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IFSTTAR becomes Université Gustave Eiffel
IN BRIEF

IFSTTAR AND DLR ARE STEPPING UP THEIR JOINT COMMITMENT TO DEVELOPING INNOVATIVE MOBILITY SOLUTIONS AND APPROACHES THROUGH THEIR “INNOMOB” LABORATORY

On Thursday, November 21, 2019, IFSTTAR and DLR signed a second cooperation agreement at Hôtel Beauharnais, the residence of the German Ambassador in Paris. This is part of their cooperative work, which got under way in 2018 with the setting-up of the Innomob virtual laboratory.

This new agreement will broaden the activities of the two institutes in the fields of mobility, particularly in the areas of connected infrastructure, autonomous and electric vehicles, human/vehicle interaction, geolocation systems, traffic management, urban logistics, etc. As a reminder, this laboratory has set itself 4 challenges:

1. Assisting advances in mobility practices for the transport of passengers and goods,
2. Developing new data collection methods,
3. Promoting planning that is more supportive of clean mobility,
4. Analysing innovative solutions for the mobility of the future.

At a time when the climate emergency and the need to act are recognised by a great number of scientists, Innomob’s work is contributing to the collective effort to find sustainable solutions for transport. A number of working groups have been set up since the creation of the laboratory. Two workshops were held in 2019, one on the impact of autonomous vehicles on lifestyles and the other on planning models.
The SSHEAR project: firm recommendations for preserving bridges and waterway structures

Scouring, which is a major cause of damage to bridges, particularly during floods, was at the core of an ambitious partnership project led by IFSTTAR: SSHEAR (Soils, Structures and Hydraulics: Expertise and Applied Research), which is sponsored by the ANR (French National Research Agency). After more than 4 years of studies and field observations, the scientific and industrial partners are now presenting their recommendations, tools and methods for improving the prevention and management of the risks associated with this complex phenomenon.

“A real success!”. Christophe Chevalier, Director of the Soil, Rock and Geotechnical Works (SRO) laboratory, shared his enthusiasm at the end of the SSHEAR project’s presentation day. Organised on September 11 at IFSTTAR’s Marne-la-Vallée site, the event brought together nearly 80 participants: researchers, engineers, experts in engineering structures, representatives of infrastructure managers, engineering firms and local authorities... They all attended in order to discover the outcome of four years of work around the theme of scouring, which is “sediment erosion caused by the flow of water at the base of structures such as bridges, banks, dykes, offshore wind turbines, etc.” the researcher summed up. “It is a particularly complex phenomenon resulting from interactions between water, the soil and infrastructure”. How does it affect civil engineering structures? Potentially, it can lead to a deterioration in the stability of bridge piers, and sometimes, in the event of major natural disasters, the collapse of all or part of the structure. This was the case for the Wilson Bridge in Tours in 1978 or the St. Etienne River Bridge in La Réunion in 2007. “In the United States, for example, more than half the bridge failures are due to hydraulic problems,” explains Franziska Schmidt, a research engineer at the EMGCU laboratory.

As an ANR project involving researchers and road and rail infrastructure managers*, SSHEAR called upon experts in hydraulics, soil and fluid mechanics, structures, sedimentology, etc. Their research was based in particular on laboratory modelling and field observations and monitoring. Three different engineering structures were studied: a motorway bridge over the Loire in Orléans, “a massive prestressed concrete structure, representative of the constructions of the 1970s”; a masonry railway bridge near Limoges, on the river Aurence, “a watercourse whose level is highly reactive to rainfall” and, finally, a dyke that runs along the Allier in Saint-Loup (Département 03), “a structure that is subjected to the type of erosion that is typical of embankments”. These pilot sites were instrumented and the sediment, water level and flow velocity were continuously monitored. “How can scour be assessed based on the vibratory response of the structure? This is one of the major questions that interests us”, Franziska Schmidt also explained.

In the coming months, the results of SSHEAR will be presented in a guide that sets out recommendations for improving the management of scour risks. Ultimately, managers and the public authorities will have at their disposal new diagnosis and warning methods, but also innovative observation and modelling tools developed by the project partners: specific survey devices, the continuous vibration monitoring of structures, a risk analysis method... “They will be able to help identify and monitor the most at-risk structures,” enthuses Christophe Chevalier. This expertise is of interest to both national and international stakeholders, “in particular our Japanese partners at the University of Tokyo and the Railway Technical Research Institute (RTRI), who are confronted with many natural hydraulic risks like those caused by the recent typhoon Hagibis”.

La Réunion, 2007: collapse of the downstream bridge of the St-Étienne River during a tropical cyclone

Device for the continuous monitoring of the scour conditions installed under a railway bridge over the Aurence, near Limoges.

OUR RESULTS WILL HELP IDENTIFY AND MONITOR THE MOST AT-RISK STRUCTURES

* the GERS, MAST and CENGYS Departments at IFSTTAR, CEREMA, the FAST jointly managed research unit, Vinci Autoroutes, SNCF réseau and the Railenium IRT
In 2020, IFSTTAR is due to become Université Gustave Eiffel

On 1 January 2020, IFSTTAR, UPEM, Éav&t, EIVP, ENSG and ESIEE Paris will become one entity: Université Gustave Eiffel. These six educational and research institutions, with recognised expertise in the realm of sustainable cities, are combining their skills and know-how to create a new type of university that will be of international stature. This ensemble - the outcome of a shared history - will represent a quarter of French research on the cities of tomorrow. It will bring together multidisciplinary skills to conduct quality research in the service of society, offer training tailored to the social and economic world and support public policies.

You have before you what is the 17th and last issue of our magazine Trajectoire. We hope to see you again soon with a new publication format in order to follow the latest developments in our research and expertise at Université Gustave Eiffel.

Hélène Jacquot Guimbal, Managing Director of IFSTTAR

Some words from Université Gustave Eiffel’s founding institutions

“THINK DIFFERENTLY ABOUT URBAN GROWTH”
We will be among the first French national schools of architecture to become part of a university, and therefore to benefit from a stimulating research and training dynamic as well as additional resources. Our objective is to participate in defining a new role for technology in a world that is resilient and resource-efficient on the one hand, but also one where social and financial issues remain paramount. This is the great challenge facing not only engineers but also all those who design cities.

Amina SELLALI, Director of the École d’architecture de la ville et des territoires in Paris-Est (Éav&t)

“A NEW MODEL IN THE HIGHER EDUCATION AND RESEARCH LANDSCAPE”
As a response to a pressing societal issue - the city and the transport of tomorrow - the Université Gustave Eiffel project is an extremely exciting challenge. In particular, the University will promote the collective production of research, training, expertise and innovation on the subject of sustainable cities, but also help develop science that is open to society.

Gilles ROUSSEL, Chancellor of Université Paris-Est Marne-la-Vallée (UPEM)

“PROVIDING SOLUTIONS THAT LIVE UP TO THE ASPIRATIONS OF CITIES LIKE PARIS”
For us, as a player in urban engineering, taking part in this internationally present university project that focuses on the city of tomorrow is a tremendous opportunity. Our engineers will have access to new educational resources and the Institute will share its skills with the world of higher education. We will be better equipped to provide analysis, technical responses and public policy support that live up to the aspirations of cities like Paris.

Franck JUNG, Director of the École des ingénieurs de la Ville de Paris (EIVP)

“RESEARCH CONTINUUM THAT EXTENDS FROM FUNDAMENTAL RESEARCH TO FULL-SCALE DEPLOYMENT”
With its highly original design, Université Gustave Eiffel has two remarkable assets: a strong geographical presence with sites and campuses throughout France, and the support of a research organisation - IFSTTAR. In the field of urban sensors, for example, we will be present on a continuum that extends from fundamental research to full-scale deployment.

Jean MAIRESSE, Managing Director of ESIEE Paris

“A SET OF SKILLS TO ADAPT CITIES TO CLIMATE CHANGE”
Thanks to the diversity of the themes covered by its components institutions, Université Gustave Eiffel will be able to cover all the scientific and technical issues raised by the city of tomorrow. IFSTTAR will be a real asset, in particular thanks to its European dimension and its experience in project management and research accreditation.

Nicolas PAPARODITIS, Director of the École nationale des sciences géographiques (ENSG-Géomatique)
More wide-ranging scientific aspirations

Organising and leading research, supporting public policies and scientific cooperation, etc. How will Université Gustave Eiffel foster a multidisciplinary approach in the service of tomorrow’s cities? Some insights from Serge Piperno, Scientific Director of IFSTTAR.

Université Gustave Eiffel’s model of cross-disciplinary research leadership has been the subject of intense work which started in the mutual understanding seminars, continued in two multi-institution working groups and was discussed during meetings between the future university’s research entities. As when IFSTTAR was created, the objective was to bring together differing practices and cultures and build future relationships and interdisciplinarity in order to achieve a successful merger that goes beyond existing interactions, without making the organisation cumbersome or duplicating our major leadership systems: LabEx, research federations, I-Site “Springboard” projects, etc.

In addition to the functions of a conventional university, Université Gustave Eiffel will continue to perform those currently carried out by IFSTTAR as a targeted research organisation. It will thus be tasked with conducting fundamental and applied research, carrying out methodological studies, developing tests and prototypes, performing expert appraisals and advisory work, disseminating and promoting its research results, by means that will include technical regulations and standardisation, technical support, technology transfer and certification. This work will be based in particular on the university’s many outstanding facilities which are at the disposal of students, researchers and companies. Clean rooms at ESIEE Paris, SenseCity, Transpolis... all these facilities will help to increase collaboration with the institutional, academic and industrial partners of the founding institutions and encourage technology transfer and innovation.

The activities of the 1,100 permanent research staff (researchers, lecturers, engineers, technicians and administrative staff) at Université Gustave Eiffel will focus around the research units and departments evaluated in 2018-2019 by the Haut Conseil de l’évaluation de la Recherche et de l’Enseignement Supérieur (Hcères). There is no intention to modify the outlines of these units which stem from the founding institutions. They will be able to contribute to cross-cutting scientific leadership mechanisms relating to many areas of research and expertise: civil engineering, transport systems and infrastructures, urban resilience, geomatics, management of scientific and technological innovation, etc. They will bring together laboratories, researchers and doctoral students to offer multidisciplinary capabilities, particularly in the realm of the cities of the future.

Contribute to the scientific leadership of Université Gustave Eiffel

In October and November, a “collective intelligence platform” invited all the staff of Université Gustave Eiffel’s founding institutions to submit ideas, themes and action plans in order to work together to shape the scientific leadership of their future institution. This online consultation attracted more than 440 contributions which aimed to promote projects that would “give substance to the future establishment”. A summary of the proposals will be published in December and will lead to a call for participation starting in January 2020. Anyone who feels interested in scientific facilitation will then be invited to express their interest in the selected topics. The aim of the initiative is “to support greater mutual understanding and to take advantage of the diversity of Université Gustave Eiffel’s research assets”.

https://jeparticipe.univ-eiffel.fr/
New international opportunities

The intention was clearly stated from the very beginnings of the project: "While the institutions that make up the future University Gustave Eiffel are each well positioned in their specific area of activity, their collective international profile has yet to be forged. Together, they will have the size and leverage to address the interconnected themes of cities and transport". Agnès Jullien, IFSTTAR’s Director of European and International Affairs, confirms: "The addition of an educational role will provide Ifsttar with a quite new international profile". With the creation of Université Gustave Eiffel, the Institute will become part of a group with nearly 17,000 students, 500 doctoral students and 1,200 researchers and lecturers representing a quarter of French research on the cities of tomorrow. This will create the opportunity to extend cooperation agreements, the recruitment of doctoral students and international networks, European research and training projects, etc.

Université Gustave Eiffel will first of all make it possible to energise our partnerships in Europe and around the world. Later, it will have a showcase effect: the university will heighten our profile for students from all over the world and will thus facilitate the recruitment of doctoral students. In addition, the dissemination of scientific knowledge to young people who do not necessarily intend to pursue a research curriculum and its assimilation by professionals working on the ground will gain in quality and quantity. We can also imagine that this new profile will provide an opportunity for new partnerships - with local authorities in different parts of the world who wish to enhance their transport systems, for example. The FUTURE I-Site has already led to the development of incentive measures to promote international exchanges, particularly in relation to the actions of the International League on Sustainable Cities and the European Network of National Information Points (NIPs) on the City or the Institut des Hautes Études sur la Ville. Université Gustave Eiffel will share its current incentive measures in order to continue to support and develop them. There are many international opportunities and their creation always results from the meeting of two people. If there are more actors in the system, and effective international leadership around it, international dynamics will naturally develop. Everyone - researchers, lecturers, technicians, administrators - must seize these opportunities and make them a reality. It is only through a collective dynamic that we will develop a broader set of internationally coordinated activities and enhance our profile. It is a virtuous circle: the more we bring opportunities to life, the higher our profile will be with a corresponding increase in the number of opportunities.

TÉMOIGNAGE

AGNÈS JULLIEN, IFSTTAR’s Director of European and International Affairs

The intention was clearly stated from the very beginnings of the project: “While the institutions that make up the future University Gustave Eiffel are each well positioned in their specific area of activity, their collective international profile has yet to be forged. Together, they will have the size and leverage to address the interconnected themes of cities and transport”. Agnès Jullien, IFSTTAR’s Director of European and International Affairs, confirms: “The addition of an educational role will provide Ifsttar with a quite new international profile”. With the creation of Université Gustave Eiffel, the Institute will become part of a group with nearly 17,000 students, 500 doctoral students and 1,200 researchers and lecturers representing a quarter of French research on the cities of tomorrow. This will create the opportunity to extend cooperation agreements, the recruitment of doctoral students and international networks, European research and training projects, etc.
WHAT INNOVATIONS HAS UNIVERSITÉ GUSTAVE EIFFEL INTRODUCED FOR THE PROFESSIONAL INTEGRATION OF STUDENTS?

Muriel Jougleux: The university brings together a large number of institutions and will be a quite new entity in the French higher education, training and research landscape. This allows us to develop training that covers a broad spectrum, allowing students to acquire many different skills, with the ability to move easily from one institution to another.

We are working together to ensure that our students find a place in the labour market quickly. We therefore focus on apprenticeship and the quality of the tasks entrusted to our apprentices, which we consider to be crucial, as well as the quality of the relations between students and their supervisors. In addition, we focus on the development of entrepreneurship among students and researchers, by encouraging the creation of start-ups.

WHAT DOES UGE PROPOSE IN THE AREA OF CONTINUING EDUCATION?

M.J.: Our offering will focus in particular on the theme of the city, a broad subject on which we have expertise in high-level research and training: smart and sustainable cities, mobility and transport, home automation, etc. We apply a transdisciplinary approach to this theme, combining the contributions of the so-called “hard” sciences with those of the human and social sciences, such as sociology and urban planning. These ongoing training courses are aimed in particular at our socio-economic partners in the domains of the city and transport. They are prepared with a view to ensuring that they are clear and that the institutions that are grouped together within Université Gustave Eiffel complement each other’s expertise.

WHAT DO YOU OFFER IN THE WAY OF PARTNERSHIPS?

M.J.: To be proactive, we are creating a “Partnership House”, a kind of one-stop shop for businesses and organisations. It will bring together all our training, expertise and research services, with the aim of meeting the needs of companies as fully as possible. For example, for their experiments on the sustainable and resilient city, we place “clean rooms” and test platforms at their disposal on our various campuses where they come to test vehicles and materials, etc. This offering is part of Université Gustave Eiffel’s bold international positioning. To develop it under the best conditions, the founding institutions have been working together on the issue of partnerships based on a joint information system since the start of the academic year 2019. We are also building a network of alumni, in the knowledge that all those who attend our university will be potential partners in the future.

APPRENTICESHIP MAKES IT EASIER FOR OUR STUDENTS FIND A PLACE IN THE LABOUR MARKET QUICKLY

A unique one-stop shop designed to best meet the needs of businesses

Muriel Jougleux is the Vice-President in charge of Partnerships and Professional Integration at Université Gustave Eiffel. She outlines the innovative and ambitious policy of this new body which deals with the professional integration of students, continuing education and partnerships with companies and organisations.
The benefits of nature in the citysolutions

Psychological well-being, improvement of soil quality, thermal and acoustic comfort... Nature has much to offer as a means of improving the living conditions of city dwellers. “It is a way of reducing the negative effects of urbanisation and adapting cities to climate change” affirms Katia Chancibault, a specialist in urban hydrology at the Water and Environment Laboratory (LEE). Together with other Nantes-based colleagues from her laboratory and the Environmental Acoustics Laboratory (LAE), since 2017 she has been participating in Nature4Cities, a European project coordinated by the Nobatek research centre. Within an interdisciplinary consortium, IFSTTAR researchers are working with academics, industry and SMEs towards two major goals: “To gain a better understanding of the role of vegetation in urban areas and to provide communities with an assessment and decision support tool”. Four pilot cities are also involved: Alcalá de Henares (Spain), Ankara (Turkey), Szeged (Hungary) and Milan (Italy). Each of them is working on a development project that incorporates nature as an answer to various problems: seeking thermal comfort for the Spanish city, improving rainwater management and well-being for Szeged... “The strength of the project lies in its systems approach, the study of the combined effects of different solutions on soil pollution, the management of vegetated areas, property values...” The partners are now developing a digital platform to encourage and improve the incorporation of nature-based solutions within urban development projects. It will be available to municipalities, experts and citizens from 2020, and will provide an evaluation of projects based on, for example, the issues to be resolved and parameters such as the vegetated surface area they provide, the climate and type of soil, etc. The aim is to help cities develop “scientifically effective, socially acceptable and economically viable solutions”.

New natural hazard protection solutions

Rock falls, debris flows, mud flows... Due to climate change, these violent mountain geophysical phenomena are becoming ever more frequent. In order to provide municipalities and local authorities with more effective protection solutions for areas that are under threat, five industrial and scientific partners* launched PRIDYN, “Protection against dynamic natural risks”, in 2016. The goal of this project which is funded by the FUI (the French government funding agency) is to create four innovative protection devices: “Rockfall detection systems (RDS) mainly for rail network concessionaires, the first textile and steel composite rockfall protection netting, flexible mud flow barriers and rockfall protection netting using forest cover instead of anchor posts”, explains Patrick Joffrin of the Rock-related Risks and Geotechnical Structures Laboratory (RRO/GERS). Near Chambéry, this research engineer conducts full-scale tests of the various installations using the IFSTTAR rockfall test station co-operated by CEREMA. “Two patents in the field of rock barrier construction have already been filed by GTS and tests will continue until 2021.”

* The companies GTS (a subsidiary of the NGE group), SITES and TEXINOV, IRSTEA and IFSTTAR.

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How can we improve safety at level crossings?

One death and nearly one serious injury every day. These are the tragic statistics of level crossings in recent years in Europe. “About 30% of rail accidents take place at these intersections between road and rail, most of them due to poor road user behaviour”, Mohamed Ghazel explains. This senior researcher at the ESTAS laboratory is involved in the 3-year SAFER-LC collaborative research project launched in 2017. Coordinated by the International Union of Railways (UIC), it brings together 17 European partners including IFSTTAR, SNCF and CEREMA. Their aim is to improve level crossing safety. They hope to achieve this by developing new tools, technologies or procedures: video surveillance and automatic incident detection systems, connectivity between vehicles and infrastructures, predictive maintenance techniques, etc. These innovations could, for example, automatically trigger the closure of barriers by geolocating an approaching train, or issue a warning to nearby vehicles and traffic control centres. The experts are as interested in evaluating the performance of these solutions as they are in analysing the human factor: “Our priority is to seek solutions that will have a real impact on users’ behaviour”. In this context, IFSTTAR is, in particular, coordinating a working group that focuses on analysing the costs and benefits of the developed solutions as well as their future implementation framework. At the end of a final meeting scheduled to take place in Paris in April 2020, SAFER-LC’s partners will share their recommendations and methodologies for “deploying effective technical solutions”. These will help European road managers and railway operators to design and operate safer level crossings, in particular the 15,000 or so level crossings in France, the vast majority of which are located on municipal roads.

Software to optimise freight train management

From the outside, managing freight trains in marshalling yards seems to be a real headache. Which sidings should be assigned to trains on arrival? Which locomotive should be chosen to sort the wagons? How should a new train be formed to send the individual wagons to their final destinations? “Marshalling is a complex process,” says Joaquin Rodriguez, the head of IFSTTAR’s ESTAS laboratory (COSYS). “There are many aspects to bear in mind depending on available resources and arrivals and departures because marshalling yard managers are required to comply with the slot times (running rights) that the network manager has assigned to outgoing trains”. To help managers make the best decisions, information technology researchers from his laboratory and LÉOST (COSYS) are collaborating on the Horizon 2020 project known as OptiYard. The aim is to develop an IT tool to help optimise the performance of marshalling yards and multimodal transport hubs. Launched in 2017 as part of the Shift2Rail* call for applications, the project is led by the International Union of Railways (UIC) and involves partners from 8 European countries. In particular, IFSTTAR’s teams have contributed to the development of software based on an algorithmic method known as “stochastic searching”: “The idea is to fully automate the marshalling process in real time with a moving time horizon, in other words to modify the planning of tasks as and when needed”. The solution is now being tested in a digital simulation environment at the marshalling yard of Česká Trebová (Czech Republic) and the multimodal port of Trieste (Italy).

* European Joint Undertaking for the modal shift to rail.
At a time when discussions are resuming on the 80 km/h speed limit, the first accidents have occurred that involve electric scooters or other PMDs (personal mobility devices) and autonomous vehicles are being developed, Trajectoire presents an overview of the many projects being undertaken at IFSTTAR in the field of road safety, one of the institution’s longstanding cross-cutting research topics.
The statistics are well known, and merciless. Since 2010, not a year goes by without at least 3,250 deaths and 70,000 injuries on the roads of metropolitan France. How can we reduce this toll stubbornly excessive toll? “It has become increasingly difficult to reduce the number of accidents and fatalities on the roads since the introduction of automatic speed cameras in 2003,” according to Marie-Line Gallenne, Scientific Director in charge of IFSTTAR’s scientific coordination. “We are also seeing a disparity between scientific knowledge and the understanding of citizens who too often consider themselves to be road safety experts. Acceptance of measures by the population and listening to scientific discourse can be decisive for improving safety,” in this researcher’s view.

Reducing road accidents is one of IFSTTAR’s main scientific goals. Nearly a third of the Institute’s work is directly related to road safety. An example of a recent achievement is the introduction of an 80 km/h speed limit on single carriageway secondary roads in July 2018. This measure, which, according to the ONISR*, saved 206 lives in its first year, was introduced on the basis of IFSTTAR’s scientific findings. “It is currently the subject of requests for waivers, but the relationship between speed and mortality is obvious as a result of vehicle deformation, anticipation time, braking distance, etc. In France in particular, road users think more about the constraining impacts of measures than about their safety”, Marie-Line Gallenne regrets.

With their involvement in the Committee of Experts of the National Road Safety Council (CNSR) (see next page), in permanent consultation with the Road Safety Authority (DSR), the Institute’s teams are contributing to the development of public policies to improve road safety. “We deal with the subject from start to finish: accidents, infrastructure-related risks, vehicles and practices, reliability of transport systems, user behaviour, automated vehicles, and the effects of alcohol on driving.... Our work can support public policies in many ways,” confirms Marie-Line Gallenne. What are the Institute’s strengths? “Its facilities and expertise” she answers without hesitation. For example, since 1995 IFSTTAR has been developing and sharing the ReVARRhone database. This register of traffic accident casualties in the Rhône Département provides valuable data on the characteristics of casualties and accidents, injury profiles, hospitalisation durations, care pathways, etc. The register also provides information on the number of casualties and accidents in the Rhône region. Another example is in Salon-de-Provence where the Accident Mechanisms Laboratory (LMA) carries out Detailed Accident Studies (DAS) so we can better understand the malfunctions of the road transport system. Finally, IFSTTAR’s test tracks, driving simulators and instrumented vehicles also contribute studies and experiments to improve our knowledge and understanding of road safety risks. These tools and facilities are used by researchers from various disciplines: sociology, psychology, medicine, mechanics, physics, communication systems, etc.

At the European and international levels, IFSTTAR has a presence in the main associations working in the field of road safety, such as FERSI (Forum of European Road Safety Research Institutes), PIARC (World Road Association) and IRTAD (International Road Traffic and Accident Database). Many collaborative projects also link the Institute to industrial partners (vehicle and vehicle equipment manufacturers, etc.), university laboratories, local authorities and other research bodies such as CEREMA and INSERM. These projects focus on the use of smartphones while driving, protection equipment for two wheeled motorised vehicles, the behaviour of pedestrians on level crossings when they encounter an autonomous vehicle, and so on.

**USERS THINK MORE ABOUT THE FINANCIAL IMPACTS OF MEASURES THAN THEIR SAFETY**

To enable readers to better understand the different aspects of accidents and road safety in order to have an informed and dispassionate opinion. This is the aim of a book published in May 2019 that was supervised by three researchers from IFSTTAR. It reviews the latest research in road safety, conducted by the Institute but also by CEREMA, INSERM and at universities. Casualty trauma, the role of infrastructure and vehicles, the cost of accidents, the involvement of alcohol and drugs, etc. These themes are all covered in the book’s four main sections which present 21 original contributions. Each theme is accompanied by intervention strategies to improve safety. Aimed at a wide audience, the book provides accessible explanations of complex phenomena.
Our recommendations also had a major influence on the Mobility Policy Bill

Can you let us know about some of your recent work?
The most recent reports we have submitted include the one on electric personal transport vehicles: scooters, rollerblades, giropods, hoverboards, etc. What rules should apply to their use and the way they share public space? What safety equipment should be made mandatory? Our recommendations also had a major influence on the Mobility Policy Bill (Projet de Loi d’Orientation des Mobilités). We have also produced other reports on pedestrian accidents, road safety issues related to automated driving and, more recently, on the waiver of the 80km/h maximum speed limit on two-way roads outside urban areas. Reducing the speed limit to 80 km/h was a measure recommended by the Committee of Experts back in 2013. However, some local authorities are considering a return to a 90 km/h limit on certain sections. Our last report therefore details the most important factors to be considered, the steps to be taken and the methodology to be applied in order to limit the negative consequences of such waivers; it is essential to conduct a survey, assess the risks, design compensatory measures to prevent the risk of a frontal collision or road departures, etc.

What topics is the Committee working on at the moment?
In particular, the many recommendations for the safety of motorcycles and lifelong learning, especially the concept of self-training as part of the new driving licence. The need to renew one’s licence every 15 years could be an opportunity to encourage users to keep their knowledge up to date in the light of their age, experience, transport mode use and changes in the Highway Code, etc.
HOW MUCH DOES ROAD SAFETY COST?

Installing a speed hump, traffic signs or a speed camera, launching an awareness campaign... What are the costs and benefits of road safety measures? How can we estimate the social cost of road accidents? To answer these complex questions, IFSTTAR’s scientists conduct research on road safety economics. This novel initiative applies two main approaches in order to understand the economic dimension of road safety. “The first harnesses the concepts and tools of economics to assess the economic implications of public policies,” explains Laurent Carnis. As a senior researcher in the Economic and Social Dynamics of Transport laboratory (DEST), he is particularly interested in measuring the “effectiveness” of new measures. An illustration of this approach is the following question: is it a good idea to introduce a new measure to avoid wrong-way driving on dual carriage-ways? “Accident reductions on the one hand versus infrastructure costs related to the measure on the other. If there are net benefits, we consider that the investment is justified from the socio-economic point of view”.

Another approach implemented by these researchers at the Institute is to study the economic consequences of poor road safety, particularly the cost of road traffic accidents. In this area, their work involves, for example, estimating material damage and administrative costs. It also involves estimating the average cost to society of a minor or serious injury, which includes, among other things, medical expenses (first aid, hospitalisation, equipment, etc.) and an estimate of the value of human life. These elements are evaluated using indicators such as quality-adjusted life years (QALY) or the value of a statistical life (VSL). “The cost of road safety is estimated at around 2% of domestic product, while the value of saving a human life is estimated at more than €3 million”, Laurent Carnis explains. “When these values are multiplied by the number of casualties on France’s roads, these expenses represent a “social cost” of between €35 and 50 billion per year”. The purpose of these results and analyses is to inform public policy: “The aim is to help decision-makers to make decisions by proposing a portfolio of potential measures which have been ranked and prioritised”.

ISAFE PROJECT: OPTIMISING EMERGENCY AID FOR ROAD ACCIDENT VICTIMS

You’re on the road to your holidays. At night, in the middle of the countryside, you lose control of the vehicle and leave the road. You overturn several times, it is a serious accident. A lot of time can be lost before someone notices you and calls the emergency services. The fire brigade arrive and then finally decide to call a helicopter...

“Time is however the most vital factor in the care of a person with multiple injuries” explains Pierre-Jean Arnoux, director of the Applied Biomechanics Laboratory (LBA, IFSTTAR/Aix-Marseille University). “From first aid to surgical treatment, the entire emergency response chain is focused on a single goal: to save time and refer casualties correctly”. How should we design the emergency response chain?

How can we better inform this chain about the severity of the accident in order to plan casualty management? This is the aim of the iSafe project launched in March 2019 with the support of the French Road Safety Delegation (DSR). As part of the FUTURE I-Site UrbaRiskLab project, iSafe is developing a warning and rescue optimisation system for road traffic accident casualties. Developed in collaboration with researchers from IFSTTAR’s Transport, Health and Safety Department (the LBA, LBMC, LMA and UMRESTTE laboratories), Université de Strasbourg, doctors and ENSOSP firefighters, this system is based on a set of technological building blocks such as vehicle-borne smart sensors to transmit information on impact conditions. Analysed remotely and in real time using numerical simulations on virtual human bodies, this data will help predict potential injuries and the level of urgency in order to inform the decisions made by those in the emergency response chain.

“Other e-call systems exist, but none of them gives information on the severity of the accident or potential injuries,” stresses the project leader. In the long term this project could therefore help to offer optimal casualty care regardless of the location of the accident, but it could also collect new data for research and the organisation of emergency services.”
At the IFSTTAR site in Bron, the simulator includes an instrumented Peugeot 308, 5 front and 2 rear screens and a quadraphonic sound reproduction system.

**Using Simulation to Explore the Future of Road Safety**

How will a pedestrian behave when crossing a street in front of an autonomous vehicle? How do motorists perceive the speed of motorcycles? What impacts will future driver assistance systems have on driving? All these questions are studied by IFSTTAR researchers using their simulators, which simulate not only the driving of cars, motorcycles and bicycles but also the behaviour of pedestrians. “Immersive simulators are used to safely observe behaviours, investigate not only human factors but also the various other factors that influence user safety: road design, vehicles, situations, information systems, etc.” explains Eric Dumont, Director of the Laboratory for Road Operations, Perception, Simulators and Simulations (LEPSiS). “The other strength of these systems is that they can be used to study situations that do not yet exist, such as the movement of autonomous vehicles, and therefore to plan measures in advance,” adds Stéphane Espié, head of the SIMU & MOTO team and designer of ARCHISIM, the multi-actor traffic model that is central to the simulators developed at the Institute. Several of the Institute’s laboratories - LMA, LESCOT, LEPSiS and LPC - use this facility to design or evaluate techniques to improve road safety in the framework of projects such as Automa-Pied, PROFIL+, AVIMOTO… Simulators are also a subject of study in their own right. The sensation of driving, the comfort of use, the realism of the scenarios and credibility of the visual scene… “Visual, dynamic (movement) and haptic (force feedback) aspects… The configuration of simulators has an impact on the validity of research results,” Stéphane Espié and Eric Dumont point out, referring here to the different approaches used to evaluate these virtual environments.

**Predicting Tomorrow’s Mobility**

It is a certainty: the advent of autonomous vehicles and new modes of mobility will have impacts on trip-making and, particularly, user safety. How can we foresee risks? How will transport users choose, adapt to and transform the new modes of transport? The researchers involved in the Virtual Traveller unifying project are dealing with these questions.

Moving from a situation where a human being controls the vehicle to one of assisted driving is not without its difficulties. “We know that autonomous vehicles and driving assistance will change our way of being in a vehicle. We’ll be busy doing more than driving and may even have our backs to the road. How can we plan for this future in a way that improves road safety?” asks Philippe Vezin, a senior researcher at LBMC. To answer this question and predict the dangers inherent in tomorrow’s mobility, the Virtual Traveller project is studying user behaviour using virtual techniques: digital modelling, simulators, serious games, etc. Selected in the framework of the i-Site Future call for projects, this project places the user at the centre of research conducted by around 50 researchers, some of them from LESCOT and LBMC, who are specialists in human behaviour, cognitive psychology and biomechanics. “The accidents of the future will not be the same as today’s. Using our biomechanics, traffic and vehicle models, we are developing accident scenarios and simulating their consequences to find appropriate solutions to protect road users even before accidents occur.” The researchers intend to use the recently launched Transpolis test platform (see p. 16) to validate their simulations under real conditions.
The circular economy summer school - experience in Montreal, Paris and Brussels

From 16 to 30 June, some 50 students, young researchers and professionals discovered the trials and strategies for the circular economy in three major French-speaking metropolitan areas: Montreal, Brussels and Paris. Visits were organised as part of the first “Cities, regions and the circular economy” summer school.

How do Montreal, Brussels and Paris break with the linear economy (take-make-consume-throw away)? What strategies do they implement in the areas of waste recycling, food supply or even the rehabilitation of industrial buildings? To find out how the three major cities answer these questions, students, young researchers, entrepreneurs and professionals in urban planning, architecture and urban economics participated in the first “Cities, regions and the circular economy” summer school. Organised by the Université de Montréal, the Université Libre de Bruxelles, IFSTTAR and the “Urban Metabolism” group of the Futurs Urbains Labex, this summer event took place from 16 to 30 June.

“For two weeks, the participants went out in the field to discover a large number of trials and exchange ideas with project leaders and local authorities, for example. The objective was to show them what these cities are doing and how to set up a circular economy project, what difficulties are encountered, the organisational methods chosen, etc.”, explains Corinne Blanquart, director of IFSTTAR’s AME department and French coordinator of the summer school. “The circular economy is a much discussed topic but it is still an emerging field of research so we need to continue to develop the tools and methods to implement it or successfully scale it up”. Supported by the Greater Paris metropolis, the event will be repeated next year as part of the “Circular Economy and Urban Metabolism” research chair founded last September with IFSTTAR.

Let’s hear from some of the participants

Agnès Bastin, doctoral student in sociology and urban studies (CERI / Sciences Po Paris)

“A summer school on the theme of circular economy is a rare opportunity: in the academic world, few working groups or conferences deal with this issue. I liked the survey and analysis methodology we used for interviews with food chain stakeholders in Montreal. It allows projects to have a greater impact and see what can be replicated, for instance. The visit to the Lavallée eco-neighbourhood site in Châtenay-Malabry was also very informative. It’s interesting to see how a large developer perceives the circular economy and incorporates the recycling and re-use of building materials into its strategy. This is an example that I expect to mention in my thesis.”

Sonia Veyssière, doctoral student in economics (ADEME / Université du Littoral / IFSTTAR)

“First, I was interested because I wanted to discover the North American context and Montreal’s experiments. I was surprised to find many local stakeholders who were involved in circular economy activities, but as yet no institutional strategy on the topic. I had many enjoyable experiences during these two weeks: the workshop on Sankey diagrams and the workshop on the prospective co-design method in Montreal, the bike tour of the Brussels urban farms... Finally, I also enjoyed making a video documentary based on our meetings, visits and discussions. This concluding task encouraged me to ask myself a question on a subject that I would not otherwise have addressed, namely the role of land in the circular economy.”
Transpolis, the experimental city for the mobility of tomorrow

Opened in July and located in the Ain département, the Transpolis platform opens up innovative perspectives for researching intelligent, connected and sustainable mobility. Packed with sensors and unrivalled in Europe, this test site provides researchers and industry with new facilities for testing their technologies in complete safety. It is becoming one of IFSTTAR’s largest facilities.

A driverless car avoids a collision during a sudden overtaking manoeuvre and then applies emergency braking in front of a robot dummy on a pedestrian crossing. This is one of the demonstrations applauded by the journalists, elected officials and partners who were invited to the opening of Transpolis on July 2 on the site at Les Fromentaux (in the Ain Département). This scenario illustrated the many experiments that are possible in this unique space in Europe. “Transpolis gives us a fantastic playground,” asserts Marc Tassone, Deputy Director of the IFSTTAR site in Bron. “This shared innovation platform is preparing the future of mobility, in particular the arrival of autonomous vehicles and shuttles. It will help us to provide essential solutions for the safety of vehicles, passengers and road equipment by serving the interests of French public and industrial research”. This €20 million site is managed as part of a partnership between the public and private sectors, linking IFSTTAR with 15 or so Transpolis SAS shareholders consisting of automotive manufacturers, transport operators, equipment manufacturers, infrastructure builders, etc.

Transpolis is a converted military base which offers more than 80 hectares of facilities and infrastructure designed to test new urban mobility technologies under real, safe and controlled conditions. Motorways, ring roads, rural roads, modifiable intersections, traffic lights, street lamps, crash-test tracks, etc. are all included. Not only this, but there are also 320 km of buried optical fibres: “Every 100 metres, street cabinets provide real-time data access. This is an undeniable asset in meeting the needs of researchers and industry”, Marc Tassone claims. Another of the platform’s strengths is digital simulation. Transpolis has a “digital twin” designed to speed up the development of driving robots, the brains of the connected car: “As in aeronautics, manufacturers will be able to train their robots for hundreds of millions of kilometres on this digital twin before implementing them in vehicles in order to validate the scenarios on the physical twin”.

Run by nearly 25 engineers and technicians, the site is already hosting several trials with partners such as Keolys, Navya, Renault Trucks, Iveco Bus and Acomos. Their work is focused on user needs and safety, for example, the charging of electric vehicles, the management of urban flows and congestion, the operating speed of autonomous buses and their acceptance by citizens, etc. Some of the work is being carried out within the framework of ENA, a project supported by the Ministry of Transport to help both urban and rural areas develop new public mobility services. “In view of the many projects and the interest shown by European scientific and industrial players, Transpolis has a very bright future ahead of it,” enthuses Marc Tassone.

A response to the challenges of developing the infrastructure of the future

Bernard Sala, Deputy Director for Forward Studies, Development and Research at Colas

“At the crossroads between in vitro research and in vivo experimentation, Transpolis offers us a safe, full-scale laboratory which is essential for testing and validating our mobility solutions. At one of the intersections, our engineers are currently testing our Flowell dynamic marking solution. They are studying this illuminated pedestrian crossing’s potential uses and interactions with pedestrians, drivers and autonomous vehicles. As a shareholder in Transpolis SAS, our group has every reason to choose this platform. We are convinced that the development of the roads of the future must be informed by the complex interactions between users, vehicles and transport infrastructure”.

Watch a video about Transpolis
https://youtu.be/dxC6xp9mqv4
“Better understanding the psycho-social factors that can have an impact on driving”

Florent Varet is a contractual doctoral student in social psychology, affiliated to the Accident Mechanisms Laboratory (LMA) at IFSTTAR and the Laboratory of Social Psychology (LPS) at Aix-Marseille Université. In December 2019, he is defending his thesis, which was jointly funded by IFSTTAR and the Provence-Alpes-Côte d’Azur Region, and deals with risky and offending behaviour among motorists.

**WHAT EXACTLY IS YOUR THESIS ABOUT?**

Florent Varet: I have researched risk and offending behaviours from the perspective of the relationships between values, social norms, and differences related to sex, gender and age. In France and elsewhere in Europe, men and young drivers (18-30 years old) are over-represented among those involved in serious and fatal accidents. Such groups are more likely to adopt risky attitudes (e.g., driving faster) and to violate the Highway Code, under pressure from their peers and their group, out of a desire to conform. I wanted to better understand the psycho-social factors behind this normative desire that can have an impact on driving.

**WHAT METHODOLOGY DID YOU USE TO ADDRESS THIS ISSUE?**

F. V.: I conducted six studies over two years, each involving a panel of 150 to 800 individuals from various socio-cultural backgrounds. The subjects were asked to answer anonymous questionnaires, which were mainly disseminated online. The questions allowed respondents to imagine themselves in different situations, to give an account of their driving in these contexts and to describe the image of themselves they wanted to project by their behaviour.

**WHAT ARE THE CONTRIBUTIONS OF YOUR RESEARCH?**

F. V.: I found that, regardless of the respondents’ socio-occupational and educational level, risky driving behaviours represent a way of asserting one’s virility and masculinity, which are associated with the values of courage, power, strength, transgression and extroversion - an attitude that is also encouraged by advertising. Driving too fast is often the preserve of young men, as some biological determinants can also play a role in this type of driving. On the other hand, both men and women can be guilty of aggressive driving: female emancipation means that female drivers model their behaviour more on male drivers - and the same pattern can also be observed for tobacco use.

The key issue is how to better combat these behaviours in order to reduce the number of accidents. It would be interesting, for example, to focus on road safety campaigns that demonstrate that women do not automatically equate courage and virility with speeding, and that they disapprove of speed violations. In my opinion, such awareness-raising operations could help to change the perceptions and representations that lead to dangerous behaviour.

F. Varet
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IFSTTAR’s expertise in damage testing on experimental pavements has enabled the Alstom group to measure the ruggedness of a new power system for electric trucks. This device, which is embedded in the pavement, has been tested under traffic conditions similar to those on motorways using the FABAC pavement testing machines.

While private electric cars are currently a great success, the switch to electric vehicles is more challenging in the case of road freight. This is because for an electric truck to have sufficient power and range, it must in principle have a large, heavy battery and this limits its payload. To overcome this drawback, the Alstom group has designed a dynamic charging system that can be embedded in the pavement. Taking its inspiration from the firm’s dedicated tramway ground power supply system, this innovation must undergo various strength tests before becoming operational. To determine the best way of incorporating the electric rail into an existing pavement without affecting its performance and service life, the company contacted IFSTTAR’s Materials and Structures Department (MAST).

“After having developed and validated the best bonding processes in the laboratory, it was necessary to check whether three 2-metre-long electric pavement prototypes were able to stand up to the mechanical stresses associated with repeated heavy goods vehicle traffic”, reports Fabienne Anfosso Lédée, head of technical and innovation activities at MAST.

To meet this challenge, IFSTTAR used the FABAC pavement testing machines at the Laboratory for Modelling, Experimentation and Survey of transport infrastructures (LAMES): “These mobile traffic simulators make it possible to study, without downscaling, the damage inflicted by heavy rolling loads on experimental roads”. These machines enabled the researchers to compare the strength of the different processes that allow the power rail to be built into the pavement. The most robust option was chosen for further testing. Over a total period of nearly a month, a rolling load of 65 kilonewtons was applied a million times to the most promising sample, which is equivalent to the passage of about 2 million heavy goods vehicles. This test was conclusive and Alstom now intends to conduct larger-scale studies at the IFSTTAR site. “Contributing to the development of an innovation that seeks to meet the challenges of the energy transition and adaptation to climate change has generated healthy competition between the Institute’s laboratories who are involved”, Fabienne Anfosso Lédée reports with satisfaction.

1. The MAST Department is involved in this partnership through LAMES and the Materials and Structures Department (MIT), while the AME Department is contributing to it via the Environment, Planning, Safety and Ecodesign Laboratory (EASE).

WHY DID ALSTOM CALL UPON IFSTTAR?

This collaboration should help to validate our APS ground-based power supply technology for roads. Our technology has already been adopted by several transport authorities to power their tram lines. But before it can be transferred to motorway pavements, a whole series of tests have to be carried out. Our tests in Sweden have shown that it is possible to recharge an electric truck that is equipped with a runner that is in contact with the power rail. The partnership with IFSTTAR now aims to evaluate the impact of this system on the ageing of the asphalt. Use of the FABAC machines has already enabled us to select the most suitable technique for embedding the GPS system. In the coming months, we will study its behaviour when subjected to repeated passages of light vehicles on a 50-metre-long test track built in the IFSTTAR Nantes centre.
Petit Campus: IFSTTAR opens its research to the very young

A new set of educational resources offered by IFSTTAR’s Promotion and Sharing of Knowledge Department (PEPS), the Petit Campus collection opens up IFSTTAR’s work to secondary school students. Available online in the «Science and Society» section, these theme-based packages include videos, games and resources for teachers.

What dangers can face pedestrians on their journey? What is an autonomous vehicle? How can we reduce noise in towns? What will the trains of tomorrow look like? IFSTTAR has long offered popularised theme-based packages to answer these questions, they are still difficult for very young people to understand. This is the thinking of Marie Excoffon-Gagnoud and Soizick De Bagneaux, from the Institute’s PEPS department: “During workshops held in secondary schools, we noticed a real expectation on the part of these young people, so we decided to make scientific information accessible to them. It is an opportunity to encourage children to ask questions about societal, technological or innovative topics. The aim is for them to take ownership of these topics and develop their critical thinking skills”.

Created in collaboration with scientific outreach specialists from the Moulin à Etincelle association, Petit Campus is a major popularisation project on complex subjects: 5th generation roads, road safety, construction materials... Reread and approved by IFSTTAR researchers, the collection currently includes 10 educational resources covering 4 themes: mobility, infrastructure, risk and the environment; regions. Each resource consists of an article that is organised around simple questions, a contact e-mail to submit ideas to researchers, videos and games to review the children’s knowledge: paper hens to print, puzzles, crosswords... Teachers also have access to tips and educational tools to use in class.

Available in the “Science and Society” section of the IFSTTAR site, Petit Campus is also present on scientific and technological education portals such as EchoSciences or the University of Lyon’s Pop’Sciences portal. “We also plan to distribute the collection in schools and out-of-school structures in the region, such as social centres or youth and community centres. And why not write the next issues jointly with young people so they can have what they really want?”

Find the Petit Campus collection on IFSTTAR’s “Science and Society” website www.ifsttar.fr/ressources-en-ligne/espace-science-et-societe
On 1 January 2020, IFSTTAR is going to merge with the University of Paris-Est la Marne-la-Vallée and create closer ties with 5 research and higher education institutions to form Université Gustave Eiffel. An interview with Jacques Tavernier, who has been Chair of IFSTTAR’s Board of Directors since 2013. The former CEO of Eurovia discusses the Institute’s role in the creation of this university with an international calling.

WHAT SCIENTIFIC CONTRIBUTIONS HAS IFSTTAR MADE AT THE NATIONAL AND INTERNATIONAL LEVELS?
IFSTTAR was created in 2011 by the merger of two research centres, the LCPC (Laboratoire Central des Ponts et Chaussées) and INRETS (Institut National de Recherche sur les Transports et leur Sécurité). The Institute thus acquired a unique combination of two areas of expertise: civil engineering on the one hand, planning and transport on the other. France excels in these fields of research, and for this reason IFSTTAR quickly gained an international reputation. A case in point is the Genoa bridge tragedy, when IFSTTAR researchers with their experience in the study of structures were called in. Another is COP 21, where IFSTTAR’s research on reducing carbon footprints was an important input to the discussions. Alongside its scientific expertise, IFSTTAR also provides the community with major facilities such as the pavement fatigue carousel in Nantes, the Transpolis test track in Lyon or the strong floor and the amazing SenseCity laboratory city in Marne-la-Vallée. Our ability to put theory to the test in practical systems is, to my mind, IFSTTAR’s major strength.

HOW WILL IFSTTAR’S RESEARCHERS PARTICIPATE IN THE BASIC TRAINING PROVIDED BY THIS EDUCATIONAL INSTITUTION?
The French University is organised around the status of the teacher-researcher, IFSTTAR is a research institution, not a teaching institution.

WHAT ROLE WILL IFSTTAR PLAY IN THE CREATION OF THIS UNIVERSITY?
A leadership role: the Université Paris-Est Marne-la-Vallée (UPEM) and IFSTTAR are behind this major collaboration project devoted to the sustainable city. By coming together, we are seeking to achieve a critical mass that achieves international recognition, and we will do this under the famous name of Gustave Eiffel. IFSTTAR will not disappear but will be transformed and improved. The Institute brings to this merger its connections with industry, its expertise on public policy, its infrastructure, the excellence of its researchers and the professionalism of its support services. It is these IFSTTAR departments that will undergo the greatest changes, but their skills will be an extraordinary asset for Université Gustave Eiffel.

Jacques Tavernier, Chair of IFSTTAR’s Board of Directors

"IFSTTAR AT A TIME OF MERGER"