

Donnons un sens à l'innovation

Interactions

ÉDITORIAL



UTC an academic partner for enterprise

The ongoing digital transformation of industry is a major societal challenge. For UTC, accompanying a growing number of companies during the changes, the phenomenon represents an increasingly strategic field for studies. This Dossier zooms in on the university's main activities and on the specific nature of its approach to the industries of the future.

Production and manufacturing are caught between massive deployments of digital processes in engineering, deep-reaching changes in the products themselves with the so-called "Internet of Things (IoT)" or "object-oriented Internet", the advent of several breakthrough technologies such as additive manufacturing (using 3D printers) and we are seeing now the outlines of a real industrial revolution in the making. What this implies is a more connected, more competitive, more agile industry, capable of innovating faster, producing better and at lower costs – including for very small series of products, even down to 'one-off' products, more economical in raw materials, in energy consumption ...

These are some of the decisive challenges for enterprises and in a wider context for developed countries, "Industrie du futur" (France), "Industrie 4.0" (Germany), "Smart Manufacturing" in the USA, "Made in China 2025" (China)... Many have already prepared and adopted a national strategic plan in this respect to accelerate the changes, the finality of which depends on local realities. In France, for example, we had to commit ourselves to 'territorial industrial renewal' and to stop delocalization, while "Industrie 4.0" in Germany aims at preserving the leadership of German industries (cf. p.15).

These challenges are strategic for UTC too. In particular, our research scientists are investigating two main 'pillars' of tomorrow's industrial scene, the data from which will prove to be a key asset. On one hand, we have a continuum of digital information pervading engineering and production processes (cf. p.7). On the other hand, we have the specialty called data analytics: automated analysis of data recorded during and via the digital continuum, transforming them into new 'knowledge' and leading on to product design and manufacturing process optimization (cf. p.10), production quality (cf. p.11) and predictive maintenance for industrial tools and machines (cf. p.12). Our scientists have likewise launched research in additive manufacturing using various metal alloys (cf. p.14). ■

Prof. Philippe Courtier,
President & Vice-Chancellor UTC

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DOSSIERS

Industry in the Future

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YOU HAVE THE FLOOR

A new look at Germany's 'Industrie 4.0'

Dorothee Kohler & Jean-Daniel Weisz,
from the Kohler C&C strategic counselling agency

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Pierre-André de Chalendar, God-Father for the class of 2017



Friday, Sept.22, 2017, Pierre-André de Chalendar, Chairman & CEO of Saint-Gobain Group, God-Father at this year's engineering diploma award ceremony, met and exchanged with UTC students for an hour on this occasion. This exchange was followed by the official signing of a strategic partnership between Saint-Gobain Group and UTC, focusing notably on some domains for factories of the future, on certain technology-intensive research such as vehicle glass windows and on developments of companies reaching out to international activities, especially in Mexico where UTC has established a branch campus and a joint research unit (with the CNRS). ■

<http://webtv.utc.fr>

A Prize gained at the European Navigation Conference 2017 for a UTC PhD student

Franck Li, currently doing his PhD thesis work at the UTC-Heudiasyc Laboratory, won the prize for the best presentation at the European Navigation Conference 2017; his presentation was entitled "Enhancing digital maps for ADAS and autonomous commuter cars" under the supervision of Prof. Philippe Bonnifait, UTC-Heudiasyc. ■

Kumpa a UTC start-up



Kumpa a very recent start-up, founded by Maxime Robinet, a student engineer at UTC, Vincent Ledoux and Guillaume Pillon (UTC-GI (computer sciences) graduates), is a UTC start up 'on the run' selected among 10 projects to receive personal coaching, by the Jury of the European Innovation Academy (EIA). They find themselves in the same league of prize nominees as projects from major universities such as UC at Berkeley (UCB) Kumpa proposes that runners/joggers transform their training sessions into an immersive video game via a smartphone "app". Once the software is downloaded, it allow you (either alone or in groups) to run/jog through a virtual world and face/create a set of challenges ! ■

<http://webtv.utc.fr> • www.kumpa.co/

RESEARCH

Smart soles

Measuring real time foot pressure and assessing upper body positioning is made possible by these smart instep soles developed by Khalil Ben Mansour, a research engineer posted at the UTC-BMBI (bio-mechanical and bio-engineering) Laboratory with his team of students.

Both light and supple, these 'smart' soles can adapt to all sorts of condition. "In



order to undertake field studies, until present, it took us half a day just to set up the equipment, whereas our new instep soles allow to make real-time measurements on the spot", summarizes Khalil, our specialist in biomechanics. The key descriptors are 'efficiency' and 'simplicity'. Five sensors integrated in both soles provide measurements of the foot pressure variations, left and right. Simultaneously an inertial sensor worn round the athlete's waist analyses the upper body and limb position. The battery and associate wiring allow full, free movement. A Bluetooth® device forwards the data directly to a smartphone or to a computer. The system is designed to be intuitive, as the pressure exerted on each sensor in a colour scale. Another screen displays body attitude via a mock-up body.



Analysing and assessing 'live' movements

After a year's work with undergraduates in the UTC-BMBI major, the system has now become operational. "Integrating the sensors in the instep soles and setting up the Bluetooth® link absorbed most of our time and energy", recalls the project manager. There are, indeed, numerous applications for the new tool, whether it be on industrial, medical or sports levels. The inexpensive price-tag for the smart soles – approx. 50 € a pair – should prove attractive to a wide public of customers. "We are currently working with a logistics company that wishes to analyse movements and body attitudes of personnel posted to an order-preparation conveyor belt, with the aim to reduce injuries and to assess energy deployment", explains Khalil Ben Mansour. The system will also prove of interest to chiropodists to help them make more precise orthopaedic insteps. Athlete training sessions can also be envisaged with improved gestures. A finalized prototype will be readied early 2018. Inter alia, an improved design with the possibility to forward data to a cloud archival storage will be proposed. ■

AWARD

New outlets for castor oil

May 2, 2017 Prof. Christophe Len, Department of Process Engineering, UTC was declared laureate of the Glycerine Innovation Award for a decade's work on glycerol. The award ceremony was organized in Orlando, Florida at the annual congress of the American Oil Chemists' Society is a recognition of a career devoted to valorising this co-product of methyl esters (an additive for biodiesel fuels).

Biodiesel fuels at the pump in Europe contain 7 to 12% methyl esters obtained from castor and/or sunflower oils. Fort

every 10 tonnes of additive produced, 1.2 tonne of a co-product, crude glycerol is also produced. Until now, this 'useless' residue (in this form) was burned. However, by refining crude glycerol at high temperature along with some chemical-

induced transformations, it can be used in a wide range of industrial, pharmaceutical and agricultural applications. Prof. Len has been studying relevant novel processes, since 2008 at UTC, to transform this primary product waste into a high added-value molecule. With his PhD students and post-docs, he has uncovered a number of paths to make crude glycerol an

inescapable green chemistry base. “We first of all succeeded the synthesis of glycerol carbonate, a biodegradable synthon that proved interesting for the production of bio-sourced pesticides that are efficient against vine pests. We then developed a series of reactions were the developed to create derivatives of the acrylic acid used by the plastics and pharmaceutical sectors to produce quinine derivatives to be deployed in the fight against malaria and also as foodstuff colouring agents”, sums up our specialist in organic chemistry.

An opening for a new chemical sector?

Prof. Len’s research also enabled an industrialization of process used hitherto but only on a laboratory scale. “When we started this research, we proceeded by batches whereas we developed a continuous industrial system to produce quinolone with maximum safety and productivity conditions”. The solutions developed here are



promising and it now remains to convince actors in the petrochemical sector of the advantages of investing in bio-refineries. The market prices for petroleum products and also the decisions taken by EU authorities in regard to bio-fuels will determine to a large extent

the deployment or not of such technologies on a large scale. ■



RESEARCH

UTC- Costech launches its on-line “cahiers”

The N°1 issue of the journal “Cahiers Costech”, presenting research work in an open access format, has been launched on-line! It is entirely devoted to social science research with technological implications. The editors aim through this unique initiative, to gain higher visibility for the laboratory’ work in these fields and to create a forum for the scientists involved.

“Our ambition is to propose a useful tool that differs from classic, paper-based printed, scientific reviews.

Consequently neither the length nor the format of the articles displayed are predetermined by the Editor. The Internet allows us to extend the visibility of a given N° over a several weeks span”, says Jérôme Valluy, Chief Editor for the Cahiers and a research scientist in political science/information and ‘comm’ sciences at the UTC-Costech Laboratory. In order to enhance this



flexible approach, the sub-editors - each in charge of a heading – make their selections from among articles submitted by the contributing scientists. The headings run from ‘anthropology’ to philosophy’ via political science and economics, each of which corresponds to a theme studied by Costech research teams. Costech, we recall is an acronym in French for Knowledge, Organisation and Technology-intensive Systems. Of course, the underlying idea is to valorise the significant research contributions made by member of this UTC unit but also, and above all other considerations, provides a forum for scientists to exchanges on these same themes. In the highly pluridisciplinary domain of social sciences, research articles are dispersed among numerous specialist reviews. The Costech Cahiers now constitute a bookmark reference that is freely accessible. Another

advantage inherent in the Cahiers format will be to encourage exchanges in social sciences within the ranks of a French engineering school. “We do our research in a setting that differs a lot from that of universities who limit themselves to exploring social ‘human’ sciences. This UTC project enables us to claim our scientific legitimacy on the themes”, assert Chief Editor Valluy. The N°1 issue (dated June 2017) carries the headline title “Social and Human Sciences in technology intensive HE establishments”. The N°2 issue of the UTC-‘Costech Cahiers’ is planned for the end of the year.

Illustrating science on the move

This new platform proposes article contents that differ from classic, mainstream papers. By attributing the same level of importance to scientific bibliographies, research notes and/or oral transcriptions compared with previously printed scientific review articles, UTC-Costech has adopted a totally novel editorial line. The aim is to throw light on work as it evolves and progresses and not only on the definitive research

results (which alone count in current peer-review reviews). “We in fact produce numerous interesting documents which are never published because the

underlying research is not quite finished and therefore do not qualify for submission to the reading committees of these reviews”, stresses Pierre Steiner, a UTC lecturer in philosophy engaged in the HOMTECH

programme (human sciences in a technological universe) who is in charge of the Cahiers heading with the same title. The objective is to illustrate the various steps that lead scientists to drawing their final conclusions. Over and above enabling access to hitherto unpublished laboratory documents, the new Costech on-line media proposed evolving contents. After initial publication, the editing work can continue as a function of research progress and re-reading. Thanks to this diverse approach, the Costech Cahiers site offers a continuously updated site one can consult and hear about the latest progress in the relevant fields. ■



plus ► www.costech.utc.fr/CahiersCOSTECH/

PROJECT WORKSHOP

A competition revamping the Seine river-banks

In his 3rd year of the UTC-HUTECH (humanities and technology major), Alexandre Murer took part in a competition organised by Ergapolis (an institute for urbanism studies). The aim assigned was to imagine new uses for three Seine river sites currently abandoned by the locals: a former agricultural plain at Chanteloup-les-Vignes near Paris and the Seine river-banks near Rouen. With his team, baptized 'Seinographie', Alexandre came first among the competition laureates. Here is a 'recap' on a highly enriching experience, to say the least.

What were your proposals to identify new functions for these unused locations?

At the Chanteloup site, soils have been contaminated with heavy metals, due to the previous local industrial activities. What we proposed is to sow non-foodstuff crops that in fact soak up the pollutants and at the same time produce eco-materials that can be used in construction work. The general ecopark looks would change each year with crop rotation and the soil quality would be preserved. For the City of Rouen, we chose to propose improvements to some stretches of the Seine riverbanks currently occupied by industrial activities and to an abandoned railroad marshalling yard. We suggested that storage spaces for logistics could be reorganised in a concertation with the industrialists involved, to free space for a bike track. The asphalt covered built-up banks which are not very appealing to strollers, bikers and tourists would become attractive again. As far as the marshalling yard was concerned, we imagined an evolving scenario. By year 2050, this site might accommodate a station on the purported Paris-Normandie high speed train line between Le Havre and Roissy-Charles-de-Gaulle airport just north of Paris. However, as this plan might not come to be, our project", says Alexandre, "has a number of variation scenarios, depending on whether the Government goes ahead with the HS train-line or not.

What did the Jury like in your proposals?

What we did was to devise an original approach we called "Landscape culture". Our objective was to incorporate the richness of local, natural heritage and the history of this river Seine to go beyond the classic opposition of urban areas and countryside. The solutions we identified, are aimed at preserving a continuum between built-up areas and open landscapes, between the past and the future. Up till now, urbanists have tended to propose completely new rehabilitation plans ex nihilo. In our project we tried to make maximum use of what already exists - to minimise costs- but also to combine local history and acceptability by the locals. We also insisted that there be a concertation, with the various actors involved. In the Chanteloup plain there is even some illegal squatter occupation of certain patches - complex situations like this can only be resolved, we feel, through dialogue.



How were the team members chosen?

There were three teams, each with 9 students from each partner school. The specialties represented were highly diverse. Our team had a students in architecture, an urbanist, a sociologist, a landscape planner and two were engineering students. In order to see these members work well together, we adopted a transverse approach for each site. The sociologist and the landscape planner has already a rich professional background. I learned a lot from collaborating with them

As one of the team engineers, what was your personal contribution to the project?

At UTC, we learn how to work in a 'project mode' so I made good use of my methodological knowledge to have us progress faster, collectively. For the purpose of making the group work more efficiently, I set up some on-line collaborative tools, made the meeting scheduling formal with systematic agendas and with minute-writing. The UTC-GSU (urban system engineering) allows to have a very wide, pluridisciplinary, vision of urban planning issues and that led me to situate the future of these three sites in a larger regional and national framework. For instance, it appeared important that our proposals take into account the majors evolutions of transport infrastructures. With the recent concept of a Greater Paris, railroads and rivers/canals will undergo major changes. We tried to imagine a future for these sites where our ideas would prove coherent with the purported global evolutions. ■

Bronze (3rd place) for a UTC undergraduate in UTC's sports elite programme



Laurine Dictus, an undergraduate doing the

UTC core programme/sports-elite won the Bronze (3rd place) in the women's junior 300 m Junior Ladies' France Roller Championship race in July 2017. ■

A handicap wheel-chair finalist in the James Dyson 2017 Awards

Two UTC undergraduates, Jordy Manière and Romain Radreaux, have been declared finalists, i.e., are in the "Top 5" line up for the James Dyson 2017 Awards, with their project 'Liftup'. LIFTUP is an invention designed to improve autonomy and comfort for persons experiencing difficulty both in sitting down and/or rising to their feet. The system supports the rear of the body and does not need an electric power feed. LIFTUP can be adapted to any wheel-chair and consists of two adjustable hydraulic pistons, providing between 50 and 70% of the force needed to either stand up or sit down - operational speed is progressive and under the person's control at all times. ■

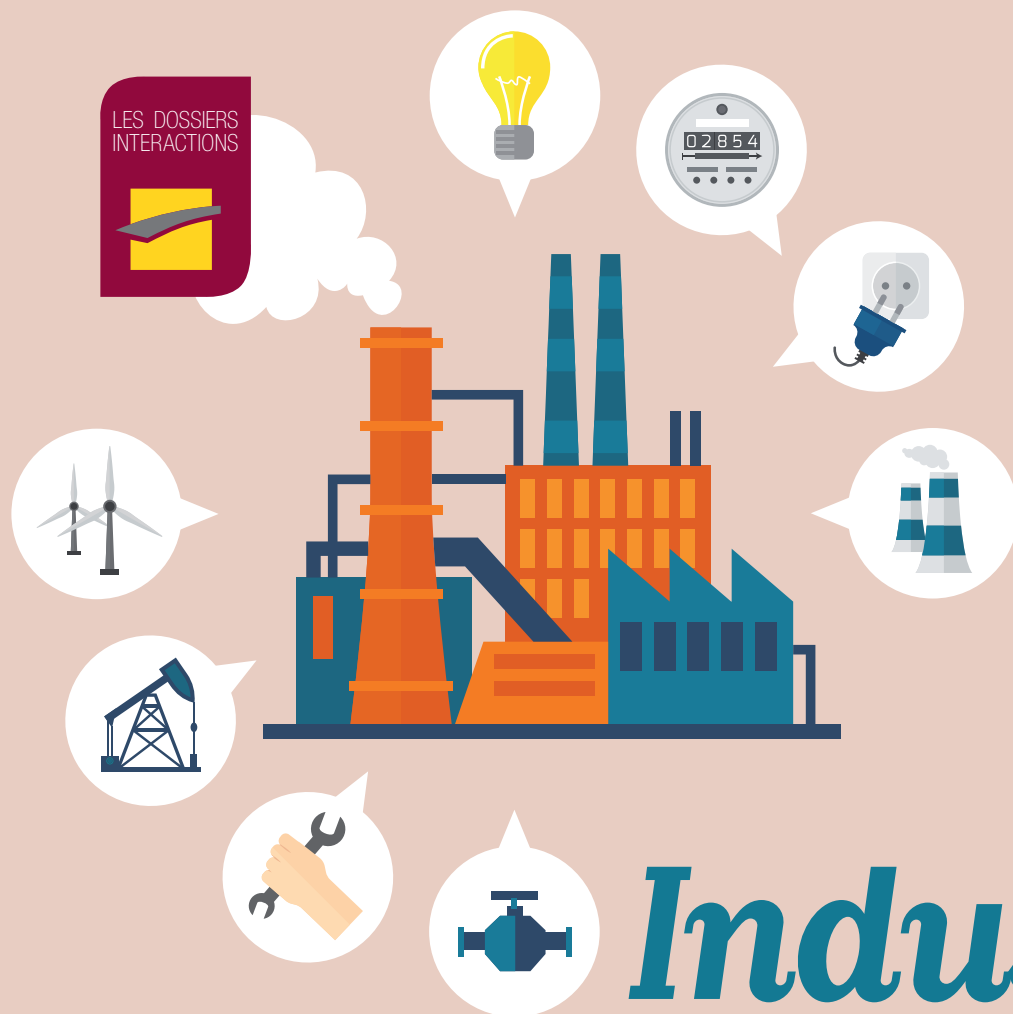


<https://jamesdysonaward.org/fr/projects/liftup/>

Factory visits at the Mexico branch campus

Students enrolled for the engineering core programme at the Liceo Franco Mexicano A.C. visited two Saint-Gobain factories to improve their skills 'on the job'. This was the first outing under the framework of the accompanying scheme for students in the core programme, for the purpose of introducing them to Franco-Mexican industrial companies. 47 new students were enrolled this year in the core programme. ■





Industry in the Future

Industry in the Future : *UTC an academic partner for enterprise*

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connected, more competitive, more agile industry, capable of innovating faster, producing better and at lower costs – including for very small series of products, even down to 'one-off' products, more economical in raw materials, in energy consumption ...

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are investigating two main ‘pillars’ of tomorrow’s industrial scene, the data from which will prove to be a key asset. On one hand, we have a continuum of digital information pervading engineering and production processes (cf. p.7). On the other hand, we have the specialty called data analytics: automated analysis of data recorded during and via the digital continuum, transforming them into new ‘knowledge’ and leading on to product design and manufacturing process optimization (cf. p.10), production quality (cf. p.11) and predictive maintenance for industrial tools and machines (cf. p.12). Our scientists have likewise launched research in additive manufacturing using various metal alloys (cf. p.14).

The positive contribution of pluridisciplinarity

“What makes our approach to these subjects original”, underlines Benoît Eynard, research scientist at the UTC-Roberval Laboratory, “is that, in the first instance, it is systemic. UTC takes the position of being less a developer

of specific technologies (robotisation, automation and control) and more an integrator, raising questions such as ‘how do you ensure these component bricks fit together in a future industrial landscape system?’. Faced with the complex issues that stem from questions like this, UTC has the advantage of being a pluridisciplinary HE institution, hence the holistic approach we have adopted”. UTC can mobilize, in parallel, its special skills, in mechanical engineering, process and chemical engineering, in computer sciences and their applications (ICTs), but also those from social sciences and humanities (see box). Thanks to this pluricultural dimension, UTC can integrate technological and social facets, and come up with proposals that are “with humans” and not “despite humans”. “We totally share the French vision of industries in the future, viz., not a 100% robotized factory floor”, explains Jérôme Favergeon,

UTC takes the position of being less a developer of specific technologies (robotisation, automation and control) and more an integrator

Director of the UTC Roberval Lab. “We agree, of course, that any repetitive tasks can and should be automated, but humans must remain at the centre of the process for all added-value tasks. That is the reason, above all other considerations, why we are focusing on methodologies and aids to decision, in order to make their tasks easier to perform”. The really specific feature of UTC is that it cares out its research engagements on the industries of the future in partnership agreements with both major Groups and SMEs, thus enabling our University to propose the most relevant solution, taking them to a higher level of maturity that would be possible if we acted alone. In order to cultivate this highly rewarding approach, we are planning to create an Open lab: one which will associate academic and industrial partners’ strengths and embodying an open, collaborative logic. ■

“It would be an error to mistake substitution and replacement”

Questions addressed by Charles Lenay, research scientist at Costech, UTC’s laboratory for technological research in social sciences and humanities.



What is your vision of industry in the future and what roles will humans play then?

It would be an error to mistake substitution and replacement. When you introduce new digital tools, or robots, you often imagine them replacing human operatives. But the truth is that tools - the history of technologies bears this out - never replace anything: they value-add and transform the domain of possibilities. So-called “smart” machines do not replace us. In reverse, they modify the way we perceive our surroundings, the way we reason, organize ourselves, interact with each other ... We often read about descriptions of industry in the future as modular, agile, resilient faced with environmental change, just as living bodies do. Personally, I feel that we should think less in terms of an isolated body adapting to its milieu, and more like a mycelium – a network of filaments that spread out underground and give rise, from place to place, to mushrooms. We humans biologically function in network modes. Digital technologies will allow us industry

to become organized in a more distributed manner in space. Large-scale factory sites, where skills and operations are concentrated, might well be replaced by a networks of smaller production sites. And there again, it would be absurd to imagine that these distributed sites could operate without humans, since it is the latter who embody the sense and meaning of the activities and who make the networks work correctly.

What contribution can the UTC-Costech Lab offer industrialists while they reflect on this topic?

UTC-Costech investigates how technology, and especially digital technologies, modify human activities and the way we experience them. We can help industrialists raise their level of abstract thinking for the purpose of better understanding what is at stake during the digital transformation of their company and to ‘rethink’ the role that their staff and teams can play, faced with automats the purpose of which is not to replace them but more to transform their activities. ■



Digital continuity, *a key-stone to Industry in the Future*

Digital continuity of information is one of the key paradigms for tomorrow's more agile, more productive industries. The UTC-Roberval Lab underscore this priority axis of its research. We present an overview, with illustrations.

Developing smarter, more connected, more tailor-made, less energy-guzzling, easier to make, maintain and recycle products ... i.e., that will necessarily be more complex, whilst continuing constantly to lowering their time-to-market and design, industrialization and production costs. To

meet challenges of this scope and nature, industrialists must forego "silo" type work (all pulling in the same direction): they need to better integrate and capitalize on their expertise – viz., integrate their data in the various professional branches involved,; so they can more readily access the information they needed to improve their efficiency, to make maximum re-use of existing data when moving on to new developments, to produce new parts 'perfectly' at a first go, to manage production in an increasingly agile manner ... This is the challenge of digital continuity, inasmuch as it designates the capacity to be able to use all the digitized data appertaining to a product or to

a system throughout their life cycle. Likewise, given that data to be integrated come from very diverse sources and necessarily heterogeneous formats: 3D CAD-CAM, technical drawings, engineering documentations, spreadsheet (Excel) files ...

A near-future, specific, research team

It can extend to development of decision aids that enable optimization of the production process, the machine tool maintenance and/or the quality of products produced or again to produce parts in an additive fabrication mode ... all the above themes are part of the industries of the future and UTC is working on them.

They suppose integration of heterogeneous data streams.

Of course, industrialists already have and use a number of life-cycle Product Lifecycle Management (PLM) systems, analytical tools to manage the data and facilitate sharing them among the professions of their sector: Product Data Management (PDM) for design related data, Manufacturing Process Management (MPM) for industrialization related data (manufacturing ranges, etc.) and Enterprise Resource Planning (ERP) for production related data (product nomenclatures, 'fabrication orders'...) However, to the extent that these

information processing systems were put together scientifically in the 1990s, they do not offer a sufficiently fine granularity to comply with today's industrial challenges.

One of the UTC-Roberval Lab's teams designs analytical "bricks" to improve the degree of granularity and to fluidify sector & professional exchanges. For the time being, the research focuses mainly on the aspect of digital continuity of information in product-process design and between engineering per se and production. But its scope of investigation is expected to expand. It can extend to development of decision aids that enable optimization of the production process, the machine tool maintenance and/or the quality of products produced or again to produce parts in an additive fabrication mode ... all the above themes are part of the industries of the future and UTC is working on them. They suppose integration of heterogeneous data streams. Digital continuity truly will be a key-stone to tomorrow's more agile, more productive industries. And as of 2018 UTC-Roberval will assign a specific team to explore and analyse these fields. ■

**Operational and cybersecurity :
two challenges for tomorrow's factories**
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A joint lab. on Digital Continuity

In 2013, UTC-Roberval Lab joined forces with DeltaCAD, a service sector and software editor company, specialized in product lifecycle management, in CAD and in digital modelling, in the framework of an ANR programme (French Research Agency) setting up a joint 'LabCom' laboratory structure Dimexp (Digital Mock-up for Multi-Expertise Integration).

Dimexp has been assigned two fields of investigation. The first concerns the continuity factor for information between a real product and its virtual, digital twin. The research team is developing a set of algorithms to be used to identify a physical object, with a set of possible applications. "Among such applications, there is product control inspections on a production line", explains Alexandre Durupt a UTC-Roberval research scientist and science coordinator for the LabCom. "For example, on an engine assembly line, the operative would video each engine using an e-pad. The system would then automatically count the number of bolts inserted and check, real time that this number corresponds to the part list for that engine, via its digital mock-up. But this tool could also facilitate reverse engineering protocols: helping to build the digitale model for a product with a very long operational life expectancy, as would be the case for an industrial machine or a motor that were designed before CAD came to be, where a modern design evolution has become necessary".

A digital twin

With this project, Dimexp is innovating on two scores. Firstly, its demonstrator allows the scientists to proceed from real objects to virtual models, whereas most digital protocols do the reverse, top down, so to speak, from top-down from model to product. We design, approve and certify, then industrialize the products virtually for the purpose of real manufacturing. But the digital chain stops there. "Our position is one we shall find among the paradigms of industries of the future", notes Alexandre Durupt: "we embody the concept of a digital twin of a real object, for which no standardized definition exists as yet, but represents as we see it an integrated system of data, models and tools that enable us to track a product throughout its entire life-cycle and to transform the data into useful information to help in fault-finding and diagnosis and as a support to agile decisions". To design this tool, the research scientists notably developed a deep-rooted neural network: an

algorithm which learned how to recognize various combustion engine parts with an additional specific feature – to be able to handle heterogeneous data. The system can recognize a part from its 2D image, but also and this is new, from 3D models (CAD or digitized mock-ups for the parts examined).

Tracking inter-professional information exchanges

Secondly – and yet another research theme assigned to Dimexp: multidisciplinary collaboration between engineering team members. The LabCom is working on a collaborative "to do list", with a tool designed to manage collaborative action lists to be used with an engineering project. The objective is to facilitate and enrich exchanges among the professions involved and more than this, to track progress and improve on the digital continuity factors. "Today, the PLM systems enable us to track the 'history' of the modifications carried out on the products as recorded in product or process manufacturing documents, but they do not indicate the reasons leading to the changes or the situation that led to the request for modification," explains Mathieu Bricogne, one of the UTC research scientists. "The idea, with this "to-be-done" list is to be able to track a posteriori the reasons for the decisions made and to capitalize on this information for the next projects in the pursuit of continuous improvement". Another advantage: to be able to track exchange also provides indicators as to operational collaboration – and this opens the path towards a more agile form of project management. To better exploit this possibility, you can build a panel of indicators deemed representative of the exchanges among professional experts during an engineering project, by implementing automated data analysis techniques and this allows you to develop decision support tools to manage collaborative engineering more efficiently. ■

"Dimexp allows us to stay one step ahead"

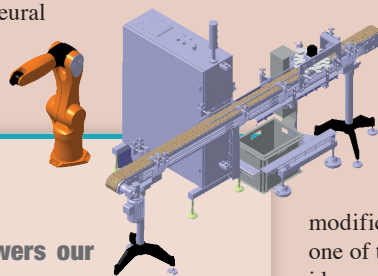
Harvey Rowson, Project Manager at DeltaCAD answers our questions

From a DeltaCAD perspective, what is the interest in your having a joint lab with UTC-Roberval?

UTC-Roberval researchers provide their scientific and technological expertise, their capacity to draw up an international state of the art on a given issue. For us this is a real added value; it is one way of anticipating market trends, given that when a hurdle appears in scientific documents, it generally prefigures the announcement for a new industrial need. But more than this, Roberval enables us to plough more innovative and relevant furrows than those we might intuitively have chosen to explore. Dimexp allows us to stay "one step ahead" in respect to emergent topics that lie at the core of the challenges facing tomorrow's industries.

How do you envisage valorising this research work?

The fundamental role devolved to Dimexp is to prove concept viability, with lab demonstrators such as TRL (technology readiness level, used to assess maturity before market launch), which is still relatively low. To increase the TRL value and develop real industrial scaled demonstrators, our objective is to sign partnerships with industrialists interested in these concepts.



Machining the right part perfectly, first time round

Optimization of the digital chain to industrialize a machined part, to better capitalize on the data, on the professional expert knowledge, thereby gaining in efficiency. This is the challenge assigned to research work carried out by UTC-Roberval Lab in the framework of two successive multi-partner projects supported financially by an interministerial incentive fund (FUI): Angel and Lucid.

If each link in the industrialization chain of a part to be machined uses specific software packages and therefore integrate data from different sources, there are standard data exchange formats. The CAD file is used by a CAM software that enables operators to model the trajectories of cutting tools in the 3D representation of the part. Likewise, the CAM file is exported via another standard in a post-processor which serves to generate an ISO code that can be executed by the numerically controlled machine tool. Notwithstanding, the chain remains complex and, above other considerations, it should be noted that digital continuity is unidirectional – running from CAD phase to implementation at the machine-tool. If, during a production phase, certain machining parameters must be adjusted directed at the machine-tool, this information is not automatically sent back to the CAM programmers: the professional experts who, on the basis of CAD, draw up the machining strategy for a given part (choice of tools, definition of trajectories ...) and the machine-tool programme per se. Knowledge acquire after fabrication is thus not necessarily capitalized on to be used again for later projects and make it possible to machining the right part perfectly, first time round.



Bidirectional continuity

Issues like these were addressed in a first FUI project (completed in 2014) called: Angel* (in French for 'An interoperable, agile, digital cognition workshop'). In order to 'fluidify' the digital chain, UTC-Roberval Lab worked on consolidating a new data exchange standard, STEP-NC (compliant Numerical Control) so as to attain its industrial transposition, says Julien Le Duigou. The advantage here is that this standard is used at each

interface of the chain and even does away with one step, viz., the need for a post-processor unit. It will be possible, in the future, for the machine-tool to read and implement directly the AM file. Moreover, STEP-NC allows you to have a return of information to the CAM level from the programme as executed by the machine tool. In this way, a bidirectional continuity has been achieved.

Aids to decision

What is the next step? It will consist of supporting the specifications of machining parameters drafting machining programmes, viz., to come up with a system capable of analysing a given CAD model's geometry and by examining comparable parts already machined by an industrialist to automatically propose the best-fit machining strategies to make new parts. This is the objective assigned to a new FUI programme launched in October 2016, called LUCID (in French for "machining laboratory using smart characterization of data")**. "In order to develop this aid to decision-support tool, we must rebuild then capitalize various strategies implemented for the different parts to be machined", explains Alexandre Durupt. "This constitutes one of the difficulties of the project, inasmuch as it presupposes that we analyse highly heterogeneous sources of engineering data (machine-tool execution ISO coded data, the CAM and CAD files ...) to identify patterns that will form the kernel of a machine strategy". The exercise is all the more complex that there may exist differing ways to produce a same shape through a machining process. ■

* : Angel combined inputs from UTC, ENS Paris Saclay, Safran, Airbus, UF1, Spring Technologies, CADLM, Datakit.

** : Lucid combined inputs from UTC, ENS Paris Saclay, ESILV, Safran, UF1, Ventana Taverny and Spring Technologies.

Digital continuity through time

Philippe Audinet, Head of Development & Support for the CAM branch of Safran Aircraft Engines and a partner to the Angel and Lucid projects, answers our questions

As you see it, what is the main benefit in using Angel?

We use it to consolidate the STEP-NC* standard. This is all the more crucial for sectors like aeronautics that our products have an operational life expectancy of thirty, forty, even fifty years. To frame this differently, this is a far longer time than that expected of any computer device used to industrialize the process, or of the machine-tools, but even of the normal career span for the CAM programmers. It also requires that we build and use data models that are stable in time, in essence, 'standardized'. By applying a single standard throughout the production chain, the connections between the various links becomes last longer.

What challenges does Lucid introduce for Safran Aircraft Engines?

When you industrialize processes needed to make aircraft engine parts, the human added-value factor is paramount. Programmers have to integrate huge numbers of parameters to make sure the parts are machined properly and guarantee the transition from the digital model to the real, physical part. This transition, in fact, is a sensitive issue inasmuch as we work with some complex materials, such as titanium, that prove difficult to machine. Our engineers are constantly faced with problems that relate to vibration, to temperatures, to tool-bending, to parts ... Consequently, there are always small discrepancies between theory and what a machine-tool really does, and several return trips are needed between CAM and manufacturing before we can obtain the part as we wanted it. Hence the interest we place in exploiting the capital background, the history of our machining programmes to better guide the programmers. That too is a form of digital continuity in ICTs and in time. Moreover, by capitalizing on our rich background, we can also assist the young programmers to progress in their special skills.



Data Analytics (DA) in the quest for *industrial excellence*

UTC can rely on a precious advantage when it comes to engaging research into industrial applications of automated data analysis: 'pluridisciplinarity'. Among current projects: designing aids to decision tools to optimize manufacturing process control and product quality assurance (QA).

Production lines today are becoming increasingly fitted with sensors that record large quantities of parameters about the process in hand and the products coming off the line.

With the 'Internet of Things' (IoT), these self-same products will be transmitting increasing amounts of data – about use, level of wear and tear, etc. Thanks to increased data storage capacities and associated data processing possibilities, the industrialists hope to draw new knowledge and significant added-values from the data flows: improvement in product design using the information incoming from real life utilization, reduction of the number of production rejects ... this are the challenge and stakes of automated data analysis, a theme where UTC can provide further, complementary skills.

Making the data speak

Heudiasyc, UTC's laboratory for computer sciences and applications (ICTs) already has amassed a lot of field experience in data analysis techniques, a mix of statistical methods, machine-learning (automat learning algorithms) and artificial intelligence (AI). "These techniques aim at identifying regular patterns in a data flow – firstly from a purely descriptive stance", explains Sébastien Destercke, a research scientist at UTC-Heudiasyc. "For example, in order to try to explain a

manufacturing faulty part in products, an a posteriori analysis can be conducted on the variables as they evolve in use. Such regularly noted patterns can be used to correlate parameters that the company's professional experts had already suspected or to reveal connexions that they had not identified hitherto, especially when the faults resulted from combinations of numerous input variables. From there on, the idea was to build predictive models – applying the hypothesis that the past will resemble the future, quite probable in a relatively stable manufacturing process, in which case the model will be able to predict a plausible output from a given set of observed inputs. The idea, notably, is to use these predictive algorithms during the production phases, to anticipate in real time, risks of faults occurring in product parts. The models can also be 'prescriptive' and suggest actions to correct a fault or improve a product. In certain cases, we can even imagine taking this still further: automating the decision implementation itself, something we are currently trying to do with driverless cars. Nonetheless, it still proves very difficult to replace human expertise in cutting-edge industrial sectors, even using the

most recent methods, the objective here often consisting of providing the process operators with aids to their decision-taking, thereby helping them carry out complex tasks".

A new QA method

UTC's Roberval Laboratory, combining expertise capabilities in process control and applied mathematics, is engaged in developing tools to optimize the control of manufacturing

processes and control of quality assessment (QA).

For example, Roberval scientist have designed and built a unique method combining multi-variable Statistical Process Control (SPC) and process diagnosis. "SPC is used to detect abnormal shifts in the critical characteristics that define product conformity with design specs, and this may be used to prevent production of more faulty parts", explains Nassim Boudaoud, a Roberval research scientist. "It is a method currently used in industrial sectors, but generally speaking only in its simplest format, i.e., with the capacity to track the characteristics of a product, one by one. But there are often correlations between these

The models can also be 'prescriptive' and suggest actions to correct a fault or improve a product

characteristics. To illustrate: the control process for the assembly tolerances for a car door may point to a defect without compromising the overall integrity of the assembled door unit, inasmuch as there are also built-in geometric compensations.” Notwithstanding, it is practically impossible to establish the decision rules applicable to monitoring several characteristics simultaneously. Thanks to Data Analysis (DA), the tools on which the Roberval

Lab is working can achieve this. Moreover, it is a truly novel innovation, combining, as it does, product and process data.” What we offer is a hybrid approach that aims at showing a better detection of ‘spec drifts’ and a forecast of evolution”, underscores Nassim Boudaoud. “In concrete terms, thanks to a historic analysis of data, we can infer connections between product characteristics and various observable states in the process and this allows us to say, at

a given time T, whether the process is operating perfectly, according to plan, or not. In the latter event, we can predict evolution to anticipate a future process state that will result in faulty product parts”. The immediate objective of UTC is to push these investigations further, testing these tools Roberval have designed and developed with real data flows and thereby proving their capacity to improve operation performance statistics. ■

Plastic Omnium :

from simple reporting to ‘spec drift’ prediction

Plastic Omnium is about to engage on research in automated data analysis in a collaborative venture with the UTC-Roberval and UTC-Heudiasyc laboratories’. Objective – to attain a new level in process control.

The Auto Inergy Division de Plastic Omnium, the world’s prime supplier of plastic fuel systems (tanks, piping ...) and depollution systems for private vehicles, has 35 factories located in 19 different countries, with one site at Venette, in the Oise ‘Department’, including the company’s global R&D centre. Two sites close to UTC, with whom the industrialist has just signed a partnership on the theme of automated production data analysis. “As we see it,” notes Philippe Convain, Digital Manufacturing Director for the Division, “DA will be the key asset for ‘Industry in the Future’. Today, we have peaked out in terms of performance levels for controlling our processes. By better exploiting our data, we hope to be able to attain a new level, resulting in lower manufacturing costs and, in the long run, gains in flexibility and our capacity to rapidly change production, if the need arises”.



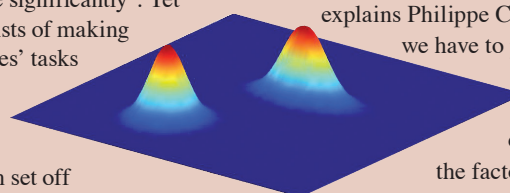
proves very useful to explain a posteriori the reasons for a spec drift in product quality”, notes Philippe Convain. “Using automated data analysis should enable us to go much further down this road, and in the first instance, it will enrich our knowledge base about the processes we employ. Today for example, we measure the thickness of our tank walls. Without this tool of data analytics, we could not control tank wall thickness and we are talking about 5 000 data recorded each tank we pressure form and we use them to deduce the physical laws that describe the links between process parameters and the product characteristic specifications. If we can attain

this goal, we shall no doubt discover a host of unsuspected links –links that we had in the back of our minds but for which we are now able to quantify to assess the real impact. And above other considerations, we shall be able to move forward from simple production reports to prediction of spec drifts: for a process that lasts from one minute, even if it takes two to three seconds computation to anticipate problem we would have enough time to react and thereby avoid a tank reject. This way, we should be able to reduce reject rates quite significantly”. Yet another challenge consists of making the production operatives’ tasks easier. For complex processes such as pressure forming of tanks, the machines can set off hundreds of alarm signals that need to be interpreted in order to make the right decisions. This is a skill that requires years of experience. “If we had the appropriate tools capable of guiding the

choice of a relevant corrective measure in the case of a spec drift, the process operators could acquire this know-how fairly easily”, thinks Philippe Convain. “Moreover, process monitoring would be less stressful and enable the operatives to focus more on improving process productivity. »

Multidisciplinary support

In order to accompany Plastic Omnium faced with these challenges, UTC will combine the expertise available at UTC-Roberval and UTC-Heudiasyc laboratories. Nassim Boudaoud, the research scientist who will be supervising the work for UTC-Roberval, defended his PhD thesis on system control at UTC-Heudiasyc and will be in a position to offer the industrialist partner his double culture in process engineering and data analysis. UTC-Heudiasyc will support the work, contributing to solving issues in process and product diagnostics and in the development of predictive and prescriptive models. As a first stage, the collaborative agreement with Plastic Omnium will see the hiring of a PhD student, who will be assigned to the project area that the industrialist has reserved in the Venette factory. “Our processes are complex and there can be hundreds of reasons for a product ‘reject’”, explains Philippe Convain. “First and foremost, we have to prove the concept for a few identified faults, by experimenting via the demonstrator installed on the factory site. Then, gradually we will be able to extend the tests to analyse other kinds of fault. And we shall test the predictive techniques on other pilot installations before we deploy them to all our factories”. ■



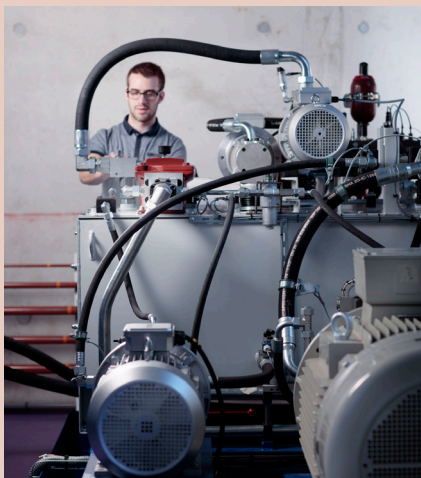
Less rejects, less stressful work

In its factories, Auto Inergy now collects and records huge amounts of data; data relating to the manufacturing process: when a fuel tank is pressure-formed, for example, some 5 000 parameters (temperatures, pressures, etc.) are recorded ... a figure to be multiplied by the 20 million, i.e., the number of fuel tanks manufactured each year by the Group. There are also data about the products themselves (diameters, lengths, fuel proof assurance ...) and the production environment (temperature in the assembly hall, etc.). “Traceability of our production



Heading for more, better, predictive maintenance

The future of industry also lies in development of predictive maintenance protocols on the production lines. UTC's Roberval Laboratory is working on an innovative methodology to better detect the fore-signals of a risk of machine failures.



Currently, in order to avoid as far as possible break-downs and failures of industrial tools and costly non-programmed down-time repair sessions, companies today tend to practice preventive maintenance, which can be systematic, or at predefined points in time or decided conditionally. In the latter case, for example, maintenance actions are triggered generally by indicators such as excessive wear of a tool. But, to better anticipate risks of break-downs and keep the number of maintenance operations down to the strict amount necessary, the ideal situation would consist of continuous

data collection about the state of the production system, thereby ensuring a reliable projection of its evolution in time. This is the principle that underpins preventive maintenance, i.e., prediction as to what moment(s) will see a possible breakdown occurring.

The connections between product, process and maintenance

A proactive approach, such as just described, is more complex to implement and, consequently, remains rare in industry today. But the upsurge of quantities of data collected on production lines and the possibility to use automated data analysis, will no doubt accelerate the movement. With this in mind, the UTC-Roberval Laboratory has begun research on an original methodology that opens the path towards more reliable, more accurate predictions. "Today, in our factories, maintenance policies for the machines tend to be disconnected from process monitoring and product quality considerations",

explains Zohra Cherfi, a research scientist working at UTC-Roberval. "And yet, when you think about it, line maintenance determines the process quality and thus, in part, the product's quality. These are early days for our research but we have the objective to identify those signals in process behaviour and/or in product quality observations, that can alert the operatives as to a risk of machine breakdown and/or failure, and with these we hope to build an aid-to-decision tool to optimize maintenance policies and their implementation". Amélie Ponchet-Durupt, likewise a research scientist at UTC-Roberval stresses that "This

The connections between product, process and maintenance : a proactive approach, such as just described, is more complex to implement and, consequently, remains rare in industry today.

is a novel approach. To be fair, there is abundant literature about the links between process, product and maintenance, but the papers mostly relate to systematic maintenance scheduling and not in regard to establishing rules for decision that take these three parameters into account, leading to making the right decisions at the right moment, in a relatively automated fashion". UTC-Roberval will be engaging its scientists on two research projects with industrialists concerned by this novel topic. ■

Saint-Gobain : optimized maintenance, *more resilient processes*

UTC will accompany Saint-Gobain Sekurit as the latter implements preventive maintenance tools that rely on automated data analysis for product quality observations, in regard to certain line processes.



UTC and Saint-Gobain recently signed an agreement with several aspects, one of which appertains to the concept of Industry in the Future.

In this area, the aim is to engage on research projects in predictive maintenance with Saint-Gobain Sekurit, a key player in the world market for car window glass. “We now have some 30 factories round the world, all operating in a highly competitive, demanding market”, underscores Jean-Luc Lesage, Executive Director Operations at Saint-Gobain Sekurit and Managing Director for its ‘Europe’ branch. “What this entails is that we must be in a position to control our processes properly, covering product quality, delivery date assurance, but also the frequency of breakdowns and maintenance costs of our glass making machines”.

Shifting gear, upwards

This industrialist has used the principles of

preventive maintenance for a long time now. He also implemented predictive maintenance methods, restricted nonetheless to only a few pieces of line equipment, without any direct incidence on the core of the glass making business, viz., the transformers. His objective is to shift gear upwards by making use of the data collected in the Sekurit factories and centralized over special data links and sensors that are increasingly equipping the company’s production lines. “Data Analytics (DA) will enable us to look for fine correlations, hitherto undetected, between the quality inspection results carried out on the glass products, the process parameters (temperature, pressure, etc.) and the operative intervention data”, explains Jean-Luc Lesage. “By analysis of this large amount of information, we hope to be able to make gains in terms of maintenance scheduling g frequencies and then amount of maintenance needed. But more than this, we expect that the added knowledge we gain from the analyses will enable us to improve process design and inherent resilience”.

Excellence on both banks of the Rhine

Over the past two years, our industrialist has conducted a few studies and launched pilot schemes, in the field of preventive maintenance, with one of the company’s academic, historic partners:

Rheinisch-Westfälische Technische Hochschule Aachen or RWTH Aachen)), in Aix-la-Chapelle (Germany). Collaboration with UTC will relate to other processes. “What we are interested in”, adds Jean-Luc Lesage, “is UTC’s expertise in process control and data analysis, but also the specific ‘signature’ of the Compiègne institution. French universities do not deal with problems in the same way as German universities or Hochschulen. When we work with partners who possess different cultures, different visions and background eXperience, we can enlarge the spectrum of our own skills and thereby move forward more efficiently”. Moreover, just as is the case with RWTH in Germany, UTC-Compiègne is close to a Saint-Gobain Sekurit factory and a Saint-Gobain R&D centre at Chanteraine (CRDC). “UTC research scientists will be cooperating with CRDC scientists and developers, relying on experience gained at the Chanteraine factory site on the data as to machine breakdowns”, adds Jean-Luc Lesage. “The interest of this tryptic, we hope, is to achieve some concrete advances for our factories”. “The core of Saint-Gobain Sekurit’s technology is Franco-German, and therefore we must subsequently seek excellence on both banks of the Rhine”, sums up Sylvie Perez, Director CRDC, at Chanteraine. “As we see things, it is especially advantageous for us at CRDC to be able to collaborate with UTC scientists in their fields of ‘excellence’”. ■

Alfi Technologies : *“More added value for our customers”*

In order to retrofit the industrial tools Alfi Technologies sells with predictive maintenance algorithms, this group has called upon the expertise of the UTC-Roberval Laboratory.

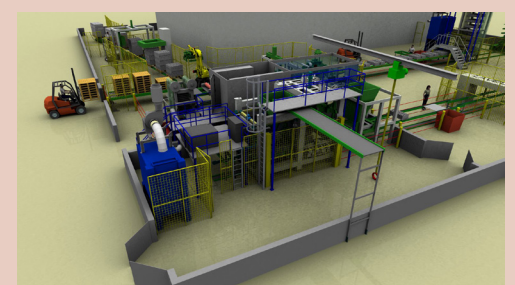
The Alfi Technologies Group designs and assembles production lines for construction materials fitted with automated systems.

“In order to exist and thrive in this market, and to preserve our engineering, activities and manufacturing factory units in France, we must, by sheer necessity, be totally reactive and innovative”, says Yann Jaubert, Chairman and CEO: “We must be able to provide answers to the specific needs of each customer ASAP, with tailor-made solutions that optimize the customer’s industrial performance level. The digital revolution gives us precisely the opportunity to do just this; as we see it, tomorrow’s industry is already here today”. As of now, the group’s design engineers produce all their work in 3D, simulating production operations on their screens and can even put on their virtual reality (VR) helmets and tour the digital twins of future production lines ...

Three challenges

Alfi Technologies would now like to move to a new stage, calling for integration of more on-board intelligence, in the production line machines. “Our aim, in particular, is to retrofit the machines with predictive maintenance algorithms that would lead on to added value for our customers”, explains Yann Jaubert. “The difficulties inherent to the project are threefold: we have to sort the data we want to collect on the production lines; we have to be able to extract models that allow us to better detect the fore-signals of a risk of machine malfunction or failures or anomalous product characteristics, and to display this information in a graphic format that can be easily read and followed by the maintenance operatives. To attain this objective at the earliest time, we chose to work with the UTC-Roberval

Laboratory. UTC is, in fact, physically close to some of our industrial sites and we have already had some previous collaboration with UTC on several other projects. The University possesses skills in maintenance issues and in data analysis, but also in electronics and signal data processing. The scientists can also help us if we wish to develop sensors for





specific data that do not yet exist- on the market-place. What is more significant is that our partnership will provide a new opportunity to show UTC undergraduates that an SME like Alfi Technologies can offer very exciting career prospects!” For Yann Jaubert, the challenge of data analysis is not restricted to simply predictive maintenance

issues: “Today, once our equipment has been installed in a factory site, we no longer have a ‘visibility’ as to how the machines behave in production mode operations, nor in regard to possible improvements we might propose. The idea now is to forward the data collected on the industrialists’ production lines back to Alfi Technologie – and this can

now be done at a cost far lower than before, using object Internet specific data links and networks. In this way, we shall be able to help our customers more easily to have their tools evolve as a function of the problems they encounter and integrate new needs and available innovations”.

Additive Manufacturing (AM): *a field of knowledge worth exploring*

‘AM’ represents a technological breakthrough and a new area of research for UTC. Initially, AM (aka 3D printing) was used for making prototypes. Now, production of polymer parts is a manufacturing possibility that interests industrialists when it comes to producing finished metal alloy parts. Provided we can overcome two hurdles.



The underlying principle of Additive Manufacturing (AM) is to make a part – from a 3D model – by successively building up layers of matter in a print process. This could in time revolutionize the way metallic alloy parts are made. For the moment, the low productivity factor for the printers excludes moving to mass production levels. Likewise there is a high price tag for the printers and/or the raw materials used, in our case metallic powders and consequently it may not prove attractive for production of simple parts. In contradistinction, it could prove very promising for small series of parts, especially when the latter are complex, or to make on demand spare parts which does away with storing spares. With AM techniques, production costs are far less correlated to complexity and quantities needed compared with classic foundry-machining processes. Nonetheless, this breakthrough 3D printing technology totally calls into question the technical knowledge base acquired through classic processes. The main hurdle here is to

ensure the control of product characteristics (geometry, tolerances, fatigue and corrosion factors ...). It also depends notably on the quality of the metallic powders used, again a complex question and often varied from one delivery batch to another. And again thermal aspects must be taken into account during fabrication – each powder layer is heated by laser to close to melting point, then cooled and this generates mechanical stresses that can induce deformation of some of the finer geometry parts.

Certain part faults are difficult to anticipate

“The key issue”, notes Jérôme Favergeon, director of the UTC-Roberval Lab, “is that, to a large extent, we ignore the connections between raw material characteristics, process parameters and the quality expected of the final part produced in this manner. It simply is not possible, as yet, to anticipate faults that may occur in a parts produced; we only see them once the part has been made (printed). This can prove critical if we are making a very limited series of parts, because if we have to carry out preliminary tests lasting several months, then proceed by trial and error, then additive manufacturing is not really commercially worthwhile”. Today, UTC is engaged in discussions with certain industrialists to carry out research on this difficulty and indeed, its academic multidisciplinary capability is an asset heretic-Roberval has specialist exports in mechanical engineering and material sciences & engineering and the UTC-TIMR Lab (Integrated transformation of raw materials) has a valuable expertise on the question of powder behaviours and applications of powder technologies. “For the moment”, says Khashayar Saleh, a TIMR powder specialist, “we have not yet

carried out any specific research on additive manufacturing. But by analogy with other applications and via our knowledge base on process engineering, we have been able to identify the difficulties that might arise: notably the issue of powder ‘flowability’, unwanted clotting of particles when the laser beam traverses the powder layer, this leading to the difficulty to obtain clean-cut edges on the parts produced, or again, irregular dispersion of the particles when the powder layer is put in position. By we do have some paths to explore”. Last but not least, UTC-Heudiasyc Lab has an excellent expertise in data analytics (DA) (cf. p. 10) that be used to obtain better part quality predictions.

A project on topological optimisation

The scope of research that UTC can undertake here is not limited to this field. Additive fabrication opens new horizons in topological optimization (optimizing the geometry of the parts produced and distribution of matter as a function of the expected mechanical properties. “Because AM allows you make increasing complex parts, it can be used to machine out less matter and lighten a part without degrading the structural limits of the parts”, notes Alain Rassineux, research scientist at UTC- Roberval. “But this implies that we adapt our tool, where possible, as used for topological optimization and compliant with the limits of the new AM process itself”. UTC Roberval has recently begun research on this question in the framework of an AM project financed by the Chinese National Research Agency, in an association with Northwestern Polytechnical University of Xi’an (China) and the Free University of Brussels (ULB), Belgium.



A new look at Germany's 'Industrie 4.0'

Germany presented her pioneering vision of industry of the future at the Hanover Fair, as early as 2011. They called it Industrie 4.0 or the 4th industrial revolution. Interactions spoke with Dorothée Kohler and Jean-Daniel Weisz, who work at the Kohler C&C strategic counselling agency and who together authored a book (in French), on the subject under the title Industrie 4.0 - Les défis de la transformation numérique du modèle industriel allemand.

How would you sum up Industrie 4.0? How did it emerge?

Dorothée Kohler : The underlying concept arose when the Germans became aware that their industrial model, largely based on their leadership in the production of machine-tools and incremental innovation, was coming under threat of Asian competition, but also because of breakthrough innovation as and when the Internet pervaded industrial sectors. Add to this the fear that the Internet giants might try to monopolize, segment after segment, access to customers' day-to-day data and corner a growing fraction of profit margins in the value creation chain for industrialists. In this context, Industrie 4.0 aims at counter the risks here by seizing the opportunities that lie in digital procedures and protocols: what is at stake is to successfully marry mechanical industries and the world of ICTs to produce tailor-made goods for the same costs as in mass production and to develop the Internet service offer, viz., connected services in relation to machines.

In your book, we note that you stress the importance of a collective dimension to Industrie 4.0 – why is this deterministic?

Jean-Daniel Weisz : What struck us in Germany was that the topic was not framed so much in terms of technology involved, but more as the "collective acting" and mobilization of collective intelligence. This particular feature stems from the highly deconcentrated nature of mechanical, electrical and electro-technical firms in Germany, with indeed very few companies having over 1 000 staff and few enterprises between which the customer-supplier relationships are very strong. For the Federal Government and the Lander (regional) Governments was – how can we get them to progress collectively if and when faced with a breakthrough innovation? Federal Government authorities notably answered this question by launching calls for collective projects. Consortiums were set up, with for example a major company or a large-scale ME (intermediate-sized company) taking the lead role, and behind them various SMEs in mechanical engineering, integrators, ICT companies and also research institutions or establishments. The Federal State plays the role of the prime contractor, creating the conditions that allow the actors to collectively assume responsibility secure their own future. This is a highly appropriate approach exemplifies the capacity in Germany to create new interactions among the

actors and to develop complementary skills that will help gain a competitive edge for the SMEs and MEs who take part.

Is the situation very different from that in France?

D. K. : German State authorities have taken aboard the fact that an in-depth transformation of the country's industrial model will necessarily lead to a societal project involving all concerned, including the trade unions. In German, the expression "Industrie 4.0" has become commonplace. In France, the subject is not tackled by politicians to any extent and the approach remains fragmentary, whereas the right attitude should be "systemic". What the digital world changes above all, is the value chain of the industrial companies, doing away with certain functions and enabling the customer to be at the heart of the process thanks to product use data, modifying the relationships with their suppliers ... Organization of work is also affected, with the emergence of new jobs ... here we have a subject that stands at the interface of politics, economics, trade unions training and research. The changes will bring with them an opportunity that potentially is very rich, and which could revitalize a new economy. The universities have a key role to play, if we wish to see French society at large getting involved in the vision and benefitting from its effects.

« The topic was not framed so much in terms of technology involved, but more as the "collective acting" and mobilization of collective intelligence »

You underscore the strong implication of research activities in Industrie 4.0, notably projects conducted in the applied research establishments such as the Fraunhofer Institutes

J.-D. W. : Yes indeed and it is interesting to note that as of 2006 - when then Germans began thinking about Industrie 4.0, the then Federal minister in charge of Training was personally committed to this industrial subject. Moreover, the strength of Germany lies also in a very dense network of universities of technology (technische hochschulen) and research establishments, notably the Fraunhofer Institutes that 'irrigate' all of the German Lander and became rapidly engaged in Industrie 4.0. This is all the more relevant for the Fraunhofer Institutes where their Presidents themselves are industrialists by profession. Social sciences – sociology, history of engineering technologies – are also party to the interest vested in the topic. All the more interested that it provides them with the opportunity, for the first time, to observe an industrial, revolution in the making, so to speak! ■

DID YOU KNOW THAT ?



Industrie 4.0 - Les défis de la transformation numérique du modèle industriel allemand [Challenges The Digital Transformation of the German Industrial Model], Dorothée Kohler, Jean-Daniel Weisz, La Documentation française, Paris, 2016.

SUMMER SCHOOL

Science served on a plate



UTC's Summer School for "Culinary science" proposes that the participants from all round the world discover how the principles of chemistry apply to French gastronomy and to 'revisit' some of our great 'classics' implementing the latest developments and technologies in agro-food sciences. The forthcoming 3rd edition will take place July 17-28 at the UTC Daniel Thomas Innovation Centre.

During the two week intensive course, the attendees hear about new foodstuff techniques that stem from research work and learn how 'cuisine' can be more health-friendly and better adapted to specific diets programmes. Prof. Claire Rossi, a UTC research scientist in charge of the major specialty course on Innovation, foodstuffs. and agro-resources, launched this summer school two year ago. "Our

objective is to provide participants with the necessary bases to scientifically understand how culinary preparations are made and to have them apply their new knowledge directly, 'hands-on'. On each day of the course, there are afternoon workshops that practice what is taught theoretically and learned in the morning lectures. Following a review of what the sense of taste entails and the role of various types of foodstuff ingredients from a chemical point of view, there are various experimentations. Proposed substitutions for sugar, fat and/or gluten are one of the highlights of the course. The processes are applied to classical recipes from French traditional 'cuisine' and are adapted to comply with the most recent trends. Demonstrations and advice are given by a qualified 'chef', blending the rules of kitchen arts and technology. Examples are a sugar-free chocolate cake or mayonnaise with twice less oil (in the earlier editions), this year's targets include, notably a vegan 'vacherin' cake with no animal-sourced ingredients. Also as in the earlier editions, there will be week-end outings to allow the participants to take in and appreciate France's culinary and cultural heritage. A wine-tasting outing will be organized to a champagne 'cave'.

lots of Asian participants who were attracted by the prestige of French culture and gastronomy and also participants with specialties far removed from food sciences", explains course organiser Prof. Rossi. The high repute of the French agro-food sector – first investor in R&D in France and a leader in world ranking is also an advantage. More and more applicants already have high-level skills and are seeking to complete their personal knowledge base. The quality of the pedagogy used and the concrete and user-friendly atmosphere of the workshops meet with unanimous approval. Mathan Goldstein, an Israeli PhD student in biology attended the 2016 session out of personal interest: "I found the summary explanations on the various forms of starch and the ways to replace them very clear, and since attending this Summer School, I cook my dishes differently". For Charlotte Verschaeren, studying nutrition and food sciences in Belgium, to complete her knowledge-base, there were also many discoveries in then course: "The varied formulae for the famous chocolate moelleux' cake without any fatty ingredients using seaweed was a revolution inasmuch as the taste is identical. I think seaweed can expect a great future from an industrial standpoint but also for kitchen uses at home". Year in year out, the programme, entitled "Culinary science for tastier and healthier food" has an ever-increasing audience. For the 2017 Edition, there will be thirteen participants from four different countries. Also this year and for the first time, there will be attendees for the adventure coming from the entrepreneurial world. ■



Participants from round the world

Ever since this Summer School existed, the formula has been found attractive to students from a variety of backgrounds. Motivations and level of skills vary too. "In 2015 and 2016, we welcomed

TRAINING

Acquiring new economic and managerial skills

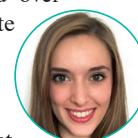
The INSEAD Business Foundations Certificate offers attendees the possibility to complement their engineering skills with a diploma from a reputed schools of commerce. It is a short (6 month) course designed to provide basics in management, finance and marketing to graduates in other specialties. It is part of the offer in the framework of the Sorbonne Universities Cluster (of which UTC is a founder member).

With her UTC diploma (majoring in Process Engineering), Chloé Azaïs earned her Business Foundations Certificate in February 2016. In the 6 months needed, our young graduate managed successfully to combine her new studies with her professional remit and obligations.

Tell us how you decided to sign up for this course?

After my UTC engineering diploma, I started looking at Master's degrees in a business school to add a line to my CV. I found the INSEAD diploma attractive inasmuch as it allowed me to balance my professional work and new studies. The twelve

hours of course work lectures are spread over Friday pm-Saturday. If you want to devote your time exclusively to the course, the time allotted allows you to avoid being cut off from the business world for too long. The fact that I qualified for a bursary grant was also decisive for me. It was awarded on the



grounds of “merit” reducing the full course cost from 15 000 to 3 000 €.

What were the admission criteria?

Selection among candidates is on the basis of the application file, but the academic track-record is not the key to admission. You are assessed mainly on personal attributes and a demonstration of your motivation to discover new subjects to study and learn. The interviews are conducted in English; all the lectures are in English too.

In what subjects did you learn most?

During my years at UTC-Compiegne, I followed several courses in marketing, behavioral analysis and management. In contradistinction, financial

and management theory were entirely new subjects for me. The intensive lectures in the Business Foundations Certificate enabled me to progress very swiftly in these subjects. And since each class was small – around twenty – left plenty of opportunities to exchange and participate.

How was the course organized?

One and a half to two month modules were organized, each aimed at presenting a new topic. There were not many tests or exams but in contrast, loads of personal work was required. Outside the class presence, reading and project work took up a lot of our time. When you are committed to the Business Foundations Certificate, you have to be ready to go all the way.

What benefits did you gain in doing the course?

Well, following this new diploma, I in fact decided to change jobs. The Business Foundations Certificate was accepted as a prerequisite to a Graduate contract Program with an American Group lasting two years and alternating engineering and training sessions on various subjects such as finance, supply chains, management and human manpower resources. In this way I was able to continue to develop my newly acquired INSEAD skills. So, barely two years after gaining my UTC engineering diploma, I have just recently been proposed for a position as head of a team of eighteen persons » ■

PROJECT WORKSHOP

UTC students getting ready for the centenary celebrations of air transportation

A set of students enrolled at UTC, have been investing time and efforts each semester for the past two years in a unique project: rebuilding a Latécoère 28, a French plane designed in 1929 of which no model exists today.



The Grand Palais Paris will host an exhibition, in 2018, to commemorate the centenary of air transportation. A Compiegne based association, the Cercle des Machines Volantes (CMV) will be associated with the event, deciding to rebuild a Latécoère 28, an emblematic French aircraft that left its mark on the early days of civil aviation. Frédéric Collinot, President of the Cercle, invited UTC to contribute to the aeronautical engineering aspects of the project. Indeed this is not the first collaborative work between UTC and CMV – UTC students have been engaged for 4 years now, rebuilding a Caudron C430 (the project is progressing smoothly but has been put on standby status for a while, as of 2016, the teams concentrating on rebuilding the Latécoère, deemed more urgent).

A project on this scale calls for rigorous organization and for this reasons, every semester, 4 to 5 students enrol for a project management credit course (CC). “We liaise with Mr Picard who initiated this project at UTC and the other students engaged in CCs as needed to implement the rebuild

project and it is our remit to recruit the students”, explains Warren Pasini, himself a UTC student. “We also look after the sponsorship arrangements”. Each CC there is an assignment of a specific problem that relates to the Latécoère rebuild programme. “Noteworthy CCs are ‘digital modelling’, to study the aircraft profile, propulsion unit ‘engine modelling’, another for the “wood stiffeners” and n for instance, this semester, we have a group studying canvas aerofoil skin properties”, explains Warren. But, prior to even envisaging rebuilding this aircraft, a huge amount of documentary research had to be done, notably for the technical, drawing held at the Latécoère Foundation and also by members alive today of the Latécoère family.

“The students used the drawing as the base to begin their modelling work, and that allowed us to make pricing estimates for parts that we could not make directly in the CMV workshops”. The objective of the Association is to have all the parts needed made by early 2018 which then will be assembled in to the final aircraft structure ready for the exhibition at the Grand Palais in Paris. The air-engines and other function-related equipment will be fitted later, opening the prospect of a historic re-enactment of the very first aero postal flight between Europe and South America.

This unusual project attracted numerous students, lecturers and research scientists. “Those who join the project are not necessarily aeronautical fans when they start, but they become fans! Several students have decided to specialize in this field and one lecturer even gained his pilot’s license”, notes Warren enthusiastically. It is a project that is highly enriching for the students inasmuch as they

have a chance to directly apply their class-learned theoretical skills to a concrete case. It also requires them to display a large degree of self-motivation, of organization, of compliance with delivery dates and relevant distribution of the tasks to be carried out. “It is also a project that calls for a large personal commitment, amounting on average to 60 hours per semester. There is a huge level of responsibility attached to the project, given that the ultimate aim is that this rebuilt Latécoère will (and must) fly”, concludes Warren.

Rendez-vous in 2018 at the Grand Palais, Paris ! ■



Pierre-Georges Latécoère created the Société Générale des Lignes Latécoère in 1918 (later to be known as the legendary Aéropostale, in 1927). WW1 had just ended. Military aircraft were being replaced by civil transport models and “By Air” postal services took a giant leap forward. Aircraft designers – to carry airmail and passengers over ever increasing distances – began proposing new models on a regular basis. This was indeed the case for the Latécoère 28, designed in 1929, with a passenger capacity of 8, in addition to the airmail load. In 1930, pilot Jean Mermoz made the first non-stop crossing of the South Atlantic aboard a float equipped Latécoère – it took him 21 hours in flight between Senegal and Brazil and this achievement opened the way for numerous aero postal lines from Europe to the South American continent.

AGENDA

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35th special days of the AMB Association (Biomedical Maintenance Agents)

October 10-13, 2017

The 35th special days of the AMB Association (Biomedical Maintenance Agents) will take place Oct. 10-12, 2017 at the exhibition centre Le Tigre (Compiègne) and on Oct. 13 at the UTC Transfer Centre, under the high patronage of the French ministry in charge of Social Affairs and Health. Among the topics on the programme: artificial ventilation in neonatology, new therapies used in reanimation, remote medicine, dialysis protocols and connected biomedical objects ...

www.aamb.asso.fr

The Science Fête

October 12-15, 2017

As every October, UTC will hold open days for the public at large for the 2017 edition. From Thursday Oct.12 to Sunday 15, 2017, the themes this year will focus on – Tourism (it is the UN International Year for Tourism for Development), Travel, a Regional Theme (technological evolutions during WW1), update on UTC and ESCOM. Workshop examples – driving a TGV locomotive, Discovering a virtual world by interaction gestures, Mini-drones ...

www.utc.fr/fetedelascience

23rd edition of the COMUTEC Forum

Thursday Oct. 19, 2017

Each year, this Forum brings together over 100 business companies and close on 4 000 students, thereby enabling the latter to discover the numerous representatives of the entrepreneurial world who may, one day, recruit them. As last year the Forum will be organized at the exhibition hall - Pôle Événementiel de Margny-lès-Compiègne, Le Tigre.

<https://comutec.org>

Electricity & Mobility, 25 years' research activities of UTC-LEC

Tuesday Nov.7, 2017

Celebration its 25 years of activity, the Electromechanical Engineering Laboratory, Compiègne (UTC-LEC), will be organizing an open day, Nov. 7, 2017. Among the subjects covered – a retrospective of 25 years research activities in the area of “electricity as a vector”, several lecture and a Round Table will offer a prospective view over the coming decade in terms of scientific and technological issues that relate to the future of all-electric vehicles.

Registration is at : <https://candidature.utc.fr/colloque/eem>

UTC's annual graduation ceremony

Saturday, Dec. 9, 2017

This year's ceremony for the UTC engineer-graduates 'commencement day' will take place Saturday, Dec.9, 2017 for the first time exclusively at the Espace Jean Legendre, Compiègne. The graduate class this year have chosen Pierre-André de Chalendar, Chairman and CEO of the Saint Gobain Group as their God-Father.

In the wings of the ceremony at:
www.instagram.com/utcompiègne

SPORT ÉLITE

From UTC to the Atlantic Ocean

Tom Laperche, an undergraduate at UTC, majoring in Mechanical Engineering, with his family background of seasoned sailors, caught the sailing bug himself when he was a teenager. He was admitted to the UTC “Sport Elite” option and has been able to balance his academic studies with his ambitions at the helm.



The head of this option, Arnaud Vannicate, monitors Tom's progress and advises him so he can devote himself to his « passion », sailing. When you are enrolled to study at Compiègne, it's somewhat difficult to train at sea during the week days. The option allows Sports Elite students to adapt the academic course schedule without changing the total number of semester for the engineering diploma to comply with the needs of a high-level sport. So, for several days a month Tom goes family to his family setting in Brittany to practice. He has no regrets at all because this optional choice combines a secure professional future and gaining some insights for my sport. “It was logical for me to follow engineering courses, inasmuch as sailing is now highly technical and increasingly so. You have to understand scientifically how structures and

materials behave and this helps in the competitions, over and above the sensations of sailing.” Tom insists on the fact that today's seagoing “F1s” are becoming technology-intensive concentrates. The general use now made of foils that enable boats to “fly” over the waters, our understanding of lift, pressure and speed has become vital to sailors. The example of ocean-going skipper François Gabart, who also holds a Mechanical engineering diploma is typical of this increasing orientation trend. Tom envisages himself as a future sailor-engineer working in design office to prepare tomorrow's Formula Ones. Since the month of May, Tom is seeing one of his childhood dreams come alive. He has been selected for the famous Transat Jacques Vabre between France and Brazil. “It's terrific to be in the same race as the famous sailors”, insists Tom. For this challenge, our 19 year old Breton will make best use of his sailing talents and also his engineering skills. His single hull 12 boat will race in Class 40 and is almost ready. “As of July, I shall supervise the interior fittings and try to lighten all the equipment as much as is possible. After that I'll do the fine tuning of the boat and get ready for the race start in November”. We wish Tom “Fair winds” for him and for his boat-mate too! ■

plus d'infos ► https://webtv.utc.fr/watch_video.php?v=K0685UBSHG9D

INDUSTRY IN THE FUTURE

Operational and cybersecurity : two challenges for tomorrow's factories

‘Operational security’ designates the way systems are protected against possible breakdown and cybersecurity to protect against intentional, malevolent attacks. UTC-Heudiasyc Lab is managing a project on future factories that includes these two features.

System control and data acquisition (better known by its acronym SCADA) enables remote surveillance of industrial sites. In future factory sites, the systems will be increasingly ‘open’ to the world via Internet and will notably be coupled with wireless sensor networks that collect production data real time via cloud based applications. Protecting increasingly complex systems against operational breakdowns and/or cyberattacks remains a challenge. UTC-Heudiasyc – in a partnership with the CRAN (System Control Research, Nancy) and the LORIA (Computer science and applicative research, Lorraine) launched ‘SURF’ (operational

security measures for future factories), the original feature of which is that it combines measures against malfunction and malevolence, which issues are usually handled separately when the systems are designed initially and this can lead to extra costs or failures, e.g., operational security measures can be redundant with the anti-malevolence measures (or even lower the security levels). Surf is designed to help development of a methodology that enables users to model and analyses both of these security measures and to certify the methods on an experimental multi-site platform. The objective assigned is to be able to identify suspicious behaviours and to predict the impact in order to set preventive corrective measures in motion. ■

START-UP

a start-up that advises major marketing divisions



There is a difficulty nowadays when a company has to choose from among 5 000 digital marketing technologies – and it is time-consuming too. And yet the choice is critical and necessary today for any web strategy policy. Compellia is a start-up specialized in digital data analysis and aims at advising marketing division executives in the e-business websites and other major group marketing managers to find the ‘best fit’ in terms of choosing a service offer.

In contrast to numerous other UTC students who began to found a start-up company before they graduated, Olivier Delcroix who obtained his engineering diploma in 2008 in the major Computer Sciences and their applications (UTC-GI), opted for a different approach.

“I had always wanted to create my start up - indeed that was what determined my choice to major in GI. However, before I actually did this, I want to gain some professional experience and acquire various additional skills to be able to understand business opportunities better, as and when they arose. I therefore started with the company BULL, for two years and then moved to Bonitasoft, a young start up founded by two former employees of Bull. I left them a year and a half ago to set up my own company Compellia, in 2015 with Benjamin Cernes and Dialekti Valsamou.”

Compellia’s objective is to meet the strong demand

from these marketing divisions for whom it is paramount, one could say, to keep themselves informed as to technological advances in a highly competitive area with its constantly evolving technologies. Advertising via the Internet and targeted e-mails have become fundamental to any marketing strategy, but it does prove difficult to find one’s way (and solutions) among the very numerous proposals. “What we propose to the marketing heads is what we call strategic computer science applications”, adds Olivier. “For this we use crawler robots which “dredge” texts from sites, analyse their structures, the technologies used ... we are scanning some 100 000 sites per day and we detect over 2000 different technologies at play”.

This innovative, new approach earned Compellia a French Tech grant in April 2016 enabling the company to continue to develop its crawler robot.

“Thanks to our platform, we can detect the technologies used by platforms similar to those of our clients. We then arrange a contact between our client and the technology users who accept to share their experience, notably via the social, professional networks. This allows our customers to have a completely objective assessment as to possible service suppliers”.

“For the moment, at Compellia, we are focusing more on the French and European markets. But our objective for horizon 2018”, adds Olivier “will be to pursue development of the robot in order to be able to detect even more, different, technologies and to strengthen our position on the European market-place”. ■

Plus ▶ <http://webtv.utc.fr>
www.compellia.com

Connected drivers to improve bus fleet management

The possibility to consult in real time the bus timetables on a phone or at a bus-stop, seems something absolutely necessary these days. The drawback is that the equipment is cumbersome and expensive and does not allow smaller companies to invest here. This was where Grégoire Piffault and his associate came up with a simple yet ingenious idea: to provide the drivers with smartphones and an ‘app’ that allows their company to geolocalise them. Simple as pie.

When Grégoire Piffault (a UTC-GSU in Urban Engineering Systems, graduated in 2008) and Nicolas Jaulin were working together for Systra – a major public transport company, that they realized that existing systems require the fitting of heavy equipment in each bus.

“Today ¾ of all bus companies do not possess a monitoring system for their vehicles”, notes Grégoire. “We then thought that new technologies should be able to offer the same functionalities, but in a much simpler and economical way”.

The two associates decided to launch a start-up, PYSAE, in 2014. The underlying principle is easy to understand: “We import the time-tables, the bus-stop coordinates, etc., and then provide our own servers stations to store the data”, Grégoire comments. The bus drivers are then ‘given’ a smartphone with our “app” enabling each bus to be geolocalised in real



time. “The data are then forwarded via the “app” to the commuters, with all the PYSAE equipped networks. “However, since we supply the data, our customers can develop their own apps, carry out traffic analyses and install, if they so wish, information screens at each bus-stop” adds our young entrepreneur.

The start-up recently developed a system to validate badges, for example, those carried by pupils on school bus circuits with equipment far lighter than those currently used, connected to the driver. Reduced operations costs obtained this way allow small operators such as territorial authorities, school transport companies, developing countries ... to



equip themselves.

“In fact, what we sell the customers is a subscription that is a pro rata of the number of vehicles they wish to connect plus some additional à la carte services, if required”, notes Grégoire. The city of Dole and the Loire-Atlantique department already use PYSAE and a contract has been signed with the national electric utility EDF to track a vehicle round the premises of a nuclear power station. Today, the two associates have just raised some investment funding to develop their product in Eire and elsewhere round the world, “and we have just welcomed on board a major shareholder, Vinci Energie, who recently acquired a minority participation in the start-up company”, says Grégoire by way

of a conclusion. ■

Plus ▶ <http://webtv.utc.fr>
<https://pysae.com>



Continuous learning

Ali Ordoobadi, who gained his UTC engineering diploma in 1987 with the specialty field of robots and electromechanically propulsion units, has been Chairman & Managing Director of Valeo Japan and Chairman and Chief Executive Officer at Ichikoh, a subsidiary of Valeo and a front line company for automobile light systems. As a manager expert in automobile sector, Mr Ordoobadi has astutely combined an acute sense of cultural mix with a deep-rooted knowledge of industrial global strategies.

More scientific than literary by training, Ali Ordoobadi had an early, passionate inclination for mechanical engineering. Ever since he was a teenager, he stripped down car engines to better understand how they worked. Born in Iran, he learned English and French rapidly. His choosing UTC as his university was swift and almost self-evident: "Compiègne offered an open, pragmatic training course with a unique international vista (at that time)", he recalls. UTC was one of the very few HE establishments proposing a robotic specialty, directly applicable to industrial sites: "The field was then quite novel and the lecturers were all extremely committed". Over and above learning and developing his engineering skills, student Ordoobadi also followed a course to learn the German language. This was an optional choice that opened up some hitherto unexpected horizons. His knowledge and achievements in German allowed him to join Siemens just after his UTC diploma award. "This was a company that epitomized for me the very best in technology combined with quality", he adds.

Rolling back the boundaries

Following this initial experience with Siemens in Germany, Mr Ordoobadi was approached by Valeo. Given that the French equipment manufacturer was expanding its activities in Germany, Mr Ordoobadi was hired to handle management of projects with the German car manufacturers. That marked the start of almost 30 years career with the French company Valeo. In the early 1990s, this company was one of the first to envisage production of 'national' parts outside France. Our young graduate engineer took every advantage of the 'spirit of conquest' and new horizons, firstly in Europe, followed by Brazil and Asian countries. After his spell in Germany, Ali Ordoobadi pursued his career ladder in Great Britain. Toyota, Nissan et Honda were busy at the time setting up new production units in Europe, thereby offering more competitive products and, in this context, Valeo began negotiations with the new actors. Travelling frequently between England and Japan, he was able to

learn yet another language and to discover Japan, a fascinating country.

After a brief experience in Brazil, Ali Ordoobadi's inclination to accept new challenges was still as strong as ever.

When he received a proposal to direct a plant in China, he accepted without hesitation. "I knew absolutely nothing about China or Chinese and I had to learn the rudiments of their language and the very different way the workers there operate – very different from my previous experiences", he underlines, admitting that this job was not easy. Product quality problems with suppliers and delays in client payments were commonplace events. However, he did manage to stabilize the operation, improving the financial situation and obtaining new orders. Nonetheless, Mr Ordoobadi feels admiration at the way the Chinese have to adapt – this stage in his career can be read as an invitation to remain humble. "Identifying the most relevant way to communicate is often just as important as defining the technical solutions", he insists, advising those who envisage moving to China to learn the language basics before travelling there. After being head of Valeo's operations in China from 1999 to 2007, he himself then moved to Japan – a country he first visited 20 years before. "With the Japanese, being punctual and compliant in terms of delivery dates is fundamental but this huge respect for process and time for ideas to mature occasionally slows down innovation and reactivity", notes Ali Ordoobadi realistically. Now Chairman and CEO for Ichikoh, since 2010, following his post as Deputy Chairman for Valeo Japan, he was able to bring a long-standing family-based enterprise back to earning profits and new growth. This new success story in no way prevents Ali Ordoobadi from underscoring that in a changing world, one

must continuously question one aims and options. After Ichikoh was taken over by Valeo in early 2017, Mr Ordoobadi moved back to his initial career company, as Chairman and Managing Director of Valeo Japan, while remaining Chairman and CEO of Ichikoh. ■

BIO EXPRESS

- 1992 PhD systems control
- 2006 INSEAD
- 2007 Vice President Valeo Japon
- 2010-2017 Chairman & CEO at Ichikoh Industries
- 2017 President at Valeo Japan



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