, lane changes, acceleration and deceleration, none of which are accessible from conventional spot measurements.

The pollution measurements were also highly sophisticated, combining very detailed knowledge of the vehicle fleet with knowledge of the emissions during fifteen days in each of the seasons at three points on the ring road with differing congestion levels.

2012 and 2013 will be spent validating and improving our congestion and pollution forecasting models. The project will end with the drafting of a series of recommendations for minimizing the possible adverse impacts (delays, pollutant emissions, safety problems) of traffic on high speed urban roads.

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Maintenance of high speed railway lines
The task of Diaghist

How can we improve the predictive diagnosis of the condition of TVM430 track circuits, which are one of the essential components of railway signalling on high speed lines? The ANR Diaghist project(1) which ended in 2011 answers this question which is crucial for SNCF with a highly innovative and ambitious demonstrator.

The concept of conditional preventive maintenance is gaining currency at the present time. In particular, this concept makes it possible to foresee the need for maintenance operations and perform them at the best time, and therefore for the lowest cost, and also limits systematic preventive maintenance operations and traffic interruptions.

The large number of track circuits (several tens of thousands) and their maintenance costs (several hundred K€ per year) justify the attempt to find optimized techniques for monitoring their condition in order to conduct prevent maintenance as efficiently as possible.

This project has resulted in a number of methodological advances. The most important of these is the development of generative parametric diagnostic models, and, more particularly, the integration of knowledge about the problem to be resolved and/or about the data in the decision-making algorithms.

This application is based on using the large volume of unlabelled data that are collected every 15 days by the inspection car while drawing on the expertise SNCF has built up to label a small part of it which will then be used to train a statistical model very effectively. In particular, we have formalized the training problem for the Independent Factor Analysis model in the case of imprecise or uncertain labels. This work could be extended to include all latent variable generative models with an evidence-based formulation which generalizes several probabilistic frameworks (e.g. semi-supervised or partially supervised).

The classification algorithms have been implemented in the “Diaghist” demonstrator which has been mounted on the SNCF IRIS320 inspection car. The quality of the results has led to the transfer of the tools to the SNCF Infrastructure Directorate in order to trial the concept of the conditional preventive maintenance of track circuits on a pilot. At a later stage, it would be possible to envisage extending this new surveillance concept to other industrial domains.

(1) The project, which brought together SNCF, IFSTTAR and the UTC, was launched in 2007.
FSTTAR’s experts are particularly focused on the issue of powered two-wheelers (PTWs), which are a subject of growing concern. This is explained by the fact that in Europe road safety has improved except in the case of motorcyclists among whom the number of casualties has even increased. In order to target risk exposure among this group of road users more effectively and understand the specific characteristics of their behaviours, the Institute is involved in characterizing and analyzing PTW trajectories which are currently a scientific stumbling block.

PTWs aside, IFSTTAR is interested in the visual strategies employed by drivers in connection with the visibility and legibility of infrastructures and their environment. The detection of fog, rain and black ice are improving all the time. Innovations mean we can now reduce traffic wear on road surfacings and model it more accurately.

Our constantly increasing need for passenger and freight transport mean that infrastructure networks have to satisfy new constraints in the area of mobility, safety and the environment. Recently developed indicators and measurement techniques provide a more accurate estimation of congestion and new techniques for overcoming it, for example reversible lanes. Ways of measuring the impact of HGVs on road safety and the service life of structures have been put forward. IFSTTAR is increasingly committed to railway transport which is benefiting from the transfer of advances in highway engineering in such areas as design, rehabilitation, modelling and non-destructive testing. The railway sector is also benefiting from ballast-free construction, techniques for characterizing performance, materials and structures and facilities that simulate train loading. The launch of the “Railéneum” IRT should make it possible to apply this research more widely by building demonstrators.
On the road
From video surveillance to meteorological observation

In order to locate and forecast weather that may disrupt traffic, for example fog, the French meteorological office (Météo-France) relies on observations. Risk maps are then drawn up by combining satellite observations with observations made on the ground.

The latter are made using a network of about a hundred weather stations spread all over mainland France. Unfortunately, the resolution of this system is not sufficient to give reliable data for a very localized phenomenon like fog. For this reason critical areas such as airports are specifically instrumented in order to measure meteorological visibility distances.

In contrast with airports, the linear nature of the road network makes this kind of instrumentation economically problematic not to say impossible. However, there is enormous potential for meteorological observations of fog on roads as many of them are equipped with video cameras for surveillance purposes.

Raouf Babari’s thesis, which was jointly funded by Météo-France and IFSTTAR and directed by IGN, set out to evaluate this potential. The outcome is a novel method for estimating the meteorological visibility distance by processing images from conventional roadside cameras, which are inexpensive, robust to lighting conditions and effective over a wide visibility range from road fog to atmospheric pollution.

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Airport pavement design
With some help from Alizé

The development of a new design method for airport pavements, in collaboration with STAC.

Traditionally, the French airport pavement design methodology is empirical, based on the American CBR (California Bearing Ratio) method for flexible pavements. It uses the CBR rating to characterize soils and applies coefficients of equivalence between different materials. It does not take account of the real configurations of aircraft landing gear or the actual mechanical behaviour of the materials.

The collaborative project between IFSTTAR and STAC (French Civil Aviation Technical Centre) is intended to overcome these shortcomings and develop a new design method for airport pavements. The method is founded on an “aeronautical” version of the IFSTTAR Alizé pavement design software package. As is the case with roads, the design process involves computing the stresses within the pavement using a linear elastic model. The main difference relates to the description of the traffic, as in the case of the airport pavement, the damage produced by each type of aircraft passing over the pavement is computed separately. Miner’s law is then applied to give the cumulative damage. The FICAV database held by STAC is used to obtain the characteristics of different airplanes. Their speed of passage and variations in their transverse position are also taken into account.

A design manual for airport pavements which describes the entire method was drafted in 2011, for asphalt pavements. It is currently being validated by a group of experts from the profession (contractors, project owners) and is due to be published at the end of 2012. A second version, for pavements with hydraulically bound foundations, is planned for a later date.

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Continuous health report

Launched in 2008, the COMPOSI-GeC project aims to develop composite materials whose core is instrumented with fibre optic sensors.

This instrumentation will produce a continuous diagnosis of structural health. Amongst other things, this will allow us to make better decisions about the appropriate time for maintenance.

COMPOSI-GeC is part of the DECID2 project (Intelligent Composite Material Demonstrator with a Dual Structural Health Diagnosis Capacity) which is run by a consortium\(^1\) that is planning to build a demonstration rig for September 2012.

This will measure 20m x 3.5m and be made from composite materials with dual instrumentation consisting of fibre optic sensors and ultrasonic patches.

In order to foresee future research needs, the consortium will build an open air ageing test rig at IFSTTAR’s Nantes site and another demonstrator that is identical to the first.

One of the DECID2 project’s deliverables is a fibre optic sensor with a smaller diameter (80μm) than most of those on the market (125μm), which facilitates the monitoring of structures. This fibre has been successfully inserted into long structural shapes made from composite materials. The fatigue durability of these materials has been tested at different temperatures (-60°C, ambient temperature and 60°C) and under dense UV radiation (in collaboration with the NIST, Maryland, USA).

The goal is to evaluate the real structural capacities of intelligent composite materials.

\(^1\) The consortium consists of manufacturers - ETPO, DFC, IDIL, IX Fiber, SYNERVIA, and laboratories - CETIM, Lemaur (Université de Rennes 1), GEM (École Centrale de Nantes) and IFSTTAR.

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New railway tracks without ballast

The FUI-NBT (New Ballastless Track project is backed by the i-Trans competitiveness cluster and is an attempt to develop a French design for rail track that is laid on concrete slabs. The specifications for this include: usability for freight at low speed and passengers at high speed, a design life of 100 years, minimum maintenance and a laying speed of 1km/day. The project has a budget of €1.6M.

IFSTTAR is playing an active part in this project with its industrial partners RAILTECH, ALSTOM, VOSSLOH and RFF, initially for the design of the slabs. The project is currently at the laboratory validation stage. For this, IFSTTAR has developed a specific test facility for the full-scale fatigue testing of this type of structure.

This novel facility makes it possible to apply cyclic mechanical loading and thermal gradients simultaneously to the tested slabs. The performance of this facility permit loading at 5Hz with axle loads of up to 40 tonnes and maximum thermal gradients in the concrete slabs of 0.8 °C/cm. The first results correlate well with the models. Fatigue tests are to be performed up to 10 million cycles in order to validate the last phase of the project which consists of the construction of a 1km section on a real railway line in early 2013.

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Asphaltic mixes
Coping with climate change

Asphaltic mixes are very sensitive to temperature. Present-day changes in the climate therefore mean we must study their behaviour.

The aim is to develop models that can forecast pavement creep if average temperatures rise a few degrees above those observed during the last 30 years. Current tools for designing mixes and pavements are not able to take account of this warming, particularly in the case of slightly special materials such as mixes that contain polymers or recycled materials or when materials are used in an unusual way. Several extremely severe cases of rutting have thus been observed on dedicated rights-of-way for public transport (Nantes busway, Nancy and Clermont-Ferrand tyred tram systems). Current pavement design tools do not consider the specific conditions of slow channelized traffic that apply in these zones.

The research sets out to develop a method for evaluating mix performance based on temperature-controlled tri-axial loading tests that will provide data for a thermomechnical model for mixes. This will open the way for an evaluation of the long-term behaviour of pavement structures and the development of design recommendations. Specific types of pavement such as public transport lanes (Busways), airport pavements and storage platforms all provide potential applications for the findings of this research.

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Wearing course
A fibre-reinforced grooved surface dressing lengthens service life

In France, the pavement bases on high-traffic roads last for 30 years or more, while wearing courses have a much shorter service life of roughly 7 to 10 years.

For this reason, IFSTTAR has started work on developing a wearing course that maintains its in-service properties much longer, for 30 to 40 years. An initial concept was developed in the laboratory between 2005 and 2007. A second project, entitled CLEAN (Long-life Self-cleaning Environmentally-friendly High Skid-Resistance Pavement) and which is funded by ANR, improved the initial concept and led to the development of tools for laying the material industrially.

We were partnered in the project by the General Councils of the Loire Atlantique and Sarthe Départements, the CETE Île-de-France and the firms Calcia, Sika and Pro.sper. This enabled us to create two experimental construction projects. The first was a roundabout at Brette-les-Pins (Sarthe) and the second 150 m of wearing course on the RD117 heading towards Saint-Philbert (Loire Atlantique). In the case of the second project, very fine grooving was used instead of the planned embed- ded chippings and gave satisfactory and what appears to be durable skid resistance with a noise level that is comparable to very thin asphaltic concrete. The fineness of the grooving means motorcycle head shake and aquaplaning are avoided.

Site monitoring has shown that, apart from a few inevitable teething problems, the grooved surfacing concept seems to be very promising.

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THESES

Pierre Aumond, IM
Numerical modelling for environmental acoustics: the simulation of meteorological fields and their inclusion in a propagation model (19/12/2011)

André Benine-Neto, LIVIC
Trajectory control in curves, towards the Perceptiv-ESC, through a piecewise affine approach (19/11/2011)

Farah Homsi, IM
A model to determine the fatigue life of asphalt mixes under complex loading (14/12/2011)

Abdourahmane Koita, LEPIS
Modelling trajectories and their reliability: application to road diagnosis (23/03/2011)

Si Hai Mai, NAVIER
A study of the deterioration of urban railway tracks (02/05/2011)

Rabih Meftah, NAVIER
Multi-scale technique for the dynamic structural design: application to the vibrations and noise produced by tyres (15/11/2011)

Philippe Pecol, NAVIER
Discrete 2D modelling of pedestrian movements – Application to the evacuation of civil engineering structures and interactions between a crowd and a footbridge (09/12/2011)

Dan Zhao-Orfila, IM
Changes in the pavement skid resistance: the influence of materials, ageing and traffic, seasonal variations (14/10/2011)

ACCREDITATION TO DIRECT RESEARCH

Nicolas Hautiere, LEPIS
Detection and Characterization of visibility conditions by artificial vision – Applications to Intelligent Transport Systems (24/10/2011)
In addition to continuing to carry out detailed accident studies and analyze the road traffic accident casualty register, a considerable amount of the Institute’s research attempts to improve our understanding of road risk, the dynamic behaviour of vehicles, the psychology of driving behaviour, legal responsibility, the cognitive aptitude of elderly persons to drive, social and geographical inequalities, hypovigilance, alcohol, narcotics and medicinal products, planning and taking account of safety in regional governance, not forgetting vulnerable users, the causes of death, or healthcare response to injuries. Biomechanics, which is the fundamental problem for road safety, is among IFSTTAR’s themes of excellence. The Institute is continuing its work on modelling the human body in order to predict injury risks, appraise and improve the protection and comfort of transport users and assist vehicle design. Research activities in this area relate to modelling and trials, and are concerned with different scales, from individual tissues to the whole body. Last, with regard to the environment, we should also mention the study into the effects of aircraft noise on the health of people living near airports.

Research Orientation 3 brings together the activities of one research unit (MA) and three jointly managed research units (LBA, LBMC, UMRESTTE). These few examples of its work only represent a small part of the wide range of research carried out by these units.

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Finite element modelling
Pregnant women and children first

The LBA has been investigating the protection of pregnant women and children in the event of a car crash for almost 8 years, in close collaboration with the Nice and Marseille welfare services.

The defence of the doctoral theses by François Coulangeat(1) and Jérémie Pérès(2) had a considerable impact on this topic in 2011. Both studies developed detailed finite element models for assessing the vulnerability of these groups of users and proposing new protection devices.

With regard to pregnant women, the recent advances have identified new injury criteria that are backed up by the available epidemiological data. In particular, these criteria are based on fluid-structure coupling that provides accurate modelling of the interactions between the uterus, the placenta and the foetus within the amniotic fluid.

By simulating a variety of impacts, the influence of the adjustments that are available in the passenger compartment (position of the seat and steering wheel) on the unborn child’s fatality risk was assessed and should provide the basis for recommendations that are based on more objective observations.

(1) A finite element numerical model of a child.
(2) Injury mechanisms in pregnant women and their foetus during a road traffic accident.

Modelling the abdomen

The first phase of the projects conducted by the Global Human Body Modelling Consortium (GHBMC) is drawing to a close. Its goal was to create the first complete model of a human being that was as bio-faithful as possible.

This ambitious programme was launched in 2008 with funding from a global consortium consisting of 8 vehicle manufacturers, one subcontractor and NHTSA (the American National Highway Traffic Safety Agency). The GHBMC has entrusted the various topics to six centres of academic expertise: Wake Forest University for geometry and assembly, Wayne State University for the head, Waterloo University for the neck, University of Virginia for the thorax, University of Virginia with the University of Alabama in Birmingham for the lower limb and IFSTTAR with Virginia Tech for the abdomen (LBMC modelled the abdomen, while Virginia Tech carried out the experimental work).

LBMC’s part of the work follows on from a doctoral thesis on abdominal modelling (with Lab PSARenault) and another on the characterization of liver tissue (with the INSA in Lyon). The abdomen develop by LBMC was validated under 12 impact configurations and the first injury criteria were proposed for the liver and spleen. Validation work will continue using data on the kinematics of internal organs obtained by Virginia Tech. The model has been tested in full or in part under more than 60 impact conditions, and injury criteria have been proposed for most anatomical regions.

This model is intended to become the reference human model in the industrial and academic sectors for improving safety. Research is due to continue, amongst other things to create models that represent other groups.

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Accident rates among powered two-wheelers
PTWs really deserve a research programme

For nearly two years, researchers from a variety of disciplines (cognitive psychology, social psychology, vehicle and infrastructure engineering, biomechanics) have been investigating the thorny problem of powered two-wheelers (PTWs). In addition to analyzing accident processes and contributory factors, the COMPAR project is attempting to identify the psychosocial determinants of PTW user behaviours. The study has thus employed two complementary methodological approaches. Two IFSTTAR units, MA and LBA, are involved in COMPAR.

This research involves three approaches. The first attempts to identify the principal accident configurations for PTWs based on a detailed analysis of 1,000 accident reports. The purpose of this work is to identify the main factors and the principal ways they combine to determine the nature of accidents.

The second approach is a psychosocial analysis based on survey data. The aim is to define and describe the profiles of PTW users and identify the psychosocial determinants of their adoption of “risky” driving styles.

The third approach used Detailed Accident Studies to investigate PTW speeds in relation to the difficulties other road users experience in detecting them.

Last, a complementary study more concerned with “secondary safety” relates to the protective efficacy of so-called “light” PTW safety equipment (summer jackets).

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Monitoring the ESPARR cohort
Exceptional data

Its unique nature means the ESPARR(1) cohort and the research based on it provide a fundamental scientific apparatus for deciding on appropriate concrete measures to reduce accidents and for monitoring casualties. Although fatality figures are often quoted, less attention is given to the large number of casualties who survive, sometimes with disabilities that are not visible.

In 2011, monitoring ended of the 1,372 road accident casualties who had agreed in 2004 and 2005 to join the ESPARR cohort and be monitored for five years. One of the qualities of the cohort is that it is a representative subsample of the Rhône Département Road Traffic Casualty Register which means the findings can be extrapolated to this population.

While receiving treatment in the hospitals in the Rhône Département, the subjects were asked to provide regular accounts of the way the accident had affected their lives from the physical, psychological, family, social, occupation and financial points of view. The subjects with the most severe injuries were offered a medical appointment in their home one, three and five years after the accident with a clinical and neurocognitive assessment.

(1) Study to Monitor a Population of Road Traffic Accident Casualties in the Rhône Département.
Narcotics and fatal accidents
The results of the SAM survey

What role do alcohol, narcotics and medicinal products play in fatal accidents?

This topic is covered by two publications. They summarize the results of the SAM (Narcotics and Fatal Accidents) survey which was conducted by a multidisciplinary team (César, LAB PSA Peugeot-Citroën/Renault, Inserm, INRETS and OFDT) under the leadership of an IFSTTAR researcher, Bernard Laumon (1).

The SAM survey is based on the analysis of 10,000 fatal accidents that occurred between October 2011 and September 2003. The first findings relate to the role of cannabis in the causation of fatal road traffic accidents and were made public in 2005. Additional analysis, relating in particular to the role of alcohol in road traffic accidents, have been conducted since. These two aspects were covered jointly for the first time in a comprehensive report. This report is the first (epidemiological) volume of the report on the SAM survey.

A second publication deals with accident analysis of over 1,000 fatal accidents. These were randomly selected during the study. This work described the circumstances under which the drivers involved in the accidents in question encounter difficulties and describes their nature.

The extremely large amount of data that was collected has improved our knowledge of the consequences of accidents over a period of time. So far, the consequences after 6 months, one year and 2 years have been analyzed and reported in a number of publications (general consequences, posttraumatic stress syndrome, impact on the return to work). More specific analysis has been conducted into, for example, pedestrians with cranial trauma, patients with whiplash injuries, the impact on the families of the casualties with the most severe injuries and the socioeconomic impact.

In September clinicians and researchers met at a symposium. The next analyses will explore how the consequences of accidents have changed over time and the impacts on specific groups (patients with cranial trauma, patients injured in the course of their work...).

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(1) The SAM project was funded by the Ministry of Health and coordinated by the French monitoring centre for drugs and drug addiction (OFDT). These two publications are available free of charge at http://www.ofdt.fr

THESES

Jean-Noël Amato, MA
Effects of des psychotropic drugs on the driving behaviours of young and elderly drivers (17/03/2011)
— Xavier Bourdin, LBMC
Experimental characterization of the human mesentery and approaches for modelling the abdomen under impact (13/07/2011)
— Aline Brunon, LBMC
Local characterization of the failure of liver tissue (19/10/2011)

Julien Caussé, LBMC
Dynamic and muscular modelling of the automobile access movement. Experimental analysis and simulation using a numerical model (20/06/2011)
— Idir Licaï, UMRESTTE
Measuring the social inequalities with regard to travel and road traffic injury accidents among the young (18/04/2011)

Mohand Medjkane, MA
Multi-scale analysis of road safety (29/03/2011)
— Florent Moissenet, LBMC
Advanced musculoskeletal modelling for the dynamic simulation of walking (29/06/2011)
— Éric Wagner, LBA
The sagittal spinal profile: its influence in crash situations (23/11/2011)
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APPLICATION OF RESEARCH FINDINGS, TIES WITH INDUSTRY AND EXPERT APPRAISALS

Meeting the expectations of society and the economic sphere and carrying out leadership in its areas of expertise are responsible for two imperatives: the Institute must foresee the need to provide technical support to local and national government and supervisory authorities and carry out very high level expert appraisals for industry.

The knowledge and know-how that is built up during targeted research programmes or projects and the Institute’s resources in terms of equipment and scientific facilities, some of which are unique in France or Europe, have allowed IFSTTAR’s researchers to produce important findings which are the subject of a highly-focused application strategy that spans the continuum from research to innovation. IFSTTAR has thus enhanced its profile in relation to the economic sphere through its subsidiaries, certification activities and patents, etc. These ties with the social and economic spheres enable it to respond appropriately to the needs of society while at the same time enriching its research programme. In order to extend and increase this dynamic, IFSTTAR is strongly involved in the competitiveness clusters that are concerned with transportation, the sustainable city and the application of new materials.

At the crossroads between scientific, technological, economic and societal issues, IFSTTAR aims to assist the relevant players along the path of sustainable and responsible mobility by making effective changes to infrastructure and by imagining the city of tomorrow, with its wealth of ethical and economic potential, and also seeks to play an active part in improving the competitiveness of the nation.

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The ErgOptim project has been integrated within the subsidiary LIER. The LCPC Experts start-up makes its first successful steps. Creation of Transpolis SAS, which is a shared innovation platform for innovative urban public transport.

ERT – Europe Recherche Transports – is a subsidiary 100% owned by IFSTTAR whose goal is to help set up projects and manage researchers in the framework of the coordination of European and national projects. In 2011, its turnover exceeded €570,000 for the management of 11 European projects. Two European projects were completed in 2011, the OPTIMUM project got under way, and the launch phases of the new SECRET and EVEREST projects took place. ERT’s recognized position in the area of transport continues to draw strength from its role as a national transport contact point for the European Commission.

For LIER, 2011 saw total turnover of €1,652M. Once again there were considerable contrasts between its different activities. Its testing activities have suffered considerably as a result of the economic downturn and are still awaiting the redrafting of the standards for safety barrier terminals and transitions. LIER’s numerical simulation activities continue to increase, by 21% to a level of €350,000, 42% of which was for customers abroad. In order to foster its international activities, LIER has set up two branches abroad, one in Poland and the other in Turkey. A new activity, “ErgOptim”, that sets out to exploit knowledge and tools that have been developed by IFSTTAR in the area of vehicle ergonomics was adopted at the end of 2011. A first programme of “CE marking” certification was carried out in partnership with ASQUER. The new tax refund for investment in research and development enabled LIER to balance its finances, apart from provisions for non-recurring expenditure. The need to relocate its test tracks has prompted LIER to play an active role in the LUTB competitiveness cluster, in connection with a shared innovation platform known as TRANSPOLIS. This project has resulted in the creation of a company, TRANSPOLIS SAS, which was incorporated on 3 November 2011 by IFSTTAR with a number of partners from industry (Renault Trucks, Colas, and the PMEs Adetel Group, Aixam, Eve Systems and Vibratec). IFSTTAR has a 45% holding in this new subsidiary.

In the case of the young start-up CIVITEC, a subsidiary in which IFSTTAR has held a 75% stake since the end of 2008, 2011 has been marked by a first industrial success (an order from ZODIAC) which rewards the excellent work of the team of developers and the company’s effective marketing structure. Its ability to call on scientific experts from IFSTTAR laboratories and members of the Institute’s governance bodies has also enabled it to gain the support of the main players in the national and international motor vehicle market.

The Pro-SIVIC® simulation and validation software packages for the in-vehicle environmental detection chain have proved their validity. 2012 should consolidate this position. IFSTTAR has a 15% stake in CERTIFER, a railway certification and expert appraisal body which is continuing to grow with the support of IFSTTAR experts. Its turnover in 2011 amounted to €5,774M, a 21% increase, and net accounting income reached €495,000, a 43% rise. In 2012, the intention is for CERTIFER’s infrastructure-related activities to mobilize IFSTTAR’s expertise.

IFSTTAR took part in and assisted the creation of the CITILOG start-up company. The world leader in automatic image-processing based road traffic incident detection was faced by a drop in its level of activity in 2010, but the situation levelled out in 2011. The company’s return to profitability is expected to be confirmed at the end of the financial year, on 31 December 2012.

LCPC Experts was set up at the end of 2010 in order to promote French research and expertise in the field of civil engineering by offering high-level expert appraisals, in particular internationally. 2011 saw the first year of its activities and its first contracts, with French public sector infrastructure owners such as ANDRA, GRT Gaz, RFF, engineers and firms in the private sector such as Tractabel, Beckaert, and the European Commission. The outlook seems very promising. A first international contract has been obtained for a geotechnical expert appraisal for a railway under construction in Saudi Arabia.
TIES WITH THE SOCIAL AND ECONOMIC SPHERES

The continued issuing of national calls for bids from the National Research Agency (ANR) and the Directorate-General for Enterprise (DGE), and European calls for bids for the 7th FPRD in areas covered by the Institute enabled IFSTTAR to achieve total contractual orders of €17.6M in 2011, which represents an increase of 2.2% over 2010.

The sources of this contractual income are shown in the diagram. 73% of the notified contracts were from the public sector and 27% of the Institute’s contractual activity directly involved a partnership with the social and economic spheres (industry or a local or regional authority).

SUSTAINED CONTRACTUAL ACTIVITIES WITH THE INDUSTRIAL SECTOR

In 2011, IFSTTAR reported income of more than €6.6M that directly involved an industrial partner or a local or regional authority. These activities with or for the social and economic spheres relate involve partnership-based research, expert appraisals, tests and certification. In 2011, almost half of this direct income was from the design and management of “structures”, including engineering structures and civil engineering in general. The area of transport covers the organization and optimization of transport systems and the road and rail sectors: this accounted for a third of IFSTTAR’s revenue in 2011.

IRCAN acquires digital still colour images of the road and its environment. When combined with the IREV operating software package it enables road managers to build up and exploit road network image banks.
The areas of geotechnical engineering, the environment and green building accounted for 9% of the direct contracts, and energy accounted for 4%.

Research into the fields of health and road safety, which is logically financed from the public purse, received contracts to the tune of €400,000 from the social and economic spheres. More precisely, direct research contracts (ignoring expert appraisals, tests and certification) awarded by industry, operators and local and regional authorities have considerably increased compared with previous years (by 20%), and their value now exceeds €3.4M. This bodes well for 2012.

In 2011, almost half this activity was generated by transport, which includes the organization and optimization of transport systems and the road and rail sectors. Together, the areas of green building, engineering structures and civil engineering and construction accounted for 22% of the contracts.

In addition, in 2011, major partnerships were put in place with industry, academia and local and regional government in the framework of the Future Investments Programme.

Most of these ambitious projects were subjected to an initial selection process in 2010 and required a considerable amount of additional work in order to take on board the comments and concerns of the General Commission for Future Investments. Several projects were successful when submitted a second time: the VeDeCoM IEED and the Efficacity project were added to the successes of the beginning of the year (the RAILENIUM and Jules Verne IRTs). The Transpolis innovation platform also received support from the DGCIS (General Directorate for Competitiveness, Industry and Services) and teams from IFSTTAR have been very much involved in the projects submitted in response to ADEME calls for interest alongside its industrial partners and local and regional authorities.

INCREASING INVOLVEMENT IN COMPETITIVENESS CLUSTERS

Its strong presence in the regions and the excellence of its laboratories allow IFSTTAR to have a significant presence in the principal competitiveness clusters which are active in the sectors of transport, the city and materials engineering. It thus plays a governance role and leads working groups in the MOVEO, I-TRANS, ADVANCITY and LUTB clusters. It maintains close ties with System@tic, Véhicule du Futur (Vehicle of the Future), Novalog, Pegase, Gestion des Risques et vulnérabilité des territoires (Risk Management and Regional Vulnerability) and Solutions Communicantes Sécurisées (Secure Communications Technologies).

The VeDeCoM IEED is backed by the Mov’eo-Rec partnership-based foundation which was set up by the motor vehicle sector, universities (including UVSQ) and research institutes (including its founders IFSTTAR and IFPEN).

IFSTTAR participates actively in the shared innovation platform known as TRANSPOLIS, and, in particular, has set up the company Transpolis SAS in which it has a 45% stake, alongside RENAULT TRUCKS and COLAS.

The mutual trust that exists between the members of the competitiveness clusters has made it possible to increase the quality and number of research contracts that have been certified by the clusters and funded by the FUI (Single Interministerial Fund) at a time when the juries are accepting a smaller and smaller percentage of projects.

It is noteworthy that research projects which have been certified by a competitiveness cluster account for an increasing share of the Institute’s resources, rising from 4% in 2010 to 4.5% in 2011.

The Institute remains committed to supporting SMEs, but the proportion of direct contracts with SMEs has remained stable, at about 10% in 2011.
Rail freight
IFSTTAR fuels the public debate

Rail transport is now treated as a separate sector by IFSTTAR, which is increasingly in demand in this field.

In the autumn of 2010, the Development Directorate of Réseau Ferré de France asked Antoine Frémont, a senior research in the SPLOTT unit, to carry out a study of freight issues in connection with the new Paris-Normandy line. The document was published in the supplementary studies section of the website that hosts the public debate on the new line (http://www.debat-public-lnpn.org/documents/etudes-complementaires.html). The new line obviously operates passenger services, but it is also part of a larger planning project that sets out to improve links between the Paris Region and its seaboard. Transporting freight by rail to or from the Paris region and beyond is essential in order to strengthen the European position of the two major sea ports of Le Havre and Rouen, as well as that of Dieppe, Caen and Cherbourg.

After placing the Normandy seaboard within its European and national context, the study highlights the conditions that are necessary for the development of rail transport, paying particular attention to the consolidation of flows, which contrasts with the disseminated flows produced by road transport flows. The addition of this freight corridor to European corridors may also help to extend hinterland of Normandy’s seaports.

In September 2011, Antoine Frémont joined RFF’s development directorate as regional planning officer.

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Museography
The contribution of ethnology

In 2010 and 2011, Anne Jarrigeon, an ethnologist employed as a researcher and teacher at the LVMT, carried out an unusual expert appraisal for the Scientific Commission in relation to the cultural and scientific schedule for the planned urban transportation museum at Chelles(1).

Anne Jarrigeon’s contribution related in particular to locating archives for the Association for the Urban, Interurban and Rural Transportation Museum (AMTUIR) and developing approaches for the association to follow in a museum. She also turned her attention to collections of vehicles and various objects and the documents collected by the association.

This young researcher was appointed to an IFSTTAR-Marne-la-Vallée University “chair of excellence” three years ago. When preparing the new permanent exhibition entitled Des transports et des hommes at the Cité des Sciences, which opened in autumn 2011, she also carried out two ethnographic studies on travel objects and the Gare du Nord, which is emblematic of contemporary multimodal systems.

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(1) The project for this museum currently has the backing of the Département of Seine-et-Marne, the Île-de-France Region, the Ministry of Culture and the RATP.
The geotechnical studies showed that wide slopes are stable with the required safety factor with 1V:3H slopes and a minimum width of 2.5 m from the rail provides sufficient bearing capacity under railway loads.

Long-term behaviour is nevertheless affected by the transport of materials by the wind. The orientation of the slopes of dunes in the Al Nafud desert, with a steep slope on the northern side and a gentle slope on the southern side is the result of the prevailing south-westerly winds. The final recommendations are to construct a moderate 1V:6H slope on the windward side while a 1V:2H slope is acceptable on the leeward side. In addition, it is advisable for there to be a flat surface at least 10m wide on either side of the railway track.

The international engineering group ISC, which is led by the Louis Berger Group and includes Canarail Consultants, Systra and Khatib & Alami, has asked LCPC Experts to conduct an expert appraisal in the framework of the North-South Railway Project (NSR) in the An Nafud desert in Saudi Arabia.

This assignment provided a way, via its subsidiary LCPC Experts, of applying IFSTTAR’s expertise in soil mechanics, materials and sedimentary dynamics on a major international project. The goal was to validate a technique for stabilizing sandy railway embankments using lateral sand banks as an alternative to the initially envisaged solution of protecting the slopes from erosion by covering them with materials that resist erosion such as riprap or stabilized soil. The appraisal was conducted by a team from the GER unit at IFSTTAR, by Thierry Dubreucq on the spot under the leadership of Jean-Pierre Magnan.
Five bridges on the A4 motorway are exhibiting lamination damage and concrete decay. The Physico-Chemical Behaviour of Materials Group (CPDM) was asked by the motorway concessionary company SANEF to determine the causes.

The CPDM applied a number of laboratory investigation techniques to identify the concrete formula that was used during construction and establish the state of conservation of the concrete by identifying the presence of substances that are liable to cause damage.

The results showed that the concrete in question had been damaged from scaling caused by a combination of several factors: the action of freeze/thaw cycles and de-icing salts, the high porosity of the concrete, failure of the waterproofing complex and the use of highly frost-susceptible aggregate.

In view of the advanced state of the process, SANEF decided to repair the affected bridges by demolishing and rebuilding the affected parts and redoubled its surveillance of structures with the same design. In this connection, the CPDM has developed a simplified inspection procedure for managers to check the state of the concrete of all the uninspected bridges in the stock which were built during the same period.

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The new LOU rugby club stadium
An expert appraisal before approval

The figures for the “Matmut Stadium” are impressive: 60,000 spectators, a cost of €12M and only 3 months to build it.

This major facility, which consists of dismountable metal structures, was built between July and September 2011 and since 9 November 2011 has hosted the matches of one of France’s top 14 rugby teams, Lyon Olympique Universitaire (LOU).

Before permission to open to the public was given, the Prefect of the Rhône-Alpes Region asked for an independent assessment of the safety of the structures (terraces, stands, lighting poles, etc.). IFSTTAR managed this geotechnical and structural expert appraisal with SETRA (Technical Centre for Transport, Road and Bridge Engineering and Road Safety) and the Lyon CETE (Public Works Design and Research Centre). The appraisal was conducted in September and was based on documents and an inspection of the finished construction, and did not set out to take the place of continuous monitoring of the design and construction work by technical inspection agencies. This type of expert appraisal provides a comprehensive view and can potentially identify shortcomings due to the fragmentation of occupations and tasks. The principal observations related to the traceability of steel used in the superstructure, the wind stress requirements in the Eurocodes, geotechnical surveys of the anthropized site, the overturning stability of the foundations and the need to monitor the structure over time.

The stand consists of a metal gantry-shaped structure with a cantilevered roof to facilitate media coverage of the matches.

As the design life of the structure is between 5 and 18 years, the terraces are a demountable tubular structure. The base of the terraces rests on a slab while the top is fixed to the structure to provide space for rooms and access beneath it.

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Assessing the safety of electric HGVs
UNEX plays a pioneering role

The wider use of electric and hybrid vehicles giving rise to a fresh crop of passive safety studies.

UNEX, which is specialized in crash tests and analyzing injury risk has successfully adapted to this situation and now takes account of the four new types of risk inherent in these vehicles:

- Electrical hazards (more than 600V), risk of electrocution for passengers and emergency services.
- Chemical hazards: leaks of electrolyte, discharge of toxic gases.
- Fire hazards: heating, electrolytic reaction, short circuiting in the cells.
- Influence of the battery on the distribution of masses.

Side impact with a mobile deformable barrier.
Haiti
An audit of a trunk road

An expert from IFSTTAR performed an audit on two rehabilitation projects on trunk roads. This followed on from the field training part of the highway engineering course run by the expert in Port-au-Prince at the request of the EU delegation in Haiti.

Debonding of the mix, which proved to be a defect of an unusual type, on the road under traffic required an expert appraisal of the pavement along a length of 60 kilometres. Investigations revealed problems in the performance and monitoring of works, which were more or less responsible for the observed deterioration, but also to shortcomings in the recommendations and preliminary studies.

An in-depth analysis identified the nature and source of the problems, assigned responsibility between the project owner and the contractor(1), and proposed remedial measures and a monitoring plan which together proved to be effective. Tools derived from application of research on the characterization of binders have revealed highly accelerated aging of the asphalt in the mix which considerably reduced the service life of the surfacing and the durability of the pavement, in a country where strong, tolerant materials should be used that can survive without maintenance as this is often non-existent.

Additional research would be very useful in order to explain these phenomena which are caused by the combination of many factors such as the intrinsic quality of the binder, construction conditions and, above all, the severe climatic stresses the pavements have to withstand.

(1) Studies, design, inappropriate choice of some techniques or the extremely clayey nature of the soil which is susceptible to shrinkage cracking.

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UNEX has marked a European first by performing a safety assessment of the MAXICITY electric HGV manufactured by Renault Trucks.

The side impact crash was performed using the large catapult to propel the barrier and watched by some 40 engineers from Volvo, Renault Trucks, PVI (a manufacturer of electric vehicle powertrains), VALENCE (a battery manufacturer), under the surveillance of SDIS 69 (Rhône Département Fire and Rescue Service).

Some thirty measurement channels were employed and analyzed. The lateral impact was obtained by catapulting a moveable deformable barrier that replicates the impact of a passenger car hitting the HGV near its batteries.

As a consequence of this first experiment, UNEX was asked by Renault Trucks to assess a hybrid propulsion system for a medium-sized HGV. The tests were conducted successfully using the impact simulation catapult and the decelerated trolley. Unix has exploited this expertise in the AZURE project with Renault Trucks and support from the LUTB cluster. This project aims to design a small urban HGV that is completely optimized for electric operation and available in a number of different models: universal chassis-cab, goods transport and passenger transport. Unix will be responsible for evaluating the crash-worthiness of this vehicle.

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Pavement damage.
Photometric and colorimetric tests on road equipment

The Photometry and Colorimetry Laboratory (LDPC) which is part of the LEPSIS unit is responsible for characterizing the performance of road equipment (signing, lighting) in terms of visibility for the purposes of research, development, standardization and regulation. It also conducts tests for certification bodies such as ASQUER or directly for industry and is endowed with major technical facilities for this purpose.

The LDPC has two goniometers with two angles of rotation in order to evaluate the performance of Variable Message Signs (VMS) and traffic signals (luminous intensity, angular visibility, colour, uniformity, phantom effect). A gonioreflectometer with 4 angles of rotation is used to test retroreflective materials (surfaces containing glass beads or microprisms used in retroreflective vertical signing, delineators, studs and fabrics). It also owns a test set for measuring the spectral/bispectral and colorimetric properties of surfaces.

Last, it has made considerable mechanical modifications to a gonioreflectometer with 3 angles of rotation in order to improve its operation. The modified device came into service in 2011. It determines the Bidirectional Reflection Distribution Functions (BRDF) of surfaces and is used to characterize pavement surfacings. In the near future this test set may be used by lighting experts or motor vehicle accessory manufacturers.

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<td>ASCQUER, AVERY, SCR PLASTIQUE</td>
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<td>Variable Massage Signs</td>
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</tr>
</tbody>
</table>

Table setting out test activities in 2011.
Protection against rock hazards
Valuable testing

In mountainous zones, which are often important in terms of heritage and the economy, rockfalls and rockslides are serious natural hazards for both persons and property.

IFSTTAR, which has been studying this hazard for several years, has already published a number of technical guides on hazard identification, site surveillance and the selection and maintenance of protection systems. Trajectory determination and rockslide forecasting software has also been developed. But modelling cannot completely replace full-scale tests as it does not provide sufficiently reliable predictions of events. The Institute’s rockfall test station at Montagnole (Département 73) means it has an exceptional facility for testing and certifying protection products at the request of Construction and Civil Engineering contractors. For example, in the case of dynamic rockfall protection screens, the European Technical Approval Guideline (ETAG) No. 27 includes a requirement for full-scale impact tests.

IFSTTAR is the only notified body for the CE marking of products of this type in France. Tests have validated the strength of several innovative devices that can withstand impact energies of between 3,000 and 5,000 kJ, i.e. a block 1.3 m in diameter falling from a height of 35m. In Europe, only three other stations have the capability of carrying out tests of this type. However, the station is able to conduct tests with a much higher impact energy, 13,500kJ, i.e. a 20-tonne block falling from a height of 70m (an impact speed of 37 m/s).

Other full-scale tests are currently being conducted for clients or in the context of research programmes: energy dissipation in granular media, new dissipative structures, resilience of engineering structures or reinforced soil mounds.

Body armour
A qualification standard in the near future

The army and police use body armour for protection.

This consists of leg armour, arm, breast and back armour. There is a large amount of equipment of this type on the market, but its effectiveness is not covered by any harmonized European standards. It is as difficult for the public authorities to make a choice as it is for manufacturers to prove they provide better equipment than their competitors.
A major French manufacturer asked IFSTTAR’s Experimental Testing Unit (UNEX) to perform two tasks: to design “bio-realistic” qualification protocols for body armour and to specify scientifically-based performance criteria.

The method developed by UNEX was original in that it consisted of testing the body armour on crash test dummies fitted with special sensors in body positions frequently used during law enforcement activities. The dummies were fitted with protection then impacted at various points with various levels of energy by impactor heads that simulate the most common weapons: baseball bats, axes and picks.

The criteria for evaluating the armour were based on fracture criteria obtained from biomechanical studies in the areas of motor vehicles and rail passenger transport. UNEX’s work has led AFNOR to set up a working group (GP3.1) in order to develop a standard. This working group consists of users, public sector purchasers, manufacturers, experts and doctors. UNEX is active as a scientific expert and in drafting the standard. This standard will provide a reference for public sector purchasers when issuing calls for tenders.

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Optical metrology test sets
The BOCCA and BIRD simulators

Numerical simulation considerably reduces the time and resources that are required to validate new detection systems based on videocameras and image processing software.

To perform this validation it is necessary to characterize the videocameras used and the objects that are created in the simulation with a high degree of precision. To this end, the LEMCO unit has built two optical metrology test sets, BOCCA and BIRD.

BOCCA (Optical test set for characterizing videocameras) is based on image analysis of an optical structure that has been calibrated under controlled lighting. BIRD (Bidirectional Reflectance Distribution) measures the distributions that characterize how materials reflect light under different angles of illumination.

The equivalent of BOCCA has been created in the Pro-Sivic simulation software in order to calibrate the simulated sensors that have been developed for this software. The simulation model could thus replicate the characterized cameras remarkably faithfully. BOCCA has mainly been used to determine the camera’s physical and optical defects which makes it possible to simulate detection systems.

The nature of the environment in which the sensor is placed is also of prime importance. Its second test set has allowed LEMCO to build up a large number of measurements of different types of material that make up the sensor’s environment. A paper given at the Transport Research Arena 2012 on BOCCA won first prize in the Safety category.

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Shape-memory dampers
The possibility of fatigue-free cables?

Civil engineering structures are subjected to very testing service conditions. Rain, wind, salt from the sea, pollution, temperature variations, mechanical loads … a whole list of external factors can cause cables to vibrate and shorten the lifetime of structures.

Devices that are currently operating on structures such as cable dampers, cable ties and extruded pipes that cover the stay cables can attenuate and increase the frequency of these vibrations. However, these devices have less impact on vibrations with high frequencies and high amplitudes.

IFSTTAR has designed and experimentally validated a prototype damper with a wider spectrum of action based on Shape Memory Alloys (SMA). This was the culmination of the European SMARTeR programme (2006-2010) which was led by the former LCPC. The core of the damper consists of 8 thin SMA wires which dissipate the vibrational energy.

Certain Nickel-Titanium (NiTi) alloys exhibit what is known as “superelastic” behaviour which means they can be deformed to a considerable extent without any residual deformation. The material undergoes a solid-solid phase transformation between two different crystallographic structures. The resulting dissipation of energy provides NiTi with a very high damping capability.

Conducting this design work also gave us an opportunity of researching into the behaviour of SMAs, NiTi in particular. A patent has been filed as a result of this project. It is currently being extended to the international level.

Protection of children
Predicting abdominal injuries

In a car crash, rear seat passengers seem to be particularly at risk of abdominal injury. The group with the greatest exposure is children of between 6 and 10 years of age who are sitting on a booster seat and wearing a seatbelt.

These injuries are still difficult to predict. Current crash dummies are poorly (or not at all) fitted with sensors for this anatomical region and do not provide us with a sufficiently accurate evaluation of risk. This problem affects the P-series child dummies that are currently specified by the regulations for the protection of children and the certification of seats. To fill this gap, the LBMC has been trying for a number of years to design abdominal sensors in the framework of the European CREST, CHILD and, more recently, CASPER projects.

The device that has been developed, known as the Abdominal Pressure Twin Sensors (or APTS) consists of two soft bladders filled with fluid which are fitted with pressure sensors and installed in the abdomen of the dummy. It is able to detect direct loads that are applied to the abdomen and estimate their intensity from the pressure.

The APTS have shown their value during laboratory tests and crash reconstructions during the CHILD and CASPER projects. Recent developments have included improved sensors, and a patent application has been filed. This system is arousing much interest and may eventually be used for regulatory purposes or in consumer tests such as EuroNCAP. Possible developments under consideration include use in adult dummies or for other transport modes.
Rail VOCO track simulation software

Rail operators and rolling stock manufacturers have asked IFSTTAR to solve some mechanical problems which may present dangers for track-guided transport systems such as instability, derailment, overturning, vibrational discomfort and rail fatigue caused by axle passages.

The Institute possesses a set of software packages that are very appropriate for this type of work, VOCO (Cars on a bend). This has been developed since 1987 using effective formalisms developed by IFSTTAR researchers. Its principle field of application is, of course, rail transport, but it can be extended to any track-guided system. In order to satisfy the new requests, the theoretical aspects of a multibody approach have been consolidated by the use of a test bench and comparisons with industrial tests, different formalisms, which are effective and novel, have been developed by the researchers such as the transformed curve or the wheel-rail contact patch under semi-hertzian conditions. Naturally, the main criteria remain robustness and computing speed, achieved by concentrating on detailed nonlinear modelling of key points. The most recent version includes a flexible nonlinear cyclical multibody track that was developed as part of the FCE MER project. The INRETS–LCPC merger gave the GRETTIA Modelling and Simulation group the opportunity to set up new synergies in the context of this research project. VOCO is a registered trademark owned by IFSTTAR. The software is currently distributed by the RATP. The creation of the Railénium IRT will also provide an opportunity for enhancing cooperation with the UTC and industry.

Version 2 of IREVE Exploiting road images

In 2011 IFSTTAR certified version 2 of IREVE(1), which is a software platform for exploiting the images collected by the mlpc® IRCAN 2 device.

The IREVE road imaging platform is a modular software package for both operational and research applications. It is able to collect information and make measurements that improve our knowledge of the road stock (additions to the ISIMAGE databank held by the SETRA) and help improve road safety (the “road shoulder obstacle” index). The images of a route are plotted on a curvilinear abscissa and georeferenced. They can then be assembled and synchronized, which provides a way of dealing with interchanges, two-way roads and navigation fixes. The working environment can be configured at will to facilitate the addition of any type of object to the road environment (signing, equipment, ancillaries). The modular nature of the software platform means that it can receive tools developed during research, for example for automated data input (automatic detection and recognition of road signs and markings) and measurements using 3D stereovision. IREVE is being developed by the Angers CECP in partnership with the LRPCs in Strasbourg (IFSTTAR ERA No. 27), Bordeaux, Angers and Rouen in addition to the SETRA. It has been available from the Angers CECP and VECTRA since 2007.

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valerie.muzet@developpement-durable.gouv.fr
CE marking of construction products

IFSTTAR is authorized by the French authorities (No. 1165) to issue CE markings for several categories of construction products (aggregates, drop-on materials, retroreflective road studs and rockfall protection kits).

Thanks to the Nantes certification unit and the expertise of the staff in the CETE network in the area of civil engineering, the Institute has put in place a rigorous and responsive structure that has been recognized by COFRAC since April 2006 after an annual audit of the type specified in the standard NF EN 45011. To date, it has issued 113 CE aggregate certificates for 241 quarries, 4 certificates for drop-on materials and 1 certificate for the studs and kits mentioned above. These certificates may be consulted at the site www.ifsttar.fr.

However, 2011 is marked by the sad loss of Patrick Gentilini. As a manager in the aggregate sector, he gathered around him the technical auditors in the CETE network, forged very strong ties with the certification unit, extended activities throughout France, became a highly valued technical point of contact for the aggregate profession (UNICEM) and obtained the congratulations of COFRAC.

All the persons at the MEDDTL who had dealings with Patrick Gentilini valued his professionalism and will have fond memories of a reserved but very pleasant colleague.

CONTACT
florence.perrault@ifsttar.fr

Certifications for concrete

IFSTTAR conducts voluntary certification activities either on its own initiative or for certification bodies which use it as a subcontractor to perform audits and tests on civil engineering products (steel, cement, aggregate, road equipment, etc.).

The CPDM (Physico-Chemical Behaviour of Materials) Group carries out certification activities within the Institute for “Admixtures for concrete, mortar and grout - Curing products” (the mark NF 085, under the aegis of AFNOR, the certifying body and CERIB, the authorized body).

In this capacity, it performs, with COFRAC accreditation, chemical tests (conventional dry extract, infrared analysis, ash content and flow time for curing products). Its other tasks include managing, in its role as sector leader, the network of CETE laboratories (Nancy, Aix-en-Provence and Lyon for chemical tests, and Le Bourget and Lille for physical tests). Last, it sends the client reports and summaries of all the tests performed by IFSTTAR and the CETEs and issues a “statement of compliance” to standards or certification requirements.
Infrared spectrometer for characterizing additives and curing products.

In 2011, the group conducted chemical tests on 387 additives and 11 curing products and physical tests on 39 additives and 2 curing products. In addition, it organized and analyzed the results of the intra- and inter-laboratory tests for COFRAC in order to determine the measurement uncertainties of the chemical tests.

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IFSTTAR helps open Line 1 on the Algiers metro line

Early November 2011 saw the opening of the first metro line in Algiers.

After two years of work supporting the rail certification agency CERTIFER, ESTAS approved the safety demonstration documents for the Siemens France automatic driver system. This is the second heavy metro system to be built in Africa and ESTAS had already carried out the expert appraisal for the first, in Cairo, in the 1990s.

On the Algiers line, CBTC (Control Based Train Communication) devices automatically control train driving, compliance with speed limits, headways and stopping points, with the human driver only operating the doors and giving the authorization to leave the station. The principle is for the automatic devices on the train to transmit the exact position of the train to the automatic devices on the ground on a continuous basis. The equipment on the ground determines the stops the train must make to guarantee safety and transmits them to each train. The individual trains then optimize their speed in order to ensure safe movements and compliance with operating goals. The technology uses massive coding of data and implements safety-critical software developed and tested using formal methods (method B).

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Line 1 of the Algiers metro.
Publishing helps the Institute disseminate knowledge, apply research and capitalize on scientific results. Its varied publications allow IFSTTAR to increase awareness about all its areas of research and expertise.

The different series of publications produced by INRETS and LCPC are intended for scientific communities, firms, universities, and, more broadly, civil society both in France and abroad. IFSTTAR will begin to issue new series of publications in 2012.

IFSTTAR’s catalogue of publications that are available on request (or on the website) gained 27 new documents and 4 scientific journals in 2011. The turnover generated by publications amounted to about €81,000, a third of which was from abroad. The publications in the different series can be purchased from the book shop at the entrance of 58 Boulevard Lefebvre, 75015 Paris, which is open from 9am to 12am and from 2pm to 4pm. They can also be ordered by e-mail from: diffusion-publications@ifsttar.fr

PUBLICATIONS IN 2011 BY SERIES

- 4 publications in the series “Guides techniques” (a).
- 9 publications in the series “Méthodes d’essai” (b).
- 7 publications in the series “ERLPC”.
- 2 publications in the series “Actes des journées scientifiques du LCPC” (c).
- 2 publications in the series “Actes de l’Inrets” (d).
- 2 publications in the series “Recherches de l’Inrets” (e).
- 1 publication in the series “Synthèses de l’Inrets” (f).
- 3 issues of the journal “RTS” published jointly with the Springer Group (g).
- 1 issue of the journal “Bulletin des Laboratoires des Ponts et Chaussées” (BLPC) (h).

PUBLICATIONS IN 2011

New scientific newsheets can be consulted free of charge at: http://www.ifsttar.fr/ressources/editions-scientifiques
APPENDICES

Presentation of the GERI .......................... 92
List of courses taught: academic year 2010/2011 .......................... 93
Composition of the Board of Directors and the Scientific Commission .......................... 97

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Location of sites and research structures .......................... 99
Acronyms .......................... 100
# Financial Resources and Expenditures (Excluding Depreciation)

## Revenue

<table>
<thead>
<tr>
<th>Description</th>
<th>Euros</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Ecology, Sustainable Development, Transport and housing</td>
<td>88,919,665</td>
<td>82.7%</td>
</tr>
<tr>
<td>Subsidy for public service provision</td>
<td>88,919,665</td>
<td></td>
</tr>
<tr>
<td>Ministry of Higher Education and Research</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Post-docs Research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finalized contracts and support allocated to research activities</td>
<td>13,011,613</td>
<td>12.1%</td>
</tr>
<tr>
<td>Research contracts with public or private sector third parties</td>
<td>4,151,152</td>
<td></td>
</tr>
<tr>
<td>Subsidies for research projects or programmes</td>
<td>8,860,461</td>
<td></td>
</tr>
<tr>
<td>Sums generated from research activity and service provision</td>
<td>4,322,771</td>
<td>4%</td>
</tr>
<tr>
<td>Fees for patents and licenses</td>
<td>332,856</td>
<td></td>
</tr>
<tr>
<td>Service provision</td>
<td>3,866,729</td>
<td></td>
</tr>
<tr>
<td>Sales of products</td>
<td>123,186</td>
<td></td>
</tr>
<tr>
<td>Other subsidies and revenue</td>
<td>1,297,983</td>
<td>1.2%</td>
</tr>
<tr>
<td>Other subsidies</td>
<td>787,487</td>
<td></td>
</tr>
<tr>
<td>Financial revenue and other earnings from ordinary operations</td>
<td>371,005</td>
<td></td>
</tr>
<tr>
<td>Exceptional earnings</td>
<td>138,612</td>
<td></td>
</tr>
<tr>
<td>Financial transactions - fixed assets</td>
<td>879</td>
<td></td>
</tr>
<tr>
<td>Total revenue</td>
<td>107,552,033</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

## Total Resources

<table>
<thead>
<tr>
<th>Description</th>
<th>Euros</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>107,552,033</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

## Expenditure

### Breakdown of Authorized Expenditure by Type

<table>
<thead>
<tr>
<th>Description</th>
<th>Euros</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities performed by research entities</td>
<td>76,244,485</td>
<td>70.2%</td>
</tr>
<tr>
<td>Mobility, energy and the environment</td>
<td>10,909,094</td>
<td></td>
</tr>
<tr>
<td>Quality, safety and transport system optimization</td>
<td>16,430,051</td>
<td></td>
</tr>
<tr>
<td>Transport and health</td>
<td>8,466,133</td>
<td></td>
</tr>
<tr>
<td>Savings of energy and natural resources for infrastructure</td>
<td>15,073,427</td>
<td></td>
</tr>
<tr>
<td>Durability of infrastructure, hazards and nuisances</td>
<td>16,272,634</td>
<td></td>
</tr>
<tr>
<td>Infrastructure safety and efficiency</td>
<td>9,093,146</td>
<td></td>
</tr>
<tr>
<td>Joint actions</td>
<td>7,570,625</td>
<td>7%</td>
</tr>
<tr>
<td>Exceptional testing facilities</td>
<td>251,844</td>
<td></td>
</tr>
<tr>
<td>Research applications</td>
<td>903,695</td>
<td></td>
</tr>
<tr>
<td>International exchanges</td>
<td>1,418,939</td>
<td></td>
</tr>
<tr>
<td>Scientific and technical publications</td>
<td>3,180,470</td>
<td></td>
</tr>
<tr>
<td>Scientific partnerships</td>
<td>1,130,069</td>
<td></td>
</tr>
<tr>
<td>In-service training</td>
<td>685,608</td>
<td></td>
</tr>
<tr>
<td>Support functions</td>
<td>24,814,982</td>
<td>22.8%</td>
</tr>
<tr>
<td>Social actions</td>
<td>839,515</td>
<td></td>
</tr>
<tr>
<td>Shared computing facilities</td>
<td>5,203,964</td>
<td></td>
</tr>
<tr>
<td>Property-related: maintenance</td>
<td>1,314,391</td>
<td></td>
</tr>
<tr>
<td>Property-related: major works, acquisitions, new construction</td>
<td>179,161</td>
<td></td>
</tr>
<tr>
<td>Head office overheads</td>
<td>7,914,161</td>
<td></td>
</tr>
<tr>
<td>Research entity overheads</td>
<td>8,887,556</td>
<td></td>
</tr>
<tr>
<td>Financial transactions</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Other general expenditure</td>
<td>476,393</td>
<td></td>
</tr>
<tr>
<td>Total expenditure</td>
<td>108,630,092</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

## Total

<table>
<thead>
<tr>
<th>Description</th>
<th>Euros</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>108,630,092</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

### Breakdown of Authorized Expenditure by Type

<table>
<thead>
<tr>
<th>Description</th>
<th>Euros</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsidized expenditure on staff for public service provision</td>
<td>75,908,697</td>
<td>69.9%</td>
</tr>
<tr>
<td>Other expenditure on staff (on research contracts)</td>
<td>5,448,588</td>
<td>5%</td>
</tr>
<tr>
<td>Unscheduled operating expenditure and investments</td>
<td>26,830,306</td>
<td>24.7%</td>
</tr>
<tr>
<td>Scheduled investments</td>
<td>442,501</td>
<td>0.4%</td>
</tr>
<tr>
<td>Total expenditure</td>
<td>108,630,092</td>
<td>100.0%</td>
</tr>
</tbody>
</table>
HUMAN RESOURCES
AT 31 DECEMBER 2011

1,206
STAFF MEMBERS
(PERMANENT STAFF AND FIXED-TERM CONTRACTS)
I.E. 1,181 FULL-TIME EMPLOYEES

BREAKDOWN OF STAFF BY DOMAIN

- TECHNICAL
- ADMINISTRATIVE
- RESEARCHER

BREAKDOWN OF STAFF BY TYPE OF ACTIVITY

- RESEARCH / EXPERT APPRAISAL
- SUPPORT
- APPLICATION / INTERNATIONAL

BREAKDOWN OF STAFF BY GENDER AND AGE COHORT

- 465 women
- 741 men

AGES:
- 15-19 years
- 20-24 years
- 25-29 years
- 30-34 years
- 35-39 years
- 40-44 years
- 45-49 years
- 50-54 years
- 55-59 years
- 60-64 years
- 65-70 years

ANNUAL REPORT 2011
# LIST OF RESEARCH PROJECTS

## RESEARCH ORIENTATION W

<table>
<thead>
<tr>
<th>Project Code</th>
<th>Project Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPWS06003</td>
<td>OPTIMIRR: Road materials that consume less energy and fewer non-renewable natural resources</td>
</tr>
<tr>
<td>RPWS12011</td>
<td>POP: Post-Oil Pavement</td>
</tr>
<tr>
<td>RPWS12013</td>
<td>Biosourced materials for sustainable construction</td>
</tr>
<tr>
<td>RPWS19007</td>
<td>Cementitious materials and manufacturing processes for sustainable development</td>
</tr>
<tr>
<td>RPWS10008</td>
<td>MATEOPT: Materials and energy for optimizing civil engineering structures</td>
</tr>
<tr>
<td>RPWS10009</td>
<td>Impact of low temperature geothermal energy on soils, water tables and structures</td>
</tr>
<tr>
<td>RPWS11010</td>
<td>Geological sequestration of CO2</td>
</tr>
<tr>
<td>RPWS29005</td>
<td>AGREGA: Aggregates for transport infrastructure construction that have fewer environmental impacts</td>
</tr>
<tr>
<td>RPWS21012</td>
<td>APPIDD: Integrated experimental / numerical multilevel approach for sustainable development</td>
</tr>
<tr>
<td>RPWS30006</td>
<td>EPFEES: Evaluating and forecasting the environmental impacts of transportation infrastructure</td>
</tr>
</tbody>
</table>

## RESEARCH ORIENTATION S

<table>
<thead>
<tr>
<th>Project Code</th>
<th>Project Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPS050002</td>
<td>COMPOSI-GEC: Demonstrator for self-diagnosing composite urban footbridges</td>
</tr>
<tr>
<td>RPS012001</td>
<td>An alternative to nuclear techniques for measuring water content and density</td>
</tr>
<tr>
<td>RPS11002</td>
<td>PREVER: Risk prevention and evaluation, particularly for powered two wheelers</td>
</tr>
<tr>
<td>RPS230001</td>
<td>PLUNIRA: HDVs and infrastructure</td>
</tr>
<tr>
<td>RPS230001</td>
<td>PALM: Forecasts and warnings during inclement weather conditions</td>
</tr>
<tr>
<td>RPS21001</td>
<td>IZV: Impact of visual information on road user behaviours</td>
</tr>
<tr>
<td>RPS21003</td>
<td>ECO-Surf: Study of tyre-pavement contact to achieve optimal and sustainable road surfacing properties</td>
</tr>
<tr>
<td>RPS211001</td>
<td>SERRES: Solutions to ensure environmentally-friendly road operation</td>
</tr>
<tr>
<td>RPS310004</td>
<td>PLATF: Railbeds and track-guided transport systems</td>
</tr>
<tr>
<td>RPS310005</td>
<td>VIF: Track for railways and track-guided transportation</td>
</tr>
</tbody>
</table>

## RESEARCH ORIENTATION R

<table>
<thead>
<tr>
<th>Project Code</th>
<th>Project Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPR150004</td>
<td>Sustainable Infrastructure and structures</td>
</tr>
<tr>
<td>RPR150006</td>
<td>Reinforcement using composite materials and bonded assemblies</td>
</tr>
<tr>
<td>RPR151004</td>
<td>Risks of internal swelling reactions in structural concretes in strategic structures</td>
</tr>
<tr>
<td>RPR1512001</td>
<td>APOS: Testing for safe structures</td>
</tr>
<tr>
<td>RPR1512002</td>
<td>FISSURES: Contribution to the detection of defects by signal and image processing</td>
</tr>
<tr>
<td>RPR1512003</td>
<td>DEDIR: From the design to the sustainable maintenance of roads</td>
</tr>
<tr>
<td>RPR1512005</td>
<td>Increasing the lifecycle of structures</td>
</tr>
<tr>
<td>RPR1512006</td>
<td>Innovative approaches for improving the durability of structures</td>
</tr>
<tr>
<td>RPR250001</td>
<td>SER: Networked sediments: a deterministic approach and operational implications</td>
</tr>
<tr>
<td>RPR250002</td>
<td>PSUR: Soil conservation in urban and road environments</td>
</tr>
<tr>
<td>RPR250003</td>
<td>Natural Hazards – Limiting the risks of ground movements in urban areas or sensitive zones</td>
</tr>
<tr>
<td>RPR250005</td>
<td>Rockfalls and rockslides</td>
</tr>
<tr>
<td>RPR251001</td>
<td>Ageing and maintenance of drainage networks and facilities exposed to biophysico-chemical processes</td>
</tr>
<tr>
<td>RPR251002</td>
<td>Sustainable stormwater management</td>
</tr>
<tr>
<td>RPR251003</td>
<td>DOFEAS: Dikes and waterway facilities: erosion, scour and earthquakes</td>
</tr>
<tr>
<td>RPR251005</td>
<td>SIPRIEN: Instrumentation system for environmental risk prevention</td>
</tr>
<tr>
<td>RPR2511003</td>
<td>SÉISME: Forecasting and mitigating the effects of earthquakes</td>
</tr>
<tr>
<td>RPR2511004</td>
<td>Hydrological risk: Towards a comprehensive consideration of hydrological risk: characterization, surveillance and management</td>
</tr>
<tr>
<td>RPR2512004</td>
<td>PRECAS: Risk prevention and the collapse of underground cavities</td>
</tr>
<tr>
<td>RPR3511001</td>
<td>CCLEAR: Reducing the impact of climate on transport infrastructure</td>
</tr>
<tr>
<td>RPR3511002</td>
<td>SECHERESSE 2: Effect of drought on buildings and infrastructure</td>
</tr>
<tr>
<td>RPR4510006</td>
<td>PLUME: Predicting noise in urban areas, from the region to the city</td>
</tr>
</tbody>
</table>

## RESEARCH ORIENTATION U

<table>
<thead>
<tr>
<th>Project Code</th>
<th>Project Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>RP0051001</td>
<td>MOD-FAB: Modelling the manufacture of granular civil engineering materials</td>
</tr>
<tr>
<td>RP0051002</td>
<td>Contributions of modelling in the field of sustainable construction</td>
</tr>
</tbody>
</table>
**STIMULUS PROGRAMMES**

**RESEARCH ORIENTATION 1**

- **DEST - LTE**
  EEST (Energy, greenhouse effect and transport): Methodology for quantifying and appraising the greenhouse gas emissions and pollutants generated by the transport sector.

- **TRANSECO**
  Conducting a survey of current practice with regard to including natural habitats in the socioeconomic appraisal of transport schemes and beginning a process of reflection (theoretical and practical) on providing compensation for the environmental damage caused by such schemes.

- **PESIMES**
  Identifying the “sound equipment” used when investigating the perception of situations of exposure to multiple sources of road and rail noise, analyzing the value and limitations of experimental and survey methodologies for studying this situation and finally identifying needs for future scientific research to study perception in situations of exposure to multiple sources of road and rail noise.

- **Acceptability of innovative vehicles.**

- **LN Satory**
  POWERPAC: Converter for a power fuel cell in the event of a failure: designing a converter to connect two fuel cells electrically and permit degraded mode operation if one of the fuel cells fails.

- **Electric vehicles: regenerative and dynamic braking.**

**RESEARCH ORIENTATION 2**

- **LPC**
  Perception of the environment and operation at safety road-rail interactions: improving safety at road-rail interactions.

- **Specific cross-cutting scientific measures in the framework of the VERONESE programme.**
  The VERONESE programme is the outcome of a request from the DR in 2009 to respond to a recommendation from the Operational Committee of the Grenelle Environment Summit in its final report of July 2008 with regard, in particular, to “The central issue of optimizing the use of transport infrastructure...”. This 4-year programme will end in 2012.

- **ESTAS - LEOST**
  ERTMS “European Rail Traffic Management System”: analysis of the performance of the ERTMS communication subsystem and its impact on railway capacity.

- **ESTAS - GRETIIA - LESCOT**
  Living lab train: building a platform for technology and observing the use of on-board mobility assistance services.

- **ESTAS - GRETIIA**
  Optimizing energy consumption in the management of rail traffic: Developing methods for optimizing energy consumption that take account of both operating constraints and mechanical and energy constraints. The developed methods will then be tested and validated with simulators such as Open-Track.

- **ESTAS - LEOST - LTN**
  Ontology (or ontologies) for evaluating the operating safety of track-guided transport systems.

- **GRETIIA - LICIT - CETE Méditerranée**
  Evaluating the safety impacts of traffic management measures: proposing optimized measures for managing peri-urban motorway traffic based on an evaluation of the safety impacts of such measures.

- **GRETIIA - LVMT - DEST**
  Numerical modelling of urban dynamics: A survey of the current state of knowledge in the area of simulation platforms and models for studying the spatial form of present-day or future cities in relation to mobility issues.

- **LEOST - GRETIIA**
  Diag-Audio: considering the feasibility of a system for automatically detecting certain defects in rail components based on the “auditive monitoring” performed by train driving crews.

- **LEOST**
  Radio logicielle: The goal is to use an OPMET discrete event simulator to simulate cooperative or non-cooperative wireless communications networks taking account of the specific features of systems and applications. The targets are communication applications for road safety in collaboration with the LVMT unit (FLASA project), communications applications for railway maintenance and operation (the ANR-VTT project which is currently being set up) and telecommunications control-command applications such as EUROTRANSDIT.

- **LESCOT - LEPSIS - LVMT - LTE**
  Green driving: Green driving and the resources that are needed for its widest possible implementation. For this it is necessary to study behaviours and identify their characteristics as well as to understand how to help drivers save energy when driving.

- **LICIT**
  QUATTRO: French mirror project for a transnational Franco-Austrian collaborative project. The principal goal is to implement qualification procedures for traffic data and standard (metric) tools for the qualitative qualification of traffic information (in particular journey times, including multimodal aspects).

- **LPC - LVMT**
  Identifying the “sound equipment” used when investigating the perception of situations of exposure to multiple sources of road and rail noise.

- **LESCOT - LEPSIS - LVMT - LTE**
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- **LPC - LTE**
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IFSTTAR covers a very large number of disciplines and most of its research projects require a regular exchange of scientific knowledge. In order to be able to combine a variety of approaches (economic, psychological, technological, sociological...), it is therefore very much in the interest of researchers to group together formally to gain a broader view of the issues they are dealing with.

This explains why, at the end of 2011, the Scientific Directorate set up 19 IFSTTAR research and discussion groups (GERI) in which scientists from most of the institute’s research structures take part. Several of them also have members from outside the Institute, including industry, the public authorities and other research organizations. The GERIs provide a framework for multidisciplinary thought and discussion, as well as cross-perspectives and forward-looking studies.

Each GERI is led by one or more IFSTTAR scientists and deals with a specific research goal, a scientific tool, a particularly cross-cutting theme, or any other subject which would benefit from the involvement of players from several disciplines. Each GERI follows an annual programme of activities around its central theme which may involve seminars, national or international symposiums and the publication of a collective reference document, guides or papers, etc. The groups provide an excellent basis for the preparation of collaborations and projects, as well as the creation of reference groups which if necessary could provide a more comprehensive response to an issue concerning transport, planning or networks. In principle therefore, a GERI is a short-lived incubation structure which can nevertheless last for a number of years, depending on its scientific goals and development.

Coordination and management of the GERIs is conducted by Philippe Dupuy, Hélène Fontaine and Marie-Line Gallenne, under the IFSTTAR Scientific Directorate.

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<td>ACTOR</td>
<td>Social and functional acceptability of technical and organizational changes to transport systems</td>
<td>Farida Saad (GRETTIA)</td>
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<td>ANIMATIC</td>
<td>Collection and analysis of spatiotemporal data for studying travel practices and driving behaviours</td>
<td>Corinne Brusque (LESCOT), Latifa Oukhellou (GRETTIA), Nour-Eddin El Fauzi (LJCF)</td>
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<td>BDRSR</td>
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<td>Marie Berbione (LEOST), François Peyret (MACS), Didier Aubert (LEPSIS), Régine Siedowsky, Gérard Sommana, Mahdi Zargayouna (GRETTIA)</td>
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<td>Amaud Bonnard (DS), Patrice Chatellier (MACS)</td>
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<td>Local areas, spatial planning and the organization of transport networks and mobility</td>
<td>Alain l’Hostis (LVMT), Hélène Reigner (MA)</td>
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# List of Courses Taught

## Academic Year 2010/2011

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<td>VAN ELSLANDE Pierre</td>
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<td>VENTURA Anne</td>
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<td>VEIZIN Philippe</td>
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<td>VULUTRESCU Bodgan</td>
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<td>WAHL Martine</td>
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<td>WANG Xuguang</td>
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</table>

COMPOSITION OF THE BOARD OF DIRECTORS AND THE SCIENTIFIC BOARD

YEAR 2011

BOARD OF DIRECTORS

PRESIDENT
Hubert Du Mesnil, Réseau Ferré de France (RFF)

VICE-PRESIDENT
Laurent Tapadinhas, Ministry of Ecology, Sustainable Development, Transport and Housing

REPRESENTATIVES OF THE STATE

MINISTRY OF INFRASTRUCTURE
Régine Breher (appointed), Ministry of Ecology, Sustainable Development, Transport and Housing
Pierre Valla (substitute), Ministry of Ecology, Sustainable Development, Transport and Housing

MINISTRY OF TRANSPORT
Laurent Tapadinhas (appointed), Ministry of Ecology, Sustainable Development, Transport and Housing
Jean-Bernard Kovarik (substitute), Ministry of Ecology, Sustainable Development, Transport and Housing

MINISTRY OF THE ENVIRONMENT
Daniel Boulois (appointed), Ministry of Ecology, Sustainable Development, Transport and Housing
Thierry Hubert (substitute), Ministry of Ecology, Sustainable Development, Transport and Housing

MINISTRY OF RESEARCH
Maria Faury (appointed), Ministry of Higher Education and Research
William Sassi (substitute), Ministry of Higher Education and Research

MINISTRY OF HIGHER EDUCATION
Alain Bernard (appointed), Ministry of Higher Education and Research

MINISTRY OF THE BUDGET
Marine Camiade (appointed), Ministry of the Budget, Public accounts, the Civil Service, and Reform of the State

MINISTRY OF INDUSTRY
Michel Ferrandry (appointed), Ministry of the Economy, Industry and Employment
Catherine Bellancourt (substitute), Ministry of the Economy, Industry and Employment

MINISTRY OF HEALTH
Emmanuel Briand (appointee), Ministry of Health, Youth, Sport and Community Life
Corinne Drougard (substitute), Ministry of Health, Youth, Sport and Community Life

MINISTRY OF THE INTERIOR
Anne Lebrun (appointee), Ministry of the Interior, Overseas Territories and Local Authorities
Fabrice Dingreville (substitute), Ministry of the Interior, Overseas Territories and Local Authorities

MINISTRY OF DEFENCE
Thierry Bretheau (appointee), Ministry of Defence
Michel Sayegh (substitute), Ministry of Defence

QUALIFIED INDIVIDUALS
Dorothée Briaumont, Comité 21
Rémi Cunin, Egis
Patrick Diény, General Council of the Rhône Département
Geneviève Ferone, Veolia Environnement
Guy Le Bras, Gart
Brigitte Martin, IFP Energies nouvelles
Hubert Du Mesnil, Réseau Ferré de France (RFF)
Marie-Pierre Reynard, SNCF

STAFF REPRESENTATIVES

CFDT
Joël Lelong (appointee), Jean-Michel Mescam (substitute)

SUD RECHERCHE EPST-SOLIDAIRES
Christine Buisson (appointee), Daniel Olivier (substitute)

CGT
Paul Marsac (appointee), Nathalie Bourboite (substitute)

FORCE OUVRIÈRE
Marion Bost (appointee), Séverine Somma (substitute)

SCIENTIFIC BOARD

The Scientific Council was formed in 2011 and official appointments were made in 2012.

The members of IFSTTAR’s Scientific Council were appointed in January 2012.
LOCATION OF SITES AND RESEARCH UNITS

**BELFORT**
Bâtiment F
Rue Thierry Mieg
Belfort Technopôle
90010 Belfort
Tel.: +33 (0)3 84 58 36 00
Research units: LTn / FClab

**GRENOBLE**
Maison des Géosciences
1381, rue de la Piscine
38400 Saint-Martin d’Hères
Research unit: iSTerre

**LYON-BRON**
25, avenue François Mitterrand
Case 24
69675 Bron Cedex
Tel.: +33 (0)4 72 14 23 00
Research units: LbMC / LEsCoT / LiCiT / LTE / uMrEsTTE / unEx

**VERSAILLES-SATORY**
14, route de la Minière
Bâtiment 824
78000 Versailles
Tel.: +33 (0)1 40 43 29 01
Research units: LViC (IM)

**NOISY-LE-GRAND**
Bâtiment Le Descartes 2
2, rue de la Butte verte
93166 Noisy-le-Grand cedex
Tel.: +33 (0)1 45 92 55 00
Research units: DEST / GRETIA / SPLOTT

**VERSAILLES-SATORY**
25, allée des Marronniers
78000 Versailles
Tel.: +33 (0)1 30 84 40 00
Research units: LEMCO / LPC / LTn

**PARIS**
58, boulevard Lefebvre
75732 Paris Cedex 15
Tel.: +33 (0)1 40 43 50 00
Research units: IM, LEPsIS (IM) / MACS / SOA / GER / MAT

**VERSAILLES-SATORY**
19, rue Alfred Nobel
Cité Descartes
Marne-la-Vallée
77447 Champs-sur-Marne Cedex 2
Tel.: +33 (0)1 64 15 21 01
Research units: LiViC (IM)

**VERSAILLES-SATORY**
25, allée des Marronniers
78000 Versailles
Tel.: +33 (0)1 30 84 40 00
Research units: LEMCO / LPC / LTn

**MARSEILLE**
Faculté de médecine secteur Nord
Boulevard Pierre Dramard
13916 Marseille Cedex 20
Tel.: +33 (0)4 91 65 80 00
Research unit: LBA

**VERSAILLES-SATORY**
19, rue Alfred Nobel
Cité Descartes
Marne-la-Vallée
77447 Champs-sur-Marne Cedex 2
Tel.: +33 (0)1 64 15 21 01
Research units: LVMT / MA

**NANTES**
Route de Bouaye - CS4
44344 Bouguenais Cedex
Tel.: +33 (0)2 40 84 58 00
Research units: IM / MACS / SOA / GER / MAT
# ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADEME</td>
<td>Environment and Energy Management Agency</td>
</tr>
<tr>
<td>AERES</td>
<td>Agency for the Evaluation of Research and Higher Education</td>
</tr>
<tr>
<td>AIPCR</td>
<td>World Road Association</td>
</tr>
<tr>
<td>ALLEVI</td>
<td>National Research Alliance for the Environment</td>
</tr>
<tr>
<td>ANCER</td>
<td>National Alliance for Coordinating Energy Research</td>
</tr>
<tr>
<td>ANR</td>
<td>National Research Agency</td>
</tr>
<tr>
<td>ANRT</td>
<td>National Research and Technology Association</td>
</tr>
<tr>
<td>BRGM</td>
<td>Office of Geological and Mining Research</td>
</tr>
<tr>
<td>CCERDOT</td>
<td>Regional Consultative Committee on Geological Research and Development</td>
</tr>
<tr>
<td>CECP</td>
<td>Centre for the Study and Design of Prototypes</td>
</tr>
<tr>
<td>CEDR</td>
<td>Conference of European Directors of Roads</td>
</tr>
<tr>
<td>CENAGREF</td>
<td>National Centre for Farm Machinery, Agricultural Engineering, and Water and Forests</td>
</tr>
<tr>
<td>CER</td>
<td>Centre for Road Education</td>
</tr>
<tr>
<td>CERTIFER</td>
<td>Rail Certification Agency</td>
</tr>
<tr>
<td>CERTU</td>
<td>Centre for the study of networks, transport, urban planning and public buildings</td>
</tr>
<tr>
<td>CETE</td>
<td>Public Works Design and Research Office</td>
</tr>
<tr>
<td>CFTR</td>
<td>French Committee for Road Engineering Techniques</td>
</tr>
<tr>
<td>CUFRE</td>
<td>Industrial Agreements for Training through Research</td>
</tr>
<tr>
<td>CIRAD</td>
<td>Centre for International Co-operation in Agricultural Research for Development</td>
</tr>
<tr>
<td>CNES</td>
<td>National Centre for Space Research</td>
</tr>
<tr>
<td>COFRAC</td>
<td>French Accreditation Committee</td>
</tr>
<tr>
<td>CSTB</td>
<td>Scientific and Technical Centre for Building Structures</td>
</tr>
<tr>
<td>DGITM</td>
<td>General Directorate for Infrastructure, Transport and Maritime Affairs</td>
</tr>
<tr>
<td>DRI</td>
<td>Directorate for Research and Innovation</td>
</tr>
<tr>
<td>DSCR</td>
<td>Road Safety and Traffic Commission</td>
</tr>
<tr>
<td>ENPC</td>
<td>National Civil Engineering School</td>
</tr>
<tr>
<td>ENTPÉ</td>
<td>National School for State Public Works</td>
</tr>
<tr>
<td>EPIC</td>
<td>Public Institution of an Industrial and Commercial Nature</td>
</tr>
<tr>
<td>EPSF</td>
<td>Public Institution in charge of Rail Safety</td>
</tr>
<tr>
<td>EPST</td>
<td>Public Institution of a Scientific and Technical Nature</td>
</tr>
<tr>
<td>EQUIPEX</td>
<td>Facilities of Excellence in the Rhône Department</td>
</tr>
<tr>
<td>ERT</td>
<td>Transport Research Europe</td>
</tr>
<tr>
<td>ESPARR</td>
<td>Study to Monitor a Population of Road Crash Casualties in the Rhône Department</td>
</tr>
<tr>
<td>FOR</td>
<td>Forever Open Road</td>
</tr>
<tr>
<td>FPFW</td>
<td>Framework Programme for Research and Development in the 21st Century</td>
</tr>
<tr>
<td>GERI</td>
<td>ISTAR Research and Discussion Groups</td>
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<tr>
<td>GIS</td>
<td>Scientific consortium</td>
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<tr>
<td>HDR</td>
<td>Accreditation to Direct Research</td>
</tr>
<tr>
<td>IDRIM</td>
<td>Institute for Roads, Streets and Infrastructures for Mobility</td>
</tr>
<tr>
<td>IDEX</td>
<td>Initiatives of excellence</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institutes of Excellence on Zero Carbon Energy</td>
</tr>
<tr>
<td>IFSTAR</td>
<td>French Institute of Science and Technology for Transport, Development and Networks</td>
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<tr>
<td>IGN</td>
<td>National Institute for Information on Geography and Forests in the Rhône Department</td>
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<tr>
<td>INERIS</td>
<td>National Institute for the Industrial Environment and Risks</td>
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<tr>
<td>INRA</td>
<td>National Institute for Agricultural Research</td>
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<tr>
<td>INRETS</td>
<td>National Institute for Transport and Safety Research</td>
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<tr>
<td>IRSN</td>
<td>Institute for Radiological Protection and Nuclear Safety</td>
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<tr>
<td>IRSVT</td>
<td>Urban Scientific and Technical Research Institute</td>
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<tr>
<td>IRT</td>
<td>Technological Research Institute of the Rhône-Alpes Region</td>
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<tr>
<td>IFR</td>
<td>International Transport Forum</td>
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<tr>
<td>ITS</td>
<td>Intelligent Transportation Systems</td>
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<tr>
<td>JTRC</td>
<td>Joint Transport Research Centre</td>
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<tr>
<td>LABEX</td>
<td>Laboratories of Excellence</td>
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<tr>
<td>LCP</td>
<td>Central Public Works Laboratory</td>
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<tr>
<td>LGV</td>
<td>High-Speed Line</td>
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<tr>
<td>LIEMET</td>
<td>INRETS Road Equipment Testing Laboratory</td>
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<tr>
<td>LNE</td>
<td>National Metrology and Testing Laboratory</td>
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<tr>
<td>LRPC</td>
<td>Regional Public Works Laboratory</td>
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<tr>
<td>LUTB</td>
<td>Lyon Urban Truck &amp; Bus Competitiveness Cluster</td>
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<tr>
<td>MEDDTL</td>
<td>Ministry of Ecology, Sustainable Development, Transport and Housing</td>
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<tr>
<td>MESR</td>
<td>Ministry of Higher Education and Research</td>
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<tr>
<td>OECD</td>
<td>Organization for Economic Cooperation and Development</td>
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<tr>
<td>PACA</td>
<td>French region comprising Provence, the Alps and the Riviera Coast</td>
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<tr>
<td>PIA</td>
<td>Future Investments Programme</td>
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<td>PREDIG</td>
<td>Research and Development Programme for Technological Innovation in Land Transport</td>
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<tr>
<td>PRES</td>
<td>Research and Academic Cluster</td>
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<tr>
<td>PST</td>
<td>Scientific and Technological Centre</td>
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<tr>
<td>PTW</td>
<td>Powered Two-Wheeler</td>
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<tr>
<td>RATP</td>
<td>Paris Municipal Public Transit Authority</td>
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<tr>
<td>RFF</td>
<td>France’s railway network operator</td>
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<td>RNE</td>
<td>National List of Establishments</td>
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<td>RST</td>
<td>French Ministry of Infrastructure Scientific and Technical Network</td>
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<td>SATT</td>
<td>Technology Transfer Acceleration Companies</td>
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<td>SCSP</td>
<td>Subsidy for Public Service Provision</td>
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<td>SETRA</td>
<td>Technical Department for Transport, Road and Bridge Engineering and Road Safety</td>
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<td>SNCF</td>
<td>French National Railway Company</td>
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<td>SNND</td>
<td>National Strategy for Sustainable Development</td>
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<tr>
<td>SNHRI</td>
<td>National Strategy for Research and Innovation</td>
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<tr>
<td>SOERE</td>
<td>Observation and Experimental System for Environmental Research</td>
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<tr>
<td>SPI</td>
<td>Engineering Sciences</td>
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<tr>
<td>SPPIGA</td>
<td>Engineering Sciences, Earth Sciences and Architecture</td>
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<tr>
<td>STAC</td>
<td>French Civil Aviation Technical Centre</td>
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<tr>
<td>STIM</td>
<td>Information Science and Technology and Mathematics</td>
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<td>TRA</td>
<td>Transport Research Association</td>
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<td>TRB</td>
<td>Transportation Research Board</td>
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<tr>
<td>UFR</td>
<td>Training and Research Unit</td>
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<tr>
<td>UMR</td>
<td>Jointly Managed Research Unit</td>
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<tr>
<td>UN</td>
<td>United Nations</td>
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<tr>
<td>UPE-MLV</td>
<td>Paris-Est Marne-la-Vallée University</td>
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<tr>
<td>URT</td>
<td>Research Unit</td>
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<td>WHO</td>
<td>World Health Organization</td>
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# ABBREVIATIONS OF IFSTTAR RESEARCH STRUCTURES

<table>
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<tr>
<th>Acronym</th>
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<tbody>
<tr>
<td>DEST</td>
<td>Transport Economics and Sociology</td>
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<tr>
<td>ESTAS</td>
<td>Evaluation of Automated Transport Systems and their Safety</td>
</tr>
<tr>
<td>GER</td>
<td>Geotechnical Engineering, Environment and Risks Department</td>
</tr>
<tr>
<td>GRETTIA</td>
<td>Engineering of Surface Transport Networks and Advanced Computing</td>
</tr>
<tr>
<td>IM</td>
<td>Infrastructures and Mobility Department</td>
</tr>
<tr>
<td>LBA</td>
<td>Laboratory of Biomechanics and Applications</td>
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<tr>
<td>LBM</td>
<td>Biomechanics and Impact Mechanics Laboratory</td>
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<tr>
<td>LEMCO</td>
<td>Laboratory of Cooperative Mobility Measurement</td>
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<tr>
<td>LEGST</td>
<td>Laboratory on Electronics, Waves and Signal Processing for Transport</td>
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<tr>
<td>LEPSSIS</td>
<td>Laboratory for Road Operations, Perception, Simulators and Simulations</td>
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<tr>
<td>LESCAST</td>
<td>Laboratory Ergonomics and Cognitive Sciences applied to Transport</td>
</tr>
<tr>
<td>LICIT</td>
<td>Transport and Traffic Engineering Laboratory</td>
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<tr>
<td>LIVIC</td>
<td>Laboratory for Vehicle-Infrastructure-Driver Interaction</td>
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<tr>
<td>LPC</td>
<td>Laboratory of Driver Psychology</td>
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<tr>
<td>LTE</td>
<td>Transport and Environment Laboratory</td>
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<tr>
<td>LTN</td>
<td>New Technologies Laboratory</td>
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<tr>
<td>LVMT</td>
<td>City, Mobility and Transport Laboratory</td>
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<td>MA</td>
<td>Research Unit of Accident Mechanism Analysis</td>
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<td>MACS</td>
<td>Monitoring, Assessment, Computational Sciences Department</td>
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<tr>
<td>MAT</td>
<td>Materials Department</td>
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<tr>
<td>SOA</td>
<td>Bridges and Structures Department</td>
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<tr>
<td>SPLLTD</td>
<td>Production Systems, Logistics, Transport Organisation and Work - Freight Unit</td>
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<tr>
<td>UMRESSTE</td>
<td>Epidemiological Research and Surveillance Unit in Transport Occupation and Environment</td>
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<td>UNEX</td>
<td>Experimental Testing Unit</td>
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