

Donnons un sens à l'innovation

Interactions

LES
DOSSIERS

Research

UTC reveals its Research Road-Map to 2023

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FROM THE PRESIDENT'S DESK



Technology-intensive Research starts here !

Seeking to understand to do better, acting to understand better and implementing to act better such are the three challenges and the guiding principles for UTC undertaking technology-intensive research, thereby resolutely going beyond the now outdated distinction made between basic and applied research. This edition of Interactions throws a particularly bright light on our research work, illustrating the diversity and the richness of the fields covered by our 9 UTC laboratories, whether the focus is on the priority scientific thrusts for the advancement of knowledge, for the fields of application or to bring solutions to societal issues: the bio-economy, mobility, energy procurement/consumption and sustainable cities, health technologies, to name but a few.

As you shall observe, the ongoing digital revolution permeates a lot of our research transversely, in mechatronics, studies in urban dynamics, for 'smart cities', smart electric grids, connected medical devices and tools and the societal change of connected men and women, technology-intensive systems with sizeable applications in robotics or the design for driverless cars ...

In like manner, readers will realize that the overall UTC research policy can henceforward only be framed in a truly pluridisciplinary and interdisciplinary mobilization of the university's academic skills and resources, which is a huge challenge already faced by the CNRS given the level of inherent hurdles! UTC has also chosen to head down this obstacle-strewn route and understands where the stakes lie. In particular - and this constitutes a major specific feature of UTC - the interactions with social sciences and humanities at the core of UTC-COSTECH's research facilitate and enhance the way we think through technological development with all its human, social, ethical and economic implications.

Let me just conclude by underscoring the fact that entrepreneurship and innovation together represent a clear transverse mission for UTC, based as it is on research and training delivered in compliance with an integrated global vision contributing to our assuming a collective societal responsibility.

Long live technology-intensive research at UTC! ■

Prof. Alain Storck,
President & Vice Chancellor UTC



Nomination of Jean-Louis Chaussade

October 13, Jean-Louis Chaussade, Chief Executive of SUEZ, was elected Chairman of the Academic Board for UTC. He replaces Thierry Morin, a consultant and former Chief Executive Officer of Valeo. ■



http://webtv.utc.fr/watch_video.php?v=NS98DBN5GKKX

Partnership agreement between UTC and the Politecnico Di Torino



Friday Sept.16, UTC welcomed a delegation from the Politecnico Di Torino who visited the UTC Daniel Thomas Innovation Centre to pursue their agreement for a strategic cooperation. Professors Alain Storck, President and Vice-Chancellor of UTC and Professor Marco Gilli, Rector of the Politecnico Di Torino formally signed this partnership agreement between the two engineering schools. ■



http://webtv.utc.fr/watch_video.php?v=2U05D9S234GS

Two UTC graduates came first at the French Edition of the annual James Dyson Award



Colin Gallois, with his UTC Mechanical Engineering diploma (specialty Industrial Design Engineering) and Xavier Garcia studying in the same specialty field, came "first" in the French edition of the James

CONFERENCE

Mechatronics

a driving force for cutting-edge technologies

Mechatronics - an alliance of mechanical engineering and electronics – today lies at the core of innovation. It is present in all sectors, leading not only to very ordinary day-to-day objects but also to the building of more complex items such as aircraft, satellites or road vehicles, with a much increased potential. During the Mechatronics REM2016 Conference, which was convened at UTC last June, is a get-together of some of the major actors in this field, and Interactions was fortunate enough to be able to interview the two main proponents, Jamie Paik and Michaël Gauthier, who offered us their vision of mechatronics in coming years.

Mechatronics, a story of synergistic action

Mechatronics can be seen as a synergistic combination of mechanical engineering, electronics, and control theory and computer sciences. It affects design and manufacturing of products for the purpose of optimizing their features, adding new functionalities. It indeed meets a real industrial expectation, connected to our consumer society, increasingly eager as it is to acquire and benefit from technological innovation on an international scale and is to be found everywhere and at the origin of considerable progresses which we can hear about in the media headlines, e.g., driverless cars, to give but one example.

UTC, a key actor to support the cause of mechatronics in France

UTC can muster considerable forces to bolster its reputation in mechatronics and become a privileged partner for a great many industrialists. As of 2008, it set up a collaboration with the CETIM Senlis (acronym for 'technical centre for mechanical engineering') to set up an Mechatronics Institute (IM), which is a pole for training, R&D and technology transfer operations; in terms of its training offer, the IM offers several possibilities for UTC students depending on the diploma they are going for, like for instance the MARS specialty (mechatronics, actuators, robotisation and systems) or the specialist Master's degree SMA (Mechatronic systems and advanced mechanical engineering. Thanks to its Daniel Thomas Innovation Centre, UTC offers prototyping facilities – a key ingredient for mechatronics – which are not only ideally suited to meet the expectations of clients but also is close to entrepreneurial concerns. Moreover, a special academic Chair was created in 2009, for Hydraulics and Mechatronics, based on the respective strengths of UTC and the CETIM and enabled a widening of the

network of technology-intensive resources in a close relationship with the industrialists. A technological platform, inaugurated in 2014 reinforced the Chair by concentrating the design & modelling tools and the experimental facilities. Through its training for its students and through collective research agreements and activities, UTC offers a high added value of skills and service for both national and international companies, where it can be observed that the needs increase continuously.

One Conference, three events

The Mechatronics REM 2016 Conference enabled the organizers to update the attendees and to present various research results. But in fact, beyond the single Conference, there were in fact three events: the 11th Franco-Japanese Conference on Mechatronics, the 9th Europe-Asia Conference on Mechatronics and 17th International Conference on REMs (Research and Education in Mechatronics).

"The 17th International Conference on REMs initially was the base-line for the two first-named events", details Michaël Gauthier, Director of the AS2M Department (Control Theory and Micro-Mechatronic Systems) at the FEMTO-ST Institute, Besancon. "It makes lots of sense to combine research and teaching. On a regular basis, the UTC students disseminate the pedagogical

contents of their courses in the industrial milieu and that adds a strong leverage effect; knowledge spreads in this manner and it is important to attach high quality to the operations. With new industrial applications, the blend of research and teaching also allow for a technology transfer to the socio-economic world and to Society in general and this proves very efficient way to do this". "Thirty years ago, very little importance was given to these subjects. Today, we seek to identify interdisciplinary solutions, added Jamie Paik, Director of the Laboratory for Reconfigurable Robotics (RRL), Ecole Polytechnique Fédérale Lausanne (EPFL), Switzerland.

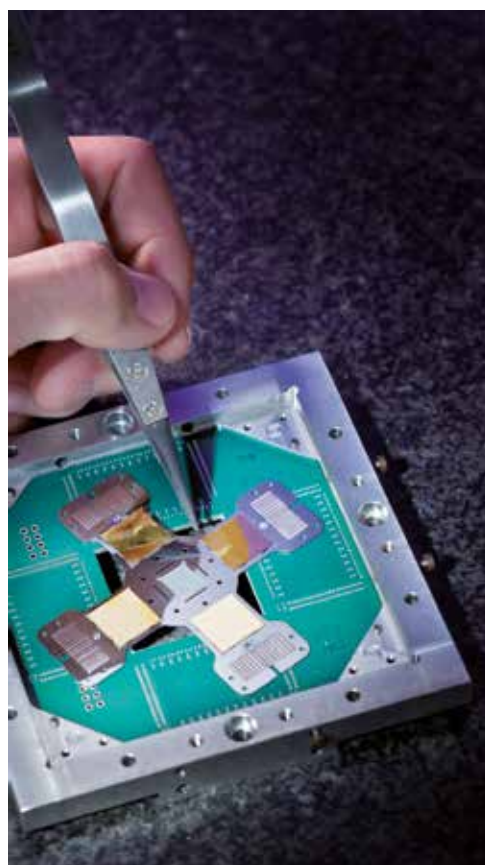
For applications in the medical sector, we envision robot sturgeons or uses in satellites, or again for our personal electronics.

So, can you explain the role for mechatronics today?

Nowadays, you find mechatronics almost everywhere, e.g., in the space sector (satellites ...), aeronautics (aircraft stability control ...), road vehicles (ESP, ABS ...), consumer appliances (washing machines, printers ...), or equipment (adapting production means, on line quality assurance and control). "The idea from a day-to-day standpoint, is that physical devices integrate increasing quantities of electronic components, sensors, actuators with a possible interface (EDP or operational) with humans. A symbolic example is the motorcar: 20 years ago, you had an essentially mechanical assembly and the repairs in garages were carried out by mechanics. Now, when you take your car to the garage, they plug it in to an interface and the system diagnoses the problem. Thus we have seen a complete revolution here, where electronics has gradually been integrated - some would say with on-board intelligence, or at least the sensing of information at various mechanical points", explains Michaël Gauthier. "This is a global trend with less and less purely mechanical parts and we indeed see increasing numbers of connected objects arriving in our lives and environment. We now have to begin working on designs that associate mechanical engineering with control electronics and this calls for highly specific talents and skills, hence the importance of having appropriate courses to have solid enough bases in both fields to assure the synthesis", he adds.

Some very concrete progress

In their respective laboratories, Jamie Paik and Michaël Gauthier, are developing system that revolutionize our lives and are applicable to numerous sectors. At EPFL, Lausanne, Jamie Paik is focusing mainly on soft robots. "By "soft robots" we are referring to 'devices' in silicon or rubber, for example. They are fairly easy to make, there are numerous projects in mechanical or robotic spheres, but it is very difficult to assess the size, the notion of scales is really a problem", she explains. "One of our applications is a belt with actuators that allow persons with muscular disorders in their abdominal region or legs to regain a degree of mobility thanks to the local additional rigidity offered by the belt. This is important for day-to-day movements, such as the simple climbing or descending of stairs! The technology we use is flexible and it is non-invasive. Now we are seeking to reduce the weight factor and to develop a portable power supply. We are also working on the concept called 'robogamis', derived from origamis, a sort of flat 2D robot such as a sheet of paper which will be folded by actuators to form a 3D structure. It is the programming that allows you to control the fold-sequences and to determine how a fold can be transformed. In this area, we have been collaborating notably with Christine Prella at UTC in regard to the actuators used. For applications in the medical sector, we envision robot sturgeons or uses in satellites, or again for our personal electronics. The power supply still has to be solved before we can assemble truly portable systems," she adds. At FEMTO-ST, Michaël Gauthier is working on "micro-mechatronics", a compression for mechatronics and micro-systems, therefore very small objects. "We design medium-sized (centimetre) robots that can be placed on a table-top, and that will work on (with) very small



components at micro or even the nanometric scale: what we call "micro-nano-manipulation". We are also investigating very small, highly integrated components for applications in non-invasive surgery. For example, we have developed an active endoscope which allows the surgeon to resect cancerous nodules on our vocal cords. What we have is a complete system lodged in just 2 cm³ with two cameras, two lights, one actuator and a mirror to correct position the laser scalpel. The surgeon traces out on an image the area to be incised and the robot reproduces precisely his hand movements. This system requires lots of work to optimize the design, inasmuch as there is not much room in the operation target 'field'. So we make robots that assemble small components that can handle both small and extremely small objects", he adds. The aim is to make the systems smaller and smarter, but above all else, to be more dexterous when the operations become complex. "In the case of a surgical operation, we want to develop robots that have the capability to move in low-angle areas so as to access certain zones while having more freedom and more mobility. High dexterity is needed for the applications and this can readily be seen in the case of compression applied to human oocytes, knowing that they change properties mechanically as they mature. We then test their mechanical rigidity to see if they are more or less flexible. We have also added some on-board intelligence, since beyond the sensor there is a data processing which leads to a sort of prognosis of the chances of the oocyte being fertilized, as measured "mechanically". This way we can identify those oocytes ready for fertilization (or, on the contrary,

that should be kept on hold. This protocol is tied closely to data processing, we have developed and the classification techniques". Another application relates to micro-assemblies and it is Michaël Gauthier who works on this theme with the start-up Persipio Robotics, Michaël being one of the co-founders. "What we investigate here (and make) are micro-assemblies, on a purely industrial basis, using small components for the clockwork mechanisms and the microelectronics, with typical dimensions below the millimetre. We also are engaged in work at the nanometric level where there is a blossoming market emerging. We use scanning electron microscopes (SEMs) which can even take us down to the atomic scale [10⁻⁸ cm]!" Micromanipulation is used to assemble the parts and are used, for example, to make chemical substance sensors for environmental control and which must have an extremely sensitive measurement capability.

Some 'revolutions' that would result from applying mechatronics

"Obviously, there is a wide biomedical scope for applications", explains Michaël Gauthier, "but there still remains to introduce considerable developments in surgical devices. No doubt in 25 years' time we shall see operations we simply cannot do today thanks to more flexible, more functional robots. For the time being, surgery depends on the dexterity of the surgeon's hands, and that has its limits". Michaël Gauthier also envisions a revolution in pharmaceuticals: "We shall see a complete substitution for chemical based medicinal drugs by biological compounds. That is to say, that we shall longer be dependent on drugs (in its wider connotation) but rather on cells that act in a medicinal way. Knowing that cells have a dimension of only several tens of microns, the action of isolating them and growing them is part of possibilities for micro-robotics". In like manner he foresees progress being made in the industrial world. "There is a huge need for further miniaturization of lots of components! Take the example of mobile phones. They have grown in size over recent years. They integrate more and more functions and the components are decreasing in size. Their assembly calls for lots of operations on these complex systems and they cannot be done either than by hand for the time being. We do not have alternate solutions for this! We often tended to think that everything was robotized, but bit is simply because we are at the limits to manual manipulations. All the more so that that when you pick up an object there" is a natural human tremble of some 50 microns we can hardly detect. But, consequently, we cannot handle objects at that scale and to do so we need robots that work under microscopes. With the ongoing micro-robotics revolution, we shall be using a position to clear this obstacle and the market ahead will grow huge. I also see a snowballing effect - robot production will make their assembly easier. Having said this, the systems too will be designed accordingly and the market for these micro-robots

There will be a joint growth between product and robot developments. We have, in a sense, broken an earlier logic. There was no technology previously, so no market. We then crated the technology and the market followed suit.

Dyson Award, with their Freewheelchair which consists of a set of two wheels that can be mounted on any model of wheelchair, replacing the standard issue wheels. The first design aim is to avoid chair-bound users who use the push-ring from jamming their fingers or suffering from wear and tear and makes it easier to move around. UTC already won the French edition of the James Dyson Award in 2013, thanks to their INHALE Project presented by Vincent Bihler and Victor Cheung. We also note that it is a second run for Xavier Garcia who was already among the finalists of the 2015 French edition for his Weeprint ecological printer. ■

Partnership between Keyrus and UTC on Big Data

KEYRUS
insight into value

The company Keyrus, an internationally reputed player in Data Intelligence, Management Constancy and corporate transformation, signed a partnership with UTC Sept. 15 to valorise the professional job opportunities that exist in Computer Science and Data Science. This pedagogical collaboration will include occasional targeted joint UTC/Keyrus actions. ■

will surely explode. As I see it, there will be a joint growth between product and robot developments. We have, in a sense, broken an earlier logic. There was no technology previously, so no market. We then crated the technology and the market followed suit. We saw something similar in the history of computers – there was a time only years ago, when we did not know how we were going to use them. Today, every home has one and likewise at our work-desks”. For Michaël Gauthier, there is an even more futuristic vision: that of 3D printing – which already exists but which soon will enable us to create and “print” modulated, connected objects, with the electronics needed installed during the print process “This will no doubt occur in the Main Street market where people will be able to print their goods directly, as and when needed”. Finally, the future will no doubt have strong ties with the space sector industries, where the advantage of micro-robotics will lie in decreased weight and component size (weight being a key factor to, the cost of launching the devices into space).



As Jamie Paik summarizes, “some 10 to 20 years back, we talked mainly about electronics as the front-stage component, as we saw increasingly rapid processors coming on line, for example. Now the focus is on the mechanical needs because

We often tended to think that everything was robotized, but bit is simply because we are at the limits to manual manipulations. All the more so that that when you pick up an object there is a natural human tremble of some 50 microns we can hardly detect.

they are used to accommodate all the electronics. We have her a question of academic fashion which changes, year in, year out, depending on which country you refer to and also what financial backing there is. As I see things, personally, I would say that there is not really that much difference with the situation we have today, and I see the research as a way to make people’s lives better and easier. There will be some major changes but they will occur in a very smooth and discreet manner as we saw with the arrival of smartphones, for instance. The medical fields will most probably be pioneers here, to see if they can get patients out of the hospital environment sooner or to have a rapid start to re-education and the treatment protocols themselves will be improved. Things like wheel-chairs will be developed further too, again with the aim to help the handicapped chair bound better. Nevertheless, we must discover and implement new designs in order to make robots perfectly safe for humans”, she concludes. ■

"THESES THAT IMPACT ON LIFE-STYLES"

Mechanical failure

A mechanical failure is often the result of a material fatigue. The natural ageing of parts, notably those made from metals and alloys, leads to the formations of cracks that may propagate and cause the part to break. And because this may have serious consequences, it is important to understand how cracks form and evolve in time.

Following a “4 week Erasmus stay that finally lasted 4 years”, Chrysanthi Papamichail, with her engineering diploma from the Ecole Polytechnique in Athens (graduated in electrical engineering and computer science) and a Master’s degree in applied mathematics is the author of a thesis on catastrophic mechanical failure she defended at the UTC-LMAC Laboratory in a collaborative programme with the UTC-Roberval Laboratory. The thesis subject she chose was the “Estimation of dynamic systems with applications in mechanical engineering sciences”

As Chrysanthi detailed for us, “we associate stochastics processes with digital techniques to model a crack and determine its propagation characteristics”. By applying a mathematical formula, the random phenomenon can be recreated virtually. “The equations enable us to estimate the propagation of the cracks over a set time interval, to identify the moment of catastrophic failure (i.e.,

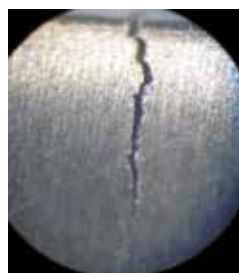
rupture) and thus to propose an operational life expectancy for materials”. The results obtained then allow us to make comparisons with real data and to improve the algorithm and also to concomitantly reduce the resource needs in terms of computational power.

There are some important applications areas, in numerous fields: “My equation is sufficiently reliable and powerful per se to be used in any sector that employs metal parts that could prove dangerous. The range of possible applications runs from building construction to aerospace, from railroads to health concerns about implants. But it can also be applied to natural events such as earthquakes or biological phenomena”, she details.

For the time being, the accent is on applications in aerospace where accidents can lead to death.

Nuclear power production also is an area where there have been significant progress, for reasons you can well imagine “but only a few countries are concerned and the data is often shrouded in secrecy” adds Chrysanthi.

In terms of prospects a lot remains to be achieved here. “It would prove interesting to develop the model further and blend it with others, and to study interactions among cracks and to use new components such as, for example, concrete, for which we have already conducted some tests. This would allow us to propose new and higher resistance construction materials”. Apart from the commercial aspects, “the key point is that the model may prevent or avoid accidents and that is of concern to the population at large, even if it is underestimated because the impact is not immediately visible”, she concludes. ■





Research

UTC reveals its Research Road-Map to 2023

By the end of year 2016, the HCERES (French national council for assessment of higher education institutions and research establishments) will have assessed all the UTC laboratories for the 5 year period, 2012-2017. The University is taking this opportunity to update its scientific research policy for the forthcoming contract (2018-2023). Interactions zooms in for its readers discovering the major orientations and how they will be implemented in the UTC research units.

3 is the magic number for UTC's research policy in the coming years!

One : the stance claimed by UTC is that of a technological research intense university standing on 3 pillars:

- seeking to understand to implement better, i.e., to advance and strengthen our scientific knowledge for the purpose of developing innovative technologies;
- to implement in order to understand better, inasmuch as the design and testing of a technological system also serve as a source of progress for science;
- to implement in order to act, inasmuch as the work done at UTC will contribute to answering societal expectations and challenges in the 21st Century.

Two : in coming years, the establishment will pursue its research activities along three major societal axes:

- the transition to a bio-economy (valorisation of bioresources, development of the bio-refinery concept ...);
- mobility, energy and sustainable cities;
- health-care-related technologies.

Three, in order to bolster its technological research programmes and its societal commitments, seen as the two sides of a self-same dynamic approach, UTC places its emphasis on the key points: a challenge (sustainable mobility, ailing senior citizens staying at home ...), a unique approach and with a privileged experimental ground, viz. the Living Lab. The main changes will

occur on these last two points.

UTC's singularity lies in its interdisciplinarity already underscored by the university authorities and which will be reinforced further. The systems addressed by the research community at UTC are becoming increasingly complex. And often, the complexity levels involved depend less on the technologies that are integrated in our research work, and more on their heterogeneous nature. Having said this, they recognizably resist any attempt to make a full representation of them and this implies that there be a change in paradigm for engineering sciences as a whole. Before, we only needed to adjust the real situation to the models offered by our scientists. Today, we must design models that allow us to take account of features that lie beyond real complexity (uncertainty and human factors, for instance). This therefore impales that we adopt a resolutely systemic approach, viz., a transverse approach to the problems we address. Hence the need to develop inter-disciplinary interactions between (and in) our laboratory units. And again, singularity in the future will lie in a reinforced policy for its academic alliances, thereby widening its position in terms of its TRL (Technology Readiness Level) which is a measure of the maturity of a given technology with respect to the market-

place – from 0 to 3 for basic research, from 4 to 6 for engineering science research and from 7 to 9 for development and later market introduction. Today, UTC is recognized as being excellent on the TRL 4 level. Our policy thrust will consist of reinforcing the lower value TRLs, viz., those that encounter

scientific obstacles. To do so, UTC will increase substantially the number of its partnerships with basic research laboratories, notably those in the Sorbonne-Universities Cluster. In parallel, we shall endeavour to strengthen our higher rated TRLs by seeking to industrialize the streams we develop in Compiègne and this will call for more partnership reserach with our socio-economic contacts.

As far as 'Living Labs' are concerned, UTC has made these a priority for experimentations and they natural prolong the logic of our adopting a singular approach. They effectively enable us to develop and test technology-intensive scale one demonstrators, not only to gain a better understanding of their inherent complexity, but also their utilizations (to implement in order to better understand) and likewise to prepare them up to pre-industrialization stages. And here again, development will involve partnership policies with industrialists, local authorities and representatives of the users communities. ■

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An interdisciplinary approach to urban dynamics

The UTC laboratory 'Avenues' addresses the question of sustainable cities. In order to comply better with the expectations generated by major urban challenges, it has redefined the framework of its research programmes for coming years. The programme contains 5 priority lines of investigation, more interdisciplinarity and more cooperation not only with other UTC laboratories but also with external partners.

Cities, i.e., urban areas, represent an extremely complex system of systems. To come to grips efficiently with the problems, the UTC-Avenues laboratory has opted to employ a systemic approach rather than a theme-by-theme analysis. "Up to date, we had two 'themes'", explains Manuela Sechilariu, Avenue's Director: "One theme is addressed by engineering scientists (civil, electrical, mechanical and urban engineering), the other by specialists in social sciences (urbanism, architecture, geography). From now on, we shall have a single tem which will combine its range of skills across the board to address 5 research priorities and transition that cities will face tomorrow".

Five major challenges

The first challenge: smart electric grids, one of the keys to implementing energy transition policies. In this area, UTC-Avenues is instigating questions of energy management and smart micro-networks on the scale of single buildings and neighbourhoods. What is at stake is to consume locally wind and solar power produced locally rather than inject into the national grid, which was not designed to absorb electricity from intermittent, decentralised sources.

The second challenge lies at the interface between energy and environmental transitions: the transportation and mobility networks. In this field, UTC-Avenues

studies flow management and availability factors for urban transportation facilities as well as the infrastructures and digital equipment needed to recharge electric vehicles the numbers of which will multiply, privileging locally produced electricity.

The third challenge – in a connection with the environmental transition, mentioned above, will be the control of hydrological risks and those associated with climate change. Here, UTC-Avenues is seeking to model flash floods, by integrating the concomitant ingredients (high rainfall conjugated with high tides in coastal urbanized areas) and likewise for uncertainty factors. The aim is to design toads as aids to decision-making such as may be needed to decide whether to evacuate or not a given population at risk. The fourth challenge lies in the digital revolution and associate transitions, with research in hand for Avenues on 3D modelling of existing buildings. What is at stake her, principally, is to facilitate and optimize building uses, coupling these 3D models with data collected (surface of building internal space, equipment installed, expected operational equipment life-cycles ...).

Last but not least, the fifth challenge – urban models, planning and 'metropolisation' – depends on analysis of urban transitions taken in a wide connotation, including demographic and socio-economic factors. Avenue's research commitments will cover three thematics – building multi-criteria tools to assess the existing buildings, compared with figures in a sustainable planning file; analysis of the relevance of regulations faced with ongoing transitions (for example, what changes will be needed if a policy decision is made to build smart grids?) and creation of tools to aid decisions to optimise existing infrastructures and to prolong as far as possible their operational usefulness (adapting the structures to demographic evolution, to new uses ...).

"The various subjects we can address via these 5 priority axes are closely meshed together, hence the interest to deal with



them in an interdisciplinary manner”, underscores Manuela Sechilariu. “Compared with other laboratories working in the same fields, our stance at UTC-Avenues is quite unique. The challenge we face over the coming years will be to prove that it is indeed advantageous”.

A growing emphasis on mobility

Another novelty feature: the laboratory has reinforced its potential in the theme of mobility. It has just created an academic Chair for Smart Mobility and Territorial Dynamics and will also inaugurate a technological platform for recharging all-electric vehicles – then charge

being collected via photovoltaic sunshade shelters installed in the UTC Innovation Centre’s parking lot. This new tool will allow UTC-Avenues to validate a certain number of theoretical concepts: how many cars parked there can be correctly recharged, in what lapse of time and how does one go about management peak demands ...? As will be the case for the academic Chair on Mobility, the parking lot facility will be a vector for interdisciplinary studies in the laboratory. “It will contribute notably to bringing together research scientists and engineers who study electricity-powered transportation with those who investigated smart micro networks, given that the two themes are closely tied”, notes Manuela Sechilariou. “But, our objective is also to support

synergies with other UTC laboratories, in particular the LEC, who carry out research on electric vehicle batteries – and with external partners such as Renault, already an industrial partner for UTC and Védécom, the Institute for Smart, Mobile Carbon-free Vehicles (of which Avenues and the UTC-LEC Lab are members)”. Synergies in the long term could also lead to the creation of a Living Lab on the theme of electricity-powered mobility and therefore would reinforce UTC in this very strategic area. ■

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Les laboratoires de recherche



Repairing & connecting humans

For the next few years, UTC’s BMBI Laboratory (Bio-mechanics and Bio-engineering) has set itself two main priorities: substitute bio-artefacts to compensate for functional failure and connected biomedical devices and tools. Among the principal assets that help innovate in these fields, BMBI offers a double set of skills combining life sciences and engineering sciences.

Repairing and connecting humans are the two major societal challenges that constitute together the core of the research programme project propose by UTC-BMBI for the forthcoming 5 year contract. The first challenge is not new. The research scientists and engineers have been working for some time now on artificial devices or bio-artefacts (liver, bones tissues, nerves ...) designed to compensate for functional deficiencies and they intend to pursue research in this promising area. The second challenge is more recent. UTC-BMBI had previously developed certain biomedical tools, notably for diagnose or functional re-education. As we move into an era of the Internet of Things, we must also be able to design connected tools that enable remote monitoring of patients, for example, allowing the latter to stay at home. Two years ago, the BMBI Laboratory set up an “e-Biomed” academic Chair to begin exploring this new research field and the scientists involved also intend to pursue and consolidate their investigations here.

Seeking to understand to implement better

Faced with its two chosen challenges, UTC-BMBI has some rare, advantageous assets to conduct research activities in relation to health technologies. “Our scope for research covers both muscle-skeleton and cardiovascular systems and this allow

Our teams include biologists and biomechanical experts, who can work on gaining a better understanding of living matter at various scales, viz., from single molecules to the whole human body.

us to investigate a wide range of pathologies”, explains Cécile Legallais, Deputy Director of the UTC-BMBI Lab. “Moreover, we have a dual set of skills. Over and beyond the engineering science researchers, our teams include biologists and biomechanical experts, who can work on gaining a better understanding of living matter at various scales, viz., from single molecules to the whole human body. This is a strong feature for BMBI inasmuch as we can use our increasing knowledge about living matter to study associate, innovative technological systems”. By combining both levels of expertise, UTC-BMBI can notably design connected objects that offer a real added value. Today, the laboratory, for instance, is working on a serious games approach to arm and foot functional re-education protocols, unique in that they are based on muscle-skeleton models developed by the biomechanics experts. They enable the patient to re-educate at home between two sessions of kinesiotherapy guided for this by an “app” to make the right movements, with the kinesiologist adjusting the exercises remotely. When they wish to rebuild bones, muscles or tendons, for example, the specialists start with the mechanical properties of living tissue and design a bio-hybrid system (coupling a bio-material with living cells) which gives the best functional fit possible. “Our challenge – for these bio-mimetic or bio-inspired systems is to systematize our interdisciplinary approach”, underscores Marie-Christine Ho Ba Tho, Director of the UTC-BMBI Lab. “And

to do this, we formalized more accurately the to-and-fro enquiries between our knowledge of living matter with that acquired for and with bio-artefacts in our projects and we implemented a transverse programme of research that combined both levels of expertise.”

Implement in order to understand better

This approach should allow UTC-BMBI to tackle even more complex systems. ‘Défi Interfaces’ is the “flagship” project of this transverse programme which aims at building a bio-hybrid system of systems that will include not only bones, tendons and muscles but also the interfaces of these three ingredients. The postulate is that the crucial points of the muscle-skeleton system extends beyond the ingredients named above to include their interfaces. “In order to mime these parts using a bio-hybrid system, we need to be able to characterize them much more accurately in living systems”, explains Cécile Legallais. “But, in reverse and thanks to the bio-artificial devices we shall assemble, we shall more certainly progress in our knowledge base about living matter, since we shall be able to model some features that are impossible to measure in human beings, viz., and to illustrate this, as an example, the effects of degenerative decline or of a muscular effect on a tendon”. To encourage synergy between life sciences and engineering sciences, while providing a greater degree of visibility to its two main areas of expertise, UTC-BMBI has also grouped together some tools that previously had been spread with



various teams into two thematic meta-platforms. The first goes by the name of Carmod, groups the living matter/systems modelling and metrology capacity, while the second, called Ingesysbio, groups together all the equipment needed for engineering work on reconstructed bio-systems.

An increasingly rich partnership-intensive ecosystem

In order to face these two challenges, UTC-BMBI will also pursue its policy of collaboration with clinical practitioners and with other research units (inside or outside UTC). The programme “Défi Interfaces” also has the support of the MS2T Labex (Control of systems of systems), thereby federating the efforts of three UTC laboratories, viz., UTC-BMBI, UTC-Roberval (mechanical engineering who will provide their expertise of material and material sciences and engineering) and UTC-Heudiasyc (with their specialist knowledge and know-how expertise in ICTs). Also and increasingly, UTC-BMBI scientists is working with col-

leagues at UTC-Costech (a UTC research unit specialized in social sciences and humanities). “When you study repaired and connected humans, you necessarily raise questions of ethics and acceptability”, observes Prof. Marie-Christine Ho Ba Tho. “Moreover, UTC-Costech is developing a research priority on Health care Technologies and this will doubtless lead to building stronger links with them”. Lastly, UTC-BMBI has two special platforms at its disposal at the university’s Daniel Thomas Innovation Centre, accessible by the laboratory’s partners and seen as key supports for its project work. The first platform, called ‘Technologies, Sports and Health’ integrates some up-to-date equipment already used to study human movement and a sports room which also has its specific measurement units. Bio-mechanics experts can accommodate persons with a variety of profiles (sports fans, medical patients ...) to study their

Study repaired and connected humans, you necessarily raise questions of ethics and acceptability’. Moreover, UTC-Costech is developing a research priority on Health care Technologies

movements/gestures and to advance their knowledge about living matter – movement here seen as a biomarker for the healthy or otherwise status of the muscle-skeleton system.

The second platform is a model for a future connected bio-medical equipped home and is none of the antennae of the project to install an e-health Living lab in the (formerly called) Picardie Region. This platform will enable BMBI research scientists and engineers to experiment with e-health tool demonstrators with real users, and under regular life-style conditions. The objective here is to work in close partnerships with the users, with social science and humanities scientists, with healthy sector actors and with relevant enterprises in order to best adapt the tools to meet the needs, to encourage their acceptability and the associate technology transfers. ■

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Technological research in social sciences and humanities

Costech (acronym in French for Knowledge, Organization and Technology-intensive Systems) is a social sciences unit in an engineering school, rather a rare inclusion and, what is more, occupying a position in humanities. Focusing as it does, on the relationships between man, technology and Society, UTC-Costech sees technology as both the object and the support level for its research. This is a specific feature of the Laboratory that its research scientists intend to extend in the coming years.

By summarizing its project for the next five years as ‘a development of technology intensive research in social sciences and humanities in today’s socio-technical milieus’, Costech defends even more vigorously its singularity. “We are engaged in exploring a new research path that associates social and engineering sciences”, say Director Serge Bouchardon. “Research here cannot be limited to just studying social acceptance of new technology-intensive systems. We must think about technology including its human, social, economic and ethical implications ... this implies that we participate in the construction of sociotechnical adjustments upstream of the

projects per se, in a co-design approach, to experiment with users, analysing the uses and effects, and producing new scientific knowledge. Consequently, we are totally in phase with the philosophy that underpins UTC.” UTC-Costech therefore is invited to interact increasingly with the seeking to understand to do better and acting to understand better other university laboratories, contributing to their research and requesting their expertise in regard to some of its own projects. One of the major challenges to come will be to consolidate this new and dynamic vision. Costech’s prime asset to achieve this lies in its unique approaches to carry out and enrich technology-intensive research.

Three research teams at different scales

The CRED team (Cognitive Research and Enaction Design) explores the interactions between man and his environment via technologies. It notably studies handicapped persons’ situations where Costech scientists have imagined a new paradigm: perceptive substitution. In other words, an approach whereby the devices proposed do not replace deficiencies but rather offer a new functional experience. With UTC-BMBI and UTC-Heudiasyc, the Costech engineers invented Tactos, a system which enables blind persons to perceive shape on a computer or smartphone screen (icons, windows ...) via a tactile return. Then the scientists enlarged the scope of their work to address hearing deficiencies and autistic patients, with the underlying idea being that the tools developed for handicapped persons can also prove useful for general public applications.

The EPIN team (Writing, Practices and Digital Interactions) looks at new social practices that depend on digital uses. Inter alia, this team investigates what is known as the ‘digital divide’ (or fracture in France



and applies a unique approach here, the term as digital literacy: providing citizens with the fundamentals they need to acquire a thoughtful and informed grasp of digital tools and their uses, hence understanding better the implications (when we leave digital 'traces' on the Internet), and also the field of possibilities. Last but not least, the CRI team (Complexities, Networks and Innovation) explores the transition from 'industrial capitalism' to cognitive capitalism, largely based on making good use of digital tools and immaterial assets: confidence, reputation, aptitude to engage in cooperative work styles ... This team also studies innovation and, as they see it, there has to be a conducive milieu and tools for innovation to flourish and be creative. An emblematic product – the tactile table designed jointly by the Costech CRED team and UTC-Heudiasyc. This collaborative digital system allows the actors involved in a project to co-create, modify and share post-its®, charts, images and other virtual documents. By monitoring how it works, we can see that the Table allows not only for a better distribution of talk-time among the participants, a bubbling source of new ideas, something we can definitely call 'collective intelligence'.

Synergies revolving round care technologies

In order to better propel the dynamics of technology-intensive research in social sciences and humanities forward, Costech intends to reinforce the degree of synergy it enjoys among its own research teams and with other research units at UTC. In regard to the future, Costech will be committing its work programmes to two transverse themes. The first relates to what we call 'care technologies', viz., those devices that provide care and attention for others, as well as the social connection, whether we are talking about ill, handicapped or persons in good health. At the heart of the concept of perceptive replacement (the CRED team) – i.e., a theme that has already led to completing several research projects with the CRI team (notably used in 'smart' hospital settings) and will lead to projects to be undertaken by the EPIN team. There is a degree of overlap with UTC-BMBI research on health technologies (cf. p. 7) to which Costech is contributing more and more. Costech, for example, conducted a study as to the acceptability (or otherwise) of tele-medicine by elderly diabetic patients, whereby they could remain at home for their

the Table allows not only for a better distribution of talk-time among the participants, a bubbling source of new ideas, something we can definitely call 'collective intelligence'

care and is co-piloting work on haemodialysis equipment designs for use at home or at specialized healthcare centres.

Co-operating with the digital world

As it builds up, this second priority thrust: "Co-operating with the digital world" is being investigated by the three research teams: EPIN (notably in collaborative writing), CRED (tactile Internet "apps") and especially CRI (the contributive economy, collaborative tools ...). This thrust leads to better synergies not only among the Costech teams, but also with the other UTC research laboratories, where a non-negligible number of projects involve digital and collaborative aspects. One final point relates to the high training potential here, since it overlaps well with the projects and scope of the University's Technology and Social Sciences Department to which Costech is attached: "Co-operating with the digital world in intercultural milieus". ■

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At the heart of tomorrow's bio-economy

At the crossroads of chemistry and biology, the UTC-GEC Lab (Enzyme and Cell Engineering) is one of the two UTC research units involved in the transition towards a bio-economy. Its priority thrust for coming years will be to reinforce research activities on bio-sourced, bio-inspired and bio-mimetic molecules. These efforts will also allow the GEC scientists to come up with proposals to compensate for the depletion of fossil fuels thanks to plant chemistry and more efficient, totally new technological applications, notably in the areas of health services and the environment.

Three Bs form the core business at UTC-GEC, viz., bio-resources, bio-inspiration and bio-mimetics. And the laboratory GEC has structured its two major thematic areas round these concepts. The first of the theme is "Plant metabolism and bio-resources" In this area, current research focuses principally on the diversity of the plant realm and the capacity plants have to produce functional biomolecules (nutritional, antioxidant, anticancer ...) that are renewable and biodegradable.

Tailor-made lipids

The UTC-GEC laboratory focuses in particular on the metabolism of lipids from oil-bearing

plants such as colza or flax – but also doing research for atypical oils from more 'exotic' plants, compatible with foodstuff and/or industrial uses (bio-lubricants, etc.). These are examples of the core research topics for the Institute for Energy Transition ITE-PIVERT (acronym for Picardie Plant Innovation, Education and Technological Research (cf. www.institut-pivert.com)) in which the UTC-GEC is engaged. "Our objective is to progress in our knowledge about lipid systems to be in a position to produce them as and how the need arises", explains Professor Karsten Kaupt, Director of the GEC Laboratory. "To proceed here, we must study plant metabolism (food-crops, exotics plants) to understand the mechanism better and if need be, to extend our research to products we think may prove of interest. We are working on alternative

systems to tailor-produce oils and are developing pilot-scale demonstrators in collaboration with the Biogis Centre at PIVERT".

Whole plant valorisation

In the more global context of whole plant valorisation, with the aim to build an integrated bio-refinery, UTC-GEC is investigating the use of innovative technologies (e.g., ionic liquids) and enzymes to help fractioning and converting lignocellulose biomass in order to produce surfactant molecules or bio-ethanol. This first theme also looks at crop safety and improvement. UTC-GEC is studying the key factors of in field crop growing, with INRA. Moreover, GEC research focuses on certain aspects of bio-control enabling producers some novel and innovative



solutions which preserve the environment and are non-toxic for our health.

Imitating antibodies

The second priority research thrust, viz., bio-mimetics and bio-molecular diversity aims at recreating molecules that offer the same properties as bio-molecules but more relevant for use in technology intensive applications. UTC-GEC is exploring two promising routes, notably in the health and environment sectors. The first is bio-mimetics which involves molecularly imprinted molecules (MIPs); when moulded round a target molecule, the print is preserved and this allows them to recognize and block the targeted molecules, exactly as a natural antibody does with its antigen. The GEC laboratory intends to multiply its research commitments on plastic antibodies with their potentially very numerous applications – notably their use as sensors, for example, to detect tumour cells, or to identify pesticides or mycotoxins in foodstuffs – but also as vectors to accurately deliver treatments to ailing tissues without causing secondary damage to healthy tissues. Compared with natural antibodies, MIPs offer several advantages. They are both more stable, physically and chemically and more relevant for certain uses and there

is no need to use lab animals to grow them – a decisive advantage in terms of ethics and costs. Moreover, whatever the target molecule, it is possible to create and produce a plastic antibody and this is not always possible with natural antibodies.

Exploiting biomolecular diversity

Another route worth exploring is the creation of very large-scale bio-banks with several million or billion different molecules, produced in vitro,

We are one of the rare laboratories in France present all along the chain running from basic research on bio-systems, their transformation or their imitation to obtain the molecules we wish to investigate further and to use these same molecules in technology-intensive applications

whether they be natural or modified molecules, recreated in such a way that they imitate natural molecules: antibodies nor fragments of antibodies, or again other molecules such as peptides or nucleic acids, proving to identify and target molecule. “In this configuration, instead of tailor-making a plastic antibody, we make use of highly efficient selection tools to identify, among some billion(s) of bio-molecules in the bank, those that can be used to recognize the target molecule we want to investigate”, explains Karsten Kaupt. “And in most cases, this does prove possible”. Using this methodological approach, UTC-GEC scientists have been able to isolate certain bio-molecules capable of recognizing a protein responsible for one kind of leukaemia and breast cancer, and also of blocking it. Here again, the potential applications look very promising.

A tranverse approach

As the Laboratory focuses its efforts on the two thematics described above, it also has blended its research scientists in order to break down possible barriers between specialties and skills. “We are one of the rare laboratories in France present all along the chain, underscores Karsten Kaupt, “running from basic research on bio-systems, their transformation or their imitation to obtain the molecules we wish to investigate further and to use these same molecules in technology-intensive applications. By grouping our two research teams together, we are now able to better integrate basic and applied research and also to develop some projects that run transversely to our two main thematics. For the moment, for example, plastic antibodies studied in theme 2 are made from synthetic polymers. Our objective now consists of using the skills and specialties of theme 1 to see if we can produce bio-sourced polymers. Our two thematics overlap and blend into each other all the more readily that the scientists are in the same overall team. On top of this we shall be launching an academic Chair on the valorisation of bio-resources for technology-intensive applications, and this will also reinforce the relationships between the two subject areas”...■

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From complex systems to systems of systems

The UTC-Heudiasyc research unit is specialized in ICTs (information & communication technologies) and sees its project for the coming 5-year contract period focusing on systems of systems. The laboratory will reorganize itself accordingly and will shift gears to be in phase with this up-and-coming, highly strategic theme.

As a result of progress made in ICTs, the possibility now offered to couple autonomous systems so they can cooperate to carry out certain tasks, opens the way to numerous potential applications: smart transportation modes for tomorrow, interconnected robots in future factories, interconnected objects, smart urban areas... But we must note that systems

of technological systems still have numerous scientific hurdles to cross. For UTC-Heudiasyc these challenges lie at the core of the laboratory's projects to come. In particular, two emblematic research topics – driverless cars and mini-drone squadrons capable of collaborating on a series of varied missions: digitizing a site, monitoring sensitive installations, accessing difficult or dangerous zones

...). “Our initial specialty was in complex systems processing digital data”, recalls Philippe Bonnifait, Deputy Director of UTC-Heudiasyc. “But, as of 2011, we moved over to systems of technology-intensive systems and created our Labex MS2T and, today, we can observe that this subject area is coming strongly to the fore. The challenge you face in handling systems of systems lies in the

data involved: quality, quantity, integrity, protection ... And the UTC Heudiasyc lab has, as a special feature, that it brings together a wide range of multi-disciplinary skills

An organisation in phase with the challenges

The core business centres on EDP (electronic data processing) in technology-intensive systems and in particular, management of uncertainty which has now become a strategic matter. Systems are increasingly making decisions or providing assistance for decision processes on the basis of scarce and uncertain information available. "The automated pilot in a driverless car must be able to analyse complex road situations and even if it is raining and if the car cameras find it hard to identify the road markings (white lines) correctly, it must be able to make real-time decisions to act according to the situation", explains Philippe Bonnifait. "This implies that the pilot system must be prepared to develop its own artificial reasoning to control uncertain dynamic systems." The Heudiasyc laboratory also has skills in mobile robotics, in distributed systems, in networks and particularly in highly dynamic sensor networks that, for example, enable two vehicles (or drones), to exchange data in a very time interval when they meet (e.g., close or on collision courses). Moreover, the lab has expertise in another very important area – cyber security, operational safety and robustness of complex control systems. Today, the Heudiasyc scientists are studying a safety feature and device that – in the event of the auto-pilot failing – would ensure the vehicle complies with safety regulations. To tackle the scientific hurdles of systems of systems in the most efficient approach, the Heudiasyc lab skills will be redistributed in three teams (instead of four at present), where each team will be able to focus on one key thematic.

First theme – knowledge, uncertainty and data handling, will bring together scientist specialists in AI; the second theme – Interacting robotics, will deal with 'interaction' per se, in a global manner, i.e., between various interconnected systems, with their users but also often in complex environments. Lastly, the third team will bring together the network, cyber-security and operational security specialists.

Two 'Living Labs' on the drawing board

The Heudiasyc laboratory will launch two projects in the field of Living Lab smart transportation modes and systems. The first project will call for the installation in a fleet of buses of communications devices to test data exchanges between vehicles during their normal bus-route navigation: with traffic updates, etc. The second project, in a collaboration with the Greater Compiègne authorities, will enable test

runs with two driverless cars, on the roadways of the Rives de l'Oise Techno-Park. "The objective", says Philippe Bonnifait, "is to demonstrate the reliability of our multi-vehicle cooperation system. In order to travel safely, the vehicles must be able to help each other and exchange data; if, for instance, one of the vehicles detects a pedestrian on the roadway, it will immediately send this information to the other vehicle, which consequently will slow down. For the moment, we are doing test runs on the track at the UTC Daniel Thomas Innovation Centre. Our next step via the Living Lab will be to test the system scale-one, in a closed circuit". A first step before a future Living Lab moves to an open circuit environment. ■

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Three societal challenges

The UTC-Heudiasyc Lab project for the coming years will seek solutions to three societal challenges framed in the French and European strategic research policies:

- transportation and sustainable urban systems, with research on smart and driverless vehicles and on drones;
- tomorrow's ICT society, with research on systems of systems in general, notably on network architecture, communication protocols and on man-machine interfaces and collaboration;
- the concepts of freedom and security in Europe, for both citizens and residents, through research on cyber-security and operational safety for complex systems.

Developing interactions to build more and wider industrial partnerships

Scientific computation lies at the heart to all technological research. The unit expert at UTC in these matters is its LMAC laboratory (acronym for Applied Maths Lab in Compiègne). For the coming years, its objective, first and foremost, is to reinforce its interactions with the other UTC research units, but also to develop further its cooperation with leading mathematical laboratories elsewhere, in particular those in the Sorbonne-Universities Cluster and the ARC Mathematics Federation of which LMAC is a member.

Whether the commitment is to design efficient scientific computational tools or to contribute to applied research thematics, UTC-LMAC focuses clearly on engineering problems. "We help UTC's laboratories to formalise and solve mathematical problems, but we also work with external research units and industrialists," says Nikolaos Limnios, Director UTC-LMAC. "Our position is logical in the framework of the university, but highly specific given the scale of our specialty, since applied maths units rarely

get themselves involved in solving engineering problems". The research done at UTC-LMAC enjoys a high international repute, based as it is on the two main pillars of the specialty. On one hand, deterministic mathematics where inverse problems are investigated: determining the inputs to a given problem (causes) via the outputs (consequences). On the other, making use of stochastic or random methods which are coming to the fore in engineering sciences. This approach allows the scientist-mathematicians to take into account certain observed random

features (for example, the fact that cracks do not necessarily propagate in the same way on identical parts submitted to identical strains) and to model the behaviour of complex systems in a more representative way than was possible hitherto. To add to and to valorise this expertise acumen, one of the main challenges for UTC-LMAC for the coming 5-year contract period will be to reinforce its relationships with the other UTC laboratories: "With enhanced interaction among our UTC labs, we would be in a better position to work on and develop more ambitious projects with results that



could offer a higher potential for signing partnerships with the industrialists we contact”, underlines Nikolaos Limnios.

A platform in common with UTC-Roberval

UTC-LMAC and UTC-Roberval laboratories will assemble a joint platform, with the objective to have it become a recognized ‘pole of excellence’ (to use French Govnt. parlance) for modelling in mechanical engineering, an area where they have initiated two new projects. The first project looks at dislocations, viz., minute imperfections in crystal structures of materials (for example, with atoms missing from certain lattice positions). “The objective is to detect these imperfections and investigate the consequences on the elasto-viscoelasticity of these materials”, explains Nikolaos Limnios. “On our LMAC staff, we have a virtuoso of hyperbolic partial derivatives (the sort of equations that govern the dislocation phenomena) and we are setting up a two-person team with a research scientist at UTC Roberval who is studying dislocations from a more mechanical stand-point. This teamed collaboration should lead to some interesting results in modelling techniques and should have some fallout for industrialists who are faced with dislocation phenomena, for example in the nuclear power production materials, in aeronautics or those that use nanomaterials”.

The objective assigned to the second project is to be able to predict resistance to catastrophic failure of very long wind turbine blades (for offshore installations with blades approx. 100 m in length) made with composites. This project was launched by a scientist at UTC-Roberval, in an association with a colleague from UTC-LMAC, combing experiments conducted on small scale models and digital modelling for scale-one blades. The difficulty inherent in this project is to be able to quantify the scaling effect, since

the failure modes for two structures made of the same composite materials differ, depending on real blade size.

The LMAC-Roberval joint platform will bring together “binomial” teams working on a similar subject matter, as well as PhDs, Post-Docs, guest academics, and will implement software packages developed or used by these research scientists ... The overarching objective will consist of making the interactions between UTC-LMAC and UTC-Roberval more “visible” and hopefully snowball, leading to further interdisciplinary projects to design innovative deterministic and random proves computational methods and means.

New developments in biology

UTC-LMAC – over and above investigating mechanical engineering problems – also wishes to develop activities and skills in biology, a field where it already has acquired some experience: for example, it did work with the Harvard Medical School on modelling of DNA chains and is pursuing work with the French Institut national de l’environnement industriel et des risques (Ineris) on toxicology and Nikolaos Limnios has just started collaboration on the modelling of aptamers (a special family of nucleic acids) with a scientist posted currently with UTC-GEC, studying various biomolecules that may have the potential to block the genesis of certain forms of cancer. This represents a new path forward for LMAC scientists. Moreover, several other projects are currently underway and will be pursued. Among these, there are studies of thermal energy storage, in collaboration with the ENSAM-Bordeaux and the Xiamen

University, China. We can add to data completion topics and source identification, which have important, possible applications – notably in medicine, where UTC-LMAC is working with INSERM-Amiens (e.g., on epilepsy in new-borns and ischemia) and also in studies on water and atmosphere pollutions.

For a better outside vista and notoriety

With enhanced interaction among our UTC labs, we would be in a better position to work on and develop more ambitious projects with results that could offer a higher potential for signing partnerships with the industrialists we contact

The other major challenge for the coming years will be to consolidate the relationships with members of the Sorbonne-Universities Cluster, notably with the University of Paris 6 (Pierre & Marie Curie) Jacques-Louis Lions Laboratory and the Laboratory for Theoretical and Applied

Statistics. In the framework of the project on modelling aptamers, several LMAC scientists and a colleague at UTC-GEC, have joined a biology and mathematics-intensive network which has just been started at the Sorbonne-Universities Cluster. In like manner, UTC-LMAC wishes to multiply its cooperation agreements with two other laboratories with which it is associated in the CNRS ARC-Mathematics research federation: at UPJV (Picardie, Jules Verne, Amiens), the Lamfa (Basic and Applied Mathematical research, Reims) and at the University of Reims-Champagne-Ardenne, the LMR (Reims Mathematics Laboratory) with the objective to participate in large-scale projects that will help consolidate LMAC’s expertise and, hopefully, lead on to novel, positive results. ■

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A wider perimeter to engage a determined system approach

The UTC-Roberval Lab is specialized in mechanical, acoustics and material engineering. The UTC-LEC (electro-mechanical engineering), works on electric actuators and power feeds for on-board systems. The plan is for UTC-Roberval and UTC-LEC to come together as of Jan. 1st 2018 as a single research unit (covering mechanical, energy and electrical engineering) while retaining the name UTC-Roberval Lab. So what is at stake? Answer – to be able to respond better to the challenges of complex technological systems.

If you do not use a systemic approach, it will prove difficult to solve the equations that describe complex technological systems. It was when realizing this that the project to unite the forces of UTC-Roberval and UTC-

LEC came to be, both research units possessing complementary skills and areas of study. For instance, today we seek to reduce the weight of cars to decrease fuel consumption. This challenge is all the more relevant when the vehicles are

all-electric and you wish to extend their range. The paradox is that while bodywork gets lighter, all-electric vehicles become heavier and heavier because of the onboard batteries, and driverless cars even more so. “The only way to solve this sort of



problem is to have the teams work together and not separately”, explains Jérôme Favergeon, Director of UTC-Roberval. “When you split the challenge into separate items, you tend to lose the overall vision and challenge: each specialty comes up with an ‘efficient’ optimized solution, but this may potentially be antagonistic with other solutions. Consequently, the final gain is nil and performance will even be degraded”.

Roberval's two assets for success

In coming together, neither lab is abandoning nor denying use of classical mechanistic approaches, viz., studying each sub-system of a given system, independently from the others. The aim now is to intelligently combine the local and the systemic approaches and to demonstrate the added value in doing so. “We possess two assets to succeed”, emphasizes Jérôme Favergeon. “On one hand, we set off down this path as early as 2012 and, consequently, today we are mature enough to pursue in confidence. On the other, and even by uniting our forces, we shall comparatively remain small research unit compared with others working in the same fields as us, with our approx. 160 scientist-engineers. In other words, we shall retain sufficient ‘agility’ to engage in transverse investigations. This position allows us stand apart from the major laboratories and be recognized for our own merits, given that we cannot rival their work in a head-on confrontation”.

Three societal challenges

Again, in coming together, both laboratories are widening their research perimeter and scope of investigations and will stand better armed to offer solutions for three societal challenges they have chosen as a framework for future work. The first challenge relates to transportation

modes tomorrow; all-electric vehicles, naturally and railroad transport where the need for technological innovation has become self-evident if we want to reduce operational costs and regain a degree of competitiveness compared with air traffic (notably in reducing the electric power consumption of locomotives). But, likewise, in the field of aeronautics or maritime, river and canal transport ... which constitute themes where UTC-Roberval has acquired research acumen with the CEREMA (Research and Expertise Centre for Risks, the Environment, Mobility and Planning): the Digital Hydraulics Laboratory.

A promising synergy horizon

The second challenge relates to energy transition policies, which are not limited to transportation issues. The academic Chair ‘Picardie Mechanical Engineering’, animated by the UTC-Roberval Laboratory has recently launched a project that touches, inter alia, on wind turbine installations. The objective here is to study the possibility of using a carbon fiber reinforced polymer that would enable the building of wind energy megastructures that must be able to resist extreme mechanical strains, such as would be the case for offshore wind farms with blades around 100 m long and occasionally hit by violent winds. This new composite, while being particularly light, could prove very resistant to ambient (and extreme) conditions and would increase the efficiency and power range of the wind turbines. Moreover, in the framework of its joint laboratory with CEREMA, UTC-Roberval is planning to work on sea-turbines and wave-energy convertors. “As we see it, these are relatively new research topics and, given that

the UTC-LEC already has a lot of expertise in energy conversion, it would make a good fit with UTC-Roberval’s acquired skills in upstream mechanical systems”, adds Jérôme Favergeon. The third societal challenge relates to revamped industrial policy in general, with two thematics to explore. The first concerns micro-factories: minute fabrication/assembly units designed to automate fastidious, demanding tasks such as making and assembling watch parts or electronic components. One of the aims here will be to optimize efficiency levels for the systems that

equip these micro-factories, to cut electric power consumption. Here again,

the concerted works between UTC-LEC and UTC-

Roberval will prove to be highly advantageous assets.

Lastly, in this chapter of renewing industrial potential, UTC-Roberval wants

to develop further its research programmes

on factories of the future – the digital transformation of industrial companies (robotisation ...)

and adaptation of management to gain in quality, costs and delivery dates as well as in the area of sustainable development targets (taking into account the complete life cycle of products, from design drawing board to end-of-life recycling, the energy efficiency of production means ...). In 2018, UTC-Roberval will assign a specific research team to investigate tomorrow’s design and fabrication chains, again from a systemic angle. ■

For instance,
today we seek to
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En route for the Circular Economy!

UTC-TIMR is a joint UTC- ESCOM laboratory (ESCOM – engineering school for organic and mineral chemistry). TIMR stands for integrated transformation of renewable matter, which lies at the core of one of the central themes for research at UTC: en route for the bio-economy and the project to build a ‘territorial’ bio-refinery. The objective TIMR has assigned itself for the coming years is to consolidate the priority thrusts of the current 5-year contract, notably in reinforcing its expertise through agreements to cooperate with other basic research laboratories and with external industrial partners.

The major societal challenges to which UTC-TMR intends to contribute are: the quest for a carbon-free economy, with lean consumption of raw materials and energy, privileging renewable resources and controlling the environmental impacts of industrial processes.

As André Paus, TIMR Director, puts it “In 2010, we chose to focus our research attention on renewable organic matter, a priority which is still valid today and will remain so for the coming 5 year contract, viz., continuing our present contract objectives. Our project consists of developing, validating and implementing knowledge and know-how in terms of processes and reactions involved in the transformation of matter”. The TIMR Laboratory has an emblematic project, viz., to build a ‘territorial’ bio-refinery, along the lines of a classic oil refinery. The project calls for drawing the maximum benefit from a natural resource to extract a maximum range of useful products. The difference here is that the resources consist of locally grown plant crops with molecules and ingredients that replace those found in oil and to invent (or improve) processes to separate these out. Applications are the same as in classic chemical sectors: foods, health, cosmetics, materials ... The objective is to attain zero wastes after the refining process is completed, creating a local industrial ecosystem in which the by-products of certain activities in plant transformation can be used as raw materials for other processes. This UTC-TIMR research unit – co-managed by ESCOM – is the principal contributor to the PIVERT, Institute (pre-competitive research), the objective of which is to prepare the operation specifications and design for a future

bio-refinery. TIMR will also be involved in the next phase – experimentation of a pre-industrial bio-refinery demonstrator pilot.

Four research priorities

Chemistry, biology, physico-chemistry, processes, risk management and prevention are areas where TIMR has the skills and expertise to develop combined research work chains enabling the scientists to address numerous complex questions met in the field of transformation of renewable matter. The research will be organized along four principal lines. Firstly, implementation of green chemistry which not only makes use of renewable resources but is also ‘lean’ in its consumption of molecules, solvents, energy ... “For example, when we transform molecules from bio-resources to make synthons, i.e., the elementary building bricks involved in more complex chemical reactions, we try to replace reactions that consume potent acids and rare, expensive catalysts, by technical approaches that induce lower costs and have less negative impact”, details André Paus. Secondly, and one of the key challenges for the valorisation of renewable resources, the TIMR scientists are developing innovative, efficient separation and plant compound transformation processes, lean in energy and water needs and integrating at design phase the principles of risk reduction. Third priority – to study the properties of plant molecules seeking the same specifications as those of the molecule’s to be replaced or to introduce new molecules for the same utilizations. For example, when you replace a mineral lubricant oil in an internal combustion engine by a plant oil, the viscosity and heat resistance characteristics, etc., must remain identical. Fourth and final priority – the research will include an environment friendly programme – treatment of effluents, measurement of impacts that the molecules used may have on the environment ...

More synergy in the Sorbonne-Universities Cluster

Whilst plant chemistry and the bio-refinery are the core objectives for TIMR, the laboratory also plans to make use of its skills in many other strategic areas: methanisation of agricultural effluents, treatment of waste urban drinking water ... or, adsorption/desorption of hydrogen on a solid, which could prove to be a solution for hydrogen storage as a key element towards solving transport problems for the future. In the coming years, one of the main challenges for the TIMR scientists will be to sign new alliances to consolidate its expertise faced with the level of complexity of the themes addressed. “We are fully aware of the concerns of the industrial sectors”, stresses André Paus.

“This approach is one of our key-features: the majority of our contracts are with industrial partners and, if we are classified currently as having a Technology Readiness Level (TRL) 3 to 6, we shall, when opportune, move to TRL 7, 8 and even 9. But, henceforward, we shall seek to reinforce our upstream (basic research) positions. Even for separation processes as basic as filtering, for example, we need to acquire a deep level of knowledge about matter if we are to be able to design the most efficient solutions to the problems. In other words, to reach classification TRL 9 we must also have a high degree of control at TRL1 and 2. Our objective therefore consists of developing co-operation with basic research laboratories. The fact that UTC is a Member of the Sorbonne-Universities Cluster is a high-potential opportunity and a way to build more synergy with the University of Paris 6 (Pierre & Marie Curie)”. ■

plus ▶ TIMR Laboratory :
<http://webtv.utc.fr> > Nos séries >
Les laboratoires de recherche





A new look at sustainable development

Up until 2013, Laurence Monnoyer-Smith was an academic professor at UTC-Compiègne, Director of the UTC-Costech Laboratory (an acronym in French for Knowledge, Organization and Technology-intensive systems). In May 2015, she was appointed Head of the French Commissariat General for Sustainable Development, as the Interministerial Delegate for Sustainable Development, functions which lie at the core of the transition in France towards a sustainable economy and associated life-style changes.

What is the remit of the French Commissariat General for Sustainable Development?

It is what we call a transverse directorate reporting to the Minister in charge of the Environment, Energy and Maritime Affairs and was established in 2008, following suit to the conclusions of the wide-ranging “Grenelle on the Environment” Conference convened in France and embodied in law. The Commissariat promotes Government policies (for all Departments concerned) that embody sustainable development questions, hence the qualifier ‘Interministerial’.

What is the role, the influence of research and innovation at your Commissariat General?

They are absolutely essential. The Commissariat has a large, well-staffed Directorate for Research and Innovation (DRI) whose remit is to initiate, encourage and animate research work on themes that related directly with our objectives; biodiversity, climate change, participative practice in relation to the environment, new components designed to trap CO₂ on roadways ... The RI Directorate also monitors poles of competitiveness where we are involved and likewise in basic research programmes about technological breakthroughs in transportation systems and maritime domains (future ships, future aircraft ...), so as to ensure their compatibility with France’s national strategic research plan to enforce policy decisions about sustainable development. However, R&I are not the only flagship concerns for the Commissariat. All the other directorates and services are concerned. Their mission – for many of them and increasingly so – is to produce ideas and new instruments to help embody environmental considerations in public policy decisions. Moreover, we are reorganizing ourselves to be more in phase with the ongoing digital revolution and deep-

reaching economic changes pertaining to climate change and also to the depletion of natural resources.

What might these new instruments be?

One of our Services is called ‘The Economy, its Assessment, and Integration of Sustainable Development Policies’ and it, for example, works a lot on the question of a ‘green’ financial base to the economy. With the Directorate for Budget Affairs, it is pre-

paring future government green bonds the revenues of which will be used to finance energy transportation projects. Increasingly, it will become a national economy service focused on the energy transition question, with a special attention being paid to helping enterprise to take climate change implications into account and to shore up their fragility faced with the associated risks. Another service (in essence a Statistical Observatory), is rapidly changing. As its title indicates, its mission hitherto has been to observe (and produce) statistics (about housing, quality of air, transport conditions and traffic, energy consumption/production ...) mainly for the purpose of reporting on their observations, to various European and International bodies. Today this Service is faced with the influence of Big Data handling and consequences. The intention here is to move from observations to statistics and then embodying and enforcing the latter in terms of actions. Making use of and comparing data from the Ministry’s own sources will prove more efficient in public policy-setting; for example, to better prevent natural risks with more efficient forecasting models. But likewise, to offer access to these data to enterprises, start-ups and to citizens at large, for the purpose of developing new services that will help us have a control over environmental issues and problems as (and before) they arise.

The Commissariat has a large, well-staffed Directorate for Research and Innovation (DRI) whose remit is to initiate, encourage and animate research work on themes that related directly with our objectives; biodiversity, climate change...

DID YOU KNOW THAT ?

According to the IEA (International Energy Agency), published in the Financial Times:

500 000 solar PV panels, were installed in the world in yr. 2015

29 million diesel-fuelled vehicles run on Europe’s road networks

Nov.4, 2016: over 80 countries have ratified the Paris Agreement (COP21) on Climate Change

This is a major policy-making target launched by Minister Ségolène Royal in Feb. 2016 under the name Green Tech.

What are the stakes for the Green Tech programme?

The Government's aim is to stimulate the creation of start-ups in the fields of energy and ecology transitions, notably by making best use of digital tools and in particular, opening access to the data of the French Ministry in charge of the Environment, Energy and Maritime Affairs and in its scientific and engineering networks (Météo France, IGN, Ademe ...). In the springtime 2016, we organized our first two 'hackathons' to identify the public services that could be improved by opening access to our data, one devoted to data about energy, the other about data on biodiversity. Two other hackathons will follow, one on prevention

of natural risks, the other on urbanism. And we are setting up incubators to accompany start-ups who present projects close to ecological transition concerns: on energy efficiency, preservation of biodiversity, on the circular economy ... The first incubator was inaugurated Sept.8, 2016 at the engineering school- ENPC, Ecole nationale des ponts et chaussées, Champs-sur-Marne (Eastern Paris suburbs). The French Commissariat General for Sustainable Development supports and supervises all these main programmes. Minister Royal launched a special programme for data monitoring which comes among my responsibilities the aim of which is to continue along the path of increasing access to ministerial data. Moreover, we shall be managing both the Green Tech venture and the incubators.

You personally have a background in social sciences and humanities: what role do you see

these specialties playing in research conducted or supported by the Commissariat?

At this point in time, they represent rather a minor role, but it is also self-evident that scientific and technological progress alone will not be able to assure an energy transition, nor to 'decouple' growth and consumption of natural resources. What will be needed are some fundamental changes in life-styles and, indeed, some serious investigations and thought are needed here. Changing behavioural patterns, stimulating short circuit production/consumption, engaging in a circular economy, seeing how the State authorities can accompany the societal changes - these are some of the questions outstanding. From here on, my personal objective will indeed be to integrate some social science and humanities input to the projects we monitor and support. ■

UTC AMBASSADOR

Bridging the gap to enterprise

Till Lafeuille not only holds his UTC engineering diploma with a specialist elective option in 'Industrial Design' but is also our Ambassador with the automobile equipment manufacturer Faurecia. He proposes each year that UTC undergrads come and discover the wide range of job possibilities in this Group which spans 34 different countries and is world leader in the field of car-seats, interior fittings and equipment and emission control technologies.



What qualities of UTC graduates are appreciated most at Faurecia?

The training packages given at UTC develop student autonomy via the diversified range of 'credit courses', validated via concrete projects. When we choose trainees from UTC to come to Faurecia, we can rest assured that they will bring an added value to the company and will not adopt a passive stance, 'wait and see'. This is not always the case for youngsters with no professional experience who come from other engineering schools. The UTC major in Mechanical Engineering (UTC-GM) and notably the elective specialty Mechatronics correspond perfectly with our needs in automation for car seats. Students with the Mechanical Systems Engineering major (UTC-GSM) also have a profile that we at Faurecia find attractive.

Tell us about Faurecia's recruitment process

Every year, we take part in the COMUTEC Forum where companies can offer internships and recruit engineers from UTC - the most recent Forum took place Oct.20, 2016. Faurecia sees it as an opportunity to present its range of professional jobs; this year we received 160 CVs from possible applicants, all in a single event! It always proves interesting to place students in real work condition so that we can test and measure their potential. Two years ago, we organized a workshop where we invited students to design and assemble a 'next generation' dashboard. This exercise consisted first of all in pricing production costs then negotiating the part prices with suppliers. Another interesting aspect of this workshop session was that at one point the

interns were invited to abandon their central role (product) to play the role of head of a production site and then to think about ways to optimize the various manufacturing steps. At other times in the year, we propose visits for groups of students to visit some of our industrial sites.

Have applicant profiles evolved? If so, how?

During the Forum, we met with students who were becoming visibly more mature and already showed a professional behaviour and approach. Orientations and desiderata have also changed. A few years ago, student-engineers were more attracted to jobs in the design offices. Today one of our main reasons to be satisfied is that they want to go increasingly for production side jobs or with a logistics or managerial orientation in mind. Since I myself graduated from UTC, 13 years ago, I have moved from design to production and then moved more to the marketing functions, i.e., a very rich experience.

What job prospect are there after doing a placement with Faurecia?

Each year, I note that the UTC students and graduates demonstrate that they possess strong qualities and integrate our company staff perfectly after doing their 6 month end-of-studies placement with us. In my design team based at Faurecia-Méru, only a month and a half have passed and yet we are now ready to offer a job to two of our four UTC interns! ■

START UP

ABCD Nutrition



It is estimated that between 1 and 11% of the population in France follow a low-gluten diet (i.e., without wheat, rye, oat or barley proteins) and it can be observed that the gluten-free foodstuff market is very rapidly expanding. Bruno Pierre, who graduated from UTC in 1987 with the major Bio-Engineering (UTC-GB) is a pioneer in the field and he reveals his recipes for Interactions readers.

Bruno Pierre registered his company group ABCD Nutrition in 2009, specialized in 'bio' and gluten-free products with five trademarks (Les Recettes de Céline, Moulin d'Amhara and Moulins, Biothentic and Viadélise). Today, ABCD Nutrition is N°2 in the gluten-free market. And yet Bruno Pierre had not imagined he would become a corporate CEO when he started his career. "I never thought I would be an entrepreneur when I graduated from UTC. I was creative, loved the idea of innovating, but not necessarily in the vision of setting up a company. Indeed, when I set up my first company, this resulted more from an opportunity and to the urge to gain my freedom". And, above all, he had a clearly positive flair when it came to detecting a potentially rich market slot: "I was working at that time, says Bruno Pierre, "with an industrial bread-making company, in their R&D division, and I met a person suffering from coeliac disease and who had his personal industrial preserve

bread supply sent over from Great Britain – it was horrible, and that led me to thinking I could probably do something here in France. Consequently I set up my first company, Valpiforme, in 1990."

That venture immediately proved a success, but in 2008 his company was bought out by Lactalis. "I started with very few assets and I was a minority shareholder", he explains. "The buy-out was not something I wanted, so after a year I chose to leave the company. Nonetheless, the gluten-free sector was still a passion for Bruno Pierre and he decided to set up a second start-up, even though this was not self-evident. "It was quite a trial to start over again from scratch in 2009 – I had to reinvest in everything"

Bruno Pierre drew lots of conclusions from this experience and he loves to share the latter with young entrepreneurs. "I definitely encourage anyone who wants to launch a start-up –y the experience you gain here is terrific. But, when

I think back over what happened to me, I think it is essential to be 'accompanied' in the adventure, and maybe that was a mistake I made with my first company. You have to build up a network even with the bankers and these relationships must be long-term constructions. Moreover, you often hear that the CEO is a lonely person. As I see it, this is only true if the person wants to be alone and a contrario, someone who wants to share his powers is never alone. I personally brought my managers in to the capital share and ABCD Nutrition has a Board of Directors. In that way, we can share the good and the bad moments of corporate life".

Bruno Pierre's passion, 26 years 'down the road' is still intact, as is his desire to innovate. "Now, we have products that are practically identical to foodstuffs containing gluten. Our next objective will notably be the development of deep-free lines and to continue of course improving the quality of all our products!" « Bon appétit! » ■

Tic Tac Trip, a light-foot travel start-up

Under French law, July 9, 2015 called the 'Macron Bill, 'free-trade' conditions for interregional bus services were introduced and, consequently, an increasing number of travellers have chosen this mode of transport. The number of companies has literally taken off and it now is exceedingly difficult to compare prices. For this very reason, viz., to simplify planning and ticket buying for travellers, Tic Tac Trip was created by Hugo Bazin (ESCP-Europe, BBA-ESSEC) and Simon Robain, a 2015 UTC graduate in the major Computer Sciences and Applications.

Simon Robain was one of the many entrepreneurial-minded UTC undergraduates. "Indeed, I chose to study at UTC because I already had this inclination to create a start-up, although at the time, I had no idea in what area this might be". So, it was during his study years that his ideas matured. "I travelled a lot round Europe when I was a student and always had difficulty in finding bus tickets that suited me and, more importantly, my transport budget. With co-founder

Hugo, we decided to set up a start-up that would answer these problems".

Simon and Hugo together

first contacted over 70 European bus companies to get their time-tables and prices. Then they developed an algorithmic comparator to select the 5 best trip offers between two cities. "Following that", adds Simon, "our comparator then compares prices and displays a selection, depending on whether the traveller wants the cheapest, the most rapid trip, with or without changes en route..."

Today (the site only went on line in September 2016), there are already 800 registered prospect 'clients'. Simon explains this success easily "Our big advantage compared with other travel advisors is that we propose combinations of companies for a given trip. And if, for the moment, we are focused on bus travel, we shall soon be expanding our business to include train trips, co-driving ... and, why not, air travel!"

However, to mark the difference with the competitors, our two entrepreneurs hope to rely a lot on the other, associate services proposed on their site. "We have added lists of hotels close to the destinations if the route with stopovers is long. And we are studying – with the companies concerned – the possibility of our customers purchasing their tickets via our site, which of course needs some specific agreements and gain the commercial status as travel agents. We are working hard on this question of associate services: car hire, accommodation, meal packages delivered to the bus just before departure ... we have loads of ideas to explore! But our business objective is to narrow down the supply side to select and retain only the very best and to be able to offer our customers a really simple and practical service." ■



TECHNOLOGY ELSEWHERE

A pervasive digital revolution & moderate consumption



AGENDA

interactions.utc.fr • www.utc.fr

A Connected Objects Hackathon

Nov. 26-27, 2016

The UTC Hackathon Association is organizing a hackathon on Connected Objects, accessible to both UTC students and external guests, whether they be novices or confirmed aficionados. Over 150 participants are expected, for a 24h stance at the UTC Daniel Thomas Innovation Centre. External experts will be on hand to offer advice. When time is 'up' the teas will present their 'inventions' to a Jury and three prizes will be awarded, 1° - The Hackathon Innovation Prize, 2° the Hackathon Design Prize and 3° The Hackathon Jury 'Liked this' Prize

Registration at: <https://assos.utc.fr/hackathon/>

Elective speciality - Management of Innovative Projects

Nov. 24, 2016 • 1-2 pm • Centre Benjamin Franklin

Invitation to students and enterprises alike to discover the skills offered under this elective specialty developed at UTC.

www.utc.fr

UTC Open Day

Jan. 7, 2017

UTC will hold its 'Open day' January 7, 2017 for lycée students and their parents who will have the opportunity to ask all the question they want to lecturers and research scientists present.

More (lecture schedule ...) at: www.utc.fr

UTC Summer School on Health/ Nutrition

July 17, 2017

UTC is organizing its 2nd Summer School on the theme "Culinary Science for Tastier, Healthier Food". Attendees will be able to familiarise themselves with basic notions about foodstuffs in agro-food preparations, including texture and additives. Two out of the seven days will be devoted to learning/tasting French culinary heritage specialties.

More and registration at: <http://culinary-science-summer-school.webnode.fr/>

Here I am, a French exchange student – I registered 2 months ago – currently matriculated at Valparaiso University, Indiana USA, with its 5 000 students in a campus that spreads over thousands of acres, only an hour's drive or so from Chicago. Before I left home, one question kept me on my toes. In a country that saw the creation of Facebook®, Twitter®, Amazon and Netflix®, how do Americans today get on with new technologies? Let me offer you an insight to 'digital USA'...

To be honest, I had discovered these special relationships (of Americans to new technologies), even before I had set foot in the States. Last April, on the HEC campus near Paris, I was talking part in a HEC Business Game which brings together lots of students from various French and foreign business schools. The aim of the game was to have us work on strategic issues proposed by business enterprises, over a two-day workshop. Among these companies was the American giant Google Inc. And, as often happens, they had sent over a few 'Google Ambassadors' to underscore the potential benefits of working with them in Silicon Valley.

But the speech given by the Lady Ambassador (in English) was not exactly enthusiastic. "Join Google and you will have the opportunity to develop your skills in an extraordinary setting ..." A few yawns appeared. Most of the students in the room were riveted to their PCs or to their smartphones. Suddenly, the Ambassador abruptly stopped her talk, came down from the dais and began to work her way round the room, still with her microphone. "Would you please close your PCs – you don't need them and switch off your smartphones too – try to reconnect with the real world!" What a paradox

it was to see a representative of the company that initiated modern comm-tech addictions losing her nerve and accusing the side-effects of her own products. But the end-result was that all the students immediately 'switched off' their devices, reconnected with her speech and discovered how to think 'out of the box'...

This anecdote clearly illustrates a general trend in the USA: a digital revolution, consumed with moderation. To give you a better idea about what this means, let me invite you to the Valparaiso Campus.

Firstly, every student has a PC. So far, not much difference with France. But the first change is that every campus building also possesses a computer-room. I didn't actually count them, but I reckon there are over 500 in self(and free) service PCs on the campus as a whole.

Every student has a smartphone too and what is noteworthy is that they keep their eyes open for the latest apps, exchanging snapshots all day long, sharing their best moments on Instagram® and even cartoons via Boomerang®. The uses are similar to those found in France. The only real

difference lies in how the apps are spread in the student population. In France, it is easy to find people without an Instagram account or not so inclined to share snaps via Snapshot. At Valparaiso, it would be a total heresy not to have these apps. I was chided several times because I deactivated my Instagram account – “Guillaume, hey man, you’re not following me anymore? “I cancelled my account” – “Well, get back on and register again!”

Our courses too are digital-intensive, so to speak. Those who are familiar with the UTC system have certainly heard of ‘Moodle’: the EDP platform used by both the academics and the students. The site holds all the previous examinations and the course support material (slides, seminars, Lab work ...). At Valparaiso University, we have the equivalent, called ‘Blackboard’. There too, the lecturers and the students can share the course work and support material, but the site is also used by the academics to propose assessments. Thus, every Wednesday, I have to complete a dissertation on Data Mining and send it in before 23h59 min. One of my mid-term exams was in a MCQ format, to be filled in in a set, limited, time via the Blackboard. In a word, the

digital work platform is used to its maximum. But I did feel out of my depth in comparison with what I experienced at Compiègne and there are even some strange ‘things’. Example, the Prof. who only wants to speak with us over the Google Hangout system! Or the other lecturer who prefers to send his exercises via e-mail “so you can do them in the environment where you feel most comfortable”. Having said that, these are in fact the only two queer things I noted on campus. I haven’t yet seen any student’s wearing Google Glasses or an Apple Watch. On the contrary, just like the Google Ambassador I mentioned, the lecturers tend to forbid use of electronic devices in class. And they can go as far as punishing, grade-wise, those who are a shade too addicted to their phones.

I must admit that there are a few shortcomings on campus from a technological view. For instance, whereas all the campus residence entrances are controlled by ID badges, in the evening between 7 pm and 1 am before accessing our rooms, we must first go through the Residential Assistant’s office, a position held by a student’s whose job it is to check comings and goings to the residence – he must

check names against a ledger list to see if a person really lives there. Any if you wish to invite friends to your room, their names will be taken by hand, on a loose sheet of paper. This is a tedious, totally unattractive task that could easily be handled by a good software package. Another bizarre touch – the registrations for the Credit Courses (CCs) are still essentially a manual business for thousands of campus students, who have to fill in and have their course requests signed.

Of course, Valparaiso is quite a long way from Silicon Valley and its digital multinationals. Nonetheless, the student microcosm is fairly representative of this general trend in the USA. Going digital? – yes, indeed; getting hooked? – not necessarily.

But as in France, when the Wifi goes down, all hell break out! But thereby hangs another tale ... read more on my blog! ■

plus d'infos ► <http://ingenuingenieur.blog.lemonde.fr>

EXECUTIVE EDUCATION

Teaching QA Management (quality assessment)

Whether we are talking about enforcing regulatory obligations or making a voluntary move in this direction, standards and certification have become absolutely unavoidable for both enterpriser and institutions. UTC proposes a continuous education course adapted to salaried personnel from enterprise: the Management of Quality Master’s diploma will enable attendees to more readily implement the assessment process on an internal basis and to use the course teachings as tools to globally improve their company performance levels.



As of start of term this year, the specialist Masters diploma NQCE (Standardization, Quality Assessment (QA), Certification and Tests), created in 1992 has changed its name to “Managing of Quality- from Strategy to Operations”. “. “The original course was launched at the time the Treaty of Maastricht was signed to facilitate trade between the European and American markets”, explains Arnaud Derathé, who is the academic in charge of the course. The course consists of 1 200 h training which are devoted not only to predict specifications, but also extends to cover aids to decision processes and management of global performance figure for the company as a whole. The arrival of the ISO 14000 and 9001 standards have changed the scene and now require the integration of concepts such as sustainable development, societal responsibility and new management skills. Another noteworthy change is that whereas the course initially targeted the industrial sectors, it has now been extended to cover more and more the service

sectors. “The profile of applicants this year range from a medical biologist to an airline pilot, not forgetting some insurance agents, road transport managers and a nuclear physicist”, adds our lecturer research scientist. Beyond the differences in profession, the exchange of experience during the course will doubtless be fruitful. An industrial approach inspired a methodology that enabling a laboratory to account for blood samples in a medical analysis agency. To develop the networking here, the dissertations presented at the end of the diploma course will be published on line and can be openly consulted by all – naturally, respecting the confidentiality criteria where sensitive data is involved.

Innovative pedagogy

With its distant learning protocol on top of the classic class formula for the new graduates and persons seeking employment, this Master’s diploma course is especially adapted to professionals

wishing to reorient their career or to acquire new skills in QA questions and applications. An on-line platform allows the attendees to follow the course ‘chapter by chapter’ which facilitates viewing time organization. Every 5 weeks, there are 3 days of residential seminar work in Paris to ensure face-to-face exchanges about the attendees’ experience and to work together on case studies. It is a one year vocational training course focused on analysing real situations met in real entrepreneurial settings. A starter site assessment allows a precise definition of a company’s needs and, where appropriate, the adding-on of new thematic modules, depending on the sector of activity. There is a ‘coaching’ option, viz., an offer for personalised accompaniment and site visits that prove particularly interesting for candidates seeking to take on new functions in the company concerned. ■



Joining a successful start-up

Jean-Charles Labbat will soon have 30 years' experience on the clock. And our reporter noted how many "successfulls" were mentioned in a one-hour interview. Jean-Charles Labbat is a chatterbox - to quote his own words - but definitely a positive thinker!



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Avec le soutien de



We talked about his time at UTC, naturally, but surprisingly the key courses he underscores were... his language studies. "One point had a tremendous impact on my career orientation. Doing a year abroad at the end of the 1980s - at Cranfield University - was not that common and it boosted my self-confidence no end". This double degree education made his jump to the USA easier, 3 years after entering the job market, with IBM Inc. aka 'Big Blue'. The only "Frenchy" in the land of Uncle Sam, at Boston with an SME that was developing faster than the US dinosaur IBM itself. Jean-Charles became (or made himself) indispensable. What better way to keep your head not only above water but also above the other 200 000 employees of the 'Big Blue' (Armonk, NY).

IBM, followed by Cisco: for some 20 years, Jean-Charles Labbat did the rounds of some famous brand-name companies, names that make young engineers dream ... "even if, when we graduate, we do not fully realize, what the scope of their activities is", he recalls. The two decades referred to led him from manufacturing to sales in mega-structured companies before he joined a middle-sized Israeli company, specialists in selling computer science and EDP security solutions. Radware France only has a dozen or so employees. Why this size choice? "Because we enjoy taking risks", explains the CE Regional Director. "And also to have direct contacts with

the senior managers at the Home Office in Tel Aviv, something you cannot do when employed in major groups. And another obvious interest is that the wide range of responsibilities we handle is varied and evolves in a booming market context." And Jean-Charles Labbat proudly adds that the company is listed on NASDAQ! "It is more important to be average in a booming business that excellent in a mature market-place".

Adaptability and pragmatism are assuredly two extra qualities in the UTC training scheme, as Jean-Charles Labbat sees it and absolutely vital if you want to "join in" and evolve. "Technology per se is moving fast, very fast", he adds. "Everything our young undergrads learn today will be obsolete in just a few years' time. Hence the advantage in having an adaptable, general training profile." Right, I heard "adaptable", correct? It is a leitmotiv in Jean-Charles' descriptions. "Before Internet, we sold products with an evangelistic sales patter package; the customer's project was of little interest to us. Today, they can find all the technical specs on the Net. So

what is our job then? We have to answer the question -will our product fit in with the customer's system and needs? Client service and accompaniment are precious. And what about tomorrow, you may ask? Markets are undergoing a new change, with a pendular swing back to development. If you are skilled in programming, then that will prove a great advantage for you over the next 5 to 10 years." ■

BIO EXPRESS

- 1989** Graduated from UTC-Compiègne®
Awarded a double-degree MSc from Cranfield University (UK)
- 2002** Awarded an MBA from the Henley Management College
- 2016** Appointed Regional Director at Radware® for France, Belgium, Luxemburg and French-speaking Africa

