INRETS and LCPC officially merged on January 1st, 2011 in order to create **IFSTTAR, FRENCH INSTITUTE OF SCIENCE AND TECHNOLOGY FOR TRANSPORT, DEVELOPMENT AND NETWORKS**. Single document combining the activities of both institutions, LCPC and INRETS, even though they were still separate during 2010, to ensure continuity and report on a year spent preparing for this merger.
On the editorial page of a document, the text discusses the strategic focus of an organization, highlighting its pursuit of sustainable development priorities and the importance of building partnerships. The page also mentions the reorganization of research units, membership in an institute, and the promotion of international partnerships. Financial and scientific achievements are noted, including a 8% growth in own resources and a 35% increase in the number of articles published in top-rated international journals.

The editorial concludes by celebrating the successful restructuring and operational readiness of a new entity, emphasizing the challenges ahead in building international reputation.

In addition to the editorial content, the page includes site locations for INRETS and LCPC, with a focus on Lille-Villeneuve d’Ascq, Lyon-Bron, Marne-la-Vallée, Marseille-Salon-de-Provence, Belfort, Versailles-Satory, Grenoble, Marne-la-Vallée, Nantes-Bouguenais, Paris, and Versailles-Satory.
As the last year of the INRETS’ short 25-year existence, 2010 was the most brilliant on record. While 2009 had already been a breakthrough year, 2010 raised the bar even higher, with: a budget surplus by year’s end, and this despite deteriorating economic conditions; all-time highs in the number of scientific publications, research contract-generated revenue and patent filings; subsidiaries enjoying excellent health; and an outstanding recruiting campaign aimed at young researchers.

While a good deal of energy during 2010 had been channelled into preparing the merger with LCPC, a fruitful effort during which trust and poise ultimately prevailed over the Institute’s natural apprehension, just as much effort went into submitting bids to the “Future Investment Programme”. The outcome of these initiatives, though not yet known with precision and bound to improve even further, attests to the strength of both INRETS’ territorial orientation and the academic and industrial partnerships it has built with research/university clusters and the competitiveness clusters in Lille, Marne-la-Vallée, Versailles-Satory, Lyon and Marseille. With INRETS and LCPC now speaking in unison within these partnerships, the value of Institute input has undeniably been enhanced.

At a time when Europe, through its 8th R&D Framework Programme, has opted to promote “smart, green and integrated transport” from among this century’s 7 major societal challenges, it is abundantly clear that IFSTTAR provides French public-sector research with a very powerful tool, heretofore missing on the international stage. Over the course of INRETS’ years of activity, construction of the European research space for the transport field will have served as a guiding light for the Institute. No doubt IFSTTAR will capitalize on this base of knowledge and experience that has been developed with such amazing foresight.
It’s with the slogan “Better Policies for a Better Life” that the OECD takes its stance. Founded in 1961, this international organisation assists governments in responding to economic, social and governance challenges. The numerous and diverse topics treated range from agriculture, fishing and demographics to innovation and sustainable development.

So where does transport fit in?

Jack Short: Since 2006, all questions relative to the transport topic have been addressed within a single body, the International Transport Forum. Existing units within the OECD organisational structure were combined to give rise to this cohesive, multimodal, global and strategic entity devoted to transport issues. As such, the Forum has adopted the same rationale that led INRETS and LCPC to merge and generate synergy from their respective skills. Our Forum, which assembles leading government representatives and public sector practitioners alongside the business and industrial communities, researchers and members of civil society, hosts discussions on transport-related topics of world-wide strategic importance. All perspectives are encouraged and given voice. Approaches can be compared, yet beyond a simple melting pot of ideas, a venue for exchanging guidelines and a strategic / technological observatory, our sessions are oriented around implementing practical steps.

The Forum studies transport systems and delivers opinions intended to help governments improve their policies. As for road safety, OECD was the first body to propose limiting speeds and controlling blood-alcohol levels. At the time, many countries still refused to adopt these measures, prior to their gradual enactment and now widespread acceptance as standards.

How have LCPC and INRETS contributed to facing these challenges?

J.S.: For a very long time, some 30 to 40 years, OECD and presently the Forum have enjoyed solid ties with both LCPC and INRETS. A tremendous amount of work has been produced jointly, particularly on pavement surfacing, a topic where LCPC has few rivals in the world. Other topics include climate change, road safety and vulnerable members of society (e.g. pedestrians, bicyclists, motorcyclists, the mobility-impaired). I’d also like to mention a recent report on the lorry of the future that sparked controversy for raising some sensitive issues. The Forum does not shy away from controversy. There was also the report on “powerfuel”, which at one point was being presented as a cure-all. Moreover, LCPC and INRETS are well represented on Forum executive committees and working groups, with a record of active participation in decisions involving research policy priorities. The pivotal contributions of these two institutions have strengthened France’s position as a transport expert on the international scene. In exchange, French expertise has been enriched thanks to the fruitful dialogue held between our organisations, at least I hope so. Such dialogue is crucial, especially during periods of economic crisis when solutions must be derived collectively. Transport turns out to be a highly sensitive indicator of fluctuations in the state of economic health. For example, if a GNP figure declines by 3%, it is observed that the retail sector loses 10% while transport plummets by 20%.

What impressions will you keep from the year 2010?

J.S.: Without a doubt, the major breakthrough lies in highlighting areas of vulnerability within the transport sector during crisis situations, whether economic or climatic. With economic pitfalls, ensuring transport flexibility obviously becomes a major strategic planning concern. The inclement weather experienced at the beginning of 2010, coupled with eruption of the Icelandic volcano, further exposed a critical shortcoming, namely the lack of communication with users and absence of intermodal information. Uncertainty must also be brought under control.
PIARC, THE WORLD ROAD ASSOCIATION, IS LIKE AN SENIOR CITIZEN WHO ENJOYS REMAINING VERY ACTIVE.

Anne-Marie Leclerc: The association celebrated its 100th anniversary in 2007, in Paris where it was founded, and now comprises over 118 member countries. PIARC holds a special place in the world for its focus on mobility issues from a broad perspective, an approach that involves considerable reflection on societal trends. The notion of mobility is tied to the provision of a basic public service that nations must guarantee to their populations in a form that’s adequate, adapted to their needs and safe.

In this context, I’m well aware of our responsibility given the high expectations on the part of road and transportation professionals. PIARC has become the premier international forum for exchanging information and knowledge covering this entire field, for industry, decision-makers and governments.

BEYOND THE CONTRIBUTIONS OF THE FORMER INRETS AND LCPC ENTITIES, WHAT WILL BE IFSTTAR’S SPECIFIC ROLE AS REGARDS PIARC?

A.-M. L.: We must avoid tying ourselves to working traditions established in the past. Mobility is a long-term field of study, projecting us 20 or even 30 years into the future, therefore requiring an increasingly global approach. The keyword to any such approach is de-compartmentalise, to engage specialists across disciplines in promoting dialogue and in seeking solutions that could not have been anticipated just a few years ago. And I’m thrilled to share this challenge with INRETS, LCPC and now Ifsttar. France’s contribution and that of its national PIARC committee, as guided by several LCPC members, is key for the Association. Especially dynamic, LCPC and INRETS are devoted, much like us, to expanding horizons and stimulating discussion on various transport-related objectives and issues.

To illustrate the challenges at hand, let’s look at the advent of new propulsion sources, including electricity, which will reshape the debate over individual mobility vs. collective mobility. It goes without saying that greenhouse gas emissions will decrease, but does this environmental benefit provide positive effects on mobility per se, on urban congestion? In the strategic plan we’ve adopted, our goal is to derive new approaches for dealing with the mobility of people and goods. We’ve also redrawn PIARC’s scope of intervention, by extending the Association’s geographic coverage. As part of a drive to expand our group, we’d like to invite more partners to contribute to the forums and exchanges sponsored.

“ESPECIALLY DYNAMIC, LCPC AND INRETS ARE DEVOTED, MUCH LIKE US, TO EXPANDING HORIZONS AND STIMULATING DISCUSSION ON VARIOUS TRANSPORT-RELATED OBJECTIVES AND ISSUES.”
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CLOSE-UP OF THE TWO INSTITUTES
MISSIONS, STRATEGY, ORIENTATION

ACCORDING TO ITS 2010-2013 OBJECTIVES-BASED CONTRACT, INRETS HAS EMBARKED ON AN AMBITIOUS PATH, FOCUSING SQUARELY ON CHANGES IN THE PROVISION OF SAFE AND SUSTAINABLE MOBILITY SERVICES.

THE 2010-2013 OBJECTIVE
Submitted for Ministerial signature during summer 2010, the 2010-2013 objectives-based contract was the outcome of extensive exchanges held as of 2009 by an assembly of 120 individuals, of whom 30 were named from outside organisations, divided into 6 thematic groups. An initial list of scientific or cross-disciplinary topics was refined and revised during the substantive discussions held. A set of shared strategic orientations covering a 10-year time frame was ultimately produced; these orientations included green mobility, transport optimisation, road safety, application strategies and governance.

Segmented into fields and action plans, this contract stipulated 28 objectives, all of which complied with the commitments adopted during the Grenelle Environment Roundtable. It also distinguished ongoing research from new projects and posted a number of performance indicators so as to offer partners (Ministries, companies, service operators) a real-time and comprehensive view of deliverable recipients and contents made available during contract execution.

Generally speaking, this document stresses interdisciplinary collaboration and follows the recommendations forwarded by AERES. The draft budget, established to both incorporate constraints imposed by the economic crisis and draw down the €1.25 million inadvertently earmarked for INRETS on its 2009 SCSP budget allocation, was adjusted to satisfy the most recent public finance guidelines stemming from the newly-adopted three-year finance law. The revised document therefore matches “the reference budget trajectory”, as required by the latest instructions issued to State transport operators (Prime Minister’s circular dated March 26th, 2010). In operational terms, a “control chart” was implemented to regularly summarise the trends in all major service management indicators.

A FORWARD-LOOKING PROGRAMME SEGMENTED BY THE INSTITUTE’S VARIOUS SITES

- Lille-Villeneuve d’Ascq: RAILLENIUM (TRI), ICON (Labex), SATT (part of the University of Lille-Northern France academic-research cluster).
- Lyon-Bron / Saint-Etienne: Transport research centre (contained within Idex-Lyon); PLIBAT (Equipes); Engineering of living tissue evolution (Equipes);
- Marne-la-Vallée: Sustainable cities (IEED), Urban futures (Labex), CLAIRE-SITI (Equipes); Centre Belgrand (Equipes).
- Marseille-Salon de Provence: Research, education and technology transfer platform devoted to the virtual human (INBS); SATT PACA-Corse sponsored by the six regional universities.
- Versailles-Satory: VeDeCom (IEED), Reliability Institute (Labex), VERTEX (Equipes), SIMU5G (Equipes), FiMecaSys (Equipes).

Note: Projects written in bold featured INRETS as project leader.

FUTURE CAPITAL INVESTMENT PLANS
Preparing bids in response to calls for tender within the scope of the “Investissements d’Avenir” capital investment programme mobilised many teams throughout 2010. Across all its sites, INRETS was requested to join consortia as either leader or partner in most categories presented. The upbeat spirit of partnerships the Institute has been able to forge was readily apparent, as was its strong credentials relative to these transport topics.
THE 2010-2013 OBJECTIVES-BASED CONTRACT

This contract represents the accomplishment of two successive initiatives covering different time periods. The first, conducted in 2009 with the participation of all units in addition to fruitful exchanges with partners, was intended to establish a 10-year road map, as a means of stretching the planning horizon far enough to see through the impacts of current short-term action plans. On this basis, the draft four-year financing contract could be written after considerable attention to the needs expressed by oversight ministries and other partners. Signed by five Ministers or Cabinet-level Secretaries, this contract tasked LCPC with 38 objectives, each of which had been matched with several indicators in order to track progress. Research, which accounts for 70% of the organisation’s activity, is heavily oriented towards achieving Grenelle Environment Roundtable priorities, especially as regards energy savings and natural resource conservation, as well as management of natural risks, including climate change-related risks, green building and the development of non-road transport modes. Other objectives include activities tied to the application of results: expert appraisals, instruction, support provided to public authorities, and certification. Moreover, several systems are listed in the contract specific to management functions and support-related efforts.

FUTURE CAPITAL INVESTMENT PLANS

With a strategy emphasising sustainable development topics and promoting the application of research findings in favour of economic actors, LCPC submitted bids beginning in 2010 on several calls for tender within the scope of the “Future Investments” (PIA) projects. These proposals were accompanied by high-level scientific partners, as part of consortia composed around cluster facilities accommodating research and university-level academics.

FOUR AWARD-WINNING PROJECTS

Four projects reviewed during bidding for the categories of facility excellence (Equipex), laboratory excellence (Labex) and technology research institutes (TRI) were announced as winners at the beginning of 2011:

- Equipex Sense-City presented by the University of Paris-East (UPE) academic research cluster, supervised by LCPC.
- Labex Urban Futures (“Futurs Urbains”), also presented by the UPE cluster.
- TRI “Railenium”, presented by the University of Lille-Northern France cluster, with both LCPC and INRETS among the project partners.
- TRI “Jules Verne”, presented by the University of Nantes-Angers-Le Mans cluster.

PREPARATION OF THE LCPC-INRETS MERGER

The Ministry of Ecology, Sustainable Development, Transport and Housing sought to merge LCPC and INRETS in order to closely coordinate research conducted in their two closely-related fields and thereby take advantage of a broader and more varied potential in generating scientific approaches. 2010 was devoted to laying the foundation for a new institution, with emphasis on the provision of support services to facilitate organisational operations. Following the lengthy administrative path to implementing this sort of transformation plus coordination difficulties introduced due to multiple sites for both parties, the official decree announcing the creation of Ifsttar was promulgated on December 30th, 2010 to take effect on January 1st, 2011.
2010

KEY DATES
January 19th: Creation of Idrrim.

February: Roads Plenary Session, held in Nantes.

March 17th: Visit by the American Deputy Secretary of Transportation, John Porcari.

April 21st: 1st project meeting for construction of the future Bienvenue building site in Marne-la-Vallée.

May 4th-6th: PRAC 2010 Seminar on Risk prevention and Driving assistance systems, plus Closing Seminar for the SARI Project, organised jointly by LCPC and INRETS.

June 17th and 18th: Structural Engineering Plenary Session held in Lille.

July 7th-9th: UCIT organised, on behalf of the AHB45 Committee (Traffic Flow Theory and Characteristics) of the American Transportation Research Board, its second summer session and the associated conference, held in Annecy, assembling 63 participants representing 13 countries, around an agenda featuring 38 presentations.

September 16th: Inauguration of the rockfall testing station.

October 8th: Signature of the 2010-2013 objectives-based contract between LCPC and the French government.

October 18th: Franco-Indian seminar showcasing LCPC, IRSTV and CISTUP, hosted by Gérard Hégron.

October 18th-24th: 1,000 researchers at Paris' Panthéon, a photography exhibition laid out by the artist Pierre Maraval, involving the participation of more than 30 INRETS and LCPC researchers.

November 26th: Joint INRETS-LCPC stand for the CIFRE Forum in Paris.

December 1st: Creation of GRETTIA from a merger of GRETIA and LTN-Marne. This new unit contributes to the development of engineering techniques specific to transport networks and systems, in addressing problems related to integration, intermodality, reliability and systems analysis. Its field of expertise includes roads and public transit with a focus on guided transport systems.
PARTNERSHIPS, JOINT VENTURES

IN AN EFFORT TO ENSURE THE CONSISTENT AND EFFECTIVE USE OF THEIR KNOWLEDGE, LCPC AND INRETS MAINTAIN CLOSE PARTNERHIPS WITH LEADING ACTORS IN THEIR RESPECTIVE FIELDS OF EXPERTISE.

Allenvi*: A long-term alliance devoted to critical sustainable development goals

For Allenvi (acronym of the National Alliance for Environment-based Research, officially launched on February 9th, 2010 by the Minister of Higher Education and Research), 2010 marked the beginning of what will certainly be a long and rich adventure. With its 12 founding members (including LCPC) and 15 associated members, this Alliance encompasses over 15,000 researchers, engineers and technicians in pursuit of a single objective: promoting a consistent and interdisciplinary approach to fulfilling the four major sustainable development challenges, namely Food Supply, Water Supply, Climate and Land Use Planning.

As of April 2010, Allenvi’s organisation featured 12 thematic working groups, 6 of which include participants from LCPC, on topics as diverse as water, climate, environmental assessment, risks, regional territories and natural resources, cities and mobility.

An initial seminar, held in July, provided a framework and road map for each group. The second seminar took place in December and focused on identifying the set of research priorities shaping the 2011-2012 schedule. Let’s note that these efforts made it possible, in March 2011, to issue the set of environmental research priorities proposed for the 2012 calendar of the ANR National Research Agency.

This Alliance also certified the first 13 networks of observation and experimentation systems for environmental research (designated by the “SOERE” label) in September and then in October published the SOERE 2011 call for tender.

The initial evaluation of activities undertaken by the young Alliance already points to fantastic successes and confirms the beginning of a long and fruitful scientific and human endeavour.

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INRETS urges ANCRE* to support more effective research in the energy field

Since 2010, INRETS has been overseeing work by the “Energy and Transport” working group (GP6) as part of the National Alliance for Energy Research Coordination (Ancre), which was created upon government request in July 2009. Ancre has extended partnerships beyond its founding members (CEA, CNRS and IFP) with French public sector research bodies concerned by energy-related problems. These partners include INRETS, which is involved in efforts to identify and ultimately overcome the main obstacles to solutions, be they scientific, technological, economic or societal. This mission involves, among other things, analysing the skills possessed by French research entities through establishing a detailed map and proposing specific programmes (from fundamental research to producing actual demonstration units) to resolve these issues.

In all, over 500 experts were invited to participate in the nine thematic groups, five of which were dedicated to energy sources (energies stemming from biomass (GP1), fossil fuels and geothermal sources (GP2), nuclear (GP3), solar (GP4), marine, hydraulic and wind (GP5)). Three other groups focused on end use (transport (GP6) supervised by INRETS, buildings (GP7) led by the CSTB Institute, and industries and agriculture (GP8) led by CNRS). The last group (GP9), more interdisciplinary in nature, was involved in forecasting and results compilation.

The activity of group GP6, directed by INRETS, entailed a two-pronged approach, i.e. by sector and by discipline. Nearly 80 scientists from the Institute contributed their expertise on vehicles, motor technology and energy across all transport sectors: road, maritime and river, rail, and air.

Emphasis was placed on vehicle weight reduction and aerodynamics as well as on the energy efficiency of transport systems.

GP6 held three meetings in 2010, with the agendas concentrating on road and rail applications plus system efficiency considerations. Air transport topics were not included since CORAC’s activities already cover these topics extensively. On the other hand, the maritime and river transport sector has not yet received sufficient attention from the standpoint of “energy” research.

By the end of 2010, GP6 had released an initial summary report with a series of recommendations on hurdles or technologies that merit further study, with specific items identified and an outline of a skills map. Their work will continue in 2011.

With the exception of air transport, let’s point out that a very large proportion of the GP6 scope has relied on output by PREDIT working groups and, as such, offers great complementarity.

INRETS urges ANCRE* to support more effective research in the energy field

LCPC proud to be one of IDRRIM’s* founding members

The Institute of Roads, Streets and Mobility-enhancing Infrastructure (IDRRIM) was created on January 19th, 2010 by transforming and expanding the CFTR (French National Committee for Road Technologies). LCPC, as one of the Institute’s founding members, had the opportunity to participate in IDRRIM’s layout and constitution, and then in its official launch.

IDRRIM’s founding originated in one of the conditions stipulated in the voluntary commitment agreement signed on March 25th, 2009 by the French government (Sustainable Development Ministry - MEDDTL), the Public Works profession (FNTP, USIRF and STPF trade associations),
The field of urban water management revises its scope of action

Urban water management activities are some of the most critical performed by local and regional authorities and basically encompass discharging stormwater, collecting wastewater and reducing pollutant effluent. More recently, management techniques designed at the parcel or district scale, which are more in sync with the natural water cycle, have been developed as part of broadening technical approaches to issues concerning land planning, urban amenities and societal aspects.

For a long time, this operational activity has nurtured close relations with research teams in the field of urban hydrology, whose results stem in large part from in situ observations and experiments, with monitoring using time scales extending a year or more. In this context, creating the SOERE (acronym for “system of observation and experimentation in environmental studies”) URBIS, which has received Allenvi certification, will allow coordinating a series of multidisciplinary and distributed approaches covering several distinct territories (Nantes Metropolitan Area, Lyon Council of Governments, Paris Region).

Alongside these advances, a club of local authorities in support of SOERE, in the form of a non-profit, is currently being constituted in order to consolidate at the national level the myriad relations already existing at the local level. By involving technicians with regional organisations in addition to elected officials in establishing and monitoring actions conducted within an observatory setting, this structure will guarantee the relevance of research programmes currently underway and help ensure permanent resource allocations.

Gulley placed in the Bottière Chesnaie green district (Nantes).
LCPC remains very active in IRSTV*

IRSTV is an interdisciplinary research federation sponsored by CNRS. This Institute encompasses some 20 laboratories throughout western France, in addition to developing a comprehensive vision of urban environments and building methods and tools to facilitate sustainable city planning practices and public policy evaluation. LCPC’s role in these efforts has been substantial. Besides a presence on the Institute’s executive body, researchers with both the GER (Geotechnical Engineering, Water and Risks) and IM (Infrastructure and Mobility) Departments contribute to many IRSTV joint research projects:

- **ONEVU**, which stands for Nantes Area Urban Environmental Observatory, is a system pursuing a number of objectives, including: acquiring long-term data, characterising material and pollutant flows in various media (air, water, soil), and analysing transfers between these media in correlation with land use practices. ONEVU is Nantes’ branch of the national URBIS/SOERE system dedicated to the urban environment, under IRSTV’s coordination.

- In the field of urban microclimatology, the GER unit models the water cycle as a function of moisture transfers between the various urban media (atmosphere, soil, hydrological networks, vegetation, built environment) along with the influence of urbanised soils. GER teams have also coordinated a regional project devoted to characterising the impacts of human activity on the physicochemical properties of urban soils.

- As for urban background noise, the IM Department has contributed to developing sound propagation models that incorporate the properties of urban landscape shapes and the interaction of sound with urban media (soil, air, buildings, vegetation). The department has also been studying the quality of sound environments (noise mapping).

Moreover, LCPC is associated with some major ANR-sponsored interdisciplinary projects coordinated by IRSTV and focusing on the evaluation of environmental and socio-economic impacts from public policies tied to human activity and social practices. Two such projects are EvalPDU (Evaluation of urban transportation plans) and VegDUD (Impacts of greening the city).

### PRIZES AND AWARDS

Like every year, many INRETS and LCPC researchers received awards in 2010 for the quality of their work and contributions.

- **Hassan Ali**, with the GER Department, received the 2010 Jean Kersal Prize awarded by the French Society for Soil Mechanics and Geotechnical Engineering (CFMS).

- **Faïcel Chamroukhi**, with LTN MIV, was honoured with the Best Poster Award from e-EGC’s Winter School session entitled “Statistical Learning and Data Mining”, held at Hammamet in February.

- **François Combes** (LVMT) came away with the prize for the best presentation by a young researcher at the European Transport Conference held in Glasgow during October (ETC Prize, Neil Mansfield Award).

- **Cécilia Cruz**, with SPLOTT, received “WCTRS Honourable Mention”, in recognition of submitting the best paper from a young researcher, entitled: “How is ‘own account transport’ well adapted to cities?” at the WCTR conference in Lisbon.

- **Romain Gallen**, with LEPVIS/LIVIC, was bestowed the silver medal at the Young European Arena of Research (TRA) in Brussels. This medal was awarded under the heading “mobility and intermodality”.

- **Siham Hairoud**, with LEOST, was recognised for submitting the “Best Student Paper” at the ITST 2010 conference in Kyoto.

- **Anne Aguilera** (LVMT), Jean-Loup Madre (DEST) and Dominique Mignot received the Prize for the best scientific article from APERAU (International Association of Urban and Regional Planning Schools).

- **Anaïs Mayeur**, with IM/LEPSIS, won the Prize for the best thesis in 2010 from the Doctoral School, for entry no. 261: “Human cognition, behaviour and conduct” from the University of Paris V.

- **Laetitia Martinie**, with MAT, was runner-up for the René Houpert Prize competition held during the 2010 AUGC meeting of the University Association of Civil Engineers.

- **Miguel Padeiro**, also with LVMT, was awarded the 2010 thesis prize from the University of Paris-East, through its affiliation with the Doctoral School called “Urban and Regional Transport Planning” (“Ville Transport Territoires”), in October 2010.

- **Judith Princeton**, with GRETIA, received a prize for the best presentation during INRETS’ doctoral workshop sessions held in Lille, in addition to the “2010 Best Paper Award” from the Transportation Safety Management Committee.
CLOSE REGIONAL TIES

AT EACH SITE WHERE THESE TWO INSTITUTES EXERCISE THEIR ACTIVITIES, A WIDE ARRAY OF MUTUALLY BENEFICIAL PARTNERSHIPS HAVE BEEN BUILT WITH LOCAL AND REGIONAL ACTORS FROM ALL ECONOMIC SECTORS AND ACADEMIA. PUBLIC AUTHORITIES, UNIVERSITIES AND RESEARCH INSTITUTES, COMPETITIVENESS CLUSTERS, MEMBERS OF THE MINISTRY’S RST SCIENTIFIC AND TECHNICAL NETWORK, AND INDUSTRIALISTS ARE CONTACTED ON A DAILY BASIS IN ORDER TO CONSOLIDATE EACH CENTRE’S GEOGRAPHIC INFLUENCE WHILE DISSEMINATING ALL OF THE KNOWLEDGE AND EXPERTISE IT HAS GENERATED.

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Paris Region

PREPARATIONS FOR THE UPCOMING INSTALLATION OF IFSTTAR HEAD OFFICES AND SOME RESEARCH AT THE MARNE-LA-VALLÉE SITE

Construction is progressing nicely with the “Bienvenue” Building, where Ifsttar offices and researchers will be moved on the Cité Descartes campus. The neighbouring Paris-East Science and Technology Cluster (PST) will offer a pool of 1,500 researchers, engineers and doctoral students representing research organisations, graduate schools, institutes and the University of Paris-East. Synergies between PST research teams will be created through a number of joint venture projects, two of which are sponsored by LCPC and INRETS:

▶ the Belgrand Centre, which groups resources earmarked for the use of databases on urban and mobility-related topics;
▶ the Immanent project, for highly distributed and nomad instrumentation for both the Transport and Urban sectors.

STRONG LEVEL OF COMMITMENT TO COMPETITIVENESS CLUSTERS

Heavily involved in the oversight of competitiveness clusters Advancity and Mov’eo, INRETS has moreover presided over the Advancity’s Mobility Scientific Council and contributed to the work of several Strategic Orientation Committees.

INRETS has participated in the Mov’eo initiative via a number of strategic action plans and the MOVEOTEC foundation. Both LCPC and INRETS have also been associated with several of the projects undertaken by these clusters, as exemplified by the following:

▶ CLAIRE-SITI project: An “intelligent” referencing system for the intermodal transport of passengers, with a pilot site set up in the Seine St-Denis Department north of Paris. This project, developed by INRETS teams in Marne-la-Vallée, has been certified by both the Advancity and Mov’eo clusters.
▶ The three projects CO-DRIVE, SCOREF and PLATA, all of which involve joint collaboration, are aimed at developing communications systems for the automobile in association with Renault, PSA, Valeo and a few innovative small and medium firms.

PARIS REGION RESEARCH ON TRANSPORT SERVICES TAKES AIM AT THE FUTURE

As founding members of the University of Paris-East, both INRETS and LCPC are closely affiliated with the university’s scientific departments as well as with the Doctoral Schools within the research and academic centre (PRES).

In 2010, the capital investment programme rallied Paris Region laboratories around a series of projects sponsored by this PRES. Among these initiatives, EQUIPEX Sense-city was devoted to the topic of nanomaterials and nanosensors adapted to physical infrastructure, urban and transport services and the environment. For its contribution, LABEX Futurs Urban, which has engaged five research units, adopted an interdisciplinary approach in urban contexts by coordinating highly-specialised research with the capability of in situ experimentation in connection with the Descartes Cluster based in Marne-la-Vallée.

These institutions are also participating alongside the University of Paris-East and the Sorbonne-Paris Cité in the Paris Region’s Innov Society for Accelerated Technology Transfer (SATT).

Moreover, the partnership with Versailles-Saint Quentin has been strengthened by the joint development of proposals for the Investissements d’Avenir investment programme. The project sponsored by the new institute VeDeCoM plans on hosting at the Versailles-Satory site over 200 new researchers (including 19 assigned from LCPC and INRETS) working on three topic areas: electric or hybrid vehicle components, onboard communications systems, and new mobility systems.

REGIONAL PARTNERS

PST - University of Eastern Paris;
PRES - University of Eastern Paris;
Competitiveness clusters: Mov’eo,
Advancity.

Aerial view of Paris.

REGIONAL PARTNERS
The Lille-Villeneuve d’Ascq Centre

In 2010, LCPC (Nantes Centre) maintained and extended its ties with regional partners throughout western France, primarily located in the Loire Valley Region, but also in the neighbouring regions of Brittany and Poitou-Charente.

Within academia, these partnerships have taken the form of participation in undergraduate instruction and doctoral training (via the SPIGA and STIM doctoral schools), in addition to launching new joint research projects (Agorouter with the Nantes-based laboratories CEISAM and GEPEA, stereovision texture measurements in conjunction with the Poitiers-based Xim-Sic Laboratory), assistance in the organisation of conferences (the 2010 Materials Congress held in Nantes with IMN, the ITS Congress in Saint-Brieuc entitled “Regions and Movements” held September 30th through October 1st, 2010).

On December 10th, 2010, the RGVC (regional civil engineering research network) project, supervised by LCPC and financed by the Lille Regional Council, held its closing seminar. This project, which included CSTB, ECN and GeM as partners, will be extended into 2011 to continue work on a GIS project before incorporation into a CNRS research consortium dedicated to civil engineering.

The year 2010 will be remembered for the “emergence” on the scene of the UNAM PRes research institute, in which LCPC has become an associate member through contributions to several of its working groups. Moreover, LCPC continues to enjoy active membership in the IRSVT Research Institute on Urban Sciences and Techniques, a consortium it now leads.

The Centre’s Deputy Director further spread the facility’s renown among scientific actors within its regional academic jurisdiction: University of Lille 1, Ecole Centrale - Lille, Regional Transport Research Consortium, PolytechLille, SPI Doctoral School, International Campus Office for Transport Safety and Interoperability, the 2007-2013 North-Pas-de-Calais regional CPER programme in the field of transport research.

The Centre has maintained an active presence in project governance and coordination for the “i-trans” competitiveness cluster throughout 2010, subsequent to its certification renewal in 2009 as a cluster with international reach. The Lille-Villeneuve d’Ascq unit sits on the Scientific and Technical Committee, Board of Directors, Executive Bureau and Programme Committees. Moreover, three projects, with applications submitted for ANR financing and involving one or more INRETS teams, have already been certified by the cluster in 2010.

This Centre has also contributed to working groups set up within the framework of the “rail industry” initiative launched in Valenciennes in October 2010 by the Minister of Industry, as an extension to the convention held on French industry.

Within the scope of a mandate issued by the Regional Economic, Social and Environmental Council (CESER) of Industry, as an extension to the convention held on French industry.

The partnerships established with project owners and decision-makers, the world of industry and consulting firms have grown closer through stronger emphasis on the two Loire Valley competitiveness clusters, PGCE and EMC², for which LCPC is a founding member.

The removal of PGCE’s certification in 2010 has not altered LCPC’s support, as the Laboratory continues to participate in and coordinate the entity’s various bodies (Board of Directors, Executive Bureau, working groups, research project evaluation and certification commission). LCPC has specifically been involved in organising events for the technical community, including “Innovation and regulation in the field of public works”, on September 21st, 2010, and as a contributor to a session determining the near-term evolution of this resource centre cluster.

Within the scope of these partnerships, the call for projects as part of the investment programme outlined in France’s “Great Loan” (launched during the last quarter 2010) led LCPC-Nantes to take a large stake in promoting three ambitious Institute-driven projects:

- IRT Jules Verne, sponsored by the EMC² competitiveness cluster.
- IDEX IC-West, sponsored by two regional PRes (academic/research centres) in the Loire Valley (UNAM) and Brittany (UEB).
- IEED France Energie Marine, sponsored by IFREMER Brest.

On July 24th, 2010, the Deputy Director of LCPC’s Nantes Centre died under tragic circumstances. Olivier Ravaux (47 years old, ICPEF-credentialed engineer) had joined the LCPC staff on March 1st, 2008. Prior to this appointment, Olivier had directed Nantes’ CIFP training centre since January 1st, 2005 and before that held several technical posts with: the Saint-Nazaire Port Authority from September 2002 to December 2004; the Vendée Departmental Planning Office from July 1996 to August 2002, and the Charente Land Planning Office from September 1995 to June 1998.
The Bron Centre

A COMPREHENSIVE AND CONSISTENT APPROACH FOR SATISFYING ENVIRONMENTAL CRITERIA

Thanks to thermal audits conducted on buildings during 2009 and then validated in 2010, the Bron facility now possesses an actual energy parcel map complete with prescriptions in terms of energy efficiency improvement and building maintenance goals.

The company transport planning approach introduced at the Bron site has been further developed with two informational meetings on carpooling and transit pass (CITY-PASS) purchase incentives following the agreement signed between the SYTRAL transit operator and INRETS.

A bicycle parking facility was installed with the potential to accommodate 26 spaces plus safety kits made available in laboratory offices.

Research teams, notably from LTE, were mobilised for several months on a project called “PLIBAT” aimed at producing exceptional scientific equipment as part of the capital investment programme. The intention here has been to assemble on the Bron site all scientific equipment required to ensure solar electric mobility for various types of vehicles, including buses and lorries.

STIMULATING REGIONAL DEVELOPMENT THROUGH LEVERAGING PARTNERSHIPS

The Deputy Director’s staff played an active role in discussions held surrounding the organisation of transport research services throughout the region, as reflected in the IDEX project (Initiatives of excellence) sponsored by the Lyon-Saint-Etienne PRES. Staff members also acted as stakeholders in efforts deployed by local authorities regarding new regional plans (e.g. revision of the Regional Higher Education and Research Plan, Regional Climate, Air and Environment Plan) and by the Lyon Metropolitan Council (Climate, Transport and Urban Planning at the metropolitan scale, Lyon Area Development Council).

The inclusion of INRETS among “Rhone-Alps Energy Environment” members has provided the opportunity for LTE to study, among other things, alternative fuels and latest-generation electric motor technology.

THE ACCIDENT MECHANISMS UNIT UNDER THE SPOTLIGHT

Entitled “How to promote and ensure necessary long-term change?”, the Francophone Road Safety Workshop was held in Lyon on November 22nd and 23rd, 2010 under the banner of the 23rd Jacques Cartier Assembly. This event mobilised the Accident Mechanisms (AM) unit, which sits on the scientific committee and produced several of the papers delivered during the proceedings. This same unit had been assigned during 2010 scientific responsibility for a major project called “SVRAI” (acronym for Saving Lives by means of Incident Feedback Analysis), financed during its initial phase by DSCR. Supervised by the Cetru Institute, SVRAI has involved a large number of teams from the Ministry’s Scientific and Technical Network. Subsequent phases are planned to associate local and regional authorities with these efforts.

Research conducted has been intended to provide greater insight on accident tendencies through use of the latest knowledge obtained from measurements of incident rates under natural driving conditions. The scope of research has been extensive (500 instrumented vehicles ultimately), with the implementation of recorders fully designed and developed by the AM unit’s DYN team.

EXTENSION OF THE APPLIED BIOMECHANICS LABORATORY’S TESTING FACILITY

In 2010, the testing facility containing the Marseille-based Applied Biomechanics Laboratory’s (ABL) catapult was expanded by 200 m². Offering direct access for the unit assigned to set up experiments, this additional space has been allocated for storing shock test vehicles and technical equipment.

This works programme provided the opportunity to install amenities to improve working conditions (showers, lavatory, heating) and upgrade the site’s safety features.

The ABL Laboratory is now housed in a 950-m² building entirely dedicated to shock testing.

During the summer of 2010, efforts intensified to consolidate the Centre’s local and regional ties. These actions included involvement in the bidding process relative to the capital investment programme, support offered to local authorities on an array of projects and certification steps by the area’s three competitiveness clusters: Eurobiomed, Risk Management and Regional Vulnerability, and Pegase. The Centre’s participation in the Traumatology Foundation and Archimedes Committee on the dissemination of scientific culture, in the capacity of research organisation representative from the PACA Region (south-eastern France) (CORPACA), has provided the unit with the stature to influence research alliances and act as a key strategic partner throughout the region, at a time when society is expressing increased concerns over mobility.
INSTITUTE COMMUNICATIONS

DURING 2010, THE COMMUNICATION TEAMS WITH BOTH INSTITUTES HAVE PURSUED THE STRATEGY OF DISSEMINATING COMMUNICATION SUPPORTS AND TOOLS WHILE EMBARKING ON A NEW PATH TO ACCOMPANY, BEGINNING INTERNALLY, THE PROCESS OF MERGING THE TWO ORGANISATIONS.

► LCPC and INRETS publications
EDuring 2010, LCPC continued publishing its “Lettre L” monthly newsletter informing all internal and external partners of the Laboratory’s latest events, with a much greater move to online readership over the course of the year. As a matter of fact, since September, the newsletter is being sent to subscribers by e-mail and remains accessible on the Website.
INRETS also continued in 2010 with publication of the AXES newsmagazine offering a popularisation of research findings in the field of transport. Also released as a monthly, AXES serves as a communication support for all of the Institute’s research work.

► Web resources
INRETS has developed a Web magazine entitled “I-media”, as a complement to the AXES magazine. This tool focuses on a number of topics raised in the paper version in addition to publishing other news reports. LCPC’s communication and information services teams have collaborated on a project to launch new sites specific to the Laboratory. The migration in favour of new tools and their integration into existing systems made 2010 a very busy year.

► The events calendar
ATEXPO 2010: February 3-4, 2010, Versailles Exhibition Centre (Paris)
Rendez-vous Carnot: May 5-6, 2010, Lyon
TRA: June 7-10, in Brussels,
INTERROUTE&VILLE: October 2010, Metz
Jacques Cartier Assembly: November 2010: 2 seminars organised by INRETS in conjunction with the CERTU Institute and MEDDTL Ministry.
Cifre Forum: November 26, Paris
QUALITY ASSURANCE POLICY

INRETS AND LCPC HAVE FOR THE PAST SEVERAL YEARS INITIATED A NUMBER OF APPROACHES DESIGNED TO CONTINUOUSLY IMPROVE THEIR ACTIVITIES, PARTICULARLY AS REGARDS DEVELOPING QUALITY MANAGEMENT POLICIES, RESULTING IN THE ADOPTION OF MANY PROCESSES AND PROCEDURES AS WELL AS AN ISO 9001 CERTIFICATION AND COFRAC ACCREDITATIONS.

LCPC’s quality improvement approach: Presentation of LCPC certifications and accreditations

LE LCPC EST CERTIFIÉ « ISO 9001 »
LCPC has been “ISO 9001” certified since October 2002, with renewals awarded in 2005 and 2008 (extending through October 31st, 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 risks, the environment and transport infrastructure operations

From September 2005 to October 2010:
LCPC successfully completed two renewal audits, one in September 2005 the other in September 2008, and 9 monitoring audits between 2006 and 2010. Certification activity had been added to the ISO 9001 scope in September 2005. The ISO 9001 certification is valid through October 31st, 2011.

LCPC HOLDS AN ACCREDITATION FROM “COFRAC TESTS”, AWARDED IN ACCORDANCE WITH THE ISO 17025 STANDARD for the 7 following testing programmes:
- prog. no. 3: Tests on hydraulic concrete and its components (PCM/Paris),
- prog. no. 5: Tests on concrete reinforcements (MACOA/Nantes),
- prog. no. 29-1: Tests on metal materials, mechanical testing (MACOA/Nantes),
- prog. no. 8: Tests on asphalt mixes and their components (SMIT/Nantes),
- prog. no. 23: Tests on rocks and aggregates (SMIT/Nantes),
- prog. no. 86: Tests on bitumen and by-product binders (SMIT/Nantes),

From 2006 to 2010: LCPC successfully completed 2 certification renewal audits, in January 2006 and January 2008, plus 6 monitoring audits. Programme no. 29-1 was added in June 2005. The Paris site has been accredited “COFRAC Tests” through May 31st, 2011, while the Nantes Centre’s accreditation is valid until February 28th, 2013.

N.B.: In 1979, LCPC was one of the 5 founding laboratories of RNE, which went on to become COFRAC in 1994.

LCPC 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”). The accreditation body was notified via the system “2+”: (audit focusing on plant production controls) for aggregate production quarries.

From 2006 to 2010: LCPC successfully completed 6 monitoring audits at its Head Office and at 2 quarry sites. The January 2010 renewal audit concerned extending validity of the “COFRAC Industrial Product Certification” accreditation until March 31st, 2015.
Cooperation with CNER, the National Road Research Centre in Rabat (Morocco)

CPC took part in a cooperative mission with Morocco’s National Road Research Centre (CNER) based in Rabat. Crucial to this cooperation was the introduction of a quality management system within the CNER organisation, along with CNER certification for its diagnostic and monitoring services as of 2011 and a proposal to improve the local road maintenance management system.

Two CNER managers, Fatiha ORAICHE (Head of the Management Systems Department) and Rachid TABBOUCHY (Head of the Diagnostic Unit), were hosted at LCPC’s Nantes Centre August 3rd through 6th and then November 29th through December 3rd, 2010.

For the record, Morocco’s road network comprises:
- 916 km of operating motorways and 600 km under construction,
- 40,000 km of rated paved roads,
- 17,000 km of rated unpaved paths,
- 15,500 km of roads under construction or being improved within the scope of the second rural roads capital improvement programme for 2005-2012.

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1. CNER was created in 1979, under the name “National Pavement Diagnostic Centre”, as a Roads Directorate Unit. In 1986, it became an autonomous entity affiliated with a Roads Directorate Division and went on to be called the “National Road Research Centre”.

2. The Centre employs 64 staff, 9 of whom are engineers, divided among the departments of diagnostics, road management systems and research.

3. The Centre also runs a laboratory for materials identification testing (soils, sand-gravel mixes) and for tests on hydrocarbon materials.
THE INTERNATIONAL STAGE

ESTABLISHING COOPERATIVE VENTURES WITH RENOWNED INSTITUTES, ORGANISING ACTION PLANS WITHIN THE SCOPE OF INTERNATIONAL NETWORKS, BUILDING THE EUROPEAN RESEARCH SPACE, PLAYING A WELL-RESPECTED ROLE OF INFLUENCE AND COOPERATION, AND DISSEMINATING FRENCH EXPERTISE AND SPECIALISATION ARE AMONG THE MAJOR GOALS BEING PURSUED BY INRETS AND LCPC ON THE INTERNATIONAL SCENE.

An international renown

The wealth of experimental knowledge, whether applied or finalised, generated by LCPC in all aspects of sustainable mobility has been hailed by the international community. This recognition places the Laboratory among the world’s leading research actors in the fields of transport, infrastructure and civil engineering.

Defined in Objective 17 of the Objectives-based contract (2010-2013), the Laboratory’s international strategy contributes to its level of scientific excellence achieved and, along these lines, several partnerships were initiated in 2010 with ARRB (Australia) on topics related to weigh-in-motion systems and with the Federal University of Rio. LCPC has also expanded its existing cooperative relationships with: the American Federal Highway Administration and IIT of Kharagpur (India), in addition to organising a mission in Japan that gave rise to working seminars held with institutions like PWRI, NILIM and PARI.

Participation in shaping the European research framework is another one of LCPC’s missions, with the aim of completing the European research space and striking a better balance in sharing projects and research facilities, both signs of efficient resource use at the scale of the entire continent. This strategic vision was underscored when Paris won the bid to host the 2014 TRA (Transport Research Arena) European conference combined with LCPC’s commitment, at the request of the MEDDTL Ministry, to jointly handle the programming task in taking the lead on urban topics as part of the Urban Europe Joint Programming Initiative. LCPC was also successful in implementing a permanent and transnational ERA-NET-ROAD bidding structure in the activities of CEDR, which has gained considerable momentum by holding its first plenary session in September in Brussels and by wrapping up the “roads and climate change” work programme.

In 2010, LCPC was awarded six European projects. Moreover, the 5th-generation road project (R5G) took a major stride forward with the formation of the FOR working group within FEHRL (federation of European civil engineering research laboratories). LCPC is one of the five leaders promoting this dynamic European approach and has made major contributions to developing strategic research plans.

INRETS intensifies its European and international action campaign

Beyond preparing its merger with LCPC, the year 2010 was spent by INRETS refining its European and international strategy with respect to Objectives 21 and 22 of its objectives-based contract for the period 2010-2013.

According to the rationale adopted in the Lyon Declaration of December 2008, in application as of 2009 by the European Commission’s publication of the “green book” entitled Towards a new urban mobility culture, the Institute has fine-tuned a number of system components to enable retaining a key role in the European research space. Let’s recall that the strategic document, signed on December 2nd, 2008 during France’s tenure as the European Union President, offered in the Lyon Declaration laid out for the field of surface transit research a Year 2020 Vision of the European research space. Moreover, as part of this momentum, INRETS and LCPC were able to gain acceptance of this strategy by seven European institutional and scientific networks.

Also during 2010, INRETS continued to participate in building a European transport research alliance and has plans to intensify efforts over the coming years. This objective, as stipulated by the new organisational committee, entails a stronger presence in Europe’s scientific
institutional networks, along with attendance at European technological forums and platforms on land transport, the production of widespread guidelines for future research and innovation framework programmes, and involvement in the latest European projects. The objective through year 2013 had already been reached as of the end of 2010, one more proof of the relevance of INRETS’ commitment to the European research scene.

On the international level, the Institute’s priority has focused on three areas where it plays a highly influential and cooperative role in the field of transport and transport research. INRETS has won accolades as a leading actor in OECD / ITF (Organisation of Economic Co-operation and Development / International Transport Forum) and from the concerned countries, as well as in the Union for the Mediterranean, on behalf of the Moscow Declaration in favour of the Road Safety Decade, as promoted by both the United Nations and World Health Organisation.

For its part, LCPC has consolidated its presence as well displaying their interest in developing researcher exchanges with their main scientific partners, especially in Europe, Japan and North America, in order to mutually recognise the excellence of our research efforts and accompany our best researchers along a guided international path to boost their careers.

Several researchers packed their bags for long-term stays abroad (lasting a year or longer) with Australia’s ARRB (Didier Bodin) and the Universities of Berkeley (Min Tan Do) and Georgia Tech (Laetitia Dablanc and Kostas Chatzis).

In terms of “incoming” mobility, we welcomed a number of foreign researchers through several channels, like contract-based recruitment in the case of Michael Regan from the University of Melbourne entering LESCOT, or as a sabbatical leave (Prof. Ryoji Matsunaka, with Kyoto University, on a research stay set up during 2010), or within the framework of European projects and contracts (Charlene Hallett, from UNSW, as a contributor to the European project INTERACTION; and Anurag SONI, from IIT New Delhi, attracted by a Marie Curie project and subsequently involved in a COST project).

Researcher mobility thus constitutes a significant dimension for the Institute in pursuing not only our scientific and international strategies, but our human resource policy as well.

INRETS subsidiary called ERT has contributed to the success of several project bids and provides valuable support in managing European projects.

For year 2010, INRETS:
- was a stakeholder in 7th R&D Framework Programme;
- was a member of 6 European excellence networks: Humanist, IDN, EURNEX, Neartc, VPH, and HYCON2;
- was a partner in 31 projects connected with the 7th R&D Framework Programme;
- was a stakeholder in 3 European associations or platforms: FEHRL (road research), FERSI (road safety), and ERTICO (intelligent transport systems);
- was a partner in 11 COST projects;
- participated in 6 OECD-ITF working groups;
- received €1,876,562 through European research contracts.

LCPC’s numbers for 2010 showed the Laboratory:
- was a stakeholder in 3 European associations or platforms: FEHRL (road research), ETRIAC (automaker), and ECCTR (building and infrastructure);
- was a partner in 11 projects connected with the 7th R&D Framework Programme;
- coordinated 2 projects within the 7th R&D Framework Programme (including those administratively overseen by ERT); and ECTP-Refine (building and infrastructure);
- was a partner in 5 COST projects;
- participated in 3 OECD-ITF working groups;
- received €1,701,815.70 through European research contracts.
International presence: Expertise in Japan, Brazil and Australia

The year 2010 brought heightened cooperation with Japan, and in November LCPC organised a study trip to the country for the purpose of discussing research topics of common interest with PWRI (Public Works Research Institute) during a bilateral seminar, as well as with NILIM (National Institute for Land and Infrastructure Management), NIMS (National Institute of Materials Science) and PARI (Port and Airport Research Institute).

LCPC was also able to strengthen its partnerships in Brazil, with COPPE UFRJ (Universidade Federal do Rio de Janeiro) on topics related to the industrial use of concretes and the design of structures with limited environmental impact, as well as with IPR (Instituto des Pesquisas Rodoviarias) on pavement control and maintenance and with the University of Santa Catarina (FUSC) on issues related to sensors and lorry traffic controls.

LCPC concluded a strategic framework agreement with ARRB (Australian Road Research Bureau) on study topics tied to lorries in particular, on the heels of 15 years of sustained exchanges, either informal or held within the scope of OECD projects or working groups; this groundwork will give rise to researcher exchanges.

Our expertise has frequently been requested; examples include: Morocco for road safety training, the Congo by the Public Works Ministry, and Cameroon where the Laboratory has been assigned to certify the LABOGENIE Laboratory.

In Asia, INRETS has pursued contacts with its Japanese partners (contact initiated with Kyoto University, hosting a delegation from MLIT and the Tokyo Highway Company in conjunction with the ENTEPE Engineering School) and developed closer relations in Malaysia where MIROS (Malaysian Institute for Road Safety) requested our expertise in the specific field of driving simulators.

INRETS researchers continued with their road safety assessments in Vietnam, as part of a World Bank/EGIS-sponsored project. In Australia, an agreement was signed with QUT and several joint INRETS/QUT projects were selected for both European financing (the Optimum project) and Australian financing (ARC). Cooperative ties with Universitas Indonesia were also strengthened, as INRETS was chosen to intervene in the Nusentara project (expert appraisal on an urban transit line running between Jakarta and the University’s main campus in Depok).

On the African continent, INRETS has become associated with SITRASS as a means of offering its expertise in road safety to the countries of Senegal and Cameroon.

INRETS & LCPC
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LCPC
Cooperation with the Turner Fairbank Center, affiliated with the American Federal Highway Administration in Washington D.C., has made it possible for a researcher to analyse, over a 4-month period, the behaviour of an ultra high-performance, fibre-reinforced concrete adapted to civil engineering structures. Another researcher initiated a one-year stay at the University of California at Berkeley to pursue a specialisation in pedestrian traffic. Among the delegations of FHWA colleagues and several universities, LCPC also hosted an American “scanning tour” devoted to bicycles and motorcycles, in addition to participating in its own study trip organised by FEHRL focusing on the United States’ major centres of infrastructure research. The first Franco-American symposium on infrastructure safety in Troyes showcased our researchers, who were responsible for three presentations. Let’s also mention the assignment of an LCPC staff member for two years at SHRP (Strategic Highway Research Program) in Washington D.C. in order to study, from the inside, how American research activities were organised and managed.

INRETS
Besides its participation on the TRB, two events highlighted INRETS’ cooperation established with the United States during 2010:

- The first was the visit by John D. Porcari, American Deputy Secretary of Transportation, to Lyon on March 17th, 2010. The discussion agenda, which featured presentations by several researchers and laboratory directors, also contained:
  - rail research and INRETS expertise in the field of rail safety
  - social, societal and economic “viability” of passenger and freight transport services
  - research conducted at INRETS on distraction in the transport sector.
  - The Vice Minister, American DOT representatives and INRETS representatives agreed on the benefit of re-establishing relations between INRETS and two of DOT’s three major research bodies, namely:

French delegation at an American research centre during a study trip held in September 2010.
While at the SPLIT Laboratory (INRETS), I coordinated a research project on the logistics services shaping America’s major metropolitan areas. I was naturally interested in feeling the pulse of American research on this very topic. Undeniably far ahead of us in many aspects of logistics, the Americans invented the concept of a “hub”, these package distribution centres, with Federal Express. Today, they manage “mega distribution centers” just outside urban zones.

In this area of research, my sense is that there’s no better place than the source to learn about phenomena, as they germinate or where they make their appearance with the greatest impact. Such is the case for freight handling and its suburban logistics found in the U.S.

The field of metropolitan logistics has been undergoing tremendous development, especially as a result of globalization, Internet use and trade acceleration. The Atlanta area has witnessed a tripling in its number of warehouses over 10 years and a package shipped by FEDEX might make up to 24 stops before arriving at its destination, meaning that the notion of freight shipment has been radically altered. A package no longer gets warehoused, it simply transits.

And yet even in the United States, for the time being, no quantification approach has yet to be devised for this phenomenon, which has made for one happy researcher!

On assignment at the Georgia Institute of Technology for the year 2010-2011, I have not cut ties with my laboratory SPLOTT: in fact, I’ve been following the doctoral students (thanks to Skype!) and returned to France already 4 times to either teach or participate in a team seminar and various European workshops. One of my objectives with this American experience is to write my application for a research director accreditation as well as complete a collective book on these subjects.

I’ve been able to establish new ties that I hope will be lasting, thus expanding the post doc pool, in addition to co-authoring articles with American colleagues well versed in these freight-related issues; at my level, I’ve made every effort to build INRETS’ transatlantic renown.

I’ve decided to continue this adventure for another year (2011-2012), in Los Angeles this time, with the Metrans Laboratory (run by USC and Caltech). Research performed at this facility is conducted with a highly interdisciplinary emphasis and significant focus on freight.

My one-year stay, from August 2010 until August 2011, at the University of California Berkeley offered one of those experiences that mark the life of a researcher.

After spending 16 years working in the area of pavement skid resistance, I was interested in gaining exposure to other fields. The new needs facing society where LCPC has sought to respond (energy conservation, passenger mobility and safety, risks due to climate change, etc.) guided me to the urban setting, in particular looking closely at problems of trip-making and exposure to accident-related risks.

My initial contacts made within the framework of a CalFrance project directed me to the Institute of Transportation Studies (ITS Berkeley), an organisation actively involved in research topics of interest to me. Berkeley’s two ITS centres, SafeTREC and PATH, where I spent my time, began concentrating on mobility problems as of the 1990’s. Today, they’re working on integrating technological progress made in the wireless communications field to provide information that’s more comprehensive and better adapted to users.

Besides the personal “reinvigoration” side of this mission, I feel that my role, as head of a research team, also consists of gradually preparing the team to be ready to enter new fields of investigation.

I took full advantage of my time in Berkeley to work on modelling pedestrian traffic and identifying research topics along with the potential for collaboration between LCPC and U.C. Berkeley.

So what image do I come away with from this stay among American research teams? The willingness to make attempts and the speed of large-scale implementation of research products, in most cases promoted by close university/industry collaboration.
INTERNATIONAL PAPERS AND PRESENTATIONS DELIVERED

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302 PAPERS DELIVERED ACROSS 39 COUNTRIES
In 2010, doctoral training received considerable attention from INRETS. Let’s note that the financing of doctoral students was absorbed to a greater extent by co-financing arrangements or external financing (CIFRE stipends, contractual supplements, regional financial aid, etc.). For all INRETS’ doctoral students taken as a whole, 45% are being financed from external sources, 39% by the Institute and the other 16% in a co-financing arrangement. The number of Research Director Accreditations (HDR) has been steadily rising, while the number of doctoral students supervised directly by the Institute has also been constantly increasing and now stands at 41%. As key partners in this training activity, the doctoral schools have been reallocating their resources, as evidenced by a smaller number of “reference” doctoral schools located near the sites of Lille-Villeneuve d’Ascq (ED SPI no. 72), Lyon (ED MEGA no. 162) and Paris-Marne-la-Vallée (ED VTT no. 528 and MSTIC no. 532).

The length of doctoral studies is less than 3.3 years. This excellent result is the outcome of combined efforts in choosing thesis topics and applicants as well as in closely involving senior staff and the organisation in monitoring activities. Nearly 60% of doctoral students complete their degree before expiration of their contract, and over 85% of new graduates find employment straight away, in a long-term post with either a private or public entity.

52 new theses were initiated during autumn 2010, with 20 being financed by the organisation through subsidies (including 3 with regional co-financing, i.e. Loire Valley and Alsace) and 10 tied to research contracts (European projects, FUI, ENR, Loire Valley Region, Valeo, BRGM, DGA and Vitres), 9 CIFRE sponsorships (5 Renault, Charier, FNTF-Elfage, Meca, Arcelor Mittal, Areva, Schlumberger, RFF, Cherib), 2 jointly supervised theses (France/Senegal and France/Chile), plus 11 other externally-financed theses including RST network personnel (IPE4A, ITPE or IPEF, active employee status).

Nearly 90% of the 2010 Ph.D. graduates found employment as of the 1st quarter 2011. This high Ph.D. placement rate testifies to the outstanding relations maintained by INRETS with future doctoral graduate employers, in both the private sector (e.g. consulting firms, transit operators, facility managers) and public sphere (universities, public authorities). The introduction of many teaching posts or in-company internships for students as part of their doctoral contracts also helps explain this strong employment placement rate.

The distribution of nationalities among doctoral student enrolment is extremely broad (in all, 38 nationalities represented), with 52% being French. In 2010, seven students brought praise to INRETS by receiving commendations during international conferences or at awards ceremonies organised by the doctoral schools.
2. SCIENTIFIC AND TECHNICAL FIELDS

INTRODUCTION TO THE SCIENTIFIC FIELDS: THE TREMENDOUS ASSET OF POSSESSING A SYSTEMIC AND MULTIDISCIPLINARY APPROACH

As a precursor to their merger, INRETS and LCPC worked throughout 2010 on a mutual adaptation of their research activities, which on the whole display very broad scientific coverage throughout the transport chain, from facility construction to actual use and impacts. As a sequel, the task of defining Ifsttar’s scientific strategy will be the focus of 2011.

This report presents an assessment of year 2010 accomplishments for each research orientation, by overlapping the scopes of projects undertaken by both institutions, whose objectives tend to be similar and/or consistent, rather than proceeding by two separate assessments.

Orientations under headings “W” (Conserving Energy and Natural Resources) and “1” (Mobility, Energy and the Environment) target research on energy consumption patterns, environmental impacts over various time scales and current construction-related challenges. Orientation headings “R” (Expertise in Assessing Durability, Risks and Nuisances) and “2” (Transport System Quality, Safety and Optimisation) encompass studies on transport system organisation, durability and risk management. Lastly, orientation “S” ("Ensuring Road Safety and Modernising Transport Infrastructure") places emphasis on efforts in connection with transport safety, an area that also takes the spotlight in orientation “3” ("Transport and Health").

We can already state that beyond establishing a more comprehensive set of topics, Ifsttar’s mark on future research programmes will be a reliance on systemic approaches that by their nature provide for a multidisciplinary framework. A major advantage with research output by Ifsttar teams (SPI, STIC, SHS and SDV) lies in the effective cross-referencing of disciplines as well as a systematic incorporation of human factors. These characteristics are already noticeable in the assessments presented below of each orientation’s contributions.

Let’s also commend the Institute’s teams for their outstanding reactivity during 2010 in submitting responses to calls for future investment programme initiatives, which will definitely shape the course of future research in this field.

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350 NUMBER OF ARTICLES ACCEPTED IN "A"-RATED INTERNATIONAL REVIEWS
31 NUMBER OF BOOKS PUBLISHED
72 NUMBER OF DOCTORAL THESSES DEFENDED

Research orientation W: Conserving energy and natural resources 30
Research orientation 1: Mobility, environment, energy 34
Research orientation R: Expertise in assessing durability, risks and nuisances 38
Research orientation 2: Quality, safety and optimisation 42
Research orientation S: Ensuring road safety and modernising transport infrastructure 48
Research orientation 3: Accident analyses, biomechanics, health 52
SAVING ENERGY AND REDUCING GREENHOUSE GAS EMISSIONS ARE TWO PRIORITIES CLEARLY PROCLAIMED BY THE MINISTRY OF SUSTAINABLE DEVELOPMENT, WITH A TRIPLE OBJECTIVE ADOPTED FOR YEAR 2020 REGARDING THE NATION’S ENERGY AND CLIMATE POLICY:

- 20% FEWER GREENHOUSE GAS EMISSIONS.
- 20% LESS ENERGY CONSUMPTION.
- A RISE FROM 9% TO 23% IN THE PROPORTION OF RENEWABLE SOURCES IN TOTAL ENERGY CONSUMPTION.

Sequestering CO₂ during concrete demolition and then storing it, along with developing hydraulic binders with lower CO₂ emissions, introducing low-energy asphalt products or substitutes, optimising the transport of building materials (aggregates, fill) so as to limit both energy consumption and CO₂ emissions, utilising the full surface geothermal potential, taking advantage of the road as a solar panel, converting vibrational energy from structures into electrical energy and lastly contributing to expanded wind energy resources by establishing rules for their foundation design, offer a wide array of practical proposals crafted by LCPC and the RST technical network to meet the next decade’s challenges.

As regards resource savings initiatives, this topic corresponds with the intentions of the Ministry of Sustainable Development to conserve resources (water and mineral-related) and preserve natural environments. Such an environmental objective is tied to an economic objective as well, in recognising that biological diversity and natural resources contribute directly to the global economy at a rate of over 40%.

Here again, LCPC’s efforts, in conjunction with the RST network, have advanced towards this objective through a set of actions focused on: deriving savings from material use (whether in engineering structures or buildings), raising the rate of onsite material recycling and reducing water consumption, optimising the use of mineral fossil resources in bitumen, or enhancing waste reuse. The technical and environmental knowledge base on resources and processes available for infrastructure (i.e. the OFRIR+ base), developed with support from the ADEME Agency and accessible via the Website http://ofrir.lcpc.fr, creates the opportunity to share with industry and project owners information on the state-of-the-art relative to a whole host of methods, indicators and properties specific to materials and structures.

A comprehensive vision is being sought, along with an evaluation of the ecological footprint of engineering projects, in addition to incorporating environmental parameters as of the design phase, whether the project focus be road or rail.
**Green Concretes**

The research project entitled "Green Concretes" was launched in 2006 and wrapped up with a seminar held on December 21st, 2010 hosting an audience of over 150. This project addresses a current context in which concrete is responsible for approx. 5% of all CO2 emissions associated with human activity, where these emissions stem primarily from cement. The research therefore was directed at integrating environmental considerations at the concrete material scale. Tasks included evaluating the environmental impact of concretes designed using common materials and then studying the possibilities offered by innovative components in terms of both environmental impact and concrete performance.

The project was organised according to a 4-point outline, featuring: an evaluation of the environmental impact of concrete; analysis of new binders capable of mitigating this impact; reuse of industrial by-products or wastes as concrete mix components; and the *in situ* placement of concrete offering environmental advantages. Several joint venture projects have provided the opportunity to study the behaviour of a super-sulphated cement (Holcim), as well as a sulpho-aluminous clinker (Italcementi) and granulated blast furnace slag (Ecocem). Thanks to the involvement of various regional CETE technical centres (Lyon, Western France and Paris), a number of studies conducted in situ have proven capable of formulating and introducing concretes composed of either demolition aggregates or metakaolin.

On the whole, these research efforts have yielded a better perception of the environmental impact of concrete and its production process. It has also been shown that the generation of alternative solutions can entail a drop in performance whose effect would need to be evaluated.

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Understanding the sedimentation phenomenon in view of improving concrete performance

Concrete homogeneity (i.e., granular distribution within the cement matrix) serves in part to substantiate the mechanical performance exhibited by the material. The sedimentation phenomenon observed in certain concretes is indeed capable of weakening the material. Improving both the mix design and placement of new concretes requires a thorough understanding of this phenomenon. The Navier Laboratory launched an experimental campaign to achieve this specific purpose. By inserting a rheometer into the Institute’s exceptional Magnetic Resonance Imaging facility dedicated to civil engineering applications, the behaviour of glass beads within model concrete specimens could be detected (velocities, spatial distribution). This particular study revealed that while sedimentation does not occur in paste while at rest, it is distinctly present once this fluid starts to flow. The observations recorded could be modelled based on equations of a Newtonian fluid by adopting as viscosity the apparent viscosity of the yield stress fluid. The research performed has led to predicting grain sedimentation velocity as a function of the particle size and mechanical behaviour of a concrete or mortar specimen. This breakthrough constitutes a first step towards optimising the mix design and placement technique for new concretes. By enhancing concrete performance, it then becomes possible to introduce smaller quantities, thus leading to material and energy savings.

BADIFOPS: In pursuit of an in-depth experimental knowledge of ultra-high performance fibre-reinforced concretes (UHPFRC)

Prevalent over the past ten years or so, this UHPFRC category of concretes offers remarkable mechanical and durability qualities that open the possibilities for lightweight, durable structures using fewer material resources. Often associated with a high level of prestressing, these structures display a behaviour that has yet to be determined with precision when adding passive reinforcements to the composition. More specifically, no reliable method currently exists to predict either the opening and spacing of cracks or the ensuing ductility. These shortcomings have limited the potential applications of the material in buildings and engineering structures.

The BADIFOPS project, adopted by the RGC&U network of Civil and Urban Engineers in 2010, has been geared to implement “simple” tests in order to better control UHPFRC cracking caused by adhesion with passive reinforcements, through use of optical fibre instrumentation among other approaches. This more detailed experimental knowledge base must allow for completing the set of design rules and proposing preliminary layouts that demonstrate the structural benefit, material savings and design robustness, especially as regards earthquake-resistant applications. This project, subsidised by the Ministry of Sustainable Development at a cost of €816,000 and supervised by LCPC, has also involved the EIFFAGE company and the CSTB and SETRA research bodies.
A research partnership was signed between the RFF rail infrastructure operator and LCPC with the goal of improving the level of carbon energy efficiency of rail capital investments. This objective involved a review of proposals to modify the design and operating protocol for high-speed lines as well as the primary lines constituting the national rail network. The intention here is to promote project technical design, with an emphasis on geometry (profile, curvature, etc.), works scheduling and operating modes (e.g. velocity).

RFF provides the benchmarks, technical data and a CIFRE scholarship to fund doctoral theses. To measure actual consumption quantities, tests on the new lines’ rolling stock will be conducted. LCPC makes available its renowned methodology for measuring environmental impacts as well as its various vehicle models to perform consumption estimations.

Research on the right track

Earthworks give rise to a large portion of the total cost of road and rail projects and moreover attract strong interest from the field of applied research. Project owners are in fact concentrating on cost reductions and mitigation of new project impacts on material resources and energy expenditures, not to mention structural quality and durability improvements.

The French experience in the field of earthworks has, until the recent past, been characterised by a preference for basic empirical aspects. As a result, the prescriptions deduced from previous experience cannot be readily extended to new situations not yet encountered. To allow for such an extension, up-to-date research on soil treatments and hydraulic binders, plus the development of innovative approaches focusing on in situ material applications, has been undertaken through reliance on a more scientific strategy within the scope of national projects (TerDOUEST, MCTF) or regional initiatives (MICATT and NDDL).

The outcome of these efforts has provided a better understanding of the physicochemical aspects of the mechanisms that trigger hydraulic setting in fine-grained soils treated with lime and/or hydraulic binders, in addition to a more refined definition of the conditions required to guarantee treatment durability. Other outcomes have been to modify Standard NF P 94-100 (test of soil capacity to undergo treatment) and lay out the short-term reuse possibilities following treatment of marginal natural materials that until now had been left in storage depots (e.g. mica-shale alterites, highly plastic clays).

Moreover, it appears that the continuous measurement of geotechnical parameters required for earthworks monitoring is feasible by virtue of innovative processes (contribution to developing onboard intelligence for the worksite equipment of tomorrow).

Streamlining earthworks to promote resource-friendly and sustainable structures

Instrumentation of the reference embankment built with treated soil as part of the TerDOUEST project.
RESEARCH ORIENTATION 1 / MOBILITY, ENVIRONMENT, ENERGY: A CIVIL ENGINEERING DISCIPLINE REINVENTED TO SAVE ENERGY AND MITIGATE ENVIRONMENTAL IMPACTS

OBSERVE AND ANALYSE MOBILITY AND LAND USE TRENDS
EVALUATE TRANSPORT SYSTEMS AND THEIR ORGANISATION
REDUCE ENERGY CONSUMPTION AND ENVIRONMENTAL IMPACTS FROM VEHICLES.

Research orientation 1 encompasses the activities of four research units (DEST, LTE, LTN-Satory and SPLOTT) and one joint unit (LVMT). Three objectives laid out in INRETS’ 2010-2013 four-year financing contract make specific reference to this orientation. The research programmes presented herein illustrate some of these units’ contributions, yet are far from covering their entire scope. The reliance on new technologies (GPS and data generated from mobile phones) to observe mobility trends and analyse relations with the regional level are prevalent among the current topics under study. Research focusing on clean and efficient vehicles (i.e. electric and hybrid), from both a technological and socioeconomic perspective (acceptability, market potential), is being ascribed greater importance, along with the effort to introduce innovation into mobility systems. Safety and security, in addition to risk perception within transport services, have also given rise to a number of research endeavours.

Analyses of environmental nuisances (noise, air pollution, greenhouse gas emissions) on humans remain a key challenge, as does the development of appropriate environmental indicators (according to a multi-nuisance approach) and, more broadly, the problem of devising an environmental evaluation protocol. Lastly, transport system durability (design, operations, use) and regional systems lie at the core of this orientation’s concerns, as evidenced in particular through: modal choice, modal shift, multimodality, intermodality, workplace organisation, tradeoffs between transport and land use, transport-related greenhouse gas emissions, and correlations between energy pricing, trip-making behaviour and locational decisions.
PLATHÉÉ: A platform for energy efficiency and environmentally friendly hybrid trains

The major objective of this project was to identify and to evaluate new technologies for electrical energy in order to reduce strongly consumption, pollutant and CO₂ emissions for ICE urban railway locomotives.

New technologies used are electrical generator like biodiesel group and PEM fuel cell system, for energy storage it was used a association of batteries and supercapacitors, energy flux between traction motor, generator and storage system was managed thanks to compact and modular power converters using the last technology of the power IGBT module, capacitors and inductances.

This platform was designed based on a standard existing shunting locomotive body equipped with electrical motor and completely re-designed for this new electrical topology. One of this original study was to establish and design different algorithms for the energy management based on the simple concept of delivering energy for the travel by the generator, and energy storage system deliver peak power for acceleration and short time thrust.

IFSTTAR-LTN was strongly involved on the design of the innovative power converter, the supercapacitor characterisation and choice, and the investigation on the energy management validation.

Results of the tests in railway conditions show a strong gain on energy consumption (20% for long distance, 40% for shunting works, 85% at parked situation). Pollutant emission reduction is expected to 60 to 99%, CO₂ reduction 20 to 40%.

This project as tramway project STEEM equipped with supercapacitor energy storage, show the strong advantage of the on board energy storage for urban transportation system.

Myths and practices in achieving transport-planning coordination: Contrasted views of four Swiss and French metropolitan areas

Enhanced coordination between transport services and planning priorities has received considerable attention among professionals as well as researchers and land development actors. Far from being a recent concern, this topic has once again been brought to the forefront by the notion of sustainable development with the emergence of new challenges.

At this point, how have actors involved in overseeing local urban development and transport policy been assimilating the changing perspectives over the past decades, in making the transition from a city designed to suit the automobile to the sustainable city? This research, financed by both the CNRS and Ademe Energy and Environment Agency, compares four Swiss and French metropolitan areas: Bern, Geneva, Strasbourg and Bordeaux. Urban planning and transport policy directions, as charted over the past 50 years, serve to identify the set of factors favouring change or, on the other hand, factors explaining the preference to maintain the same political choices.
Logistics sprawl in Atlanta

For the past ten years, major US cities such as Atlanta (fifth economic centre of the country) have experienced a rise in their position as logistics hubs. At the same time, the relative position of smaller cities and rural areas was decreasing. Even traditional logistics areas such as port-cities (i.e. Savannah for the south-east) have been ‘by-passed’ by freight flows, containerised goods being carried directly from import ports towards major distribution centres (DCs) close to consumer markets.

In Atlanta, the number of warehouse and logistics facilities increased by 240% between 1998 and 2008. Inside metropolitan areas, these facilities increasingly locate at the metropolitan fringe. This phenomenon is referred to as ‘logistics sprawl’: in Atlanta, between 1998 and 2008, the average distance of warehouses to their barycenter has increased by 3 miles, while the average distance of all establishments to their barycenter has increased only by half (1.5 miles).

Local governments have not yet taken these evolutions and their impacts (increased truck-miles and congestion) into account. Three counties have been observed. For the first county, central but with logistics facilities located in a poor area, logistics activities bring good jobs and revenues for the county. They wish to consolidate and further develop these activities. The second county, newly urbanised and 30 miles south of Atlanta’s downtown, has established mega distribution centres (over 500,000 square feet) as a niche they wish to develop. The third county, in the north and already very developed, wishes to stabilise and ultimately reduce the importance of logistics facilities to focus on tertiary developments in the future.

National research group on Participatory Democracy and Public Participation in Decision-Making: Assessment and prospects

The group, chaired by the Institute for Humanities and Social Sciences of CNRS (National Centre for Scientific Research), aims to develop research on participatory democracy and public participation in decision-making processes. It promotes the coordination, the exchange and the sharing of research work that each associated partners (14) and laboratories (55) undertakes. The success of the first doctoral days illustrate the vitality of the research field in France, its opening set of themes and scientific disciplines. The growing activities of the Group intend to shape this field, especially with a new academic review, Participations (De Boeck).

The Group focuses on citizens’ contribution, beyond their usual involvement in the institutional political life, to choices about society. Its research work covers all the fields where collective movements meet processes of institutionalisation aiming at the inclusion of the citizens in the working-out and the implementation of public action and decision.

The Group thus constitutes the favourite tool for dialog between the community of social scientists (at CNRS, IFSTTAR, INRA, DEMAGREF, CIRAD), the institutions and companies that have to implement public participation in decision-making processes (ADEME, the French Environment and Energy Management Agency; ARF, the Association of French Regions; CNDP, the National Commission of Public Debate; RFF, the National Rail Network; RTE, the French Electricity Transport Network; EDF Inc., the French Electricity Board), and the civil society (FNE and ADELS).
Indicators of environmental sustainability in transport

The work carried out in the frame of the COST 356 action “EST - Towards the definition of a measurable environmentally sustainable transport” and published in May 2010 (INRETS report n°282) tries to answer the following questions:

- How can environmental impacts of transport be measured?
- How can measurements be transformed into operational indicators?
- How can several indicators be jointly considered? And how can indicators be used in planning and decision making?

Firstly we provide definition of indicator of environmental sustainability in transport. The functions, strengths and weaknesses of indicators as measurement tools, and as decision support tools are discussed. We define what environmental sustainability in transport may mean through the transport system, the concepts of sustainable development and of environment. The concept of chain of causality between a source and a final target is developed, as a common reference for indicators and assessments. As the decision making context influences the perceived and actual needs for indicators and methods, we also analysed the dimensions and context of decision making. We derived criteria and methods for the assessment and selection of indicators of environmental sustainability in transport, in terms of measurement, monitoring and management. The methods and the criteria are exemplified for seven chains of causality.

Methods for a comprehensive joint consideration of environmentally sustainable indicators are analysed and evaluated. They concerned aggregated or composite indicators as well as multi-criteria methods. Five case studies are presented.

Finally, recommendations for continued research and development of indicators and joint considerations methods for assessment of environmental sustainability in transport are given.

Project entitled FLUIDE (French acronym for River, City, Intermodality and Durability)

Working towards a service offering durable mobility: France’s major river cities and their ports. Comparative study featuring Paris, Lyon, Lille and Strasbourg, plus international comparisons within the framework of the Sustainable Cities programme sponsored by the ANR Agency. This project is intended to examine how river ports are capable of contributing to the development of a sustainable freight transport system, especially by promoting modal shift in favour of waterways, through the harmonious integration of extensive urban spaces.
The entire volume of research conducted under this heading involved some €11 million in LCPC's own resources and another €4.6 million directly allocated, with 9 of the projects corresponding to activities sponsored by the RST scientific and technical network with a direct link to this orientation. Given the scope of these efforts, research orientation “R” accounted in 2010 for a large share of LCPC's overall activity, especially given its focus on: infrastructure sustainability, structural life cycle extension, material pathology studies, natural hazard mitigation, and nuisance and impact control. Several major projects were concluded in 2010 with sizeable contributions to the knowledge base. Among them, the “Sécheresse” project explored the effects of drought on buildings. “Sécheresse 2”, scheduled as a follow-up for launch in 2011, will specifically investigate clay shrinkage and swelling, as part of a framework agreement signed with the INERIS Institute. The Suburban Basin Hydrology project, wrapped up in 2010, will be succeeded in 2011 by a research mission intended to incorporate hydrological risks at the global scale, for which a cooperative venture with the Météo France Weather Agency has already been initiated. The Durability and Ageing of Polymers for Civil Engineering Applications project also came to a successful completion in 2010; its results served to develop a number of behaviour prediction models specific to these more recent polymeric materials, whose ageing phenomena remain relatively unknown.

Among the other studies completed during 2010, let's cite advances on the characterisation of soils and linear structures by means of electromagnetic methods (as a substitution for the nuclear methods currently in use, which have given rise to a number of risks and constraints). Moreover, a new action campaign based on a novel and up-to-date approach, under the banner “CCLEAR”, was prepared during 2010. This project, which is aimed at minimising the impact of climate change on transport infrastructure, will take shape over the period 2011-2013 and is expected to produce recommendations regarding methods and design techniques currently in use.
**Multilevel platform for modelling the durability of concrete structures**

Within the Materials Department, the “Microstructure, Sustainability and Modelling” Group has been working on predicting the life cycle of concretes exposed to the penetration of harmful agents such as atmospheric carbon dioxide or chloride ions. It is recognised that a performance-based approach has been ongoing since 2004 focusing on sustainability issues using a series of laboratory-measured indicators.

Yet concrete mix designs have in the interim become much more complex and presently contain a wide array of additives (e.g. fly ash, slag, silica fume, limestone filler) in order to satisfy the requirements to reduce greenhouse gas emissions.

Against this backdrop, building models capable of quantifying the life cycle of concrete structures is now considered a necessity. The objective here is threefold: contribute to understanding the mechanisms at work, provide the possibility of predefining concrete mix designs able to meet the imposed life cycle criteria; and reduce the costs associated with laboratory testing.

A platform for modelling the physicochemical processes of concrete deterioration, when exposed to external aggressions, has been developed at LCPC. This tool has been devised in collaboration with the Navier Laboratory by running the finite volume computation code called “BiL” (designated by Patrick DANGLA), in conjunction with the Matlab® software. Model output via this platform integrates the various physicochemical mechanisms inventoried and underscores the complex couplings taking place between transfers (water, ions, water vapour) and chemical reactions (hydration, carbonation).

Various modelling levels are indeed available: first “engineering” type models, then an intermediate category whose purpose is to identify durability indicators by means of an inverse analysis of experimental results, and lastly comprehensive models. First-level models have been set up as probabilistic to account for variability in model input data.

**Urban sound mapping simplified through use of a GIS software package**

Since enactment of the December 30th, 1996 Law on Air Quality and the Rational Use of Energy (LAURE), conurbations with over 100,000 population are required to adopt an urban transportation plan (PDU) with the aim, among other things, of reducing the impact of transport facilities and services on the environment.

This same law also stipulates a re-evaluation of the PDU Plan every 5 years, though it did not set forth the specific procedure to follow. Sponsored by IRSTV(1) in coordination with the Nantes Metropolitan Government, the ANR Eval-PDU (2008-2012) project has pursued this mission by gathering several research actors specialised in environmental issues. The “Acoustics” team with the UR EASE unit (part of the IM Department) joined in the proceedings of the IRSTV’s GIS(2) workshop in order to craft an approach for producing new noise maps adapted to address local challenges.

As opposed to the conventional tools that had been used until now within the scope of European Directive 2002/49/EC relative to evaluating and managing environmental noise, this latest approach features full integration within a dedicated GIS freeware (OrbisGIS), along with simplified computations and an algorithm optimisation routine for producing noise maps.

This new strategy results in noise maps at the scale of a large conurbation like Nantes, while offering a significant reduction in computation time (down to a few hours vs. several days when implementing conventional tools). This substantial savings makes it possible to compare a number of PDU scenarios within a relatively short time period, which corresponds to the constraints imposed by a decision-making process. Along the same lines, the services currently developed around the OrbisGIS software will soon provide local and regional authorities with the opportunity to generate their own noise maps by directly using the resources of a Web service and then distributing their maps through new dynamic media available for consultation (geospatial PDF, interactive Internet map).

(1) IRSTV: Acronym for the Urban Scientific and Technical Research Institute (INRÉTS), a public research institution, whose members include LCPC.
(2) Geographic Information System (GIS).
European project ISTIMES: Experiments at the Montagnole rockfall test station

One of the objectives of ISTIMES project (www.istimes.eu) is to evaluate the potentialities offered by the integration of different electromagnetic techniques able to perform non-invasive diagnostics for surveillance and monitoring of transport infrastructures. Experiments in controlled conditions are so necessary to analyse the characteristics and potentialities of diverse EM sensing techniques for the infrastructure monitoring. The full-scale rockfall test station of Montagnole (French Alps) owned by IFSTTAR has been so used to practise such test. Test were carried out on a reinforced concrete beam (16 m long and 21 tonnes) laid on two pillars screwed on two foundation structures realised at ground level.

Experiments addressed the progressive damage, at different stages, of this structure submitted to falling blocks impacting the soil close to its foundations (indirect impact) and in a second phase directly onto the structure.

Steel blocks of 2.5 and 10 tonnes were used and two falling actions scenarios were unrolled:
- Impacts onto ground at 5m from the North pillar: 12 launches from 100 kJ up to 6000 kJ.
- Direct impacts onto beam at 6m from beam North extremity: 4 launches from 25 kJ up to 125 kJ.

The follow-up of ground evolution before and after solicitations was realised by ground penetrating radar and electrical resistivity tomography.

To conclude, during these trials allowed to demonstrate that such methods are able to instantly give information on plastic deformation of the structure.

Presentation of an RGIB module of the “CESAR-LCPC” Finite Element programme

Internal swelling reactions (ISR) can affect hydraulic concrete structures by causing cracking and expansion of the material which lead to degradation of structures mechanical behaviour. These pathologies mainly consist in alkali-aggregate reaction (AAR) and/or delayed ettringite formation (DEF). The modelling of these phenomena in CESAR-LCPC F.E. code was based on a sub program called “ALKA”, for AAR, and newly developed sub program called “RGIB” that allows modelling the behaviour of a structure affected by AAR or DEF. This program takes into account several coupled phenomena: effects of the early age thermal history, anisotropy of the imposed expansion related to the direction of concrete casting, damage resulting from cracking of the material, drying shrinkage and coupling between the expansion and the state of stresses.

Many case-studies have shown that it is necessary to model displacement discontinuities in the concrete, mainly to take into account two phenomena:

In addition to multi-cracking, observation of isolated cracks with an important opening, resulting from interactions between pathology and mechanical behaviour of the structure. Control of these cracks opening sometimes requires an explicit modelling.

Among techniques available to deal with ISR affected structures, the stress release can be effective (e.g. sawing of dams). To evaluate the potential efficiency of this technique, creation of cutting lines in the structure, and reclosing of the cut as a result of subsequent swelling need to be modelled (Figures 1 and 2).

The algorithm development aimed to possibly combine contact elements and non-linear coupled models of durability mechanics related to ISR modelling.
Evaluation and diagnostic of building energy performance

L CPC, acting within the framework of the MACS Department, is developing data measurement and processing systems to limit heat losses in buildings while reducing unnecessary energy expenditures.

The set of buildings chosen, which are responsible for approximately half the country’s energy consumption, actually represent one of the richest sources of energy savings should extensive thermal renovation programmes be implemented. To proceed along these lines, methods will need to be applied that allow accurately assessing building performance and then prudently guiding the ensuing works.

LPC’s efforts have pursued this strategy by developing intelligent instrumentation methods intended to very closely monitor energy performance over time and identify the intrinsic characteristics of buildings. Such an approach consists of combining the measurements output by a small number of standard, low-cost and non-invasive sensors with a numerical model.

It has been demonstrated that identification algorithms are indeed capable of determining, in real time, the energy status of buildings along with the thermal characteristics of its various components, for the purpose of distinguishing the share of total consumption ascribable to environmental loading from the share due to actual use. These research advances have led, among other things, to a patented algorithms are indeed capable of determining, in real time, the energy status of buildings along with the thermal characteristics of its various components, for the purpose of distinguishing the share of total consumption ascribable to environmental loading from the share due to actual use. These research advances have led, among other things, to a patented

Several research projects (Immanent, ANR/MEMOIRE as one example) involving renowned partners like CSTB, LEPTIAK and CETE-Western Regional Office are committed to this topic. Partnerships with innovative start-ups (Actility, Solamen) will help disseminate the results of these efforts among industry professionals.

Intelligent instrumentation methods make it possible to analyse and accurately predict actual building energy performance.
RESEARCH ORIENTATION 2 / QUALITY, SAFETY AND OPTIMISATION: SAFE, EFFICIENT AND UNIVERSALLY ACCESSIBLE TRANSPORT SYSTEMS

PROVIDE A NEW TECHNICAL TOOLBOX TO IMPROVE THE SAFETY AND EFFICIENCY OF TRANSPORT SYSTEMS. 

PROMOTE A USER-CENTRED TRANSPORT SYSTEM DESIGN.

OPTIMISE THE OPERATIONS AND USE OF TRULY INTERMODAL NETWORKS.

These objectives, written into the INRETS’ 2010-2013 four-year financing contract with the State, refer to research orientation 2, which combines the activities of five laboratory units (GRETTIA, ESTAS, LPC, LESCOT and LEOST) as well as three joint units (LICIT, LEPSIS, LIVIC). This orientation offers a major advantage by associating an Engineering Science approach with a Human and Social Sciences perspective in order to evaluate or design technical objects in addition to building system optimisation models. The array of groundbreaking results published during 2010 and presented herein provides a partial glimpse of the extensive output of teams affiliated with this 2nd research orientation.

Efforts expended in this domain are also noteworthy for their tremendous contribution to the VERONESE project, with among other things the implementation of collective actions shaped around topics such as “green driving”, the evaluation of communication and localisation technology, and simulation platform development. Other successes in 2010 include: mobilisation of several laboratories working on this orientation within the European NEARCTIS network of excellence, whose accomplishments feature a final state-of-the-art assessment in the field of “cooperative systems” and the launch of a series of strategic debates on comprehensive inter-organisational research programmes at the European scale.
Two-dimensional modelling of traffic in dense road networks

The GRETTIA research centre initiated in 2010, as part of an ENTPE-sponsored thesis programme, developmental work on a two-dimensional traffic model. The focus here lies in dense, extensive networks, with the aim of approximating the network using a two-dimensional orthotropic medium, i.e. a medium that is able to distinguish preferred propagation directions.

The level of traffic in the network is approximated by the flow of a two-dimensional (surface) fluid. This model incorporates the balance between supply and demand and is therefore well suited to conduct impact evaluations at the macroscopic scale. The primary model outputs provide a macroscopic view of traffic (directional flows at each point) and the various costs of origin-destination trip-making.

The model describes traffic over very large and dense networks or else on the secondary surface network, as a complement to a standard macroscopic traffic model. According to this second configuration, the model avoids requiring a highly-detailed description of traffic in a network with too few measurement points to produce an exhaustive analysis of traffic conditions.

This research effort will last through the end of 2012 and the ultimate model derived will be combined, as part of the Digital City project, with both the MAGISTER-GSOM multi-model traffic platform and the UrbaSimCE pollutant emission model, which is currently under development.

“StatAvaries 2”: A decision-making software

The significant decrease in headways, combined with a programme to automate a portion of the metro rail network, has constrained the RATP operator to change its control system. Beyond the modifications introduced on the operations side, this modernisation campaign underlies a critical topic: detection of rail track failure. Up until now, this detection process has for the most part relied on the previous control system and train conductors. RATP has thus sought to build a tool that assesses the impact of a range of choices (in the areas of operations and maintenance) on the indicators of each line, namely: availability, preventive and corrective maintenance actions.

A statistical model of the type VirMaLab (output by the virtual maintenance workshop) has been developed for the purpose of accurately simulating: rail deterioration, the complete diagnostic chain, and maintenance policy. Special attention has been paid to modelling rail deterioration (through introducing a semi-Markovian approach) as well as determining the possibilities offered to users for varying a wide array of parameters.

In order to better match RATP’s specific needs, i.e. evaluation of specific indicators given a precise schedule, an original and multilayer VirMaLab approach has been devised. This set-up shows a variable picture of system granularity over time, thereby depicting both the degradation dynamics of the targeted defect and the associated indicators (internal defect/predictive maintenance, failure/schedule lapses, etc.).

Featuring a user-friendly interface to facilitate its application, the StatAvaries software is currently installed in the STF Rail Facilities and Engineering unit and heavily used within the scope of the OCTYS programme.

StatAvaries, a decision aid software tool dedicated to the rail sector.
n forging a solid partnership with the CSTB Building Research Centre and as part of its contractual commitments, the LICIT Laboratory has been working towards integrating its dynamic traffic simulation tools into a series of 3D digital platforms dedicated to urban management issues.

The interface between the Symuvia traffic simulator and CSTB’s EveCity virtual reality platform was finalised in 2010, along with completion of the TerraMagna project (2008-2010). This global platform interacts directly with the traffic motor in order to both recover the dynamic positions of vehicles and execute auxiliary modules for evaluating relevant environmental nuisances, in particular noise propagation. Results of this module execution may be visualised either as a map or in auralised (acoustic) form. Noise emissions are provided in a workable format thanks to advances by the LTE unit. Ongoing research is intended to enhance tool sharing, especially through implementation of a common data structure.

The LICIT facility is involved in other projects built around digital platforms for the city, including Terradynamica. Launched in 2010 under the aegis of Thalès, Terradynamica (2010-2013) has been assigned to develop an integrated pedestrian/vehicle simulator guided by an advanced (AI) actor management system. The LEPSIS team has also contributed to these efforts. Moreover, as part of the Digital City project (2009-2013), LICIT has been working closely with GRETTIA on designing traffic models specifically suited to estimating atmospheric pollutants, as well as with IGN on generating data production chains as required by the traffic simulation protocol.

How can the impact be assessed of a modification in attentional demand on the cerebral mechanisms involved in processing relevant information from a driving scene?

This novel study, undertaken within the scope of the DACOTA project (ANR, Predit 2005) as a joint venture with the University of Lyon 1 (LEACM/CRISt) and CERMEP (Bron), focuses on finding an answer to this question.

The cerebral activity of test subjects performing a simulated driving task has been recorded using a magnetoencephalograph (MEG). Results indicate that by increasing the demand for attention through active listening of a radio broadcast (requiring answers to questions) actually affects the response to traffic signals (changing from green to orange) and to road signs. This impact is felt during the sequence covering detection, categorisation and all subsequent decision-making (braking/turning). This study has proved that such an impact, resulting in heightened or muted activity within different parts of the brain, varies depending on the type of information to be processed and shows a strong correlation with degree of urgency (obligation to stop/road directions to follow).

The European Union set up a European rail management system “ERTMS” to ensure, with high level of safety, train operation on different European rail networks. As the full deployment of this system is long and expensive, evolutions are necessary and raise other technological challenges. The goal is to determine how to use ERTMS specifications to produce test scenarios. This work presents methods, models and tools dedicated to the generation of test scenarios for the validation of ERTMS components based on functional requirements. The development of ERTMS system requires adequate methods for Modelling and evaluating its behaviour. Evaluation and certification of the
system can be done by generating test scenarios applying formal methods. The Unified Modelling Language (UML) is a widely accepted Modelling standard in industry. However, it is a semi-formal language and it does not allow verification of system behaviour. In this case, formal models like Petri Net can be used. These methods are used in order to formalise ERTMS specification. Tests scenarios are generated on the basis of Petri net models. One scenario is considered like a firing sequence in the reachability graph of the Petri net. Then, test scenarios are applied on ESTAS’s ERTMS platform simulator in order to check the components behaviour. Finally, the approach, developed in this document, has been applied to ERTMS components in order to demonstrate the validation and certification costs reduction and also to minimise the upgrade and retrofit constraints and validation cost. 

Use of a driving simulator to gain familiarisation with a front-to-back collision warning system

By warning drivers whenever the trailing distance between vehicles becomes too small, front-to-back collision risk warning systems eliminate a large number of accidents, especially in cases where driver attention is diverted. Yet drivers are not inclined to accept such a system due to the frequent warnings issued that serve no purpose. Within the scope of the FUI Matis project, LPC has been working on the impact of familiarisation gained on a simulator with this driving assistance system (in terms of both acceptance and use). Sponsored by the Mov’eo research cluster and supervised by Renault’s Technical Simulation Centre, the project (2008-2010) has associated three other partners, from industry (Oktal) and scientific research (Collège de France, INRETS-LPC). Results indicate the distinct advantage derived from simulator-based familiarisation with the system, as opposed to a simple reading of the guide describing system operations. This use of a simulator enables drivers to actively explore the system’s capacities and limitations, in addition to acquiring more knowledge of its underlying operations, thus instilling greater confidence in the system while generating more efficient interactions and safer behaviour behind the wheel. Towards meeting the goal of a bona fide application, the level of realism inherent in the simulator must also be taken into account: drivers draw greater benefit from an active form of familiarisation delivered on a “full-scale” simulator rather than on a mini simulator.

“VeLo”: Inter-Vehicle Communication and accurate relative Localisation

Coordinated by ST Microelectronics and finalised at the end of 2010, the industrial research project entitled “VeLo” has assembled a consortium featuring ST Microelectronics, Autocruise, CEA LETI, INRETS-LEOST along with the CNRS’ millimetre-scale platform. This project, budgeted at € 1.85 million and benefiting from ANR financing (part of the agency’s 2006 telecom programme), has successfully developed a prototype automobile radar, equipped with the capabilities of inter-vehicle communication and accurate relative localisation of all obstacles within radar coverage. The radar, communications and localisation functions rely on the new Ultra-Wideband (UWB) radio technology transposed at 79 GHz. In 4 GHz of bandwidth, brief pulses account for a duration of 750 picoseconds; consequently, they provide a level of localisation precision to within a tenth of a metre for a radar range extending 30 m. System blocks were produced in employing the BiCMOS9MW silicon-based technology developed by ST Microelectronics. The operations of these blocks turn out to be compliant with the specifications.
defined upon initiating the project. A doctoral thesis, jointly supervised by the IEMN Institute of Nanotechnology Electronics and Microelectronics and the LEDST Laboratory, was successfully defended on the topic of accurate relative localisation of obstacles.

Moreover, this project has incorporated steps leading to standardisation. The 79 GHz (77-81 GHz) band has been designated as the permanent band for short-range automobile radar systems resulting in low production costs) over a large scale makes for a very appealing technique when using this millimetre-scale UWB.

The primary difficulty with this mission was to acquire a substantial quantity of data, and, owing to this fact, will be imposed upon the psychology of risk-taking.

P
romoted by the IGN Institute and financed by the ANR Agency since 2008, the Itowns project is intended to define and test new types of virtual urban browsers.

The primary difficulty with this mission pertains to acquiring a substantial quantity of data, including a broad selection of city images from. In 2009, a memorandum was submitted back to the Commission in support of the options developed as part of this VeLo project. In time, both short- and long-range automobile radar systems will be operated exclusively at the millimetre frequency. The combination of radar, communications and relative localisation functions into a single, highly-integrated sensor (hence

“itowns”: Automated detection of vertical signs for virtual urban browsers

Reading list: The psychology of risk-taking

D
iving dangerously, smoking, drinking, living on the edge, gambling… but why are we taking all these risks? The psychology of risk-taking (Editions Lavoisier, 2010), the latest work by Jean-Pascal Assailly, provides a comprehensive view of the state of research conducted on this extremely complex topic.

The reasons pushing us to take risks are to be found not only in our psyche, but in our body and environment as well. With an obvious focus on psychology, while pursuing an exploration of biology and context, this book has been laid out in three parts.

The options developed as part of this VeLo project. In time, both short- and long-range automobile radar systems will be operated exclusively at the millimetre frequency. The combination of radar, communications and relative localisation functions into a single, highly-integrated sensor (hence resulting in low production costs) over a large scale makes for a very appealing technique when using this millimetre-scale UWB. In 2009, a memorandum was submitted back to the Commission in support of the options developed as part of this VeLo project. In time, both short- and long-range automobile radar systems will be operated exclusively at the millimetre frequency. The combination of radar, communications and relative localisation functions into a single, highly-integrated sensor (hence resulting in low production costs) over a large scale makes for a very appealing technique when using this millimetre-scale UWB.
"SURTRAIN": Train monitoring platform built from the joint implementation of image and sound analysis algorithms

The SURTRAIN project, which was completed in June 2010, demonstrated the feasibility of an integrated onboard audio/video monitoring platform to assist with the tracking of perpetrators of criminal acts on trains. Alongside project partners SNCF, CEA/LIST and MARTEC, the LEOST Laboratory has devised a new set of detection and localisation algorithms for noise-related events (screams) based on signals captured by a network of microphones. Two official system demonstrations were successfully carried out during the test train’s commercial operations. Thanks to support for the system expressed by the SNCF Railway Company, LEOST is now seeking to evaluate its algorithms over longer rail itineraries. The laboratory has also applied these results to raising the level of safety for at-grade crossings.

The SURTRAIN project was awarded the Transport System Quality and Safety Prize at the Predit 4 programme’s halfway point, during a Crossroads event held on May 11th, 2011 in Bordeaux.

"TEMPUS/TPTEO": A new generation of travel time estimation algorithms

In the topic area of travel time estimation and prediction, LICIT has devised a new series of urban and interurban algorithms. For urban trips, this project focused on introducing an integrated approach towards estimating multimodal travel times, extending door-to-door and in real time, in order to derive algorithms adapted to itinerary calculations within multimodal transport networks. The resulting tools have been incorporated into a platform labelled “TEMPUS”.

On the interurban side, the proposed travel time estimation methods collate all available information (traffic data, toll transactions and their data fusion step) and have built in the impacts of meteorological events. Findings from this research, conducted in partnership with AREA, have been programmed into the TPTEO demonstrator device.

Developing multimodal features for future trip-making.
RESEARCH ORIENTATION S/ENSURING ROAD SAFETY AND MODERNISING TRANSPORT INFRASTRUCTURE

ACHIEVING A DRASTIC REDUCTION IN THE NUMBER OF TRANSPORT-RELATED DEATHS REMAINS A NATIONAL AND INTERNATIONAL OBJECTIVE. TODAY, THESE EFFORTS HAVE BEEN ASSOCIATED WITH TRANSPORT SYSTEM QUALITY CONSIDERATIONS, IN PARTICULAR FROM ENVIRONMENTAL, SOCIAL AND ECONOMIC PERSPECTIVES.

In terms of research organisation, after assessing current conditions and inventorying external needs (provided by the RFF and SNCF companies), an initial series of two research projects (PLATIF and VIF) could be validated, for implementation effective over the period 2010-2013. Devoted not only to rail platforms and track but also to all types of guided transports, both of these research projects offer an approach to analysing infrastructure broken down “by component”. This strategy is intended to facilitate the subsequent assimilation of other “objects” (bridges, tunnels, etc.) or other cross-disciplinary challenges (e.g. sustainable development and the environment, facility management, materials, instrumentation) by relevant Institute actors, in adopting the principle whereby each project must encompass for every single component examined all aspects relative to either the new infrastructure (design, etc.) or the infrastructure already in service (monitoring, etc.).

Four projects have been included within this part of orientation “S”. The first two provide breakthroughs in computation methodology: pavement structure design, and soil behaviour and structures through a finite element-based approach. The two remaining projects are run more like demonstrator projects: a footbridge made of composite materials, and specifications of an “invisible construction site”. The results of the first two projects have given rise to a more detailed presentation.

Ever-increasing needs in the areas of passenger and freight transport make it absolutely necessary to rely on infrastructure networks adapted not only to new constraints as regards user safety but also to changing operating conditions, with optimal integration into the environment.

Intended as a complement to the orientations established in under the “W” and “R” headings, the set of research conducted under orientation “S” comprises projects dedicated to either a specific topic (road safety), specific objects (rail), or broader considerations, focusing on structural design and computations, new materials and their monitoring.

As regards Road Safety, six projects raise the following issues:

- Impacts of lorry traffic on the safety and durability of transport structures: Plinfra.
- Measurements, predictions and management techniques aimed at roads and traffic during inclement weather conditions: PALM.
- Links between road perceptions and user behaviour: I2V.
- Evaluation and prevention of road-related risks, specifically those involving bicycles and motorcycles: PREVER.
- Pavement surfacing optimisation as a function of skid resistance, noise and rolling resistance from the time of service start-up until their renewal: ECOSURF.
- Traffic evaluation and improvement and the effects of traffic on both the environment and safety: SERRES.

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INFRACALL: The infrastructure-based “e-call” service

INFRACALL is an accident warning chain configuration activated via infrastructure. Comprehensive, this project comprises sensors able to detect the collision of a vehicle with the infrastructure, and extends through the transmission of an alarm to a call centre and its subsequent processing. Infracall is a project sponsored by the Single Interministerial Fund (FUI), conducted jointly by an infrastructure manufacturer (Aximum), a telephone operator providing the SMS connection (Bouygues Telecom), an automaker responsible for relaying to the call centre (PSA), and a motorway concessionaire (SANEF) offering a suitable test site. The LIVIC Laboratory was assigned the detection and analysis phases.

Sensors attached to the infrastructure are able to continuously measure the accelerations experienced by the infrastructure. A camera snaps a photograph, which is necessary for the operator to determine accident severity. A priority SMS message is then sent to the IMA (Inter-Mutual Assistance) warning processing centre.

The system has been validated during crash tests, the most violent being a frontal shock test at 110 km/hr with a vehicle weighing 1,300 kg. The most heavily exposed sensor transmitted its alarm in 30 ms and was able to detect a 45-g maximum acceleration. The alarm was sent in 30 seconds.

In conjunction with this testing campaign, a statistical accident study carried out in the Paris Region offered the opportunity to select test sites and improve understanding of the different types of accident zones.

The next step calls for instrumenting a shock attenuator placed on a motorway onramp under the jurisdiction of the SANEF network.

Detection of two-wheeled vehicles by means of fixed video sensors

Despite the decline of road deaths in recent years, the movements of two-wheeled vehicles in urban areas remain a potential problem. Infrastructure and behaviour are in some instances poorly adapted and generate difficulties in the mutual compatibility of each vehicle category.

The aim of this thesis, which is part of the METRAMOTO project, is to develop a tool to automatically count two-wheeled vehicles in urban areas using a fixed video system placed beside the road. This system must be able to count all vehicles and classify them into various categories.

For this purpose, we used two cameras to apply stereovision methods, in an effort to obtain the both the distance and dimensions of the various vehicles, in addition to reducing the detection errors linked to their shadow on the ground.

The approach uses two omnidirectional cameras with fisheye lenses, placed one above the other, on a pole about 10 metres aboveground facing down. These cameras are designed to cover the scene 25 metres all around the pole.

The initial tests, intended to determine the type of cameras used and their position relative to the observed scene, were conducted using the Pro-Sivic simulator. This software is able to simulate different types of video sensors and generate realistic scenes. These tests served to validate the sensor selection and justify the choice of optical wide angle (fisheye).

As a next step, these tests will be performed on actual intersections, using a prototype already produced with the configuration of cameras defined by simulations.
Environmental impact of the French Intelligent Speed Adaptation System (LAVIA)

In 1999, the French Ministry of Transport launched a significant program of experimentation and evaluation in order to assess the effects of different kinds of intelligent speed adaptation (ISA) systems in terms of driver acceptance and effectiveness of speed reduction in their daily trips. The LAVIA (Limiteur s’Adaptant à la Vitesse Autorisée) has been tested in France’s Yvelines department with three variants: advisory, voluntary limited and mandatory limited. An experiment carried out over a one-year period, on a sample of 90 drivers using 20 equipped vehicles, generated a considerable set of recorded data under natural driving conditions. Key results on safety have been reported in several papers. Besides the initial project objectives, which were restricted to acceptance and safety impact studies, it appears that a major aspect, in line with sustainable mobility challenges, concerns LAVIA’s impact on fuel efficiency. In this report, we presented the results of an extensive statistical analysis focusing on the respective impacts on fuel consumption of the system’s three variants. Several statistical methods, both descriptive and explanatory, were introduced in order to study their usefulness in analysing the natural driving data obtained from large-scale field operational tests (FOT). The impacts of the LAVIA system on fuel consumption are discussed in detail, along with the system’s interaction with posted speed limits, infrastructure type, trip goals and congestion levels. A discussion on the relationship between speed limit regulation policies and fuel consumption is provided as a conclusion.

Completion of the 11 S 063 project: Advanced tools for computing pavement structural design

This research project, extending between 2006 and 2010, was intended to enhance the French pavement design method, while developing a series of pavement structure computation tools. The project was conducted in partnership with the network of LPC, SETRA and STAC organisations, in addition to university partners.

An initial stage of the project was devoted to updating the Pavement Structure Design and Dimension Guide originally published in 1994. The second stage involved pavement modelling. Several computation tools were developed or improved, including the Viscoroute software application (for viscoelasticity computations), and two modules of the CESAR-LCPC structural computation code: CVCR (for viscoelasticity and nonlinear elasticity), and ORNI (for predicting rutting). Other accomplishments of this stage were modules for the ALIZE pavement design software dedicated to airport runways and special loads (e.g. industrial platforms).

The final stage associated with this project focused on analysing the behaviour of actual pavements and drawing comparisons with modelling output. An experiment was also performed on the fatigue carousel in order to study the effect of various types of loads (simple axle, double axle, triple axle) on asphalt pavements. Among the main results of this project, let’s mention: the Viscoroute software package, for producing quick computations of pavements in viscoelasticity, and the CVCR module (for viscoelasticity and nonlinear elasticity) as part of the CESAR-LCPC computation code; updates to the ALIZE software (for airport runways and special loads); latest update of the Pavement Structure Design Guide (to be completed in 2011), and the publication of a standard specific to pavement design (the NF P 98-086 Standard).

The pavement design standard was updated in 2011.
Progress report on the 11S 082 project: Use of finite elements in geotechnical engineering

Geotechnical projects, even the most common ones, are becoming more frequently justified by computations performed according to the finite element method. The incorporation of contacts between soils and structures, as well as soil constitutive laws (whose domain of validity rarely gets mentioned) and issues regarding the numerical quality of solutions (i.e. convergence quality obtained for iterative processes, appropriateness of the mesh for the given problem), are aspects easily capable of influencing the finite element analysis.

This project has been organised around four research approaches:
- analysis and evaluation of existing computation tools,
- influence of modelling processes and development of result quality indicators,
- critical analysis of computations relative to actual structural behaviour,
- recommendations for geotechnical structural computations by means of the finite element method.

In order to generate a choice of theoretical bases to be recommended, we’ve offered to develop a set of local error estimators capable of assessing, after execution of the computation, whether or not the mesh applied is sufficiently well adapted and, if not, to indicate the zone to be modified as well as the modification required.

From a more general standpoint, we’re proposing to improve the quality of how computations are used according to the finite element method, by highlighting the limitations of potential interpretations based on the results generated.

The beneficiaries of these research findings are all actors involved in producing finite element computation tools, designing structures and verifying computation protocols derived from these numerical analyses.

The SARI project: Multidisciplinary and complementary approach among actors

The SARI(1) project is a coordinated action programme sponsored by PREDIT that took place between 2005 and 2010, with the objective of improving road safety in rural zones where some 2/3 of all accidents occur, primarily as a result of loss of vehicle control.

SARI project financing: €4 million, Ministry of Ecology, Sustainable Development, Transport and Housing (OSDR and DRI).

26 public sector laboratories and technical research centres (CNRS, Engineering schools, INRETS, LCPC, CEA, CETE and universities).

3 Departmental Councils (Côtes d’Armor, Maine-et-Loire, Essonne).

11 firms (subsidiaries of major groups, and small and medium industries).

SARI: French acronym for Automated road monitoring.

“Designing a complement to current on-board safety technologies, with greater focus on processing road specifications and data on the road environment in order to introduce a safety dialogue with network users” was the stated mission of this action programme, which required developing coordination among a new set of research actors, including local and regional authorities, road-related industries and a broad cross-section of disciplines: applied mathematics; mechanics; automation, physics, dynamics, optics, signal processing, electronics, social psychology, law, and economics.

The involvement of local and regional authorities lent a real legitimacy not only in developing a series of relevant products, but also in verifying that product acceptability studies were appropriate.

The contributions received from CETE Technical Centres proved critical in terms of onsite road experiments, as CETE researchers provided the resources for evaluating and validating the effects of new systems.

The solutions proposed by SARI offered improved driver information on road conditions, which were responsible for a good share of accidents. This information, relayed by infrastructure facilities that were effectively localised, detailed and relatively inexpensive, required diagnostic tools in order to localise the most significant dangers and evaluate the risks incurred by users.

(1) SARI: French acronym for Automated road monitoring to inform drivers and facility managers.

This project was awarded the PREDIT President’s Special Prize at the May 2011 Crossroads event held in Bordeaux.

inrets / lcPc

Road visibility: A multidisciplinary approach.

Sébastien Glaser - iM/Livic

Development of a weigh-in-motion system.

Josselin Petit - iM/LePsis

Design and evaluation of a real-time, computer-generated image visualisation operator for driving simulators.

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RESEARCH ORIENTATION 3 / ACCIDENT ANALYSES, BIOMECHANICS, HEALTH FOR A MOBILITY THAT PRESERVES THE HEALTH OF BOTH USERS AND RESIDENTS

CONTRIBUTE TO THE BASE OF EPIDEMIOLOGICAL AND ACCIDENT ANALYSES TO BETTER UNDERSTAND THE INTERACTIONS BETWEEN TRANSPORT AND HEALTH. PROVIDE TOOLS TO IMPROVE ROAD SAFETY AT THE LOCAL LEVEL. PURSUE THE STUDY OF HUMAN BODY COMPLEXITY AS PART OF THE BIOMECHANICAL MODELLING PROCESS.

Three objectives listed in INRETS’ 2010-2013 four-year financing contract make direct reference to this research orientation, which combines the activities of one dedicated unit (MA) and three joint units (LBA, LBMC and UMRESTTE). The few examples selected to illustrate the significant results generated during 2010 only represent a small share of the broad range of research output by these units. Beyond focusing on Detailed accident studies and creating a Registry of road accident victims, several projects have specifically targeted improved knowledge of road-related risks. The list of principal keywords convey the standard accident scenario terminology, including: driving system malfunctions, dynamic vehicle activity, behavioural psychology, legal responsibilities, cognitive driving aptitude of the elderly, social and geographic inequalities, lapses in vigilance, alcohol, narcotics and medicines, safety enhancements and incorporation into regional management policy, as well as vulnerable user categories, causes of death or health care response for injuries.

The biomechanical approach entails modelling the human body in order to: predict the risks of developing lesions; evaluate and improve user protection and comfort; and provide vehicle design assistance. The research activities conducted within this field involve both modelling and experimentation and have been developed at various scales: human tissue, organs, and the human being itself. Moreover, as regards the environment, mention should be made of a study dealing with the effects of airplane noise on the health of airport area residents.
Disparity in road risk zones

The risk of being involved in an accident varies depending on the type of urban zone. This risk has been measured for residents of less privileged districts within the Lille Metropolitan Area and then compared with measurements for populations living in nearby more affluent districts.

The residents of designated Underprivileged Urban Areas experience, on the whole, a 36% greater risk of being involved in a road accident. This higher rate soars to 44% for men while remaining at 17% for women. Residents of these “at-risk” areas between the ages of 20 and 39 are 46% more likely to have an accident than their similarly aged counterparts in more well-to-do districts, yet this additional risk exposure drops to 28% for the 40+ age cohort.

For children, this upward bump in risk equals 10%, though let’s not overlook that underprivileged areas have a higher proportion of children in their demographic mix, with a quarter of the population aged 15 and younger. Children therefore present a significant road safety challenge.

Accident victims tend more often to be passengers or pedestrians, given that access to automobile ownership has become a source of new forms of inequality.

It can also be observed that for residents of such distressed zones, accidents occur closer to the place of residence (3.7 km) compared to accidents recorded in more affluent districts (4.3 km).

In many cases, actions prescribed within the scope of major urban projects consist of opening these districts to neighbouring zones with different demographics. Yet such initiatives raise the level of risk for all residents affected by the project, while the number of accidents related to strictly local activities, especially those involving younger pedestrians, is quite substantial. This number is likely to increase with the influx of new vehicles into the target area.

Building an effective model of a child

Since 2006, one of the LBA Laboratory’s main areas of research has focused on producing a digital model of the human child. Advances during 2010 have finalised the geometric characterisation of soft organ growth in both the thorax and abdomen. This research was coordinated within LBA around several Master’s degree internships, a doctoral thesis (Baptiste Sandoz, defended in January 2010) and the ANR-sponsored project entitled “Secur-enfant” (2006-2010).

Another breakthrough in 2010 was completion of the first digital model using finite elements of a 6 year-old child in its entirety with a reliable biological replication based on scanned images (torso and head), along with the scaling of an adult’s geometry (appendages). This model has made it possible to study the lesion-producing mechanisms when exposed to shock, and moreover the work programme has given rise to a thesis (François Couflageat, 2008-2011) and then partially included in the European project entitled CASPER (for “Child Advanced Safety Project for European Roads”, FP7, 2008-2011).

Once again within the scope of the CASPER project, anthropometric measurements on a sample of children 3 and 6 years old have led to highlighting shortcomings in the adaptability of seat belts and retention systems relative to human morphology. As an example, the current classification of child retention systems (car seats, booster seats) was found to contain a number of deficiencies in the “under 3” category.
Bicycle accidents: Cycling for sport is not the same as cycling for transportation

The accident rate for bicyclists on the road is far from negligible. The accident data currently disseminated overlook no less than 90% of cycling injuries, even more so when the injuries are less serious and/or self-inflicted (i.e. absence of a third party to the accident).

The Rhone Department’s Registry of Road Traffic Victims, based on statistics recorded by the care units at public and private hospitals, is much more comprehensive and realistic. It shows a total of 1,000 bicycle injuries a year for the department, compared with the 100/year figure reported.

The data for 1996 through 2008 (16,849 cyclists hurt on the road) indicate less severe accidents in cities than in rural areas, most likely due to the slower speeds travelled by both bicycles and motor vehicles. Registry data also demonstrate that wearing a helmet reduces the risk of serious head injury by 66% in urban areas and 93% in the rural zones.

A complementary survey conducted among a population of 898 cyclists found that the helmet is very well perceived and extensively used by sports cyclists, yet is not viewed favourably and only worn infrequently among cycling commuters or those who use their bicycle as a means of transport. Moreover, the focus on heightened visibility when riding in traffic, which constitutes an additional level of protection, remains poorly understood.

Three-fourths of urban cyclists are dressed in dark colours and 25% admitted to never riding at night with a light. An upcoming study will be dedicated to distinguishing among the standard bicycle accident scenarios.

Wearing a cycling helmet in the city reduces by 66% the risk of serious head injury.

Biomechanical characterisation of abdominal structures

New methods for biomechanical characterisation of abdominal structures have been developed. An experimental protocol has been set up to analyse the behaviour of the abdominal wall under two types of loads (uniform pressure and local contact). The deformation of several abdominal walls under these different loadings has been observed by using 4 video cameras. These cameras allowed performing stereovision on both the internal and external faces of the abdominal walls. Such protocol has been made possible thanks to 3 new equipments acquired during these last two years by the laboratory of biomechanics and impact mechanics with INRETS funding.

In parallel, tests for mechanical characterisation of the hepatic capsule, a planar fibrous connective tissue, have been performed.
Automobile driving is a complex task that requires strong perceptive, motor and cognitive capacities. As a result of the distraction induced, telephoning while behind the wheel could constitute an accident risk. As the new century gets underway, the majority of countries have not yet opted for an outright ban on telephone use when driving, like in France, but instead prohibit drivers from using the hand-held communication devices. Evaluating the efficiency of such a regulatory measure in terms of both acceptability and safety, in addition to drawing comparisons with other types of road safety enhancement measures and estimating the economic impact, offer the research paths intended to assist decision-making in the area of road safety public policy. The specific task assigned by the DSCR Directorate for Road Traffic and Safety to a group of CNRS researchers, Inserm and teams from Dest, Lescot, MA and Umrestte was to assemble a knowledge base from all this recent input.

A diversion of available attention resources, causing disturbance to the driving activity, is a practice experienced by nearly half of all drivers in France (particularly acute among youth, men and professional road users). One of the main conclusions drawn from this expert evaluation is that such diversions engender a threefold increase in the risk of having an accident, whether a hands-free device has been installed or not, with one accident in ten nationwide attributable to calling while driving. In spite of these findings, according to experts, drivers are still unable to fully assess the risk they’re taking when communicating behind the wheel, while institutional responses tend to be muted, with a focus on driver behaviour and introducing regulations. Until now, the socio-economic data available have not justified a ban on phone use while driving.

First, unidirectional tensile tests have been carried out on samples of superficial hepatic tissue. These tests allowed the quantification of hyper elastic properties of the hepatic capsule and some local failure criteria, especially, a strain failure criteria, defined from 2D full strain field measured by digital image correlation. Thanks to the acquisition of tools for 3D strain full field measurement (video cameras and software), the same type of characterisation has been carried out for a more realistic loading of the hepatic capsule, i.e. an inflation test.

Telephone and road safety: Sharing expertise with the Inserm Institute

A poster campaign to build awareness of the risk taken when using the phone while driving.

Thesis Defences

**Thesis Defences**

**Virginie Astier - LBA**
A Finite Element model of the articular shoulder complex: Applications to reconstructive surgery.

**François Gabriel - LBA**
Contribution of time-frequency techniques to the mechanical characterisation of the human body sustaining a shock.

**Anaïs Garo - LBA**
Biomechanical modelling of the effect of bone structure age: Application for the simulation of fractures.

**Baptiste Sandoz - LbMc**
Contribution to the geometric and mechanical modelling of the child’s torso.

**Raphaël Dumas - LbMc**
Methodological contribution to the three-dimensional kinematic and dynamic analysis of motion.

**Anaïs Hours - UMRestte**
Contribution to the study of health impacts due to environmental risks.
3. APPLICATION OF RESEARCH FINDINGS, INDUSTRIAL RELATIONS, EXPERT APPRAISALS

146 PARTNERSHIP CONTRACTS
€15 MILLION IN CONTRACT-GENERATED REVENUE
73 MISSIONS INVOLVING EXPERT APPRAISALS

Subsidiaries and joint ventures 59
Industrial relations 60
Expert appraisals 61
Testing 64
Patents 67
Equipment 68
Certification 69
Publishing policy 70
Publications and documentation 71
THE EXPERTISE DEVELOPED OVER THE COURSE OF EXTENSIVE RESEARCH PROJECTS AND PROGRAMMES, ALONG WITH A FULL RANGE OF FACILITIES AND SCIENTIFIC EQUIPMENT (SOME BEING ONE-OF-A-KIND IN FRANCE OR EUROPE), HAVE PROVIDED AN IDEAL SETTING FOR RESEARCHERS. THEIR IMPRESSIVE RESULTS HAVE GIVEN RISE TO A HIGHLY-FOCUSED APPLICATION STRATEGY THAT SPANS A VERY BROAD CONTINUUM FROM RESEARCH THROUGH INNOVATION. TO CONSOLIDATE AND BUILD UPON THIS MOMENTUM, THE INRETS AND LCPC ENTITIES HAVE BECOME HEAVILY INVOLVED IN COMPETITIVENESS CLUSTERS TIED TO TRANSPORT ISSUES, THE SUSTAINABLE CITY AND THE UTILISATION OF NEW MATERIALS, ALL WITH THE AIM OF STRENGTHENING FRANCE’S STANDING.

INTELLECTUAL PROPERTY

In 2010, the intellectual property efforts of these two entities remained above the average output for similarly-sized public-sector research laboratories, i.e. with a median annual value of more than 5 filings.

INRETS proceeded during 2010 with the filing of 11 intellectual property assets, including 4 patents and 3 software applications, while LCPC accounted for a total of 15 assets, encompassing 6 patents and 5 software applications.

PROMOTING A RESPONSIBLE FORM OF TECHNOLOGY TRANSFER

INRETS embraces the move to accompany innovation by participating in construction of the VALORIS platform, designed to mobilise the collective efforts of 30 leading actors from France’s major industries, small and medium firms and research centres. This initiative was launched by ANRT in March of 2010 and has been hailed as a reference for deriving economic value from public research findings. Moreover, it has provided a tangible national response to the Guide for a responsible partnership produced at the European scale. The relations nurtured by INRETS and LCPC with the professional community in the fields of transport and civil/urban engineering are reflected not only by both entities’ attention to technology transfer, but also by their mutual effort to stimulate the role of incubator.

In this context, the ErgOptim development process achieved a milestone with the vote of confidence in this new activity announced at the December 3rd, 2010 INRETS Board meeting. ErgOptim’s objective entails identifying application potential for the research results and expertise generated in ergonomics at the LBMC and LESCOT facilities. Relying on scientific methods and a software tool dedicated to advanced ergonomic simulation (RPx), these applications target large industrial clients, along the lines of Renault, PSA, Volvo Trucks, Alstom and SNCF (railway).

Initially set up in 2009, the project entitled “Luxondes” (instrument for measuring electromagnetic fields radiated by modern equipment, notably cell phones) has reached a maturation stage, as evidenced by the recent submission of a licensing approval request. The joint venture agreement signed on August 31st, 2010 between INRETS and ASF (motorway concessionaire operating in Southern France) sealed a partnership initiated several years prior to develop an alarm radio beacon intended to dramatically reduce the risk of pile-up accidents on motorways. This device was based on an initial patent and subsequently gave rise to a joint patent filing.
SUBSIDIARIES AND JOINT VENTURES
BROADENING THE SCOPE OF ACTIVITIES AND CREATION OF LCPC-EXPERTS

Acting to support researchers within the framework of European projects, the ERT organisation (Europe Recherche Transports) posted record turnover in 2010, topping €620,000. The outstanding performance of this subsidiary (100% held by INRETS) is owed to its effective participation in European projects devoted to transport, along with the renewal of its PCN (National Contact Point) Transport mission with the European Commission for years 2010 and 2011.

The INRETS/LCPC merger has apparently served to intensify ERT’s level of activity, especially in light of the upcoming calls for projects as part of the 7th R&D Framework Programme.

LIER’s testing activity has been slightly hampered by order cancellations due to the economic downturn. In contrast, numerical simulation projects have continued to expand, accounting in 2010 for a turnover of €300,000 vs. €179,000 a year ago, for a 67% rise. A key consideration here is that 38% of this figure was generated from studies conducted for foreign clients.

On the whole, LIER’s 2010 financial results remained quite stable, posting a total turnover of €2.238 million. Faced with the prospect of site relocation by 2012, the Laboratory became actively involved in the TRANSPOLIS project, sponsored by the LUTB cluster, alongside other major industrial partners like Renault Trucks, IRISBUS and UTAC, as well as a few academic partners.

The young start-up CIVITEC, 75% held by LCPC and INRETS with an equal split between the two, completed its first financial year of operations in 2010 with a turnover of €250,000. This entity proposes a platform dedicated to building models and running simulations of environment perception systems (sensors) and their control functions. The line of Pro-SiVic® software provides the automobile and vehicle safety industries with the capability to design, evaluate and validate system performance and reliability.

CERTIFER is a rail certification and appraisal organisation in which INRETS holds a 15% stake; despite competitive pressures, this entity has posted steady growth in activity. 2010 turnover exceeded €4.75 million, for a net gain of 21% compared to 2009.

INRETS is also a 2% shareholder in the former start-up CITILOG. World leader in the automated detection of road incidents through image processing with a relay to road facility managers, CITILOG suffered a setback in 2010 with the cessation of Chinese contracts, as these had constituted a significant source of overall activity. Yet the continuation of domestic project work, combined with an increase in recurring maintenance activities, compensated for a portion of this loss. The organisation’s total turnover declined 42% relative to 2009, from €5.5 to €3.2 million.

The year 2010 was highlighted by the creation of a joint appraisal subsidiary (LCPC-Experts) between LCPC (40% participation), Egis (40%) and the PRES UPE cluster (20%), combining to offer a contribution potential of some 3,500 researchers. This new entity provides service to professionals in the building and development industry, through proposing very highly-specialised expert appraisal missions. The objective pursued by LCPC-Experts is to quickly reach a turnover of €1 million and then extend to €3 million over a 5-year horizon.
INDUSTRIAL RELATIONS
EXPANDING RELATIONS WITH INDUSTRIAL PARTNERS

RESULTS
Despite the economic downturn, year 2010 further strengthened INRETS’ and LCPC’s reputations for scientific excellence among key socio-economic actors. The total amount of direct contracts concluded with industrial partners represented an increase of some 15% over 2009, climbing from €1 to €1.147 million. Among the most noteworthy joint ventures initiated, let’s cite cooperation with TOYOTA for the protection of senior drivers, EPSF for rail safety and ASF for highway safety.

The ratio of direct contracts entered into with small and medium firms to all direct contracts also rose, from 7% in 2009 to 11% in 2010. This growth, with further potential for improvement, reflects the organisation’s sustained efforts in promoting and disseminating research findings at various events sponsored by Chambers of Commerce and Industry, trade shows reserved for small and medium firms, in addition to initiatives directed at OSEO or the ANRT innovation agency.

PARTNERSHIPS WITH INDUSTRY
Shaped in large part by framework programmes signed with large firms operating in the road, rail and waterway transport sectors, strong relations have been built over the years with partners Alstom, RATP, SNCF, Valeo, Renault, Faurecia and Toyota, as well as in the infrastructure sector with RFF, EPSF and VNF, among others.

In 2010, INRETS organised or participated in several project reviews, seminars, daylong study sessions, trade shows and other events, offering in each instance a forum and meeting venue suitable for concluding direct contracts or initiating cooperative ventures.

Such was the setting for a presentation of research activities to the Federation of Rail Industries before an assembly of leading actors from throughout these sectors.

THE CARNOT NETWORK
Operating under the banner of the Carnot Institute since 2007, INRETS took the lead in coordinating the 2010 Land Transport Alliance event, combining 15 Carnot member institutes (out of the 33 active organisations), concentrating on issues in transport.

As the last year of existence for both INRETS and the INRETS Carnot Institute, 2010 was noteworthy for an intensive partnership-building campaign, in association with its main industrial partners in favour of the strategic programme choices made by INRETS’ Carnot Institute. Valeo, Renault Trucks and Alstom contributed to determining the proper allocation of the ANR Agency stipend towards financing source-related initiatives (green car, ERTMS, virtual man).

Since 2006, LCPC has been a member, along with the ENPC Engineering School, University of Marne-la-Vallée and Esiee, of the consortium entitled “Vitres” (acronym for City, Transport Infrastructure, Networks, Environment and Services), which offers the Laboratory the opportunity to boast the title of Carnot Institute member, This label promotes, among other things, collaboration with private sector partners and enables benefiting from ANR Agency financing, in an amount based on the sum of contracts signed with private partners. Every year, the Carnot-Vitres Institute has received between €370,000 and €470,000. This “allowance” serves to finance:

- scientific and technological resourcing projects (acquisition of scientific equipment, thesis scholarships, post-doc assignments, foreign missions, etc., within the scope of research projects conducted by the Carnot laboratories);
- so-called “profession-building” actions (e.g. legal support, intellectual property management, sharing of best practices and tools).

Over the past four years, 31 projects have been subsidised in this manner, worth a total amount of nearly €1.5 million.

COMPETITIVENESS CLUSTERS
Given the strength of its regional roots, INRETS played a very active role in 2010 overseeing the MOV’EO, I-Trans, ADVANCITY and LUTB clusters and moreover embraced the status of top-tier member within SYSTEM@TIC.

The level of trust established between cluster members was manifested by participating in projects sponsored by the Single Interministerial Fund, with a slightly higher number of projects despite a more restrictive selection process. The proportion of research contract allocations channelled via a cluster out of total entity resources amounted to 4% in 2010 vs. 3.7% in 2009.
EXPERT APPRAISALS

IFSTTAR’s research efforts rely upon the innovation expectations and needs expressed by companies, industry, project owners and public policy decision-makers gathered during consulting or appraisal missions.

LCPC appraises demonstrators used in the “Green Tax on Lorries” project

Within the scope of implementing measures adopted during the Grenelle Environment Roundtable, the Sustainable Development Ministry (Infrastructure, Transport and Maritime Affairs Directorate, DGITM), in conjunction with the Ministry of Budget and Public-Sector Accounts and Reforms (Customs and Excise Duties), initiated towards the beginning of 2009 a competitive process for introducing a green taxation system on lorries weighing over 3.5 tonnes throughout the national and local networks. The laboratory’s MACS Department based in Nantes (part of the GEOLOC Group) contributed its expertise to DGITM on satellite positioning.

The four candidates selected for this competition were asked to supplement their initial proposal and final bid with demonstrator systems. All four opted for satellite technology (GNSS) in order to detect lorry crossings at toll-charging points on the network, coupled with a data transfer protocol between on-board terminals and the computation centre through use of GSM technology.

The GEOLOC team was assigned to organise two testing campaigns (in March-April 2010 for the initial proposal and October-November 2010 for the final bid), with an additional contribution from CNES on quality aspects relative to the selected GNSS components.

These campaigns capitalised on the expertise and tools developed by the team regarding GNSS receiver evaluation, with an emphasis on the reference trajectory determination system. These tests made it possible to assess the robustness and maturity of on-board terminals equipped with a GNSS receiver. They also helped define mapping correlation software applications for detecting crossings at toll-charging points while travelling on the national and local road networks in French Departments 44 and 35.

Technical assistance for the quality approach adopted inside a Qatari laboratory

The QGOSM (Qatar General Organisation for Standards and Metrology) Laboratory, located in Doha, was awarded the ISO 9001 certification for its quality management system by the Bureau Veritas certification body in June 2010.

This milestone acknowledges the technical assistance offered by LCPC since 2007 to Qatar’s laboratories within the QGOSM group as part of the broader framework of a technical assistance contract signed with the nation of Qatar.

The impetus behind this mission was provided by EADS and the Welding Institute, two French companies involved in a Qatari joint venture (EADS-IS CCQ). Contractually bound with QGOSM, these two entities collaborated with LCPC Departments in order to assist the host country in refining its “civil engineering and road-related” activities. The LNE Laboratory was also requested for input regarding QGOSM’s other sectors (metrology, electrical devices, precious metals, etc.).
The quality manual has since become operational (V1.04), along with the process map. The training of laboratory personnel in both the quality approach and requirements associated with the ISO 9001 international standard was scheduled in English, with simultaneous translation into Arabic by an onsite interpreter. The next step will focus on certifying laboratory test procedures according to the ISO 17025 international standard, as COFRAC has accepted to conduct all evaluation steps until receipt of the corresponding certifications.

In all, LCPC and LPC network staff will have completed some 20 missions of one week each, broken down as follows: 4 missions on quality management, 2 on hygiene and safety, and 14 on quality testing in the three technical units of “Asphalt”, “Soils and aggregates” and “Building materials”.

The French delegation welcomed in Qatar.

Application of Galileo to rail localisation

Rail, like the other modes of transport, has been incorporating over the past decade or so satellite technology applications, especially those involving localisation (GNSS). The range of anticipated applications has widened thanks to the potential offered by European systems EGNOS then Galileo, whose services include information on signal integrity. These solutions pave the way to rail applications oriented around ensuring the safety of passengers and freight, though their performance under actual environmental conditions still needs to be demonstrated, along with proof of qualification and certification of future on-board receivers supporting this rail safety system.

The LEOST Laboratory has been examining these issues since 1998 and has progressed within the scope of the European project LOCOPROL or, more recently, the PREDIT project called Tr@in-MD. In 2008, the DGITM (Infrastructure, Transport and Maritime Affairs) called upon the team’s expertise to determine the array of potential GNSS applications in the rail sector and better identify the various obstacles, including the mandatory compliance demonstration of all new equipment (in this case, a GNSS receiver), plus meeting all rail safety requirements.

This field of investigation implies conducting studies under actual use conditions, in order to assess equipment performance and the impact of local receiving environments. The approach proposed in 2010, on behalf of DGITM, included a series of measurement processing methods to evaluate output on the basis of precision, availability, continuity and integrity. These methods were then implemented on recorded datasets to demonstrate their applicability when quantifying performance indicators.
French Guiana: Coming to the rescue of the Larivot Bridge

Built between 1974 and 1976, the Larivot Bridge is a strategic structure that enables the RN1 national highway to cross the Cayenne River in Guiana and connect the capital with Kourou, where the region’s space centre is located. 1,225 m long, this bridge rests on 34 piers, each composed of a massive reinforced concrete joist embedded into 6 inclined metal piles filled with concrete.

On November 25th, 2009 however, following a 21-cm subsidence of Pier No. 13 (see photo), the bridge was closed to all traffic. A committee of experts was urgently convened by the Infrastructure Directorate of the Guiana Public Works Office to assist in managing this predicament. The committee, presided by Thierry Kretz with the Setra Agency and on which Bruno Godart represented LCPC, was assigned to introduce strict monitoring controls at the bridge site, in addition to the emergency reinforcement of Pier 13, and inspection and diagnostic of the other piers. The committee was asked to propose reinforcement solutions that would lead to quickly reopening the facility to traffic. An underwater inspection revealed that a pile of Pier 13 had been sheared and cropped and moreover that the pier had been in a state of unstable equilibrium, whereby its collapse could, by means of chain reaction, cause the entire bridge to collapse.

As part of this joint appraisal mission, LCPC’s professional contribution focused on diagnostic methodologies pertinent to pile degradation, detailed monitoring and pile corrosion assessment.

Despite the availability of control methods specific to foundation pile integrity for built structures, these approaches were found to be non-applicable to this bridge’s submerged piles. An investigation carried out among companies working in the offshore business concluded that the diagnostic methods actually employed (ultrasound imaging, TOFD, ACFM, pulsed eddy currents, etc.) were not applicable to the case of this bridge. A team of divers was thus requested (after securing pier P13) to measure the residual thickness of the underwater metal pile sleeve at various points using an ultrasonic wave device, as this is the only non-destructive method capable of yielding quick and reliable results.

LCPC also participated in designing the close monitoring campaign and defining alarm thresholds. This campaign, intended to ensure the safety of personnel assigned to investigate and reinforce the structure, was launched by LRPC-Bordeaux by installing inclinometers on joists of several piers.

The reinforcement of Pier 13 relied on an underpinning step that consisted of building upstream and downstream of the pier (without destabilising it) two 4-pile platforms interconnected by a metal frame placed underneath the joist (see figure).

The next step was to explain the origin of these structural disorders. Pile failure was caused by corrosion due to dissolution. The role of microorganisms (i.e. biocorrosion) in accelerating this deterioration was indeed likely, though the welding seams were not implicated. The identified corrosion had caused local perforation of the sleeve at a spot where the concrete had decomposed, allowing the sleeve to be crushed and torn, followed by pile subsidence.

After mobilising the RST network in an effort to save the Larivot Bridge, French Minister Jean-Louis Borloo sent a letter of gratitude and congratulations.
Rail security: Detection of hot axle boxes

At the request of EPSF, two research units affiliated with INRETS, ESTAS and LTN combined their respective skills to tackle the topic of operational security and detection of hot train axles as part of the CAS-DBC project. The risk associated with undetected abnormal heating of a train axle box would be to trigger axle failure, which in turn causes train derailment with all the serious consequences that entails. By relying on results from ANR’s Deufrako ROSA research project as well as on available statistical data, this study sought to characterise, model and quantify the risk of an accident, along with each control measure by means of a safety systems approach. During a second phase, several cases of axle temperature rise were modelled so as to determine the best pace for introducing ground detection systems. In addition to the reports published, two parametric tools for quantifying the risk induced by the appearance of a hot axle box over the national railway network were submitted to EPSF.

Experimental validation of on-board lorry weighing systems

Lorries are subjected to various rules relative to driver qualification, speeds and loading weights. Each lorry is assigned a maximum permissible threshold beyond which the load is considered excessive. An overloaded lorry becomes unstable and, consequently, capable of causing accidents, particularly in the presence of strong winds during turns. An overloaded vehicle also causes infrastructure deterioration. On-board lorry weighing therefore offers a combined commercial, economic and social utility.

With the assistance provided by a weighing system, freight haulers load their vehicles appropriately in avoiding excess or insufficient loads. They’re able to identify the optimal loading that corresponds to a maximum use of vehicle capacity. From their vantage point, road and infrastructure facility operators rely on on-board weighing systems to assess fines for load limit violations, in an effort to eliminate a road hazard source.

Knowing lorry load weight in real time is highly useful information and has given rise to the following applications:
- in driving assistance systems, to prevent the risk of a lorry overturning;
- for controlling excess loads and avoiding pavement and bridge damage;
in order to calibrate the weigh-in-motion stations already installed at several sites.

The doctoral thesis defended in December 2010 established the conditions for installing an economical and reliable on-board weighing system in lorries, based on an estimation of dynamic impact forces.

The choice of appropriate lorry model to take infrastructure characteristics into account has been analysed, yielding a set of model parameters that enhance estimation reliability.

In order to validate the estimation algorithms, an experimental campaign run on a fatigue carousel, called the Accelerated Load Facility (ALF), was conducted in Melbourne during March 2010, in cooperation with the ARRB (Australian Road Research Board) Laboratory. A number of sensors, such as strain gauges, LVDT displacement sensors, accelerometers and pressure sensors, were installed onto the ALF (as illustrated in the figures).

Placed adjacent to wheel hubs, these gauges measure the amount of deformation due to shearing strain, hence the vertical force. This so-called axle instrumentation method provides a force measurement reference and allows drawing comparisons with model output.

As for eventual follow-up work, an experiment using a semi-trailer tractor is being prepared for the purpose of validating the test approach in real time on a track.

Development of a cyclic triaxial test on asphalt mixtures

In order to evaluate the rutting resistance of an asphalt mixture, the current approach adopted is based on tests using a rutting device capable of simulating the action of a wheel travelling over an asphalt plate. This test, which is quite reliable when classifying standard materials, has however demonstrated its limitations when determining the rutting resistance of pavements on trolleybus lines. Moreover, the temperature and pressure conditions are fixed and the applied loading is not homogeneous, making it poorly adapted to deriving constitutive laws.

In this context, a new temperature-controlled triaxial test on asphalt mixtures has been designed in conjunction with the doctoral thesis of Juliette Sohm. This test makes it possible to assess mixtures under stress states close to actual pavement loadings (either monotonic or cyclic axial stress, at a constant confinement pressure). The 80-mm diameter specimen is fitted with sensors for measuring axial and radial deformations according to variable parameters: temperature, axial stress, confinement pressure, and frequency.

This test enables analysing mixture behaviour subjected to a wide range of loadings: creep under static loads, short-term cyclic behaviour (complex modulus), and long-term cyclic behaviour (rutting). Its benefit lies in characterising innovative asphalt materials whose rheology remains relatively unknown (i.e. hot, warm or cold mixes, use of new binders).

Initial test applications were devoted to studying creep under a static load, leading to the development of a model for platform computations in the presence of static loading. Current studies are focusing on rutting characterisation and modelling, with severe and highly-concentrated traffic loads (trolley cars and buses).
Safer moving walkways for skiers

Subsequent to a fatal accident that occurred in 2004, a Ministerial order was issued to more strictly govern the operations of moving walkways, and its STRMTG Division (responsible for ski lifts and guided transport systems) was assigned to ensure compliance. The equipment managers were interested in increasing operating speeds from 0.7 m/s to 1.2 m/s, in order to convey more skiers to the tops of ski slopes.

To assess the risks tied to such an increase in speed while quantifying all eventual trauma sustained by users when activating moving walkway safety systems, the STRMTG Division requested the involvement of UNEx (acronym for INRETS’ Experimental Testing Unit). The ensuing testing campaign was intended to establish an original protocol, in addition to conducting a series of in situ tests and validating the technical safety solutions introduced by ski resort moving walkway manufacturers.

By taking advantage of the experience gained during crash tests, UNEx engineers simulated the hazardous positions of a 6-year-old child on a walkway moving at 1.2 m/s and then measured both the pinching forces acting on body members and strangling forces. At this age, the skier is quite vulnerable, especially when falling flat on the stomach or when an arm or scarf gets caught in the drive mechanism at the end of walkways. Generally speaking, at such high speeds, the primary risk for skiers occurs while exiting the walkway.

Engineers worked to modify the sensors on an impact dummy in order to adapt it for evaluating the risk of child injury caused under hazardous conditions (arm or scarf).

The data analysis provided by experimental measurement systems mounted on the walkway served to assess risk-making criteria and highlighted potentially dangerous situations.

UNEx proposed to its audience of manufacturers several leads for improving their products, including the possibility of reversing the system’s direction of rotation as well as simple solutions for manually releasing the drive mechanism powering the walkway. Following this testing campaign, a number of safety features were modified by manufacturers in an effort to upgrade installation safety.

Completely satisfied with the outcome of this initial round, STRMTG sought to standardise all facilities in use, namely by requesting UNEx to test the walkways of two other French manufacturers during 2011.

MEET UNEx

UNEx (or INRETS’ Experimental Testing Unit) began as a shared test platform offering the services of some ten engineers and technicians specialised in studying passive automobile safety and evaluating accident injury risks. This activity has been extended to assessing systems and structures exposed to shock, as well as characterising materials in a state of rapid dynamics.

UNEx allocates 70% of its activity to INRETS’ in-house research requests stemming from individual research units, with the remaining 30% devoted to expert appraisals or industrial services relative to facilities evaluation or new product development processes.

The unit’s knowledge base has been built through mastering rapid dynamic measurements, high-speed digital cinematography (1,000 to 10,000 images/second), plus a solid set of skills in metrology and the capacity to reproduce multiple configurations of shock test set-ups, from characterisations conducted on a few square-centimetre sample to a full-scale vehicle crash test on a dynamometric shock wall.

The testing facilities consist mainly of: a crash catapult (capacity: 2 tonnes, 120 km/hr), a shock simulation catapult mounted on a decelerating truck (capacity: 800 kg, 70 km/hr, programmable deceleration), 5 high-speed digital cameras, mountable shock data acquisition systems, impact dummies, and a set of over 400 sensors (measuring acceleration, force, displacement, moment and pressure).

The unit also offers an efficient technical team and fully-equipped workshop able to design and build a variety of experimental assemblies and prototypes, from simple sensor adaptation to the transformation of a vehicle into a driving simulator.
**PATENTS**

**“BIND”: A toolbox used to analyse experimental data**

Efforts to implement a shared software platform for interpreting the data collected during experiments on instrumented vehicles or simulators led, in 2010, to creating the BIND framework.

Developed in a Matlab environment, the BIND software may be considered like a toolbox dedicated to the analysis of experimental data. This application, inspired by the LESCOT approach to data modelling and benefiting from the extensive research performed on software architecture, has been designed to compile digital and videographic data as well as streamline access to these datasets in view of subsequent interpretation. Consequently, this framework proposes a number of high-level functionalities (e.g. data access control in both reading and writing modes, graphics module synchronisation, mathematical computations) that serve to quickly build processing scripts and analytical software; moreover, it promotes data use by supporting interactions between the team’s researchers and developers, which in turn accelerates the cycle of “defining operational hypotheses/statistical validations”.

Several data enhancement applications (video-based information coding, calculation of automatic indicators, etc.) have already been released thanks to BIND, thus providing the opportunity to take advantage of not only software developments but also expert knowledge in the area of data analysis. BIND has led to filing a declaration of inventorship along with a submission to APP. The choice of most suitable software licence for disseminating this state of progress is being decided. BIND inventors Arnaud Bonnard and Damien Sornette are currently tackling issues related to research applicability.

**Night fog detection by onboard vision**

The driving assistances are being enriched with vision capabilities. But degraded visibility conditions alter the operation of these systems. The night fog detection is a component, which allows characterising the video signal and realising new types of driver assistance.

The work presented was carried out as part of the projects ANR DIVAS and ANR-DEUFRAKO ICADAC. This work is of great interest to a French automotive supplier and a German car manufacturer.

The fog is visible through the interaction of light with droplets of water. At night, the light comes from street lighting and vehicles lights. Thus, the camera sees the presence of halos around light sources and a backscattering veil generated by our own lights. This veil is visible in the absence of external light sources. The achieved detection relies on the identification of these two phenomena. The developed system was tested on a vehicle from LIVIC, as well as with data obtained in the fog chamber of Clermont-Ferrand.

A software combining the two types of detection has been achieved and a patent is pending. This work will be pursued to quantify the characteristics of the detected fog, thus allowing the realisation of driver assistances which adapt dynamically to weather conditions.
EQUIPMENT

“VICTOR”: Instrumented vehicle used for studying driver behaviour

The project to instrument a new vehicle for the purpose of collecting data for input into an analysis of driving activity under in situ conditions was wrapped up in May 2010, with implementation of the VICTOR project.

The instrumentation found in the Peugeot 307 VICTOR, used as an acronym of “Instrumented Vehicle for studying Driver Behaviour”, was designed in order to measure, in as non-intrusive a manner as possible, a set of parameters capable of reporting on driver activity. Accordingly, a variety of systems collect information in real time relative to the driver (e.g. an oculometer, camera on the driver’s face), the vehicle (actions involving mechanics, dynamics) and the environment (GPS positioning). When experiments are run, researchers accompany the participant and record, by means of observation charts, a number of items in addition to the measurements. VICTOR has been equipped with dual controls, which allow for the presence of a driving instructor to ensure the safety of passengers and other road users. This protocol proves necessary during studies conducted on specific populations (e.g. individuals with a history of cranial trauma or afflicted with age-related diseases).

VICTOR, like its predecessor MARGO (LESCOT’s other instrumented vehicle), makes use of MOPAD, the laboratory’s Labview acquisition software. This design feature ensures both data collection homogeneity and compatibility with BIND, LESCOT’s data interpretation platform. VICTOR’s installation is very quick, though its technological possibilities remain limited: in essence, VICTOR offers a stable version of the developments previously tested on MARGO.

Since its introduction, 90 participants have already taken part in experiments using VICTOR. Vehicle designers Philippe Deleurence and Bruno Piechnik are currently working on the relevant documentation and quality procedures.

Implementation of the PEGASE generic map with field-specific applications

As part of its R&D efforts aimed at sensor networks, the MACS Department has developed a generic wireless platform capable of satisfying measurement and processing needs associated with heterogeneous and complex data: PEGASE (acronym for Generic Expert Platform dedicated to On-Board Wireless Applications).

Since February 2009, the PEGASE platform has been licensed by LCPC to the company A3IP (located in the town of Sautron in France’s Loire-Atlantique Department), which until now has sold around 200 units. The PEGASE system serves as the foundation for a turnkey solution to a structural monitoring set-up or else as a roadmap for development and rapid prototyping.

PEGASE has stimulated instrumentation renovation on the Ci-Bing Bridge in Taiwan by the French firm Advitam, whose capacity to communicate via the TCP/IP protocol has enabled tracking, both remotely and in real time, erosion phenomena on piles detected locally through a series of PEGASE maps equipped with accelerometers, inclinometers and water level sensors.

The PEGASE system also provides the basis of LCPC’s new CASC sensor, whose purpose is to acoustically monitor bridge cables. Over a 3-year period, some 20 PEGASE-CASC sensors were installed on the Ancenis suspension bridge to validate the new system under actual use conditions.

Several other specialisations have also been featured on the PEGASE map, including: real-time control of drinking water quality, pollution sensors placed in urban locations, and structural deformation indicators.

Moreover, a professional training module has been developed with a focus on the PEGASE system. A number of sessions have been (and will continue to be) hosted for companies, laboratories and LCPC’s partner schools.

Besides the intrinsic system improvements to be introduced as required, the MACS team has built into PEGASE the potential to operate around the clock on solar panels.
CERTIFICATION

ACQPA’s activities within the LCPC environment

Created in 1994, ACQPA (acronym of the Association for the Certification and Qualification of Anti-Corrosion Paints, and set up as a non-profit) includes LCPC as one of its founding members. This organisation delivers, via a third-party arrangement, a recognised French certification label for paints that provide structural protection. The association oversees three major aspects of the certification process that are both complementary and necessary: paint system quality (anti-corrosion, use in marine environments and concrete), qualification of painting staff, and qualification of supervision inspectors. ACQPA has therefore assembled all relevant actors concerned by the quality of structural protection; its members have been split into four boards (Designers, Producers, Applications specialists, and Technical centres/Experts). The independence of ACQPA’s decisions is maintained thanks to a well-balanced representation of these four boards on the association’s Board of Directors and various certification committees.

LCPC has been acting in the capacity of Secretary General since ACQPA’s creation, in addition to providing technical secretariat support to three certification committees related to paint systems. This responsibility implies managing 485 individual paint systems and another 250 products involving some twenty manufacturers. Moreover, ACQPA has certified 380 operators and 36 inspectors in 2010 alone, bringing its total personnel qualifications awarded to 3,566 operators and 260 inspectors. This strong spurt in activity necessitated creating and filling a permanent Managing Director’s post within the association.

As 2010 drew to a close, all activities heretofore performed by LCPC on behalf of the association were officially transferred over to ACQPA.

INRETS placed on the rails

The activities of certifying and evaluating rail system safety, whether conducted at ESTAS or LTN, are handled by assigning personnel or establishing industrial partnership contracts via the French Rail Certification Agency, which INRETS helped create at the request of the Transport Ministry.

The Institute has also been involved on its own behalf with project consulting assignments, such as in Lille for doubling the capacity of the metro system’s Line 1. In 2010, INRETS’ contribution was directed to the field of urban public transit focusing on electric tramway lines powered by ground sources in the cities of Angers and Reims, as well as on various automated pilots for the metro systems of Lyon, Algiers and Budapest. The automatic lateral guiding system on buses in Bologna was also appraised.

In the field of rail transport, INRETS advanced the certification process for many safety devices equipping the standardised European Train Control System (ETCS/ERTMS), including odometric systems, on-board calculators for French or other trains (Breda in Italy, Siemens in Germany), and equipment for signalling and switching stations. The Institute also has a stake in: service start-up of the renovated Bourg-Bellegarde line, introduction of ERTMS on the Eastern France-European high-speed rail line, and repeat participation in safety-related work on cross-Channel lines.

LCPC certification activities

LCPC, in partnership with the CETE regional research centres, has been pursuing certification activities either under its own aegis or on behalf of certifying bodies within the scope of subcontracted auditing and testing missions (AFNOR, ASQUCER, ACQPA, ASQPE, CERIB, AFCAB) on products used in civil engineering applications (steels, cements, aggregates, road equipment).

Since 2003 (as posted in the Official Journal, July 22nd, 2003 issue), LCPC has also been designated as a European “notified body” for the certification of industrial products, which includes placing the EC marking on aggregates. In this role, the Laboratory has awarded since May 25th, 2004 a total of 113 certificates to quarries for their mastery of the aggregate production process. These activities rely on the work of several technical divisions with COFRAC accreditation for testing, in accordance with Standard 17,025, and a COFRAC-accredited certification unit compliant with Standard 45011 for product certification system management. Sector managers lay out the annual monitoring plan and validate all pertinent certification decisions, while auditors assess the means of production and product quality and the certification unit oversees both the financial flows and contractual commitments.

The financing sources for certification activities stem entirely from fees generated according to certification guidelines or as specified in subcontracting agreements signed with the certifying bodies. For year 2010, a tally of these activities amounts to a revenue of €2.134 million for expenditures totalling €1.702 million.
PUBLISHING POLICY

INRETS’s and LCPC’s publishing activities constitute a natural outlet for disseminating knowledge and showcasing research findings. The Institute’s editions and publications are intended for scientific communities, technical companies, universities, public authorities and, more broadly, a civil society that knows no national borders.

2010 RELEASES COM普RISE

- 9 published texts, including one reprint, in LCPC’s Studies and Research collection (« Études et Recherches »)
- 5 published texts, including one reprint and one English language version, in the Test Methods collection
- 4 published texts, including one reprint and a CD-ROM, in the Technical Guides collection
- 3 books published jointly with the Sebra Agency
- 13 published doctoral theses
- 2 issues published of the Bulletin des Laboratoires des Ponts et Chaussées (BLPC) scientific journal
- 3 publications released in INRETS’ Synthesis collections
- 3 publications released in INRETS’ Proceedings collection
- 5 publications released in INRETS’ Research collection

Rounding out the Institute’s 2010 publication calendar are:
- LCPC’s 2009 Activity Report
- INRETS’s 2009 Activity Report
- Four-year financing contracts with the State
- Catalogue of Publications
PUBLICATIONS AND DOCUMENTATION

INRETS CONTACT: michele.bidal@ifsttar.fr

CASSIS: Open to the public

Access to the CASSIS documentary collection for the entire Internet community was made available during third quarter 2010, via the INRETS Website. The Institute considers this objective a critical one in that it provides the window to expose and allow consultation of research work and corresponding publications. Web users are able to find in this open archive system all references to INRETS’ scientific output and moreover are led to the unabridged text of these publications, in complete legality and in compliance with the rules of confidentiality. CASSIS also offers access to the catalogue of INRETS libraries, containing over 60,000 references in the transport field.

Various functionalities have been added to accompany visits to the site, including: export of bibliographical lists, shortcuts for triggering pre-established requests to list INRETS’ Collections or publication directories by year, and compilations of results. An online help tool is also available to visitors for consultation and/or download.

http://www.inrets.ressources-et-documentation/services-ist/cassis.html

INRETS / LCPC 2010 ANNUAL REPORT

LCPC CONTACT: sylvie.legret@ifsttar.fr

LCPC pursues its policy of storing publications in the “HAL” open archive

The Documentation Unit decided to set up a publications repository within the “Hal” system and has received subsequent support from the Laboratory’s Scientific Division. This publication storage facility has been streamlined thanks to direct interfacing between the in-house documentary portal Calliste and the open archive. A total of 224 publications were deposited during 2010, vs. 570 in 2009, the year this policy was adopted.

http://hal.archives-ouvertes.fr

NUMBERS OF VISITS DURING THE 10-MONTH PERIOD OF PUBLIC CONSULTATION

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http://www.inrets.ressources-et-documentation/services-ist/cassis.html
4. APPENDICES

AS OF JANUARY 1ST, 2011

1,313 LCPC’S 663 PERSONNEL
AND INRETS’ 650 PERSONNEL

11 SITE LOCATIONS

95 RESEARCH PROJECTS
AND MISSIONS

List of LCPC research projects and missions  74
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Human resources  86
Research entities listed by Ifsttar site  87
Acronyms  88
# LIST OF LCPC RESEARCH PROJECTS AND MISSIONS

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<tr>
<th>Project Code</th>
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<td>11N081</td>
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<td>11K091</td>
<td>PALM: Forecasts and Warnings during inclement Weather conditions</td>
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<td>11K101</td>
<td>12V: Impacts of visual indices dedicated to driving (formerly 11MEP1)</td>
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<td>11K102</td>
<td>FREVER: Risk prevention and evaluation (formerly 11K063)</td>
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<td>11M062</td>
<td>SERRE: Solutions to ensure environmentally-friendly road use</td>
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<td>Streamlining earthworks for cost-efficient and durable structures</td>
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<td>Green concretes - environmentally-sensitive concretes. Reductions in greenhouse gas emissions</td>
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<td>OPTIMIR: Road materials that consume less energy and fewer non-renewable natural resources</td>
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<td>Performance-based, probabilistic approach for the life cycle determination of reinforced concrete structures</td>
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<td>Durability and ageing of polymers used in the field of civil engineering</td>
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<td>11L091</td>
<td>AGREGA: Aggregates used in transport infrastructure construction causing fewer ecological impacts</td>
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<td>11L092</td>
<td>EFES: Evaluation and prediction of environmental impacts due to transport infrastructure</td>
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<td>11L093</td>
<td>Cementitious materials and manufacturing processes in pursuit of sustainable development goals</td>
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<td>11L094</td>
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<td>11L101</td>
<td>MATEOPT: Materials and Energy for Optimising civil engineering structures (formerly 11LEP2)</td>
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<td>11L102</td>
<td>ECG-Surf: Study of tyre-pavement contact to achieve optimal and sustainable properties of road surfacing materials (formerly 11LEP1)</td>
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<td>11L103</td>
<td>Impacts of low-temperature geothermal energy on soils, aquifers and structures (formerly 11LEP3)</td>
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<td>11LEP1</td>
<td>Mitigation of the climatic impact on transport infrastructure</td>
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<td>11M062</td>
<td>Rock-related risks</td>
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<td>Urban noise: Predicting noise in urban environments</td>
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<td>11M064</td>
<td>Hydrology in urban Environments</td>
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<td>11M065</td>
<td>Characterisation and treatment of stormwater drainage residue</td>
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<td>11M066</td>
<td>Seismic hazards and risks</td>
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<td>11M067</td>
<td>Drought: Evaluation of risks related to drought</td>
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<td>11M071</td>
<td>Vibrations: Reducing vibrations in urban settings</td>
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<td>11M072</td>
<td>OSS: Structures located in seismic zones</td>
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<td>11M081</td>
<td>Hydrology of suburban catchment basins</td>
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<td>11M091</td>
<td>SER: Networked sediments: A deterministic approach and operational implications</td>
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<td>PSUR: Soil conservation in both urban and road environments</td>
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<td>11M093</td>
<td>Natural risks: Mitigating the risks of ground movement in urban or sensitive zones</td>
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<td>11M094</td>
<td>Rockfalls and rockslides</td>
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<td>11M095</td>
<td>FURET: Invisible construction sites</td>
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<td>Predicting noise in external environments: From the regional to urban level (formerly 11LEP1)</td>
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<td>11M102</td>
<td>Sustainable stormwater management (formerly 11MEP3)</td>
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<td>11M103</td>
<td>GIFEAS: Dykes and waterway facilities: erosion, caving and earthquakes (formerly 11MEP2)</td>
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<td>11N051</td>
<td>Durability in rock formations - Underground storage</td>
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<td>13N051</td>
<td>ACTENA: Monitoring of inaccessible tensioned cables</td>
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<td>11N052</td>
<td>RSI: Prevention, modelling and repair of structures affected by delayed ettringite formation</td>
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<td>11N062</td>
<td>MOGC: Optical Methods for use in Civil Engineering</td>
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<td>Structural pathologies: Diagnostic and treatment of structural pathologies</td>
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<td>Optimisation of pavement maintenance: Incorporation of user and neighbour expectations, and environmental considerations</td>
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<td>11N071</td>
<td>Characterisation of thin pavement layers, asphalt concrete and infrastructure cladding materials by means of non-destructive methods</td>
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<td>11N072</td>
<td>SOLEM: Characterisation of Soils and Linear Structures through use of Electromagnetic Methods</td>
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<td>11N073</td>
<td>MADMECA: Life-cycle maintenance and extension for steel structures and cabled structures</td>
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<td>Internal pavement damage: Mechanisms and detection</td>
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<td>Management of structural risks</td>
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<td>11N091</td>
<td>Reinforcements using composite materials and bonded assemblies</td>
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<td>11N101</td>
<td>Ageing and maintenance of drainage networks and facilities exposed to biophysicochemical processes (formerly 11MEP1)</td>
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<td>11N102</td>
<td>Risks of internal swelling reactions in structural concretes on strategic facilities (formerly 11MEP2)</td>
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<td>11N103</td>
<td>SIPHREN: Instrumentation system for environmental risk prevention (formerly 11MEP3)</td>
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<td>11N104</td>
<td>Rail platforms and guided transport systems (formerly 11MEP4)</td>
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<td>21N04241</td>
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<td>11P052</td>
<td>CESAR-LCPC: Performance improvement and professional development</td>
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<td>11P061</td>
<td>TRIGNSO: Geotechnical surveying techniques, and geotechnical modelling of sites and structures – Soil and rock rheology</td>
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<td>11P062</td>
<td>Measurement of cracking impact on the behaviour and durability of structures made of cementitious composites</td>
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<td>11P063</td>
<td>Advanced pavement structure computational and design tools</td>
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<td>11P064</td>
<td>Modelling and numerical simulation of heterogeneous materials with a discrete composition</td>
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<td>Fondephy: Physical foundations of the mechanical behaviour of materials used in pavement structures</td>
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<td>PCINF: Physical Chemistry of Porous Media</td>
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<td>11P071</td>
<td>FONDAME: Soil Foundations and Improvements</td>
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<td>Use of finite elements in geotechnical engineering: Modelling of soil blocks and geotechnical structures by the finite element method</td>
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<td>Composi-Geo: Demonstrator of urban footbridges built using composite materials, with self-diagnostic capacity</td>
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<td>Rail track infrastructure (formerly 11L061)</td>
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<td>11P102</td>
<td>MansProd: Unsaturated granular materials and sustainable manufacturing processes (formerly 11L062)</td>
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<tr>
<td>11P103</td>
<td>Contributions of modelling in the field of sustainable construction (formerly 11L063)</td>
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LIST OF SPECIFIC RESEARCH ACTIONS UNDERTAKEN BY INRETS DURING 2010

ORIENTATION 1: MOBILITY, ENERGY AND THE ENVIRONMENT

BEST: EESt (Energy, greenhouse effect and transport): Quantification and evaluation methodology aimed at greenhouse gas emissions and pollutants generated by the transport sector.

LTE: Hybrid vehicles and vehicle dynamics: Braking optimisation on hybrid vehicles and the potential for recovering the corresponding energy.

Acceptability of innovative vehicles: Identifying individual factors (representations, appropriation) and social factors (acceptability) capable of either facilitating or hindering the substitution of a conventional vehicle by an electric or hybrid vehicle.

Use of electric vehicles.

Transport policies and climate change: An international comparison.

LTN Sarthe: Multicriteria optimisation of rail traffic with the goal of minimizing energy consumption.

LVME: Knowledge of professional trip-making: Gaining further knowledge of professional trip-making, understanding the determinants and share of overall mobility.

Map of airport locations and low-cost service offering: How is regional land use being reshaped?

SPLUIOTT: Organisation of package delivery services, by emphasising an understanding of constraints, especially in two specific areas: the sorting platform and local delivery routes.

INTEGRATIVE PLATFORMS (IP)

LPC: Lifelong learning: Compiling the body of knowledge produced by INRETS on lifelong learning (classroom education, driving instruction, licensing exam, post-license training, rehabilitation, training for older drivers).

LTN Marne-la-Vallée: ITQUR: “Innovations in urban and regional guided transport services”: Multidisciplinary approach involving improved public transit, especially guided services, in terms of performance, safety and competitiveness.

LesCOT: Situations involving transport for the disabled: Stimulating research on “Disabilities” at INRETS; improving the visibility of INRETS’ research activities on this topic; promoting synergy across the various approaches; positioning INRETS at the forefront of research conducted on disabilities.

LegSOT: GNSS: “Global navigation satellite system”: Developing and proposing a localisation system based on the use of satellites (GNSS) in order to meet the needs of transport system researchers and users.

SSTE: “Land transport safety and security”: Establishing a strategic SSST research agenda and pursue a number of research options around selected projects, theses and joint ventures.

GREtIA: ACTOR: “Social and functional acceptability of both technical and organisational changes”.

ORIENTATION 2: TRANSPORT SYSTEM QUALITY, SAFETY AND OPTIMISATION

LPC: Expansion of road/rail network connections.

LTN MV: “Diag PAC”: Converter for high-powered fuel cell placed in a default situation.

INTEGRATIVE PLATFORMS (IP)


Public participation in the Transport decision-making and research processes (IP 2: “Public conversation”).


LTE: Electric vehicles: Deriving a consensual scientific vision on the advantages and disadvantages of electric vehicles as an alternative to the internal combustion vehicle in order to limit environmental impacts in accordance with various use scenarios.

LVME: Local-level planning, spatial layout and the organisation of transport and mobility networks.

ORIENTATION 3: TRANSPORT AND HEALTH (ACCIDENT ANALYSES, BIOBMECHANICS AND HEALTH)


MA: Hybrid vehicles and vehicle dynamics: Braking optimisation on hybrid vehicles and the potential for recovering the corresponding energy.

INTEGRATIVE PLATFORMS (IP)

MA: Motorcycles: This platform is intended to unite researchers from both INRETS and outside entities specialised in the field in order to address issues, in all their multiple facets, relative to motorcycle use of the basic road traffic system.

COPIE: Pedestrian behaviour when interacting with the immediate environment, especially in an urban environment.

Database used for road safety research, instituted to fill a need for organisation, information and communication in the field.

UMRESETTE: Road Risks related to Work and the Workplace.

WHO (World Health Organisation) Centre for Collaborative Studies.

TESS-Ped (Transport, the Environment, Safety, Health issues in Emerging and Developing Countries): Promoting exchanges between teams or researchers working in similar countries or common topics across different regions of the world, consolidating multidisciplinary approaches, coordinating and expanding INRETS’ expertise and research capabilities; establishing lasting partnerships; and strengthening the Institute’s international visibility in this field.
## LIST OF COURSES TAUGHT
### 2009/2010 ACADEMIC YEAR

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EC: Ecole Centrale
ENSTA: Ecole Nationale Supérieure des Techniques Avancées
ENPC: Ecole Nationale des Ponts et Chaussées
PFE: Ponts Formation Éditions
ENP: Ecole Nationale des Travaux Publics de l’Etat
ENSA: Ecole Nationale Supérieure d’Architecture de Nantes
ESIS: Electrical Engineering School
EPSA: Institut Polytechnique des Sciences Avancées
IUP: Institut Universitaire Professionnel
IUT: Institut Universitaire de Technologie
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ENPE: École Nationale des Travaux Publics de l’État/IPSTA  
ESIEE: École Nationale Supérieure d’architecture de Nantes/ISEE  
IPSA: Institut Polytechnique des Sciences Avancées/ 
IUP: Institut Universitaire Professionnel/IUT  
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<tr>
<td>VANHOLME Benoit</td>
<td>LCPC</td>
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</tr>
<tr>
<td>VEIT Thomas</td>
<td>INRETS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VENTURA Anne</td>
<td>LCPC</td>
<td></td>
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</tr>
<tr>
<td>VEZIN Philippe</td>
<td>INRETS</td>
<td></td>
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<tr>
<td>VINOT Emmanuel</td>
<td>INRETS</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>WANG Xuguang</td>
<td>INRETS</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>YERPEZ Joël</td>
<td>INRETS</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>YLMAZ Deniz</td>
<td>LCPC</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

## FINANCIAL RESOURCES
### AND EXPENDITURES (EXCLUDING DEPRECIATION)

### REVENUES

<table>
<thead>
<tr>
<th>Source of Revenue</th>
<th>Euros</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Ecology, Energy, Sustainable Development and Regional Planning</td>
<td>45,826,659</td>
<td>80.4 %</td>
</tr>
<tr>
<td>Subsidy for public service provision</td>
<td>45,826,659</td>
<td></td>
</tr>
<tr>
<td>Ministry of Higher Education and Research</td>
<td>69,804</td>
<td>0.1 %</td>
</tr>
<tr>
<td>Subsidy for public service provision</td>
<td>69,804</td>
<td></td>
</tr>
<tr>
<td>Finalised contracts and support allocated to research activities</td>
<td>6,159,058</td>
<td>10.8 %</td>
</tr>
<tr>
<td>Research contracts signed with public or private sector third parties</td>
<td>2,412,229</td>
<td></td>
</tr>
<tr>
<td>Subsidies on research projects or programmes</td>
<td>3,746,829</td>
<td></td>
</tr>
<tr>
<td>Value generation from research activity and service provision</td>
<td>4,217,169</td>
<td>7.4 %</td>
</tr>
<tr>
<td>Fees for patents and licenses</td>
<td>339,021</td>
<td></td>
</tr>
<tr>
<td>Service provision</td>
<td>3,784,609</td>
<td></td>
</tr>
<tr>
<td>Service provision</td>
<td>93,539</td>
<td></td>
</tr>
<tr>
<td>Other subsidies and revenues</td>
<td>757,352</td>
<td>1.3 %</td>
</tr>
<tr>
<td>Other subsidies</td>
<td>549,286</td>
<td></td>
</tr>
<tr>
<td>Financial revenue and other earnings from ordinary operations</td>
<td>100,918</td>
<td></td>
</tr>
<tr>
<td>Exceptional earnings</td>
<td>102,941</td>
<td></td>
</tr>
<tr>
<td>Financial transactions - Fixed assets</td>
<td>4,207</td>
<td></td>
</tr>
<tr>
<td><strong>Total revenues</strong></td>
<td>57,030,042</td>
<td>100.0 %</td>
</tr>
<tr>
<td><strong>Carryover from 2009</strong></td>
<td>3,912,571</td>
<td></td>
</tr>
<tr>
<td><strong>Total resources</strong></td>
<td>60,942,613</td>
<td></td>
</tr>
</tbody>
</table>

### MANDATED EXPENDITURES

#### Breakdown of mandated expenditures by recipient

<table>
<thead>
<tr>
<th>Activity</th>
<th>Euros</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities performed by research entities</td>
<td>40,046,468</td>
<td>70.8 %</td>
</tr>
<tr>
<td>Road safety</td>
<td>6,448,732</td>
<td></td>
</tr>
<tr>
<td>Environment, natural risks and sustainable development</td>
<td>13,621,598</td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td>19,976,138</td>
<td></td>
</tr>
<tr>
<td>Joint actions</td>
<td>3,818,898</td>
<td>6.6 %</td>
</tr>
<tr>
<td>Exceptional testing facilities</td>
<td>535,813</td>
<td></td>
</tr>
<tr>
<td>Research applications</td>
<td>428,353</td>
<td></td>
</tr>
<tr>
<td>International exchanges</td>
<td>617,517</td>
<td></td>
</tr>
<tr>
<td>Scientific and technical publications</td>
<td>1,677,562</td>
<td></td>
</tr>
<tr>
<td>Scientific partnerships</td>
<td>218,558</td>
<td></td>
</tr>
<tr>
<td>Permanent training</td>
<td>340,995</td>
<td></td>
</tr>
<tr>
<td>Support functions</td>
<td>12,095,903</td>
<td>22.4 %</td>
</tr>
<tr>
<td>Social actions</td>
<td>666,422</td>
<td></td>
</tr>
<tr>
<td>Shared computer facilities</td>
<td>2,336,490</td>
<td></td>
</tr>
<tr>
<td>Property-related - maintenance</td>
<td>1,266,260</td>
<td></td>
</tr>
<tr>
<td>Property-related - major works, acquisitions, new construction</td>
<td>387,386</td>
<td></td>
</tr>
<tr>
<td>Head office overhead</td>
<td>5,054,300</td>
<td></td>
</tr>
<tr>
<td>Research entities' overhead</td>
<td>2,137,316</td>
<td></td>
</tr>
<tr>
<td>Financial transactions</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Other general expenditures</td>
<td>247,729</td>
<td></td>
</tr>
<tr>
<td><strong>Total expenditures</strong></td>
<td>56,561,269</td>
<td>100.0 %</td>
</tr>
<tr>
<td><strong>Carryover to 2011</strong></td>
<td>2,881,344</td>
<td></td>
</tr>
<tr>
<td><strong>Contribution to the reserve fund for financing head office transfer operations from Paris to Marne-la-Vallée</strong></td>
<td>1,500,000</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>60,942,613</td>
<td></td>
</tr>
</tbody>
</table>

#### Breakdown of mandated expenditures by type

<table>
<thead>
<tr>
<th>Type of Expenditure</th>
<th>Euros</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel expenditures on subsidies for public service provision</td>
<td>40,354,290</td>
<td>71.3 %</td>
</tr>
<tr>
<td>Other personnel expenditures (i.e. on research contracts)</td>
<td>1,474,588</td>
<td>2.6 %</td>
</tr>
<tr>
<td>Unscheduled operations and investment</td>
<td>13,809,192</td>
<td>24.4 %</td>
</tr>
<tr>
<td>Unscheduled operations and investment</td>
<td>1,266,260</td>
<td>1.6 %</td>
</tr>
<tr>
<td><strong>Total expenditures</strong></td>
<td>56,561,269</td>
<td>100.0 %</td>
</tr>
</tbody>
</table>
### REVENUES

<table>
<thead>
<tr>
<th>Source of Revenue</th>
<th>Euros</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministry of Ecology, Energy, Sustainable Development and Regional Planning</td>
<td>43,858,234</td>
<td>77.8%</td>
</tr>
<tr>
<td>Subsidy for public service provision</td>
<td>43,858,234</td>
<td>77.8%</td>
</tr>
<tr>
<td>Ministry of Higher Education and Research</td>
<td>214,315</td>
<td>0.4%</td>
</tr>
<tr>
<td>Subsidy for public service provision</td>
<td>214,315</td>
<td>0.4%</td>
</tr>
<tr>
<td>Finalised contracts and support allocated to research activities</td>
<td>8,899,205</td>
<td>15.8%</td>
</tr>
<tr>
<td>Research contracts signed with public or private sector third parties</td>
<td>1,458,006</td>
<td>2.6%</td>
</tr>
<tr>
<td>Subsidies on research projects or programmes</td>
<td>7,441,205</td>
<td>13.4%</td>
</tr>
<tr>
<td>Value generation from research activity and service provision</td>
<td>865,825</td>
<td>1.5%</td>
</tr>
<tr>
<td>Fees for patents and licenses</td>
<td>16,467</td>
<td>0.1%</td>
</tr>
<tr>
<td>Service provision</td>
<td>849,158</td>
<td>1.5%</td>
</tr>
<tr>
<td>Service provision</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Other subsidies and revenues</td>
<td>3,109,260</td>
<td>5.5%</td>
</tr>
<tr>
<td>Other subsidies</td>
<td>451,965</td>
<td>0.8%</td>
</tr>
<tr>
<td>Financial revenue and other earnings from ordinary operations</td>
<td>141,529</td>
<td>0.3%</td>
</tr>
<tr>
<td>Financial transactions - Fixed assets</td>
<td>2,515,766</td>
<td>4.6%</td>
</tr>
</tbody>
</table>

**Total revenues** 56,946,639

Carryover from 2009 0

**Total resources** 56,946,639

### MANDATED EXPENDITURES

#### Breakdown of mandated expenditures by recipient

<table>
<thead>
<tr>
<th>Type of Expenditure</th>
<th>Euros</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities performed by research entities</td>
<td>36,065,051</td>
<td>65.4%</td>
</tr>
<tr>
<td>Mobility, energy and the environment</td>
<td>10,583,645</td>
<td>18.9%</td>
</tr>
<tr>
<td>Quality, safety and transport system optimisation</td>
<td>17,048,480</td>
<td>30.2%</td>
</tr>
<tr>
<td>Transport and health</td>
<td>8,432,926</td>
<td>15.1%</td>
</tr>
<tr>
<td>Joint actions</td>
<td>3,534,032</td>
<td>6.4%</td>
</tr>
<tr>
<td>Exceptional testing facilities</td>
<td>1,629,053</td>
<td>2.9%</td>
</tr>
<tr>
<td>Research applications</td>
<td>335,981</td>
<td>0.6%</td>
</tr>
<tr>
<td>International exchanges</td>
<td>723,409</td>
<td>1.3%</td>
</tr>
<tr>
<td>Scientific and technical publications</td>
<td>420,321</td>
<td>0.7%</td>
</tr>
<tr>
<td>Scientific partnerships</td>
<td>425,258</td>
<td>0.8%</td>
</tr>
<tr>
<td>Support functions</td>
<td>15,519,471</td>
<td>28.2%</td>
</tr>
<tr>
<td>Social actions</td>
<td>92,397</td>
<td>0.2%</td>
</tr>
<tr>
<td>Shared computer facilities</td>
<td>2,539,499</td>
<td>4.5%</td>
</tr>
<tr>
<td>Property-related - maintenance</td>
<td>57,026</td>
<td>0.1%</td>
</tr>
<tr>
<td>Property-related - major works, acquisitions, new construction</td>
<td>223,635</td>
<td>0.4%</td>
</tr>
<tr>
<td>Head office overhead</td>
<td>2,518,907</td>
<td>4.5%</td>
</tr>
<tr>
<td>Research entities’ overhead</td>
<td>7,032,249</td>
<td>12.7%</td>
</tr>
<tr>
<td>Financial transactions</td>
<td>3,055,758</td>
<td>5.6%</td>
</tr>
<tr>
<td>Other general expenditures</td>
<td>0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

**Total expenditures** 55,118,554

Carryover to 2011 1,380,577

**Total** 56,499,131

#### Breakdown of mandated expenditures by type

<table>
<thead>
<tr>
<th>Type of Expenditure</th>
<th>Euros</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personnel expenditures on subsidies for public service provision</td>
<td>34,601,580</td>
<td>62.8%</td>
</tr>
<tr>
<td>Other personnel expenditures (i.e. on research contracts)</td>
<td>4,273,391</td>
<td>7.8%</td>
</tr>
<tr>
<td>Unscheduled operations and investment</td>
<td>16,008,943</td>
<td>29.0%</td>
</tr>
<tr>
<td>Unscheduled operations and investment</td>
<td>234,540</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

**Total expenditures** 55,118,554

100.0%
**APPENDICES**

1. **Yves Bamberger** - Director of Research and Development, EDF  
   - Ministry of Research: Laurence Piketty (appointee)  
   - Ministry of Higher Education: Daniel Garrigue (appointee)  
   - Ministry of Transport: Régine Bréhier (appointee)  
   - Ministry of Road Safety: Laurent Laure (appointee)  
   - Ministry of Health: Catherine Ferreol (substitute)  
   - Ministry of Interior: Emmanuel Briand (appointee)  
   - Ministry of Industry: Michel Ferrandry (appointee)  
   - Ministry of Defence: Thierry Brebeuf (appointee)  
   - Ministry of Higher Education and Research (MESR): Michel Gayagh (substitute)

**VICE PRESIDENT**

Yves Crozet - University Professor, Université Lyon 2  
- Climate-related negotiations (MeeDDM)  
- Researchers: Marie-Pierre Meynard (appointee)  
- Researchers: Francis Raymond (appointee)  
- Researchers: Dominique Bellanger (appointee)

**MEMBERS REPRESENTING THE MINISTRIES**

- Ministry of Research: Laurence Piketty (appointee)  
- Ministry of Higher Education: Daniel Garrigue (appointee)  
- Ministry of Transport: Régine Bréhier (appointee)  
- Ministry of Road Safety: Laurent Laure (appointee)  
- Ministry of Health: Catherine Ferreol (substitute)  
- Ministry of Interior: Emmanuel Briand (appointee)  
- Ministry of Industry: Michel Ferrandry (appointee)  
- Ministry of Defence: Thierry Brebeuf (appointee)  
- Ministry of Higher Education and Research (MESR): Michel Gayagh (substitute)

**ELECTED PERSONNEL REPRESENTATIVES**

Researchers:  
- Christine Boisson (appointee) - Director of Research, LCST  
- Martine Waild (substitute) - Research Project Manager, LEOST  
- Hugues Chollet (appointee) - Research Project Manager, LTN  
- Joël Leclerc (appointee) - Research Project Manager, LIE

**ELECTED PERSONNEL REPRESENTATIVES**

Researchers:  
- Fabien Chiappini (appointee) - Manager of the Research and Innovation Strategy Unit  
- Jean-Louis Chazelas (appointee) - Project Manager for Projects, Engineering and Capital Investment, RATP

**PRESIDENT OF THE SCIENTIFIC COUNCIL**

Christine Bénard  
Director of Research, MICHELIN

**GOVERNMENT REPRESENTATIVES OVERSEEING ECOLOGY, PUBLIC WORKS, TRANSPORT**

  - Jean-Louis Chazelas (appointee) - Project Manager for Projects, Engineering and Capital Investment, RATP  
  - Xavier Foata (substitute) - Manager of the Construction and Technical Policy Subdivision, General Directorate for Infrastructure, Transport and Maritime Affairs  
  - Philippe Bisch (substitute) - DHUP, General Directorate for Planning, Housing and Nature

**OTHER APPOINTED MEMBERS**

- Philippe Bisch - Scientific Director, IOSIS  
- Marie-Pierre Meynard - Manager of the Research and Innovation Strategy Unit  
- Antoine Frérot - Director of Research and Technology, SNCF

**ATTEND THE BOARD MEETINGS IN A CONSULTATIVE CAPACITY**

- Former President: Jean-Pierre Médevielle, Deputy Managing Director in charge of International Affairs  
- Former President: Bernard Cambou, Scientific Director  
- Former President: Dominique Nignot, Deputy Scientific Director

**ADDITIONAL ATTENDEES AT BOARD OF DIRECTORS’ MEETINGS**

- Olivier Havan, Louis Michel Boulet - Deputy Director, Nantes Centre, LCPC  
- Henri Van Damme - Scientific Director, LCPC  
- Jean Bonny - Director, LCPC  
- Dominique Payan - Secretary General, LCPC  
- Arnaud Depince - Accountant, LCPC  
- Christian Gaviériaux - Project Manager, LCPC

**COMPOSITION OF THE BOARDS OF DIRECTORS**

**YEAR 2010**

**INRETS**

**PRESIDENT**

Yves Bamberger - Director of Research and Development, EDF  
- Ministry of Research: Laurence Piketty (appointee)  
- Ministry of Higher Education: Daniel Garrigue (appointee)  
- Ministry of Transport: Régine Bréhier (appointee)  
- Ministry of Road Safety: Laurent Laure (appointee)  
- Ministry of Health: Catherine Ferreol (substitute)  
- Ministry of Interior: Emmanuel Briand (appointee)  
- Ministry of Industry: Michel Ferrandry (appointee)  
- Ministry of Defence: Thierry Brebeuf (appointee)  
- Ministry of Higher Education and Research (MESR): Michel Gayagh (substitute)

**VICE PRESIDENT**

Michel Ray - Technical and Innovation Director, EGIS

**GOVERNMENT REPRESENTATIVES OVERSEEING ECOLOGY, PUBLIC WORKS, TRANSPORT**

  - Jean-Louis Chazelas (appointee) - Project Manager for Projects, Engineering and Capital Investment, RATP  
  - Xavier Foata (substitute) - Manager of the Construction and Technical Policy Subdivision, General Directorate for Infrastructure, Transport and Maritime Affairs  
  - Philippe Bisch (substitute) - DHUP, General Directorate for Planning, Housing and Nature

**PRESIDENT OF THE SCIENTIFIC COUNCIL**

Christine Bénard  
Director of Research, MICHELIN

**GOVERNMENT REPRESENTATIVES OVERSEEING INDUSTRY**

  - François Raymond - Manager of the Office of General Affairs and Performance, General Directorate of Planning, Housing and Nature  
  - Xavier Foata - Manager of the Mineral Resources Division, General Directorate of Planning, Housing and Nature

**ADDITIONAL ATTENDEES AT BOARD OF DIRECTORS’ MEETINGS**

- Bernard Bachelier - Head of Budget Control Unit - MEEEDOM  
- Hélène Jacquart-Guimbal - Managing Director, LCPC  
- Olivier Havan, Louis Michel Boulet - Deputy Director, Nantes Centre, LCPC  
- Henri Van Damme - Scientific Director, LCPC  
- Jean Bonny - Director, LCPC  
- Dominique Payan - Secretary General, LCPC  
- Arnaud Depince - Accountant, LCPC  
- Christian Gaviériaux - Project Manager, LCPC
COMPOSITION OF THE SCIENTIFIC BOARDS

YEAR 2010

INRETS

PRESIDENT
Christine Bénard - Scientific Director, Technology Centre, MICHELIN Tyre Manufacturing Company

APPOINTED MEMBERS EXTERNAL TO THE INSTITUTE
Michel Amiet - DGA/DGET, Defence Ministry
Jean-François Huerre - Head of Safety and ITS, Legal and Institutional Relations Division, PSA Peugeot Citroën
Christine Bénard - President, Scientific Director, Michelin
Pierre-Étienne Gautier - Scientific and Technical Director, Innovation and Research Division, SNCF
François Combettes - General delegate to the RATP Innovation and Sustainable Development Mission
François Gardes - University Professor, Paris 1 Panthéon Sorbonne, Economics Department
Liisa Hakamies-Blomqvist - Director of NordForsk (Nordic Research Council)
Valérie Issaray - Director of Research, INRIA, ARLES Project

INSTITUTE PERSONNEL REPRESENTATIVES
Corinne Blanquart (appointee) - Research Project Manager, SPLOTT
Mireille Chiron (appointee) - Director of Research, UNRESTTE

INRETS/LCPC 2010 ANNUAL REPORT
JANUARY 1ST, 2011, IFSTTAR IS BORN

THE PUBLICATION OF DECREE NUMBER 2010-1702 DATED DECEMBER 30TH, 2010 OFFICIALLY FOUNDED THE FRENCH INSTITUTE OF SCIENCE AND TECHNOLOGY FOR TRANSPORT, LAND PLANNING AND NETWORKS (IFSTTAR). FOR A LOOK BACK AT 2010, A YEAR DEDICATED TO PREPARING FOR THIS MERGER.

Climate change and, more broadly, the challenges associated with sustainable development have placed constraints on our urban societies, requiring a drastic re-evaluation of regional development patterns, services and relevant engineering approaches. Against this backdrop, the French government has decided to unite the efforts of the LCPC Laboratory specialised in civil engineering research and the INRETS National Transport and Safety Research Institute, in order to address these challenges through a new public entity assigned the scientific and technological scope to authoritatively cover the fields of mobility and construction.

As of spring 2010, Hélène Jacquot-Guimbal, LCPC’s Managing Director, was appointed to head up the new entity emanating from the merger of these two research institutes. To ensure a successful outcome, Ms. Jacquot-Guimbal set up a number of working groups tasked with auditing the respective operating modes of the range of support services, with the aim of identifying synergies and potential discrepancies to be resolved. Upon completion of this analytical phase, an intermediate report was distributed to the various oversight Ministries.

During the second half of 2010, an intense team involvement in the project was focused on the priority objective of ensuring operational support services as of January 1st, 2011, the official launch date of Ifsttar, acronym for the newly-formed French Institute of Sciences and Technology for Transport, Development and Networks.

A NEW INSTITUTE, A NEW IDENTITY

A participative approach was adopted to help create a new identity for Ifsttar. A committee composed of some 20 volunteers from LCPC and INRETS met in a working group format to consult and direct steps towards establishing this future visual identity. Dubbed the “Brand workshop”, with branding implying identification of a logo, this workshop held fruitful exchanges between volunteers, observers and official representatives of the two organisations.

LOGOTYPE

A logotype composed of both a sign and a typeset.

SIGN

A sign that suggests synergy, complementarity and the connections between different professions.

TYPESET

Simple and solid: a lineal typeset (in a sans serif font)

Respected, serious and elegant: A streamlined typeset using only upper case lettering.
HUMAN RESOURCES
AS OF JANUARY 1st, 2011

BREAKDOWN OF PERSONNEL BY FIELD OF SPECIALISATION

LCPC
- Research and Expert appraisals
- Applications, dissemination and international action
- Support functions

INRETS
- Research and Expert appraisals
- Applications, dissemination and international action
- Support functions

663
LCPC STAFF (656.4 FTEs)

650
INRETS STAFF (633.66 FTEs)

BREAKDOWN OF PERSONNEL BY EMPLOYMENT STATUS

LCPC
- Administrative
- Technical
- Research

INRETS
- Administrative
- Technical
- Research

BREAKDOWN OF PERSONNEL BY AGE COHORT

LCPC
- 226 women
  - <25 years: 16
  - 25-40 years: 92
  - 41-55 years: 90
  - >55 years: 28
- 437 men
  - <25 years: 22
  - 25-40 years: 173
  - 41-55 years: 156
  - >55 years: 86

INRETS
- 282 women
  - <25 years: 31
  - 25-40 years: 119
  - 41-55 years: 101
  - >55 years: 24
- 368 men
  - <25 years: 52
  - 25-40 years: 148
  - 41-55 years: 107
  - >55 years: 61
RESEARCH ENTITIES LISTED BY IFSTTAR SITE

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

**LYON-BRON**
25, avenue François Mitterrand
Case 24
69675 Bron Cedex
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Research entities: LbMc / Lescot / LICIT / LITE / UMRESTTE / UNEA

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ACRONYMS

ADEME Environment and Energy Management Agency
AIE Permanent International Association of Road Conferences (World Road Association)
ALLENVI National Research Alliance for the Environment
ANCRE National Research Co-ordination Alliance for Energy Sustainability
ANR National Research Agency
ANRT National Research and Technology Association
ARRB Australian Road Research Bureau
BRGM Bureau of Geological and Mining Research
CEPER European Conference of Road Facade Managers
CEISAM Chemistry and Interdisciplinary Approaches: Synthesis, Analysis and Modelling
CEMAGREF National Centre of Farm Machinery, Agricultural Engineering, and Water and Forests
CERTU Centre for the study of networks, transport, urban planning and public buildings
CETE Public Works Design and Research Centre
CFTR French Committee to promote engineering techniques
CIFRE Industrial Agreements for Training through Research
CIRAD Centre of International Co-operation in Agronomic Research for Development
CNES National Space Studies Centre
CO Objective-based contract
COFRAC French Accreditation Committee
COGN European Co-operation in Science and Technology
DGA General Directorate for Armament
DGCCIS General Directorate for Competitiveness, Industry and Services
DGITM General Directorate for Infrastructure, Transport and Maritime Affairs
DOT Department of Transportation
DSCR Delegation for Road Safety and Traffic Conditions
EADS European Aeronautic Defence and Space Company
EASE Environment, acoustics, safety and eco-design
EMC2 Steel assemblies and complex composites
ENPTE National Engineering School of State Public Works
EPSF Public-sector rail safety institution
EQUIPEX Exceptional facilities
ERT European Research Transport (European Transport Research)
FHWA Federal Highway Administration
FOR Forever Open Road
FVI File listing compensated victims
GEPEA Food Processing and Environmental Engineering
GER Geotechnical Engineering, Water and Risks
GES Greenhouse gases
GIS Scientific consortium
GNSS Global navigation satellite system
IDDRIM Institute for Roads, Streets and Mobility-Enhancing Infrastructure
IDEX Initiatives in pursuit of Excellence
IEED Institutes for Excellence in the area of Carbon-Free Energies
IM Infrastructure and Mobility
INERIS National Institute on the Industrial Environment and Risks
INRA National Institute for Agronomic Research
INRETS National Institute for Transport and Safety Research
IRSN French Institute for Radiological Protection and Nuclear Safety
IRSTV Research Institute on Urban Sciences and Technologies
IRTS Technological Research Institutes
LABEX Laboratories in pursuit of Excellence
LCPC Civil Engineering Research Laboratory
LVG High-speed rail line
LIER INRETS' Road Equipment Testing Laboratory
LBPC Regional Civil Engineering Research Laboratory
MAT Materials
DGGDI General Directorate for Customs and Indirect Taxation
MEDDTL Ministry of Ecology, Sustainable Development, Transport and Housing
MESR Ministry of Research and Higher Education
NILIM National Institute for Land and Infrastructure Management
NIMES National Institute for Materials Science
OECD Organisation for economic co-operation and development
PACA French region comprising Provence, the Alps and the Riviera Coast
PARI Port and Airport Research Institute
PCRD Research and Development Framework Programme
PGCE Civil Engineering and Green Building Cluster
PIA Future investment programme
PREDITT Research and development programme for technological innovation in land transport
PRES Research / academic clusters
PRES WEB Research / academic cluster at the European University of Brittany
PST Science and technology clusters
PWRI Public Works Research Institute
RATP Paris' Municipal Public Transport Authority
RFiF France's railway network operator
RST Scientific and Technological Network
SATT Society for the Acceleration of Technology Transfer
SCOT Regional master plan
SCSP Subsidy for public service provision
SETRA Roads and Motorways Design Engineering Office
SITRASS International solidarity on transport and research in Sub-Saharan Africa
SINF French National Railway Company
SOA Buildings and structures
SOERE Observation and Experimentation System for Environmental Research
SPI Engineering Sciences
SPICGA Engineering Sciences, Geosciences, Architecture
STAC French Civil Aviation Technical Centre
STIM Sciences and Technologies in Information and Mathematics
TRB Transportation Research Board
UN United Nations
UPJ University of Paris-East
UPJ-M-LV University of Paris-East – Marne-la-Vallée Campus
USHIF Federation of French Road Builders Unions
WHO World Health Organization

ABBREVIATIONS OF INRETS RESEARCH OR SERVICE UNITS

DEST Department of Transport Economics and Sociology
ESTAS Evaluation of Automated Transport Systems and their Safety
GRETTIA Engineering of Surface Transport Networks and Advanced Computing
LA Bioinformatics and Proteomics Center
LBMIC Biomechanics and Impact Mechanics Laboratory (UMR-7 9405 IFSTTAR/University of Mediterranée)
LEMCOD Laboratory of Cooperative Mobility Measurement
LEGST Laboratory on Electronics, Waves and Signal Processing for Transport
LEGDOT Laboratory Ergonomics and Cognitive Sciences applied to Transport
LEGIT Transport and Traffic Engineering Laboratory (joint research unit ifsttar/ ENITE怎 School)
LPC Laboratory of Driver Psychology
LTV-Salory Research unit on New Technologies
LVMT City, Mobility and Transport Laboratory
LTE Transport and Environment Laboratory
MCA Research Unit of Accident Mechanism Analysis
UMR-ESTCEPSE Epidemiological Research and Surveillance Unit in Transport Occupation and Environment (UMR-1 9054 IFSTTAR/ENITE怎 School)
UNEX Experimental Safety Laboratory
SPLOTT Production Systems, Logistics and Transport Organisation and Work - Freight unit

THE ABBREVIATIONS OF THE DEPARTMENTS AT LCPC

Geotechnical Engineering, Water and Risks Department

GER

GER 1 Seismic risk and soil dynamics
GER 2 Behaviour of soils, rocks and structures
GER 3 Design of geotechnical structures
GER 6 Hydrology and drainage
GER 7 Water and soil pollution
GER 8 Earthworks and earth structures
GER 9 Physical models in geotechnical engineering

Infrastructure and Mobility Department

IM

IM 1 LEPSIS (Laboratory for Operation, Perception, Simulators and Simulations), a jointly-managed research unit
IM 2 LIVIC (Laboratory for Vehicle-Infrastructure Driver Interactions), a jointly-managed research unit
IM 6 EASE (Multi-Scale Approach to the Environment and Infrastructure Safety), a jointly-managed research unit
IM 8 AGIT (Transport Infrastructure Analysis and Management), a research unit

Measurement, Nondestructive Testing and Scientific calculations Department

MACS

MACS 1
MACS 2
MACS 6
MACS 7
MACS 8
MACS 9

Materials Department

MAT

MAT 1 Mix design and laying
MAT 2 Experimental behaviour and mechanical modelling of materials
MAT 3 Microstructure, durability and modelling
MAT 4 Physical and chemical behaviour and durability of materials
MAT 6 Aggregates and material manufacturing procedures
MAT 7 Materials for transport infrastructure

Structures and Bridges Department

SBA

SBA 1
SBA 2
SBA 6

Strengthening and durability of bridges
Metallic and cable structures
This document is the successful outcome of a collaborative effort. Warmest thanks are hereby extended to all contributors.