

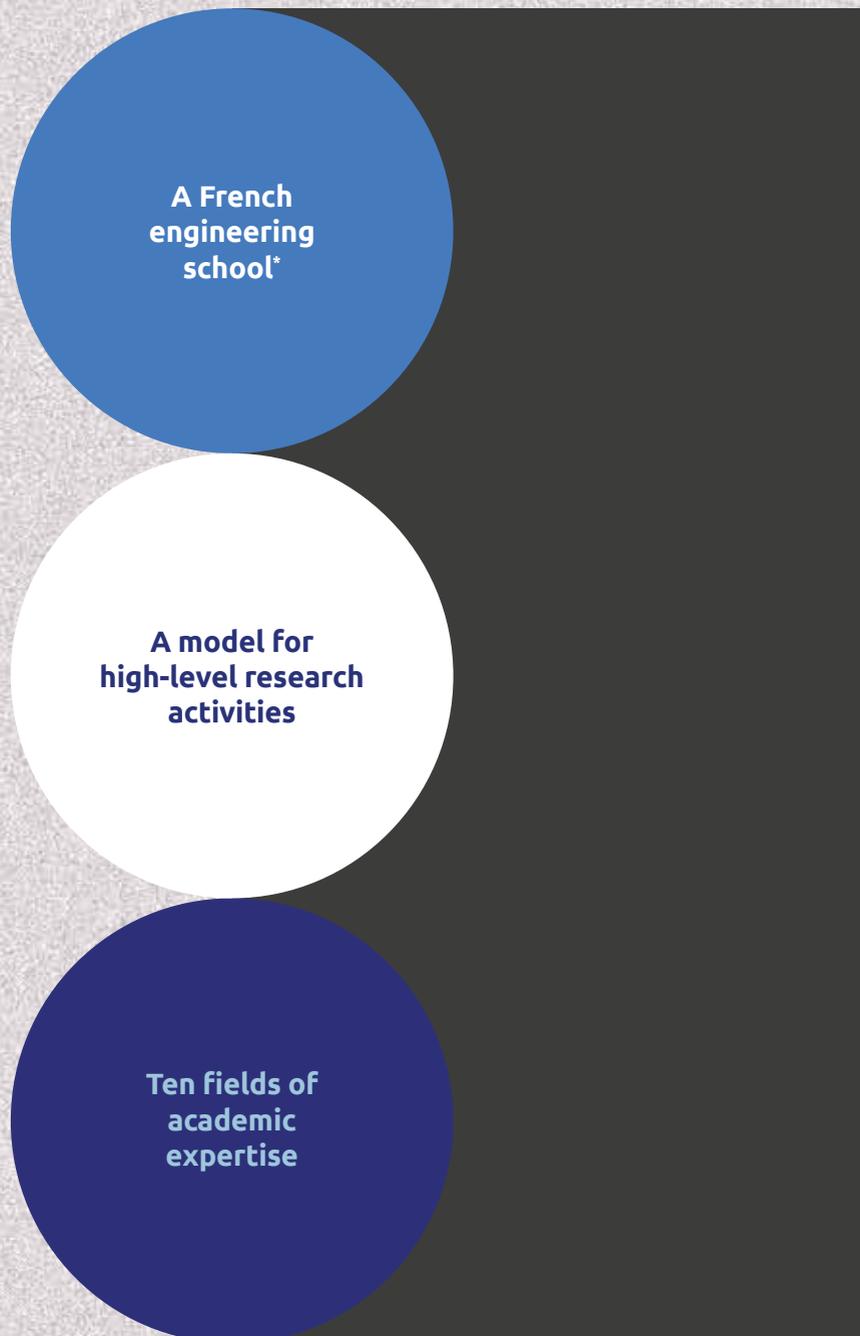
UNIVERSITY OF TECHNOLOGY, TROYES

utt

Facts & Figures



utt
UNIVERSITÉ DE TECHNOLOGIE
TROYES



UTT-Troyes,
one of the five
major public sector
engineering schools
in France

Université de Technologie de Troyes

Open Expertise

*France has a dual system of Universities and 'Grandes Écoles' (GEs- engineering schools). Admission to the GEs is by competitive examination. Admission to Universities is a 'right' conferred by obtaining the Baccalaureate: places are offered via a national on-line 'Parcoursup' assessment and placement system. The three French UTs (UTC-Compiègne, UTBM-Belfort Montbeliard and UTT-Troyes) are exceptional in that they have dual status, as Universities and as Grande Écoles.

UTT-Troyes: a model in training, research and technology transfer

7 096 graduate engineers¹

3 101 student engineers²

195 PhD students and Post-Docs²

24 % non-French students

National higher education diplomas and degrees

The UTT engineering diploma, with its 7 elective majors

1 Master's degree with 3 specialist majors and 6 training combinations

1 PhD degree with 3 specialties at UTT-Troyes

4 specialist Mastère courses[®]

11 University diplomas, nationally accredited

3 Vocational training degrees

Dedicated personnel

164 tenured lecturer-cum research scientists

236 'admin' and technical support staff

8 research teams assigned to the Charles Delaunay research institute

A dynamic partnership-intensive outreach

60 TT (technology transfer) contracts are signed each year

UTT-Troyes has signed over 230 international university partnerships

3 000 private sector partners

UTT-Troyes has created 4 industrial Chairs

2 439 student engineers²

526 females, 444 non-French nationals, 592 grant-holders,

149 in the apprentice engineering scheme

37 with professional contracts 37 disabled students

UTT-Troyes awarded 485 diplomas in 2018

UTT-Troyes's annual budget (without research activities)

24 m euros²

UTT-Troyes annual research budget

13,6 m euros²

1. Alumni.

2. Fiscal yr. 2018.

From the President's desk

Benefitting from its dual status, being both a university and an engineering school, UTT-Troyes relies on its 8 research teams to propose training packages that encompass the entire university cycle: Bachelor's degrees, engineering and Master's degrees, PhDs plus various university diplomas and some specialist Mastère[®] programmes.

Ever since it was created, UTT-Troyes has opted for innovative pedagogy, centred on the possibility given to the students to choose their course modules and to build a personalised cursus that matches their professional aspirations. This approach allows students to make and defend their choices, which makes the UTT student profile so special: they are immediately operational when faced with unfamiliar challenges, they show a capacity to work in teams and have acquired the practice of undertaking and exploiting exploratory approaches.

These training packages, once completed, provide the graduates with all the skills needed by the entrepreneurial, engineering and business worlds. Designing and assembling new materials, handling "smart" connected objects and robotics, managing ICT systems transformed by artificial intelligence (AI), cybersecurity, using novel management processes, "open" innovation, collective intelligence, are among the numerous topics that are also investigated in the UTT's research projects, in its training and technology transfer schemes, all of which are structured into 10 areas of expertise:

1. Networks, Connected Humans and Objects
2. The Circular Economy and Sustainability
3. Nanotechnologies and Function-Oriented Materials
4. Logistics and Production in the Future
5. "Silver" Technologies
6. Mechanical Engineering Design and VR (virtual reality)
7. Innovative Materials and Manufacturing Processes
8. Security Issues and Risk Management
9. Design and Uses for Digital Technologies
10. Monitoring/Surveillance and Operational Security Data Management

UTT-Troyes is also a key player in the economic and social development of the Champagne & Grand Est Region. It takes an active part in setting up innovative and dynamic ecosystems via various academic, territorial, scientific projects and mergers, with an overarching ambition that extends to the UTT's European dimension.

UTT-Troyes is a public higher educational establishment which from the outset developed a strong capacity to work closely with the business world, through partnership-based research programmes, innovation, initial and continued education/training schemes.

UTT-Troyes encourages and promotes student initiative, commitments and entrepreneurial ventures, deemed an integral component in the training of young men and women ready to imagine the future, to manage its complexity, to adapt to change whilst mobilizing an acquired corpus of advanced scientific and technological skills.

As UTT-Troyes celebrates its semi-jubilee, this already highly 'international' establishment, is now focusing on Europe with the prospect of becoming a European University of Technology alongside six academic partner universities. This policy approach is in line with the vocation adopted by UTT-Troyes to direct its activities in such a way as to seek to identify and provide answers to some of today's major societal challenges: global society, the concept 'industry of the future', environmental issues, health and ageing – which all necessarily call for increasingly close scientific partnerships.

Pierre Koch

President & Vice-Chancellor

Director UTT-Troyes

UTT-Troyes, a dynamic development showcase in pursuit of excellence

- 1994** - UTT-Troyes was established by Government decree
- 1996** - Graduation of the first class of "UTT-Troyes engineers"
- 1997** - Installation on today's Campus site
- 2000** - Creation of the UTT's PhD School
- 2004** - Inauguration of the first UTT Master's degree
- 2005** - Creation of the Sino-European School of Technology of Shanghai University (UTSEUS).
- 2006** - Launching of the Charles Delaunay Institute (UTT-ICD)
- 2007** - First extension to the UTT Campus
- 2008** - UTT-Troyes welcomes the first class of UTSEUS Chinese students
- 2009** - Changeover to the establishment being responsible for self-management as embodied in the University Reform Bill
 - Launching of the UTT Vocational degree programme
- 2010** - Creation of the UTT Partnership Foundation for Risk Detection & Prevention, Complex Systems and Global Security Issues
 - A joint UTT/CNRS research laboratory
 - Partnership agreement signed with INRIA (French national research institute for digital sciences, research on automation and control)
- 2011** - Inauguration of the UTT Apprentice engineering scheme
- 2015** - Inauguration of a 5 000 m² extension devoted to research activities
- 2016** - Launch year for several specialist Mastère® degree courses
 - Inauguration of the Chair of "Silver" Technologies, devoted to senior citizens' needs for enhanced autonomy
 - Creation of the College of Humanities, devoted to improved outreach for Social Sciences and Humanities
- 2017** - Launch year for the MIND protocol (acronym in French for Maîtriser, INnover, Développer) [NDT Control, Innovate and Develop]
 - Inauguration of the Chair of "Connected Innovation"
 - Inauguration of the Chair of "Crisis Management"
- 2018** - Inauguration of PRESAGES, a research, experimentation, modelling and training platform for crisis management studies
- 2019** - Inauguration of the Chair of Global Security *aka* "Anticipate and Act"

Pedagogical Innovation

In 2017, the French ministry in charge of Education launched a call for expression of interest (CEI) to help accelerate pedagogical transformations. The transition from secondary school classes to higher education is a major challenge if we wish to see the students we admit succeed. At UTT-Troyes, the "EcoPARA" CEI Project aims at setting up a centre for investigation, exchanges and production of pedagogical resources to be made available to teachers in both secondary and HE establishments.

In this CEI framework, UTT-Troyes, in association with the University Reims Champagne-Ardenne, is developing a project code-named "ImmerSup": a portal site to orient students actively and help them prepare for an admission to an HE establishment.

Again and with the same aim, i.e. to help students succeed, another project "Ailes" was declared laureate of a call for projects entitled "Territorial ways and means to assist orientation to HE studies", under the Government inventive PIA3 (programme of Investments in the Future). The "Ailes" Project covers 228 high schools in the Grand Est Region.

EUT+

UTT-Troyes and its 6 European partners:

- Технически университет София, Technical University of Sofia (Bulgaria)
 - Hochschule Darmstadt, University of Applied Sciences (Germany)
 - Technological University Dublin (Ireland)
 - Rīgas Tehniskā universitāte, Riga Technical University (Latvia)
 - Universitatea Tehnică din Cluj-Napoca, Cluj-Napoca Technical University (Romania)
 - Universitat Politècnica de València (Spain)
- have been working together for several months in favour of the prospect of a European University of Technology as a response to a call for projects by EACEA (Education, Audiovisual and Culture Executive, notably in charge of the Erasmus schemes) with a common objective: to test a new model and new practices to train European citizens in scientific, technological and humanist skills.

The challenge here is to contribute to the building of a more inclusive European Union, paying increased attention to growing "excellence" in all territories and engage in a new phase where UTT-Troyes can deploy services and take advantage of new opportunities. The various projects developed in the EU will help narrow down the definition of future European universities that Europe aims to launch as from 2020. UTT-Troyes and its partners are actively pursuing their contribution to the exploratory work, and to building a common future within a reinforced Europe. In the framework of this venture, UTT-Troyes has the support of the French State authorities.

UTT-Troyes, a strategy for outreach and building the future

A network embedded university

UTT-Troyes is a member of the CDEFI (*i.e.* the National Conference of Directors of French Engineering Schools) of the CGE (*i.e.* the National Conference of the Grandes Ecoles) and of the CPU (*i.e.* the Conference of University Presidents and Vice-Chancellors).

UTT-Troyes is also a part of the network of French universities of technology.

The UT Group

This UT group is composed of four universities of technology, *viz.*, UTBM-Belfort-Montbéliard, UTC-Compiègne, UTT-Troyes and the Sino-European School of Technology of Shanghai University (UTSEUS), created in 2005.

The UT Group has 11 000 matriculated students; 800 PhD students; 800 lecturer-cum-research scientists and 800 support and admin staff and awards 2 000 engineering diplomas each year.

Promotion and recruitment of student engineers are shared, as is the development of international outreach policies and transverse research projects.

“UTT 2030”, a strategic project

With this strategic project “UTT 2030” and its so-called “site contract”, UTT-Troyes is adapting to institutional, economic and competitive evolution. The project is built in a collaborative manner and aims at strengthening the university’s international standing and to support a long-term, sustainable economic model.

UTT-Troyes, coordinating Higher Education activities in its “territory”

UTT-Troyes is located in the heart of a campus area and an ecosystem that are in favour of innovation with, less than 1 kilometre away, the IUT [university Institute of technology], the “Aube en Champagne” science park with its Young entrepreneur centre and three other Grandes Ecoles: EPF [general engineering], ESTP [Public works] and the Y SCHOOLS [Commerce]. Over the past decade, with 10 400 students, Troyes and its suburbs have seen the student population tripled. Troyes is now an attractive city for young people who wish to pursue higher educational studies.

The UTT Foundation

The UTT Foundation brings together the graduates, the students’ and friends, as well as partner enterprises, with some 2 500 private donors and over 150 sponsor companies. There is a committee of “ambassadors” who are

motivated to convince even more people to become involved and committed to the development of UTT-Troyes.

The Foundation has adopted the following policy priorities:

- Ensuring a multiplication of innovative pedagogical projects;
- Promoting the diplomas awarded by UTT-Troyes;
- Empowering the UTT Chairs of “excellence”: SilverTech, Connected Innovation, Crises Management.

ASANUTT

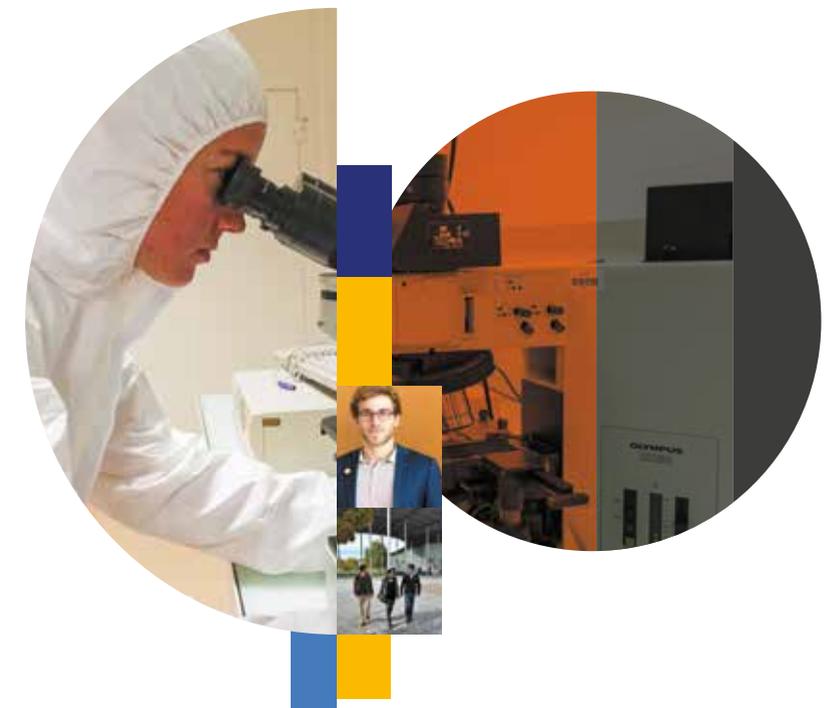
ASANUTT (the UTT alumni association) aims at bringing together all UTT-Troyes graduates. Its policy is to enhance, support and animate the alumni network members who hold jobs in business enterprises and to promote the *alma mater* through their success stories and track-records. 11 352 UTT-Troyes graduates are registered in LinkedIn.

A public HE establishment accessible to all

Annual tuition fees are set by the ministry in charge of HE, Research and Innovation. UTT-Troyes has 24% students with bursary grants³.

42 360 m² total floor space

- 2 industrial halls, 2 200 m²
- 2 000 m² university library space
- 5 000 m² of laboratories and research platforms
- 4 000 m² for sports activities
- 1 spin-off unit located in Nogent (52 Haute Marne Region)



³.Academic year 2018-2019.

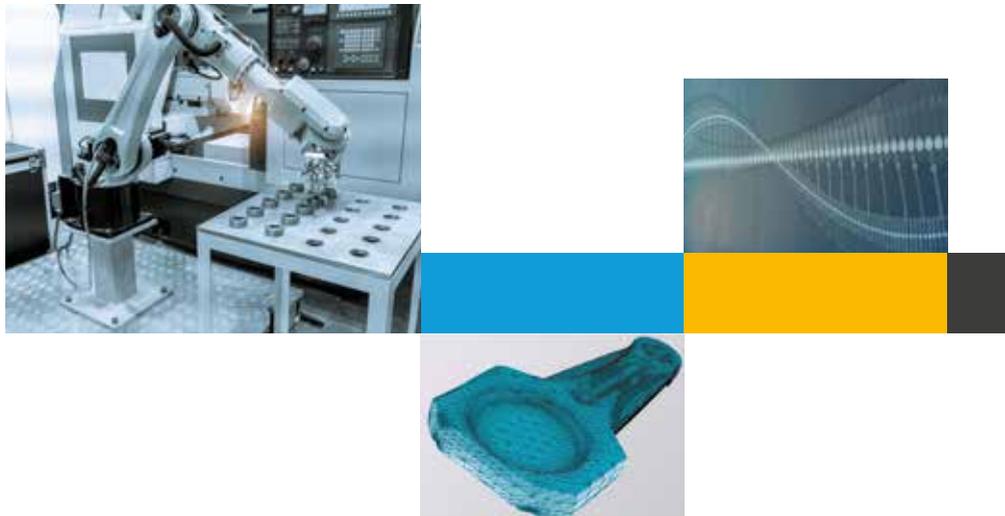
Training course packages that combine the aims of excellence and innovation

The five-year engineering diploma, with seven elective majors⁴

- Industrial Automation, Control and EDP
- Industrial Engineering
- Mechanical Engineering
- Computer Sciences and their Applications
- Materials: Technology and Economics
- Network and Telecommunications Engineering
- Materials and Mechanical Engineering, an apprenticeship scheme

A Master's degree with six elective specialist course combinations

- Engineering and Management of Applied Global Security (UTT-IMSGA)
- Engineering and Management of the Environment and Sustainable Development issues (UTT-IMEDD)
- EDP Security and Systems (UTT-SSI)
- Optimization & System Security (UTT-OSS)
- Materials and Advanced Processes (UTT-MMPA)
- Optics and Nanotechnologies (ONT)



4 specialist Mastère⁵ courses[®]

Access via continuing education routes to following specialties:

- Expert in Big Analytics and Metrology
- Expert in Forensic sciences and Cybersecurity
- Expert in 'Silver' Technologies
- Performance Manager in the context of Industrial Transformation

4 Vocational degree courses:

Access via continuing education routes to following specialties:

- Control in traditional and renewable energy sources
- Digital technology Investigator
- Material design and shaping processes
- BIM (Building Information Modelling), innovative materials for BIM, design and costing (to be launched in 2020)

11 French University Diplomas (DUs)

Access via continuing education routes to following specialties:

- Operational Criminal Analysis & Investigations
- Data Protection Officer
- Data Protection Officer –public sector
- Oral and Biomechanical Implantology
- Search for Digital proof
- Hospital Data Management and Logistics
- Coordinator for an Emergency & Crisis Unit
- Digital Security Implementation
- Management of 'Silver' Technology Projects
- Governance, protection of health-related data
- Big Data Engineering

A PhD school with three specialist areas

- Socio-Technological Systems
- Material Sciences, Mechanical engineering, Optics and Nanotechnologies
- Optimization and system security issues

⁴.These seven UTT Majors have all been accredited by the French national engineering diploma awards commission (Commission des titres d'ingénieur CTI).

⁵.A specific UTT diploma, post Bac+5, accredited by the National Commission for French 'Grandes Écoles' (CGE).

UTT-Troyes offers a training model in phase with the needs of today's professional world and job markets

98 % of the UTT graduates secure their first job in less than 4 months⁶

71% secure their first job before graduating.

First job exploration time: 0.5 month.

Initial gross salary is €40 000 per year.

96 % of UTT graduates hold managerial posts.

80 % have a permanent contract.

13 % work outside France.

Variety of job opportunities⁶

40 % of UTT graduates go to industrial sectors and 60 % to service sectors

One out of 4 graduates is hired by a consultancy agency or similar service.

24 % find their first job in the Computer Science & EDP fields or in Telecommunications.

52 weeks are spent in company setting internships

All UTT students carry out a 4 week industrial 'immersion' placement, followed by two long internships: they are assigned a mission, as assistant engineers, for a 24 week period at the beginning of their 4th year at the UTT; they carry out an end-of-studies placement, lasting 24 weeks, during their last year at the UTT.

UTT graduates as start-up entrepreneurs

10 graduates created a business venture in 2018, indeed 6 while still undergraduates. 14 student engineers have the status of being student-entrepreneurs, as from January 1, 2019.

Students adopt and push 'Innovation'

- The students' club – "Genius UTT" organizes a 'Nuit de l'innovation' [Innovation Night], once every semester. The various editions this far have seen the programming of public lecture sessions, debates, events and activities round the central theme of innovation.

- 'Junior Conseil UTT' was certified a "Junior-Entreprise" June 9, 2018.

"24 h Innovation"

The Gaïa association of student engineers at UTT-Troyes took part in the international final round of "24 h Innovation" and was awarded the First Prize in 2019.

⁶. Professional profiles for the 2018 class of graduates.



The following student engineers received awards in 2018 and 2019

- The 'Female Student engineer France' prize went to a UTT student doing a double degree.
- A student majoring in Computer Sciences and EDP systems (UTT-ISI) won the 1st Prize in the category "newcomers" during the 6th edition of the Student Entrepreneur "Défi" Challenge.
- 2 students received the 1st Prize at the Australian eChallenge France.
- 3 female students won the 1st Prize awarded by the Regional ChampagneArdenne InnovaTech Challenge 2019.
- 3 student engineers majoring in Mechanical Engineering (UTT-GM) were awarded the 1st Prize for Innovation in Science and Technologies, organized by the International Conference for French speaking engineers and technicians in training (CITEF).

108⁷ companies took part in the annual UTT-Enterprise Forum

Abington Advisory, Accenture, Actinuanace, Acuity Solutions, Adista, Aduneo, Aesculap, Agendize, AKKA Technologies, Albéa, ALTEN, Altran, ANSSI, Apsys, ASANUTT, Assystem Energy & Infrastructure, Assystem Technologies, Atos, Aubay, Axon'Cable, Bassetti, Bertrandt, BI & GEO IT CONSULTING (BIGIT), BI consulting, BNP Paribas, Brézillon, CAPFI, Capgemini, CARDIWEB, CGI France, Codra, Cryostar, Danone, Dassault Systèmes, Davricourt, Decathlon, Deloitte & Associés, Devoteam, digital.security, DXC Technology France, EDF, Edifixio, Electrolux Laundry Systems France, ENGIE IT, Euro Information, Exakis, Fealinx, Fives Maintenance, Flexia, Flowbird, Gatewatcher, Gemalto, GFI, Gravotech Marking, Groupe Ozitem, Harmonie Technologie, Heineken, Humans4Help, Hutchinson, Iliade Consulting, Innovateam, I-Tracing, John Deere, Keonys, Klee Group, L'Oréal, LGM, Marine Nationale, Mazars, Mc² Groupe, MeilleursAgents, Meritis, Meta4, Michelin, NetXP, Nexworld, NGE, One Point, Orange Cyberdefense, Ortec Group, Ouibus, Percall Group, Provadys, PwC Luxembourg, Sagemcom, Schmidt Groupe, SDZ ProcessRéa, Sector, SEGULA Technologies, SEKOIA, SII Idf, Sinfim, Smile, SNCF, Société Générale, Sofyne Active Technology, Sogeti High Tech, SOLUTECH, Sopra Steria, SURYS, Synetis, Talan, Technopole de l'Aube – YEC, Tohtem Makerz, Wavestone, WISE Partners, Worldline.

There are 11 "campus partner" companies who enjoy privileged collaboration with UTT-Troyes:

Capgemini, Axon Cable, Edifixio, I-Tracing, Sopra Steria, XMCO, Codilog, Euro Information, Almond-Rampar, Société Générale et Technology & Strategy.

Companies and industrialists present their fields, markets and professions

Every Thursday, a business company is invited to the UTT Troyes campus to present its fields of activity, its products, markets and the professional openings and opportunities with concrete proposals for internships and sandwich course arrangements, for example: Louis Vuitton, Capgemini, Chanel, Accenture, Alten, Solutec, Axon Cable, Engie IT, Edifixio, I-Tracing, Sopra Steria, Decathlon, XMCO...

7. Year 2018.



MIND: Master, Innovate and Develop

This MIND approach enables students to develop their own sense of initiative as well as their capacity to innovate, by committing themselves to project work and/or in getting involved in associations. The MIND concept has three underlying core-values.

- enhancing use of already acquired skills and new skills;
- stimulating innovation and creativeness ;
- developing personal experience via concrete projects.

A key moment in the discovery of an innovation-intensive process, comes with the so-called 'Innovation Crunch Time' which occurs once a year for all UTT student engineers, who spend 3 days experimenting, imagining and organizing their ideas in multidisciplinary teams working on innovative topics provided by partner companies, local authorities, other student-entrepreneurs, under the guidance and counselling of industrial and/or academic coaches and mentors.

Via the experience of these MIND projects, students can acquire skills complementary to classroom work.

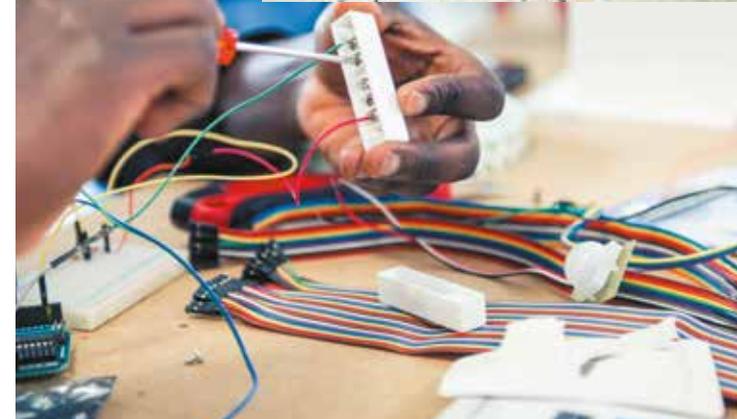
The projects are monitored by lecturer-cum-research scientists. They can also qualify for the awarding of ECTS credits.

A specific toolbox is made available to the students:

The MIND Lab: a co-working space where the spirit of initiative, innovation and entrepreneurship can be sparked, evolve and develop;

The MIND Tech creation and fabrication workshop, equipped with 3D printers, various machine-tools, engraving machines which are needed to ensure that projects can be properly implemented;

The MINDStart: a financial, committee for MIND projects managed by UTT students which convenes twice a year to decide on funding measures.



Sandwich training courses: the UTT apprenticeship scheme and the professionalization contract

Two diplomas can be awarded under the UTT apprenticeship scheme

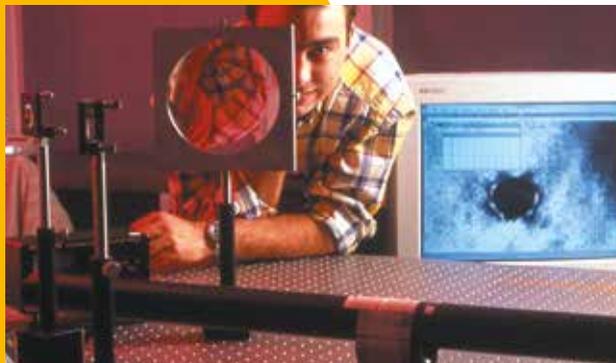
- “Material Sciences and Mechanical Engineering” diploma, via the Nogent (Haute-Marne) UTT spin-off campus: with 149 students enrolled as apprentice engineers as from January 1, 2019.
- A professional degree “Energy (Traditional sources and Renewables) Management”, in partnership with the Saint-Joseph Group, Troyes.

A degree with a professionalization contract

This is a professional degree in “Material Science Design and Shaping”.

Final year sandwich course

UTT-Troyes offers its students the possibility to carry out their final year of studies for their engineering diploma through a sandwich course arrangement. The professionalization contract co-signed by a host company, is seen as a privileged path to start their professional career. The students earn a salary during this final year. The contract calls for specific training and a work load to be organized within the company.



Continuing adult education

Certain training schemes can be offered to: companies; employees; job-seekers.

Professional Training Packages

4 specialist Mastère® courses, 3 Master’s degrees with 6 possible training combinations; 3 vocational degrees and 11 university accredited diplomas (DUs) all of which can be accessed via continuing adult education and sandwich course arrangements.

VAE, a scheme that assesses and validates past professional experience

All diplomas and degrees awarded by UTT-Troyes (degree, master’s degree, a mastère®, engineering diploma), can be awarded on the basis of the VAE scheme (assessment and validation of past professional experience). Each candidate here benefits from a strictly personal assessment process.

Tailor-made training schemes

Tailor-made training packages can be proposed to major (industrial) groups or to SMEs. For example:

- The BIM (Building Information Modelling) Manager certificate, drafted and developed for the SNCF Réseau (national railway network) in a partnership with the in-house SNCF UDI-University. The programme aims at certifying acquisition of new skills in project management and implementation of associate digital models.
- Training for staff at the Société Générale bank in charge of implementing the new EU directive GDPR (General Data Protection Regulation) in the various bank units and its branch offices.

Interactive online training packages

The MOOC “Big Data: Intelligence, products and markets with the advent of Big Analytics” brings together lecturer-cum-research scientists and consultant experts in the field of Big Data, proposing a primer on-line course to make participants more aware of this specialty, highly appreciated by entrepreneurs.

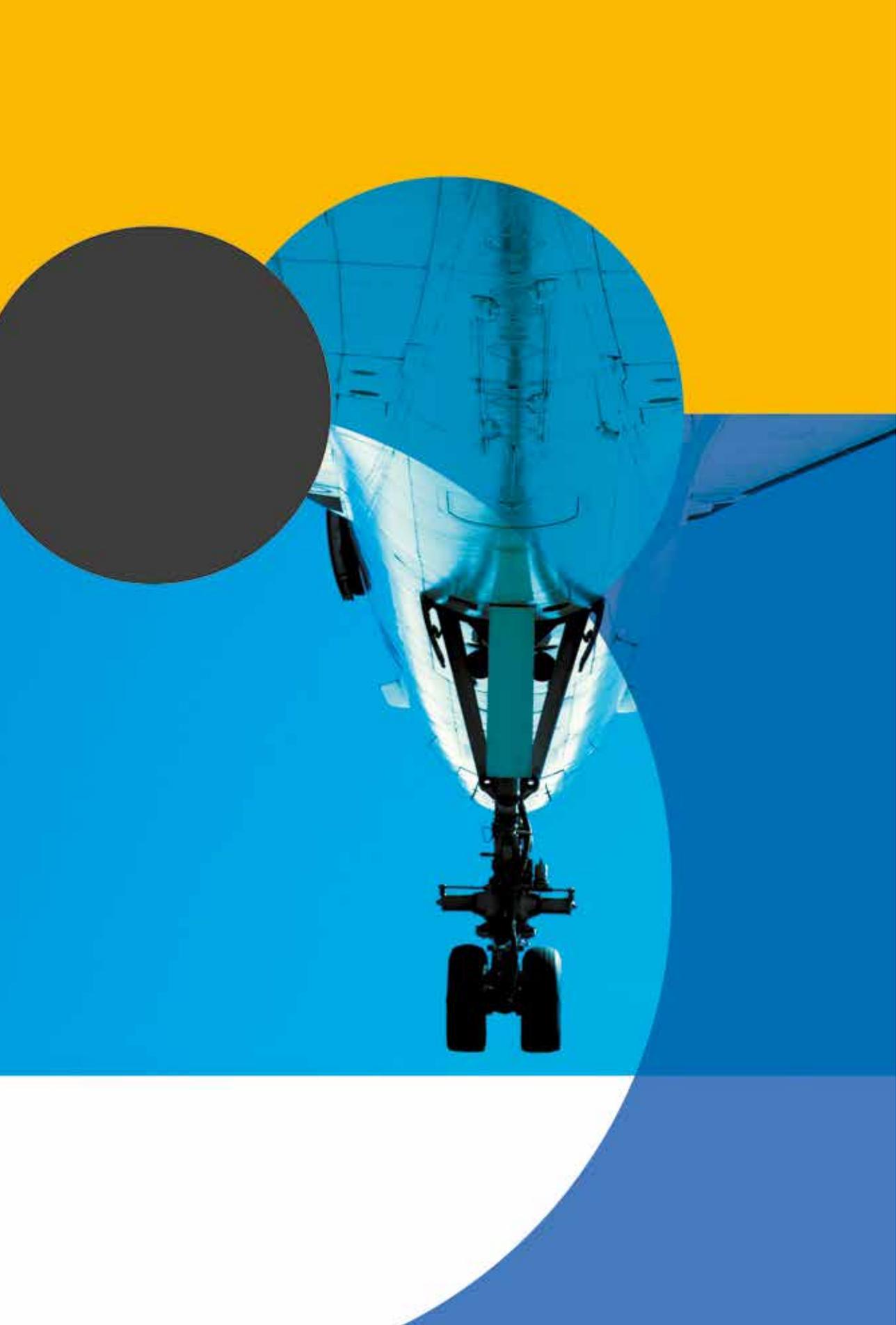
Pedagogical Innovation

In 2018, the UTT developed a partnership with the Agency Openclassrooms to provide and facilitate access to the second year of a Master’s degree in EDP Security and Systems (UTT-SSI) for employees and job-seekers through a 100% on-line format. This partnership strategy in pedagogical innovation for continuing education purposes was like wise implemented with the CCM Benchmark Institute, leading to the launch of a Big Data Engineering Certificate using “blended learning” (combining face-to-face and on line classes) when the Big Data Paris Exhibition was organized in March 2019.

1.5 m euros⁸

Budget for continuing adult education intra-, inter-enterprise and sandwich course arrangements.

⁸.2018.



UTT-Troyes, a university with a rich international outreach and open vista

24 % of UTT students are non-French⁹

Over 50 nationalities are represented on the UTT Campus.

Student engineers spend 1 to 2 semesters outside France

Placements abroad are obligatory.

Students spend 6 months either doing placements and/or studying at partner university.

Study mobility schemes: 400 students every year.

Placement mobility schemes: 120 students each year in company or laboratory settings.

Students are advised during their search for and choice of courses abroad. This personal counselling is both pedagogical and administrative.

The UTT welcomes 260 non-French students every year.

The cultural, social and linguistic integration of non-French students comes in addition to personal mentoring. Thanks to a successful university experience, these foreign students later become ambassadors for UTT-Troyes.

25 international “double degrees” are on offer

171 non-French students this year are doing a double degree at UTT-Troyes.⁹

18 UTT students are attending classes for a double degree outside France.⁹

50 graduates from the class of 2018 also were awarded a degree/diploma by a partner university.⁹

Foreign language proficiency is a prime asset for future professional engineers

Whilst continuing to progress in English, students at the UTT must necessarily choose a second foreign language (German, Spanish, Italian, Japanese or Chinese).

Minimum scores (in English) to obtain the UTT Engineering diploma:

TOEFL IBT: 100 – TOEIC: 850 – BULATS oral: 3+

BULATS written proficiency: 70 – Linguaskill: 170.

Mobility is encouraged and facilitated

The UTT's International department assists all students going abroad as well as non-French students coming to Troyes. The candidates are assisted in all their administrative proceedings. French language primer classes are organized and certain technical core courses are given in English to help with the integration of non-French speaking students.

Interlink, an association welcoming non-French students

Interlink, liaising with the International department, facilitates the integration of students organizing, as it does, a series of cultural, artistic and sports events.

Exchange programmes and dynamic networking

UTT-Troyes has academic connections/contacts on every continent, with 230 partner universities. Close relationships are constantly being built with these partners. Every year, UTT-Troyes welcomes numerous foreign university delegations. Examples:

CEGEP Three-Rivers (Canada), Kasetsart University (Thailand), Binus University, Xidian University (China), Universidade Federal do Rio de Janeiro (Brazil), Università degli Studi di Trento (Italy), Amity University (India).

The EU Erasmus + Programme offers over 200 UTT students the possibility of an incoming/outgoing mobility grant with another European high-standard HE establishment.

For UTT-Troyes this has led to:

- bilateral agreements with 81 universities in 27 countries
- 140 outgoing mobility grants for studies and 64 for internships¹⁰
- 2 "Capacity building in the field of Higher Education" projects: Mose-Fic and ASI-CIAO

"Campus France" is a privileged partner for the international development of UTT-Troyes: it helps organize international exhibitions and "development-intensive" days in various counties abroad or in the French regions, it provides certification via the label "Bienvenue en France", sets up high-profile fast-track potential candidate recruitments (ex. with Malaysia), offers promotion, recruitment, visa and grant management, liaises with French Embassies abroad.

The Global E3 consortium (Engineering Education Exchange), which has over 70 HE establishments spread round 24 countries, encourages and facilitates the mobility of US student engineers (and indeed those from all 24 counties). It chooses a maximum 3 to 4 partners for each country in this global network. It makes its choice on the basis of criteria of excellence and excellent management of incoming/outgoing students. In France, UTT-Troyes is one of the 3 chosen by Global E3, alongside INSA-Lyon and ENSEA-Cergy.

¹⁰.Academic year 2018/2019.

¹¹.2018/2020.

The Chinese Scholarship Council (CSC), pre-selects 80 "excellent" rated Chinese students from that country's best high schools each year. UTT-Troyes then makes its choice and admits 20 candidates to the first year of the 5 year engineering course. Other programmes enable admission procedures, again for "excellent" Chinese students, to one of the UTT's engineering majors or to its PhD school.

Brafitec and Arfitec are acronyms for two specific training programmes in Brazil and Argentina. 20 students benefit from these schemes each year.

UTT-Troyes invests in Africa

Phase 2 of the co-operation programme with the Institut Saint Jean in Yaoundé (Cameroon) will see the establishment of an accredited University Diploma (DU) in "Network engineering, Computer Sciences and EDP systems"¹¹.

Co-ordination of two Erasmus + programmes for "Enhanced learning/teaching capacities in Higher Education", viz:

- Mose-Fic, implementation of European HE standards for the benefit of engineering training schemes in Cameroon;
- ASI-CIAO, appropriation of international standards to improve organization of engineering training schemes in West Africa (Senegal and Togo).

Building a Franco-Senegalese Campus with a consortium of French HE establishments to design, implement and reorganize this year's higher education training schemes in Senegal to better satisfy the socio-economic needs of the country.

Eleven African HE establishments are accompanied in their progression towards academic autonomy, and to help build their own method to seek and secure quality improvement to enable accreditation/recognition by the French national committee for engineering diplomas (CIT) and certification by EUR-ACE, judging that these establishments have reached and comply with international standards.

Support for the creation of a Master's degree in "Hygiene, Security & the Environment" at the University Eduardo Mondlane (Mozambique).



The Sino-European School of Technology of Shanghai University (UTSEUS)

With the two other French universities of technology UTs, i.e. UTBM-Belfort-Montbéliard and UTC-Compiègne, UTT-Troyes has exported the model of our French UTs to create the Sino-European School of Technology of Shanghai University (UTSEUS) at the University of Shanghai. This international HE establishment trains 1 000 students 250 per year, 129 of whom are awarded a UT diploma).



UTT-Troyes a dynamic campus

42 student societies, clubs and associations

1 691 registered students¹²

The UTT Campus has made it possible for students to indulge in a great variety of challenges: Innovation Night, Sports Night, Robotik, crew participation in the EDHEC round France sail boat race, the water-polo tournament, the fight against Cancer.

Theatre, the jazz-band, the UTT Gala, humanitarian activities, First Aid First Responder courses.

1 691 students registered in university sports and athletics¹²

476 registered with the FFSU (French Federation for University Sports).

28 in the special 'Sport/Études' section, 2 of whom are "elite" level athletes.

There are close to 45 sports activities organized on the UTT campus and at various nearby public facilities (swimming pool, tennis courts, athletics circuits, football and rugby pitches, etc.)

UTT sportsmen/women on the podium¹²

Vice-champion de France grandes écoles (male basket-ball).

Vice-champion de France grandes écoles (5-a-side football)

Vice-champion de France universitaire (water-polo).

Vice-champion de France universitaire (decathlon).

Vice-champions de France universitaire (bike and mixed run).

Promoting personal student commitments

Two prizes promote the personal commitments of UTT-Troyes students: the Academic Prize and the Ellipse Prize. The latter is a reward for a student (male or female) who – over and above having brilliant achievements in his/her studies, also displays a noteworthy cultural vista and an exemplary sports track-record.

¹². Academic year 2018/2019.

**Socio-economic
challenges**

**"Blue Skies"
and technological
research**

**Transverse
thematics**

UTT-Troyes,
a research-intensive
model constantly
seeking 'excellence'

Institut Charles Delaunay (ICD)

Over 360 staff, including 123 lecturer-cum-research scientists, 183 PhD students, 22 technical support staff and 'admin' agents work at ICD (Institut Charles Delaunay) in engineering science, science and technologies in ICT as well as in social sciences and the humanities.

Research conducted at ICD is emblematic of a model for scientific activities specific to the French Universities of Technology, *i.e.*, combining "blue skies" and technology intensive research.

The research topics chosen may be related to socio-economic challenges (health issues, acceptable life-style and well-being, the environment, transport, energy, risk factors, security of both goods and persons, and communication systems), or to multidisciplinary knowledge bases (innovation in sciences and technologies concerning matter and materials, digital computation, high level computation and associate mathematics, social sciences and humanities faced with global change), as well as interdisciplinarity knowledge bases in the framework of the transverse thematics "Global security" and "Services and the concept 'Industry of the Future'".

UTT-Troyes has developed connections with numerous major research establishments: INRIA, IRD, CEA, CNRS. In 2019, the team entitled "Light, nanomaterials, nanotechnologies" obtained the ERL certification by the CNRS.



8 scientific and technological platforms:

Nano'mat

- Used for nano characterization and nanofabrication using materials employed in mechanical engineering, optics, biology and agro-resources.

CapSec

- Safety/security sensors.

EcoCloud

- Analysis and assessment of environmental impact.

CyberSec

- Cyber-security.

Living Lab ActiAgeing

- Design and assessment of technological solutions to help senior citizens remain autonomous.

Num3D

- 3D digitization and VR (virtual reality) engineering.

Adhere

- Elaboration and characterization of surface deposits and associated functions.

Presages

- For research, experimentation and modelling of security related management activities.



3 Departments:

- Physics, Mechanical engineering, Material sciences and engineering and Nanotechnologies (**P2MN**)
- Operations Research (**OR**), Applied Statistics and Modelling (**ROSAS**)
- Social sciences, Environment and Information & Communications Technologies (**ICTs**) (**HETIC**)

2 Institutes

- The Institute for Global Security and Anticipation (**ISGA**)
- The Institute for Services and Industries of the Future in Troyes (**ISIFT**)

1 College of Humanities

8 Research Teams

- Autonomous Networks & Environments (**UTT-ERA**)
- Automated Mesh Generation and Advanced Methodology **GAMMA3** (a joint **UTT-INRIA** research unit)
- Interdisciplinary Research on the Transition towards Sustainable Socio-technological systems (**UTT-CREIDD**)
- Light, nanomaterials, nanotechnologies (**UTT-L2n**)
- Logistics and Optimization of industrial Systems (**UTT-LOSI**)
- System Modelling & Security (**UTT-M2S**)
- Life assessment of structures, materials, mechanics and integrated systems (**UTT-LASMIS**)
- Technologies for co-operation, Interaction and Knowledge Bases in Collectivities (**UTT-Tech-CICO**)



Institute for Global Security and Anticipation

The mission assigned to the Institute for Global Security and Anticipation (UTT-ISGA) is to investigate innovative practice and to improve, enhance and augment the knowledge bases in the fields of global security for populations and institutions, for risk prevention and crisis management protocols.

Its objective is to encourage and enhance the emergence of scientific collaboration among academic, institutional and industrial actors and citizens. It offers a forum for discussion/debate and innovative thinking in the continuum of the tryptic: research, training and valorization.

The ISGA Institute relies on the development of interdisciplinary research that complies with two complementary finalities: one being academic, the other operational.

3 areas of research and expertise:

- **Anticipating threats and implementing security strategies:** through analyses of new forms of threat, changing actors, security policies; prevention of risks associated with sociotechnical systems; event-driven approach, crises and no-break activities and services, coordination of the actors and decision makers.
- **Data for security measures:** through analyses of new technologies in security areas, artificial intelligence, data handling and building of knowledge bases, big data, image processing, signal and data acquirement, drones, onboard sensors.
- **Digital confidence and cybercriminality threats:** digital analysis in hyper-connected milieus, threat detection using content analysis algorithms, integrity breakdowns, steganography and security measures for data flows and system exchanges.

Institute for Services and Industries of the Future in Troyes

The institute for Services and Industries of the Future in Troyes (ISIFT) focuses its activities on the concept 'Industry of the Future' and, in a wider context "Services and Industries of the Future".

There are several academic partners to the Institute, viz., UTT, EPF, Y Schools, ESTP, URCA and also strong interactions with both industrialists and other institutions. The overarching aim is to implement a monitoring system with exchanges and development of new solutions and methods that can be implemented in the corporate systems and services, with a strong roots in the territory of Troyes and its surrounding areas.

The ISIFT has strong territorial connections in that it is committed to intense coordinating efforts with schools and other universities in the Grand Est Region around the theme "Services and Industries for the Future". This approach is also used at a national level in close collaboration with, *e.g.*, the S.smart network. The Institute's international ambitions are noteworthy in terms of rich and promising exchanges with countries in Africa, in the Mediterranean Maghreb countries, in Asia and in the Americas.

Having noted that the so-called Industry of the Future (or "Industrie 4.0) calls for changes in organization and manpower management, the ISIFT focuses its work on the development of four priority axes: research, training, promotion and its platforms. These four priorities enable the scientists to develop innovative solutions and systems that will be promoted and transferred to an agile framework proposed to the industrialists in order to help accelerate their in-house technological development. The Institute's platforms will enrich the training course packages and adapt them to best fit and comply with the industrial needs and to provide Proof of Concept (PoC) for the technological solutions developed.

6 themes in research, training promotion and associate platforms:

- 'Smart' Production and Robotics
- Energy and Materials
- The Environment, Humans and Machines
- Advanced Engineering Processes and Materials
- Sensors and Connected Objects
- 'Smart' Services

Research Team

Autonomous Networks & Environments

With its 7 tenured research scientists and a score of PhD students, UTT-ERA is the University's "network" research team, whose scope of activities run from network control and management (taken in its wider context, using collective intelligence protocols, for example), with the ultimate aim of building an autonomous network, capable of ensuring its own self-configuration, self-repair and self-protection. The ERA team also devotes time and effort to investigating the concept of "services", integrating the notion and factor of security. A network is a true support structure for mobile/remote services and should be empowered to provide both quality and protection.

Main scientific priorities

- Network & Service infrastructures
- Network & Service Security



Environnement de réseaux autonomes

A selection of this year's successful achievements¹³

- Chief Editor for a French technical review "Gestion et contrôle intelligents des réseaux" (ISTE). These publications are translated in both English and French.
- ERA staff members sit on key International Conference Programme Committees: IEEE Globecom, IEEE ICC, IEEE IM/NOMS.
- One staff member sits on the Steering Committee for the Rendez-vous de la Recherche et de l'Enseignement de la Sécurité des Systèmes d'Information (RESSI) [HE & Research on EDP Security]
- Positive assessments from the Association des Parents d'Enfants Inadaptés (APEI) de l'Aube [Aube department Inadapted Children's Parent Association], in regard to work under way and results obtained thus far in the framework of the regional BAC Programme: Big Data as an aid to help procure comfort for vulnerable persons.
- Publication of several IEEE international reviews with Impact Factor (IF) > 5.
- ERA's ANR DOCTOR project has deployed an large experimental Information Centric Network (ICN) that carries web traffic. Experiments are conducted with UTT students as end-users and constituted a 'world wide first' for the use of an ICN network under real, 'hands-on' conditions.

13. 2018/2019.

Research Team

Automated Mesh Generation and Advanced Methodology

(a joint UTT-INRIA research unit)

Numerous companies, whether small, medium-sized (SMEs or major industrial groups, rely on digital mock-ups to design their products and predict behaviour. A mock-up is an ensemble of computer generated models of discrete configurations selected to approach the physical reality of the phenomenon under study. Computer modelling requires that the object and its environment be presented in mesh format. The aim of the UTT-GAMMA3 scientists is to study and develop algorithms for the purpose of allowing an automated generation of mesh configurations that can be used in digital modelling programmes. Beyond this, the team also intends to create an automated algorithmic loop to be applied to these calculations/computations in order to obtain a solution at a given level of accuracy.

Main scientific priorities

- Large scale mesh creation and associated computer science applications
- Geometric modelling
- Adaptive computation and applications

Génération automatique
de maillages et méthodes avancées

A selection of this year's successful achievements¹⁴

- For several years now, UTT-GAMMA3 has accompanied and assisted a start-up, LevelS3D, notably in the area of the reconstruction of 3D models using scanned recordings of real structures (transformation of cloud point coordinates and meshing). The solutions developed in this collaboration with UTT-Troyes are integrated directly into the S3D products. Thus, the above collaboration is registered under a research programme framework based on the development of digitized applications in so-called "augmented" reality. These mobile "apps" can be downloaded to (and activated on) Smartphones, digital i-pads, etc. The application areas of interest here prove especially attractive to actors in the building sector, notably architects, interior design specialists for what is called "home staging", house decorators and even special effects engineers working in the world of cinema creations.

14. 2018/2019.

Research Team

Interdisciplinary Research on the Transition towards Sustainable Socio-technological systems

The objective assigned to the UTT-CREIDD team is to better understand the concept of sustainability and how society goes about implementing associate recommendations. The team focuses on analysing the underlying notions and how they are deployed in terms of territorial and/or industrial logic; research covers industrial and territorial ecology and eco-design, including how these factors interact. The CREIDD also seeks to define, analyse and critically review sociotechnical prospects and forms of governance that are currently being envisaged for future deployment policies.

Main scientific priorities

- **Prospective foresight : technological and societal foresight studies in relation to territorial evolution, consumer trends and associate production modes.**
- **Indicators and aids for decision making: understanding decisions made in regard to territorial development projects.**

Recherche
interdisciplinaire
sur la transition
vers la soutenabilité
des systèmes
sociotechniques

A selection of this year's successful achievements¹⁵

- Success all round at the ETN CRESTING, on "Circular economy: sustainability implications and guiding progress", with the active participation of 15 European PhD students working on circular economy thematics.

Development of a participative science in the heart of rural areas to gain a better understanding of the brakes and levers connected with social transition phenomena in terms of sustainability, and in environments under high-level constraints (*viz.*, a collaboration with the Chênelet Institute, covering implementation of the "Grand Chambardement" [Major Upheaval], a field project on Energy Transition).

15. 2017/2019.

A selection of this year's successful achievements¹⁶

Research Team

Light, nanomaterials, nanotechnologies

Nano-optics is a fast growing field of research associated with numerous scientific, technological and socio-economic challenges, including energy-related problems (lighting, photovoltaic (PV) arrays, etc.), telecommunications, health and security. The UTT-L2n research team is focused on the observation, the understanding, the manipulation and uses made of light beams on a nanometric scale. Employing a global approach, the L2n scientists are contributing to the development of nano-optics, with 6 multidisciplinary research priorities (mentioned below).

As from January 1, 2020, UTT-L2n will be a certified (ERL) CNRS research unit. The thematic of "Nano-optics and nano-photonics" will take front stage at a University School of Research (EUR) event code-named "NANO-PHOT" the assigned objective of which will be to train already "excellent" students, at Master's and PhD degree levels.

Main scientific priorities

- Nano-spectroscopy
- Molecular Plasmonics and Nano-photochemistry
- Nano-biophotonics
- Nanophotonics
- Modelling
- Nanofabrication

- Organization of the prestigious 15th international conference on "Near-field optics, Nanophotonics and related techniques" at UTT-Troyes: 500 participants from over 30 countries.

- Creation of the start-up company: Phase-Lab Instrument.

- Admission of the Nano'mat Platform, managed by UTT-L2n, in the CNRS Renatech+ network.

- Active participation in the European ITN LIMQUET project on "Light-Matter Interfaces for Quantum Enhanced Technologies".

- 4 year extension to the framework agreement "In-Fine", a joint laboratory between UTT-L2n and a private company SURYS, plus setting up of two CIFRE financed PhDs.

- Certification (validity 3 years) of a new project FACCTS, France And Chicago Collaborating in The Sciences: An Additive Manufacturing Approach to On-demand Single Photon Sources and Quantum Networks.

- Signature of a new doctoral programme between UTT-Troyes and SUSTech, South University of Science and Technology, Shenzhen – China, focussing on nanophotonics.

- New project "Photonics 4" an engineering school pact instating an International Master's degree on photonics, in collaboration with Centrale-Supélec Metz.

- Publication in ACS Sensors, highlighted by the CNRS (INSIS) Institute.

- During the SPIE Conference on "Optics + Photonics" organized in San Diego, California, a PhD student registered with UTT-L2n was awarded a Prize for "Best presentation" in the category "Nanophotonic Materials XV".

- UTT-Troyes welcomed its first CNRS scientist, who joined the L2n research team.

Research Team

Logistics and Optimization of industrial Systems

The UTT's LOSI teams are specialists in OR (Operations Research) applied to logistic and production systems *per se*. They occupy an original slot between applied mathematics and industrial engineering. The LOSI objectives are to develop aids for decision making to improve complex systems and to solve difficult mathematical combinatory problems. The team is engaged concomitantly in academic research, in partnership activities and in TT (technology transfer) operations.

Main scientific priorities

- Designing production and/or logistics systems
- Scheduling, planning and operations management
- Assessment of supply chain performance and management
- Optimization of transportation, especially for problem vehicle rounds

Logistique et optimisation
des systèmes industriels

A selection of this year's successful achievements¹⁷

- New research partnerships with the launching of 3 industrial PhD theses: 1° with the Troyes Hospital Centre (modelling patient flow in A&E units and optimized logistics for meal deliveries); 2° with the clothing company Petit Bateau (optimization of production and transformation to a 4.0 Factory configuration; 3° with the tyre company Michelin (scheduling of production campaigns).¹⁷
- Confirmation of the collaborative dynamism with partners in the local industrial and economic milieus. Launching of 5 new industrial PhD theses with the Troyes Hospital Centre (analysis of health-related data using industrial intelligence methodology), with Afova (optimization of downstream logistics and development of digital twins to assist installation of a new 4.0 Factory, Norelem (optimization of industrial performance) and Brodart (optimization of production scheduling)¹⁸
- Organization of the 9th IWOLIA (International Workshop on Optimization on Logistics and Industrial Applications) with the Fraunhofer IOSB and the University of Karlsruhe (Germany). First Franco-German meeting on the theme Industrie 4.0.¹⁷ Organization of the International Spring School of the Operations Research Research Group on the theme of Integrated Operational Problems.¹⁷
- Participation in series of lectures given by the UTT Chair of Connected Innovation (4 talks scheduled each year) on the themes dynamic tariffing, artificial intelligence assisting in hospital logistics, e-Commerce and production *Made in France*[®].

¹⁷. 2018.
¹⁸. 2019.

Research Team

System Modelling & Security

The UTT's M2S research team (System Modelling & Security) has organized its programmes of research activities around the theme of system monitoring and operational security. The original feature here is that the M2S team tackles in parallel questions concerning monitoring/surveillance, life expectancy prognostics and the reliability factors assigned to dynamic systems, including optimization of provisional maintenance. The M2S team is also developing approaches specific to sensor arrays that are becoming increasingly common in today's world. In most of its projects and development work, the team preferentially applies quantitative techniques based on statistical modelling protocols and machine learning in AI (artificial Intelligence).

Main scientific priorities

- Surveillance/monitoring
- System reliability factors and maintenance
- Distributed processing and sensor arrays/networks

- Organization of the international workshop ACM IH&MMSec, Paris (7th ACM Workshop on Information Hiding and Multimedia Security) and the ALASKA steganalysis challenge.

- Organization of the PARACHute 2018 Conference at UTT-Troyes, in the shape of an experimental participative workshop on co-redesign and assessment of solutions for the prevention and detection of senior citizens taking a bad fall.

- Co-organization of the 7th edition of the JETSAN Conference in Paris on the theme "Artificial Intelligence applied to e-Health and to personal autonomy"

- Co-organization of the Pharmakon AI Workshop at UTT-Troyes: "Technology vs Ethics and Morality".

- The TEMPORAL Project, financed in the framework of the PIA/ANDRA Programme with two other academic HE partners (ICD/M2S and CPPM IN2P3/CNRS) and 3 industrial partners (Damavan, Weeroc and Mirion Technologies): designing a new generation of Compton cameras for the detection and localization of radioactive sources. This is a multidisciplinary project ranging from gamma ray detection using crystals (a physical principle), to 3D reconstruction of the radioactive source (signal processing), followed by management of a fleet of mobile robots carrying the Compton cameras (a sensor network).

- A 'maturing' project GinO (Indoor n'Outdoor Geolocation). In the framework of the agreement between UTT-Troyes and the Hôpitaux de Champagne Sud, the M2S team have developed a geolocation algorithm (for physical persons or connected objects) based on the Wifi signal emitted by antennae located in the hospital units. The algorithm has been successfully tested in the Troyes Hospital Centre, and enables a highly accurate localization, given the erratic Wifi signal behaviour (much more reliable than using classic triangulation).

- Signature of a collaboration contract with the Norwegian University of Science and Technology:
 - scientific agreement on Condition Monitoring and Maintenance optimization
 - co-supervision for PhD theses (currently 2 PhD students).

Research Team

Life assesment of structures, materials, mechanics and integrated systems

The UTT-LASMIS develop mechanical engineering tools for use in the design and manufacturing/assembly of critical components for operational security and safety reasons. Good examples here are the turbines in aircraft engines, medical prosthetics, nuclear power station parts, automobile engines, aircraft flight control surfaces and actuators.

The LASMIS team relies on internationally recognized skills in material designing and processing, in characterization of parts and structures, in mechanical modelling of these materials and processes and associate EDP developments (software packages).

Main scientific priorities

- Prestress engineering
- Virtual forming
- Virtual and integrated engineering
- Development of innovative materials

- UTT-LASMIS is a member of the 'GeoMec' GDR Geometry and Mechanical Engineering (created in 2018). This GDR is affiliated to the CNRS-ISIS Institute (Section 9) and to the CNRS-INSMI (Section 41). The themes investigated relate to the links between "traditional" mechanical engineering and geometry, with several projects already under way. One of the roles of the Research Group is to see potentially interesting projects emerge at the interface between the two specialist approaches: traditional/geometric.
- UTT-LASMIS has been recognized by ANDRA on merit – in a group of laboratories working on scaling of metallic infrastructures for the storage of HA (highly active) radioactive waste.
- A series of experiments conducted at ISIS/Engin-X near Oxford (UK) using neutron diffraction (a 'major scientific instrument' provision) to explore the links between elaboration processes and life expectancy for aircraft engine parts made of a nickel based 'super-alloy'. They are conducted under a long term collaboration agreement between UTT-LASMIS and Safran Aircraft Engines that began in 2015 the results of which will be reported and embodied in a CIFRE financed industrial thesis in October 2019.
- An 18 month extension to the 'CONtraintes – DimensiOnnement – Relaxation' (CONDOR) programme with the IRT (Institute for

- Technology Intensive Research) entitled 'Matériaux: Métallurgie and Processes' (M2P). The objective assigned here is to model shot-blasting processes taking into account the micro-structure and the geometric complexity of the parts analysed, and thereafter to include this data in the design phases to dimension the parts and at the same time study induced fatigue factors. This project is a collaboration between the UTT research scientists and colleagues from ONERA, ENSAM ParisTech, Areva, MPSA, Safran, Turbomeca and ArcelorMittal.
- Four RESEM Projects – in collaboration agreements with the IRT-M2P, Metz: COMBO (2017-2019), VIBFORM (2018-2019), FRONTALAS (2019-2020), COMBINE (2019-2021). In the framework of these various projects, the team also collaborates with UTT-L2n, IJL, Nancy, LEM3 de Metz, LASIE, La Rochelle and EPF/École des Mines.
- The ANR ALMARIS Project – in collaboration agreements with ONERA, the Material Research Centre at Ecole des Mines de Paris, ENSAM Paris and the private sector company Polyshape. The assigned objective is to produce optimized architecture using super-elastic alloys (NiTi based) using an additive fabrication LBM laser (Laser Beam Machining).
- The ANR ReSEED Project confirms the status of UTT-LASMIS as a key player in 3D digitization and Reverse

- Engineering (RE) and strengthens its collaboration with the software editor DeltaCAD and academic partners such as UTC-Compiègne and EC Nantes.
- The ACOE Project (acronym in French for Combinatory Analysis of High Entropy Alloys) and the PORO-FAB Project (acronym in French for Functionalization of Porous Metallic Materials obtained through Additive Fabrication Processes), both projects are conducted in the framework of a collaboration agreement of the LRC NICCI and signed by UTT-Troyes and the CEA (French national Agency for Atomic and Alternative Energies)
- Acquisition of a hybrid Physical Vapour Deposit (PVD) reactor (four 200 mm sources) (PECVD (SiC, SiOx, DLC).
- Organization of the 16th national conference of the "GIS Smart" with URCA, UL and Unistra, held at the Karellis Savoye mountain resort: 130 participants.
- UTT-LASMIS chosen as event manager for the organization of the CAMAT d'Aussois 2020 national conference on: "Residual Stresses New tools for New challenges – Elaboration, uses and life expectancy".
- A Chinese Government Thesis Prize awarded to Jianqiang Zhou for his remarkable PhD work carried out at UTT-LASMIS, financed by the French Ministry for Higher Education, Research and Innovation. The thesis was defended in public June 28, 2018.

Research Team

Technologies for co-operation, Interaction and Knowledge Bases in Collectivities

With their wide-ranging backgrounds in computer sciences and their applications, in psychology, in ICTs as well as in sociology and management sciences, the 14 lecturers-cum-research scientists of the UTT-Tech-CICO research team examine technologies (taken in a broad context), whether uses come in the design of technology-intensive objects, in the analysis of uses associated with these objects, or in the use of technologies and techniques as tools in their personal research areas. The founding postulates for the Tech-CICO team are as follows:

- One cannot separate Man from Technology. Human activities are modelled by technologies and the latter are adapted, even transformed when (and as) they are put to use, thereby enabling their appropriation by end-users.
- Our knowledges bases and associate documents evolve constantly. Modelling here is a co-construction task shared by all the actors where a plurality of points of view must be taken into account.

Main scientific priorities

- Dynamics of uses and appropriation of digital technologies by collective bodies
- Designing digital technologies compliant with collective practices
- Analysis and design of inter-comprehension tools/devices

Technologies pour la coopération, l'interaction et les connaissances dans les collectifs

A selection of this year's successful achievements²¹

- Celebration of the UTT-Tech-CICO 20th anniversary with Senator Philippe Adnot (Aube), Pierre Koch, President & Vice-Chancellor UTT-Troyes, Paul Gaillard, 1st President & VP UTT-Troyes, Jacques Duchêne, 1st Director of Research, UTT-Troyes and Manuel Zacklad, founder of the UTT-Troyes Tech-CICO research unit.
- In the framework of the PEPS Learn & Make Programme, financed by the CNRS, organization of a seminar at AgroParisTech on "Makers, or learning by doing – from computer encoding techniques to ecological transition".
- UTT-Troyes welcomed two Brazilian research scientists: Cristiano Borges, Universidade Federal do Rio de Janeiro (UFRJ) – Dept. of Computer Science, and Nelson Nunes Tenório Junior, Centro Universitário de Maringá | CESUMAR · Department of Knowledge Management.
- Valorisation of studies conducted in 'social innovation' project work financed by the French 'Grand Est' Regional authorities for the benefit of visually impaired persons and house-bound persons with an exhibition, a videogram and three international review articles.
- Co-organization of a special Session at the International Conference on Information Systems for Crisis Response and Management (ISCRAM) held at Valence, Spain, on "Knowledge, Semantics and AI for Risk and Crisis Management".
- Co-organization of the Cerisy Conference on "Social sciences and Humanities in the field of Technological Research", in the framework of activities of the GIS-UTSH, Cerisy-la-Salle.

21. 2018/2019.

Research

Training

**Transfer
of technology**

UTT-Troyes
has cutting edge skills
and expertise
in ten areas

Networks, Connected Humans and Objects

The Circular Economy and Sustainability

Nanotechnologies
and Function-Oriented Materials

Logistics and Production in the Future

"Silver" Technologies

Mechanical Engineering Design
and VR (virtual reality)

Innovative Materials
and Manufacturing Processes

Security and Risk Management

Design and Uses for Digital Technologies

Monitoring/Surveillance
and Operational Security Data Management

Expertise

Networks, Connected Humans and Objects

Electricity consumption meters, socks, bottles of water, bracelets, etc. By 2020, the number of connected objects/things in the world will lie somewhere between 50 and 80 billion items. And human beings, just like infrastructures, cities and factories will also be continuously connected (round the clock “365/7-7/24-24”)

Research activities

Research teams involved

- Autonomous Networks & Environments (UTT-ERA)
- System Modelling & Security (UTT-M2S)
- Logistics and Optimization of industrial Systems (UTT-LOSI)
- Automated Mesh Generation and Advanced Methodology (UTT-GAMMA3)

Innovations

MyCaptR effectively scans a space/volume, establishes exact point-to-point measurements and builds the corresponding 3 D model. This innovation relies on a powerful algorithm developed by research scientists to assist the private company **LevelS3D**.

OptaUrgence is an aid to predict patient flow in A & E (Emergency) Units. The UTT-LOSI research scientists collaborated – for the purpose of preparing a tool to be used by hospital staff – with the Troyes Hospital, analysing and defining statistical models to establish and monitor inflow rates at the A & E services.

GinO (Indoor n’Outdoor Geolocation) is an object-localizer algorithm based on using the Wifi signals from antennae located in health-care establishments.

Collaboration with private enterprise

- Development of an innovative solution to monitor company networks, using ‘**Montimage**’.
- Assistance for the modelling of “Smart City” data (with the utility **Engie**).
- New insurance approaches, based on knowledge/behaviour patterns of the persons insured (with **La Mutuelle Générale** insurance company).
- Ergonomy for a graphic “client authentication” system (with **Orange Lab**).

Training packages

ENGINEERING DIPLOMA IN

NETWORK AND TELECOMMUNICATIONS ENGINEERING

This specialty course trains engineers capable of managing corporate networks and/or operators, in a context of variable network architecture and services.

The course integrates mobile technologies, and data security.

There are 3 professionally oriented elective specializations strongly involving new technologies:

- The convergence service-networks;
- Mobile Technologies connected objects (or Internet of Things (IoT));
- Security measures for communication systems.

MASTER'S DEGREE IN

OPTIMIZATION AND SYSTEM SECURITY

The UTT's specialist Master's degree, code-named OSS, provides aids to decision making to control and optimize industrial processes. The course will help engineering managers to integrate new economic, technological, environmental and social constraints prevalent in today's industrial activities.

The course proposes a multidisciplinary approach and modelling techniques.

The students will acquire professional skills, modelling research methodologies and a reinforced knowledge base for potential applications.

ENGINEERING DIPLOMA IN

INDUSTRIAL AUTOMATION, CONTROL AND EDP

The professional responsibilities of these engineers will lie in designing innovative on-board systems and smart production systems. They must be able to intervene at any level of a production chain, and/or in the processing of associate data and in automated control processes. This specialist training course was created jointly by UTT-Troyes and URCA-Reims for the purpose of training engineers for the "Factory of the Future (FoF)".

2 professional elective specializations focus on design of automated systems:

- Smart production systems;
- On-board technologies and Interoperability.

ENGINEERING DIPLOMA IN

COMPUTER SCIENCES AND THEIR APPLICATIONS

This is a specialist training course in computer sciences and their applications enabling engineers who qualify to control a company's data/information retrieval, storage, transmission and circulation practices. They will constantly seek the best fit between end-user needs and the available computer/EDP tools.

3 professional elective specializations focus on project management:

- Software induced innovation
- Data and knowledge promotion
- Accompaniment in digital transition

PHD

SOCIO-TECHNOLOGICAL SYSTEMS

SPECIALIST MASTÈRE

EXPERT IN FORENSIC SCIENCES AND CYBERSECURITY®

This specialist course examines and analyses the technical, functional and legal aspects of the security measures envisaged/applied to EDP systems and provides for an efficient control of security and system safety audit techniques.

This training course on cybersecurity facilitates managerial understanding of the technical and technological environments in which industrial companies operate today. It allows the corporate heads to secure their information/EDP systems with cutting-edge tools, techniques and methodologies. The course processes have been certified "SECNUMEDU"²² by the French national agency for EDP system (ANSSI or Agence nationale de la sécurité des systèmes d'information).

SPECIALIST MASTÈRE

EXPERT IN BIG ANALYTICS AND METROLOGY®

Specialists trained in this course learn to design, implement and operate innovative solutions to help handle and analyse big data. The solutions here call for skills in computer science, mathematics and statistics as well as in social science and humanities. They may be heading a team of data scientists in charge of promoting corporate data, ensuring – as they do – an advisory mission as data strategists for the development of relevant processes or applications appertaining to operations involving exploration of huge volumes of data or to counsel/advise large industrial groups, SMEs or State services and local authorities when it comes to controlling and governing the use of their data sources and production.

MASTER'S DEGREE IN

EDP SYSTEMS SECURITY

This Master's degree provides training in identification and assessment of the risks when implementing prevention solutions with reference to governance parameters to ensure security (assessment of risks, taking into account of legal constraints, policy definitions, continuing improvement process) and cyberdefence (detection and counter-measures when incidents/attacks occur).

Connected objects constitute an ecosystem similar to a biotope. The Internet of Things (IoT) will lead to a revolution far exceeding that initiated by the advent of Smartphones®.



²²SecNumedu, labelling of higher Education courses in Cybersecurity. The objective of this labelling is to provide assurance to students and employers that training in the field of cybersecurity meets a convention and criteria defined by ANSSI in collaboration with actors and professionals in the field (institutions of higher education, industrial).

Expertise

The Circular Economy and Sustainability

A so-called “circular” economy is defined as one that produces goods and services, while seriously limiting consumption and waste of raw materials, and the use of non-renewable energy sources.

Research activities

Research team involved

– Interdisciplinary Research on the transition towards sustainable socio-technological systems (UTT-CREIDD)

Platform

EcoCloud

The EcoCloud platform is designed for analysis assessment work on environmental impact, essentially carried out by the UTT-CREIDFD research team. The platform offers skills, methods and tools in line with the rules and standards of eco-design and industrial ecology; which are used to evaluate strategic deployment scenarios in the search for potential sustainable development.

Innovations

Solar Tears

The objective of this research project is to improve access to drinking water for populations in developing countries, as an application of the precepts of “lean innovation” and recent technology-intensive solutions that take into account the specific socio-economic and cultural factors prevalent in the target populations (partner countries Kenya, India, Cambodia).

PNSI

This project benefits from funding by the ADEME (French Environment & Energy Management Agency) and is coordinated by the IEC (the Institute for a Circular Economy).

Part of the methodology has been field tested in 4 French regions, enabling the implementation of local circular economy projects. Some 600 private sector companies have identified and exchanged ideas about resources and needs, in the framework of the circular economy concept.

PST ecodesign

In short this project covers Development and Instrumentation of analytical tools needed to measure environmental impact. Part of this project work was finalized in the framework of the MP-ACV (Life Cycle Analysis) project in liaison with the IRT – M2P and the ANRF project called “Convergence”.

Collaboration with private enterprise

- A project on lean innovation, eco-design and personal protection gear for farmers using phytosanitary products & sprays, with '**Axe Environment**';
- Technical problems and Issues in industrial ecology and network modelling with **ArcelorMittal**;
- Regular expertise exercises in collaboration with the Institute of Circular Economy (IEC);
- Territorial and local 'embedding" and acceptance issues for nuclear power plants, with the electricity utility, **EDF**;
- Studies conducted with **EDF** on decentralized energy production, transmission and distributing systems.

Training packages

VOCATIONAL DEGREE COURSE

CONTROL IN TRADITIONAL AND RENEWABLE ENERGY SOURCES

In partnership with the Saint-Joseph Group, Troyes, this degree course trains professionals to produce, exploit and use renewable energy sources and to optimize energy consumption.

MASTER'S DEGREE IN

ENVIRONMENT AND SUSTAINABLE DEVELOPMENT ENGINEERING AND MANAGEMENT

This Master's degree trains specialists in the strategies underpinning the "dematerialization" (paper free) of economic activities. The graduates here can help businesses and territorial local authorities to benefit from an uncoupling effect between financial and physical flows, using the principles of industrial ecology, eco-design and eco-technologies. Two course possibilities are offered: either the national course or an international course leading to a double degree in agreement with the Université de Sherbrooke, Québec, Canada.

PHD

SOCIO-TECHNOLOGICAL SYSTEMS



A circular economy has as its assigned target seeking methods to establish low consumption rates and the efficient management of Earth's depleting resources. The future will necessarily witness a deep-reaching mutation of all forms of organization (local and global) as well as of our life styles.

Expertise

Nanotechnologies and Function-oriented Materials

Nanotechnologies – *i.e.*, the manipulation, assembly and observation of matter at its 'ultimate' limits (10^{-9} m) – enable design and creation of nano-devices with hitherto unknown properties and optical functions.

Research activities

Research teams involved

- Light, nanomaterials and nanotechnologies (UTT-L2n)
- Life assessment of structures, materials, mechanics and integrated systems (UTT-LASMIS)

ACTION – A certified programme benefitting from the Government Incentive framework scheme “Investments for the Future”

The Government 'Labex' ACTION certified programme relates to the integration of smart systems in matter. The programme objectives lie in the design and operational assembly of photonic systems on chip substrates for use in highly complex computation, and of “smart” structures that offer more functions, with higher reliability rates, for vehicles, energy control devices, medical instruments and equipment. The three founder members are: FEMTO-ST (Besançon), ICB (Dijon), UTT-L2n (Troyes).

Platform

Nano'mat is a dual site platform (Troyes and Reims) specialized in nanofabrication and nano-characterization for numerous applications. Its purpose and main aims are to accompany research work, alongside academic and industrial development.

Innovations

Development of Optical Sensors for various applications (“excellence” certified Labex Chair in nano- and integrated sensors);

Novel nanoparticle synthesis (Aluminium, zinc oxide);

Integrated Lenses (polymer lenses fitted to optical fibre cables, axicon lenses mounted on substrates);

Development of an integrated **spectrometer** (SWIFT, COBISS);

Nanostructuration of surface grains using the SMAT technology;

Integrated Light Sources, ranging from single photon emitters (used for quantum computing), to LED assemblies for general lighting purposes.

Collaboration with private enterprises

- Creation of the **In-Fine Lab**, a joint venture between UTT-L2n and Surys, *i.e.*, a laboratory designed for the development of large-scale films and nanostructured surfaces with unusual and interesting optical properties. The objective assigned to the laboratory is to encourage and enhance the emergence of new products making the best use of the UTT's special nanotechnology oriented skills, transposable to the structuring of industrial polymer films. This partnership with the company **Surys** allows the research scientists to develop new structures via modelling, design and nanofabrication – up to and including function and industrial approval. The In-Fine Lab is now in its consolidation phase, as confirmed by the 5-year extension of the framework agreement – now valid until 2022.
- **Woodoo**, a pioneering start-up in the field of bionic wood fabrication, chose UTT-Troyes to accompany their R&D work. The company has developed a patented technology for the fabrication of translucent, rotproof wood, three times more rigid than natural wood and more fire-resistant.
- Development of a layered structured protection for a scintillating crystal, with **Napa-technologies**.

Training packages

MASTER'S DEGREE IN

OPTICS AND NANOTECHNOLOGIES

This Master's degree focuses on the light-matter interactions at a nanometric scale, addressing a range of topics, from nano-materials to associate instruments and devices. The training acquired opens the way to R&D professions in nanotechnologies.

ENGINEERING DIPLOMA IN

TECHNOLOGIES AND ECONOMICS OF MATERIALS

Student engineers enrolled on this course are trained in a multidisciplinary manner in a range of scientific and technological, economic and environmental fields. They are capable of sizing and scaling, choosing and shaping materials, in a global approach in compliance with industrial and societal constraints

3 professional elective specialisations are offered, covering material treatments, from purchasing to transformation and recycling:

- The economics of materials and the environment
- Material and component technologies and associated trades
- Transformation and quality factors in materials

PHD

MATERIAL SCIENCES, MECHANICAL ENGINEERING, OPTICS AND NANOTECHNOLOGIES



New nanomaterials, extremely sensitive sensors, new anti-cancer drugs/therapies, integration at very low physical scales of opto-electronic devices... nanotechnologies are accompanying the ongoing digital and ecological revolutions.



Expertise

Logistics and Production in the future

With optimization, robotisation, connected warehouses, artificial intelligence (AI), logistics will represent a key function for future industrial activities.

Research activities

Research teams involved

- Logistics and Optimization of industrial Systems (UTT-LOSI)
- Life assessment of structures, materials, mechanics and integrated systems (UTT-LASMIS)
- System Modelling & Security (UTT-M2S)
- Interdisciplinary Research on the transition towards sustainable socio-technological systems (UTT-CREIDD)

Collaboration with enterprises

- Optimization of in-house logistics at the Troyes Hospital Centre, via a specially created software package used to measure and predict A & E incoming patients' flow rates. Forecasting rate here is better than 90 %. Likewise, creation of another software package to manage delivery of medicine, meals and recovery of soiled linen, *etc.*
- Bin-packing problems (3D optimization of how and how many) objects can be placed/stored in a minimum number of boxes), with **DS Smith**, the European backpacking specialist, leader in cardboard box manufacturing.
- Creation of the UTT Chair of Connected Innovation. This chair is devoted to developing new knowledge in the area of valorisation of data provided by logistic, production and market systems, with the prospect of optimizing performance levels. The Chair will propose aids to decision making that will enable the three partners and sponsors to face the challenges raised by the advent of the Factory of the Future (FoF), *viz.*, Concerto – **Kaufman & Broad Group**, **Norelem** and the **Chamber of Commerce & Industry (CCI) of the Aube Department**.

Training packages

ENGINEERING DIPLOMA IN

INDUSTRIAL ENGINEERING

When training is completed, this category of engineer will be able to design and implement various industrial and logistic processes. He/she ensures a seamless transition to the Factory of the Future (FoF) configurations. He/she will plan production lines, optimize flow of matter, parts and goods and likewise guarantee correct operational functioning for plant installations and associated services. He/she will be able to control costs, improve performance ratings and to discuss/negotiate with the various players in the system as a whole (customers, suppliers, end-users).

3 professional elective specializations, focusing on logistics, system and service security, are offered:

- On site, plant logistics and production
- External logistic and transportation
- Reliability, Availability, Maintenance and Safety

ENGINEERING DIPLOMA IN

INDUSTRIAL AUTOMATION, CONTROL AND EDP

The professional responsibilities of these engineers will lie in designing innovative on-board systems and smart production systems. They must be able to intervene at any level of a production chain, and/or in the processing of associated data and in automated control processes. This specialist training course was created jointly by UTT-Troyes and URCA-Reims for the purpose of training engineers for the "Factory of the Future (FoF)".

2 professional elective specializations focus on design of automated systems:

- Smart production systems;
- On-board technologies and Interoperability.

PHD

OPTIMIZATION AND SYSTEM SECURITY

SPECIALIST MASTÈRE

MANAGER FOR PERFORMANCE ASSESSMENT AND INDUSTRIAL TRANSFORMATION®

This specialist Mastère is intended to provide information for CEOs and those in charge of advising industrial groups and companies as they change and adopt today's transition policies. The course covers the key issues of an industrial enterprise: societal and environmental responsibilities, staff and manpower management, budgetary control or operational excellence (lean management, continuous improvement). The students registered for this Mastère analyse the limits of current models and give thought to possible innovative solutions. The programme promotes collaborative co-working methods that are both creative and help make participants more aware of their future responsibilities.

UNIVERSITY DIPLOMA (DU) IN

HOSPITAL EDP SYSTEMS AND LOGISTICS

The programme of this diploma focuses on hospital EDP systems and logistics. It enables the students to acquire specific skills for the implementation of complex EDP systems and logistics engineering.

The programme is the result of close collaboration between UTT-Troyes and the Troyes Hospital Centre. It draws on the reality of health-care polices conducted in hospitals and opens the way to seeing future technologies coming into the health sector (devices like Radio-Frequency Identification (or RFID) tags), Internet of Things (IoT), flow modelling algorithms).



The Factory of the Future (FoF) will be more agile, more flexible, less expensive to run and more user-friendly towards to the factory workers and its environment, thanks to high-level automation and digital integration of the entire production chain.

Expertise

“Silver” technologies

Today in France, the elderly (i.e., those 60 years of age and over) are some 15 million, they will be 20 million in 2030. The number of those aged 85 and beyond will increase by a factor of 4 over 40 years, rising from 1.4 to 4.8 million by 2050. The objective of Silver Technologies is to recognize, privilege and aid our senior citizens.

Research activities

Research teams involved

- System Modelling & Security (UTT-M2S)
- Technologies for co-operation, Interaction and Knowledge Bases in Collectivities (UTT-Tech-CICO)

Platform

The ActiAgeing Living Lab

The Living Lab ActiAgeing (LL2A) offers an innovative framework for the design and evaluation of technological solutions to support the autonomy of older people. It adopts a human-centred and participatory design approach. The analysis equipment includes a real-time video analysis device with an eye tracking system coupled with a 3D motion analysis system.

As part of the European research project ECHORD+++ CLARC, LL2A is working on a robot capable of assisting clinicians with the care of elderly patients. CLARC is a mobile robot, capable of receiving the geriatric patient and his family in order to accompany them to the medical consultation room. It also plays an important role in the complete geriatric evaluation of the patient.

LL2A hosts participatory workshops, bringing together different stakeholders: senior users, health professionals, aging experts and robotics researchers.

Collaboration with private enterprises

The UTT has appointed a Chair in “Silver Technology”, inaugurated in 2017 devoted to the accompaniment of the elderly by health-care workers.

The objectives assigned to the Chair cover 3 distinct training/research fields:

- Training packages specific to “silver” technologies, among which an innovative approach via experimental co-creation workshops, where initial and continuing training can be mixed, *ad lib.*;
- Scientific and technology-intensive research examining high-value, socio-medico-economic solutions that can be tested in line with ongoing Living Lab ActiAgeing activities;
- Valorisation and TT (technology transfer) activities, a recurrent procedure at UTT-Troyes, aimed at a wide range of players in the “silver economy”.

Sponsorship agreements have been signed with 3 major private sector companies: **Plurial Novilia** (*social accommodation*), **the Crédit Agricole** (*banking*) and **Kéolis-Santé**, and 3 local SMEs: **Assystel** (*home aids*), **Festilight** (*lighting appliances*) and **Alpix** (*business-oriented EDP*).

Training packages

PHD

OPTIMIZATION AND SYSTEM SECURITY

SPECIALIST MASTÈRE

EXPERT IN SILVER TECHNOLOGIES®

This Mastère course trains specialists able to understand the eco-systems of the elderly, to be able to control the integral parts that constitute of silver technologies, assessing the innovations proposed in terms of their socio-medico-economic dimensions and to be able to manage solutions as and where deployed to ensure the best compliance with the personal wishes and impaired capacities of those concerned as the “silver economy” gets under way and comes into play fully.

Five silver-relevant themes are explored: gerontology (*the science*), connected objects (Internet of Things (IoT)), health-care data, and methodologies in co-design and assessment work, management of silver technology projects.

UNIVERSITY DIPLOMA (DU)

GOVERNANCE, PROTECTION & PROCESSING OF HEALTH RELATED DATA

On completion of this diploma course, the graduates will be able to take part in the deployment of project involving health-related data, in full compliance with the EU’s GDPR (*General Data Protection Regulation*) pertaining to the protection of personal data and the identification processes of technical solutions adapted to merging and processing data. There are 2 training modules: one on processing and merging of data used for diagnostic and decision-related purposes; the other on regulatory data storage, and protection of health-related information.

UNIVERSITY DIPLOMA (DU)

MANAGEMENT OF ‘SILVERTECH’ PROJECTS

This course trains health sector professionals and young graduates, turning out experts in the management of so-called ‘Silvertech’ projects. New technologies such as the Internet of Things (IoT) in conjunction with new services, occasionally lead to new obstacles and hurdles. Companies here can produce seemingly attractive technical solutions but they can prove largely out-of-step in terms of “usability” or “acceptability” by the elderly in their environment. To correctly manage a Silvertech project, it is essential to gain considerable knowledge in case studies and to also take into account the complex psychological and physical worlds where senior citizens actually live. Currently, the course offers 3 priority themes– the Health-related Economy, Ethics and Silver Technologies, Deployment and Management of Silver Technology Projects.



Technology will propose products and services enabling the elderly to benefit from the very best, autonomous and safe living conditions.



Expertise

Mechanical Engineering Design and virtual reality

Design, maintenance, training, production, uses: we see more and more VR (virtual reality) and AR (augmented reality) online applications, welcomed and adopted by individuals and by corporate structures. A new world is unfolding.

Research activities

Research teams involved

- Automated Mesh Generation and Advanced Methodology (UTT-GAMMA3)
- Life assessment of structures, materials, mechanics and integrated systems (UTT-LASMIS)

Platform

3D digitisation and virtual engineering (“Num3D”)

“Num3D” is a regional, multi-site platform operated and managed by UTT-LASMIS. It is equipped with instruments, devices and associated software to ensure in-house development of virtual engineering: reverse engineering design, immersive visualization, digital mock-ups, virtual shaping for mechanical engineering components, advanced PLM (product lifecycle management).

A programme certified by the Government as an “Investment in the Future”

The IRT (Institute for technological research) “Materials, Metallurgy and Processes” (code-named ‘IRT M2P’)

This Government certified structure, benefitting from an incentive grant under the provisions of the “Investments for the Future” programme, consists of setting up a collaborative platform between academic and private sector research. This IRT M2P is managed by academics of the Grand Est Region (University of Lorraine, UTT-Troyes, UTBM-Belfort Montbeliard, the CNRS); the Government approved “poles of competitiveness” (Materialia, Véhicule du futur [Vehicle of the Future], Fibres Grand Est, Microtechniques) and numerous private sector companies. IRT M2P is staffed by 300 research scientists and engineers seconded by university laboratories and staff from industrial R&D units. The main IRT site is located in the city of Metz’ ‘Metz Techno’pôles’.

Collaboration with enterprises

- Development of a software solution for the modelling of parts and mesh generation with **Safran Composites**.
- Management issues in nuclear waste repository storage, with the national agency, **Andra**. Design and Modelling for the mechanical long-term behaviour of the containers used to store radioactive waste.
- Design and development of software packages for mesh generation technologies and geometric modelling of certain structures:
 - > An adaptive BL2D mesh generator acquired by **NIPPON STEEL** (metal shaping modelling involving cutting processes and cracks taken into account via interface elements);
 - > Surface mesh generator BLSURF acquired by: **DASSAULT AVIATION, MSC-SOFTWARE, CST – Computer Simulation Technology**;
 - > acquired by the CEA (national atomic and alternative energy source agency) Deformable 3D mesh regenerator, OPTIFORM acquired by the **CEA**.

Training packages

ENGINEERING DIPLOMA IN

MECHANICAL ENGINEERING

This training package ensures that the Mechanical engineering graduates can design, assemble and manufacture tomorrow's mechanical products, applying cutting edge technology, virtual prototyping tools, new materials whilst complying with increasingly stringent environmental constraints.

They will have acquired multidisciplinary skills (in mechanical engineering, in automation & control, in computer sciences and their applications) all of which combined are needed to correctly build and implement complex mechatronic devices.

There are 3 professional elective specializations in mechanical engineering to (running from the virtual to the real):

- Design and industrialization of mechanical systems, in connection with environmental issues
- Specific computer science applications and EDP for mechanical engineering purposes
- Digital modelling in mechanical engineering.

MASTER'S DEGREE IN

MECHANICAL ENGINEERING, MATERIAL SCIENCES AND ADVANCED PROCESSES

The MMPA specialty is designed to train students in experimental modelling and mechanical engineering characterization, with a strong emphasis placed on uses of so-called "advanced materials".

PHD

MATERIAL SCIENCES, MECHANICAL ENGINEERING, OPTICS

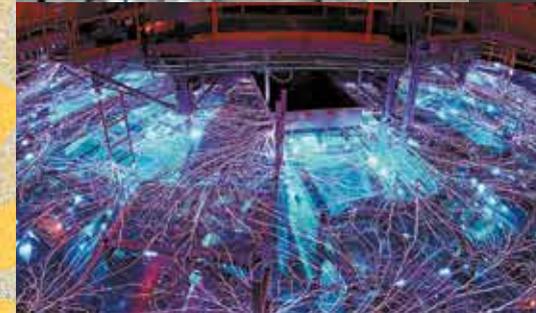
AND NANOTECHNOLOGIES

PROFESSIONAL ADD-ON COURSE

ANALYSIS OF RESIDUAL STRESSES USING X-RAY DIFFRACTION TECHNIQUES

This is a training package specifically designed to provide for the analysis of residual stresses using X-ray diffraction techniques, the teaching being done by UTT-LASMIS lecturers, addresses engineers already active in industry, PhD students and research scientists.

This feature 'residual stresses are prevalent in the mechanical engineering industry sectors. They are introduced into materials and assembled subsystems when component parts are being prepared (machining, welding, surface treatments, deposits and coatings). They are superimposed on operational service stresses and can lead to deformation of parts and even catastrophic failure. Consequently, stress control is essential when it comes to ensuring security/safety for any technology-intensive parts and their life expectancy.



Virtual reality (VR) is among the key technologies we are about to see deployed in the Industry of the Future ("Industrie 4.0"). And now that data has become the crude oil of the 21st Century, "playing" with reality is inevitable.

Expertise

Innovative Materials and Manufacturing Processes

The material content is the essence of a product; it confers colour, shape and sets the conditions for high-quality parts. All industrial products depend largely on the original materials assembled together.

Research activities

Research teams involved

- Life assessment of structures, materials, mechanics and integrated systems (UTT-LASMIS)
- A Corresponding Research Laboratory, *viz.*, *NICCI: the Nogent international centre for CVD innovation*
The French national Agency for Atomic and Alternative Energy Sources – CEA signed an agreement recognizing the UTT Nogent spinoff site as a Corresponding Laboratory, enabling access to special equipment and co-financing of PhD theses. The scientific fields explored are as numerous as they are varied: extreme milieus, new energy-related technologies, health-care, environment, energy efficiency.

Platforms

3D digitisation and virtual engineering (“Num3D”)

“Num3D” is a regional, multi-site platform operated and managed by UTT-LASMIS. It is equipped with instruments, devices and associate software to ensure in-house development of virtual engineering: reverse engineering design, immersive visualization, digital mock-ups, virtual shaping for mechanical engineering components, advanced PLM (product lifecycle management).

ADHERE

This platform is equipped to provide ways and means to make and test deposits and surface-added functionalities. ADHERE contributes to strengthening the partnership between UTT-LASMIS and the CEA concerning surface sciences and engineering.

Nano'mat is a dual site platform (Troyes and Reims) specialized in nanofabrication and nano-characterization for numerous applications. Its purpose and main aims are to accompany research work, alongside academic and industrial development.

Collaboration with enterprises

- Material life expectancy assessments, analysis of residual stress, modelling of surface pre-stress shot-blasting processes with IRT M2P
- Measurements of residual stresses in aluminium alloy parts, with **PSA** (car manufacturer)
- Modelling of behaviours and catastrophic material failures, with the **CEA**.
- Assessment of the impact of residual stress due to shot-blasting in designing industrial assembly parts (an IRT M2P project) CONDOR, in a collaboration with ONERA, ENSAM Paris-Tech, SAFRAN Group, AREVA and PSA.

Training packages

ENGINEERING DIPLOMA IN MECHANICAL ENGINEERING

This training package ensures the Mechanical engineering graduates can design, assemble and manufacture tomorrow's mechanical products, applying cutting edge technology, virtual prototyping tools, new materials whilst complying with increasingly stringent environmental constraints. They will have acquired pluridisciplinary skills (in mechanical engineering, in automation & control, in computer sciences and their applications) all of which combined are needed to correctly build and implement complex mechatronic devices.

There are 3 professional elective specializations in mechanical engineering to (running from the virtual to the real):

- Design and industrialization of mechanical systems, in connection with environmental issues
- Specific computer science applications and EDP for mechanical engineering purposes
- Digital modelling in mechanical engineering

ENGINEERING DIPLOMA IN TECHNOLOGIES AND ECONOMICS OF MATERIALS

Engineers from this course are trained in a multidisciplinary manner in a range of scientific and technological, economic and environmental fields. They are capable of sizing and scaling, choosing and shaping materials, in a global approach compliant with industrial and societal constraints

3 professional elective specialisations are offered, covering material treatments, from purchasing to transformation and recycling:

- The economics of materials and the environment
- Material and component technologies and associated trades
- Transformation and quality factors in materials

ENGINEERING DIPLOMA IN MATERIALS AND MECHANICAL ENGINEERING

Engineers from this course are trained in a range of scientific and technological, economic and environmental fields. They are capable of sizing and scaling, choosing and shaping materials, in a global approach compliant with industrial and societal constraints. Their polyvalent training enables them to offer solutions to meet the complex needs of industry and use the appropriate materials. They work closely with teams of colleagues "in the field" and are capable of coming up with innovative solutions to comply with various entrepreneurial constraints.

PHD MATERIAL SCIENCES, MECHANICAL ENGINEERING, OPTICS AND NANOTECHNOLOGIES

VOCATIONAL DEGREE COURSE

MATERIAL DESIGN AND SHAPING PROCESSES

The objective of this course is to gain new skills in materials and in mechanical engineering, together with initiation to/improvement in use of industrial tools needed for the design and fabrication of various mechanical parts. The improved control in this two areas is reinforced by new knowledge acquired in terms of materials, mainly metallic but also polymers and composites.

MASTER'S DEGREE IN

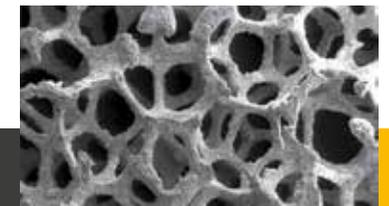
MECHANICAL ENGINEERING, MATERIAL SCIENCES AND ADVANCED PROCESSES

The MMPA specialty is designed to train students in experimental modelling and mechanical engineering characterization, with a strong emphasis placed on the uses of so-called "advanced materials".

UNIVERSITY DIPLOMA (DU)

ORAL IMPLANTOLOGY AND BIOMECHANICAL ENGINEERING

In a partnership between UTT-Troyes, its research teams in LASMIS and L2n and the French learned society for Biomaterials and Implantable Materials (SFBSI), this course is on offer to dentist-surgeons, maxillo-facial surgeons, stomatologists, lecturers and research scientists and all other professions who may find themselves involved in implantable systems and biomaterials at large. The course will build on their previously acquired knowledge, with clinical and basic training in dental implantology and use of lasers.



A polymer "opal" which changes colour when stretched, a material lighter than an aerogel, a contractile gel which stores light energy, an "invisible" man's cape, or a self-welding polymer... a full mosaic of revolutionary materials soon available to support reliability constraints and all ecologically compliances, to better serve the need of the Industry of the Future.

Expertise

Security and Risk Management

As new interactions appear, between risks and threats, between the physical and the digital worlds, between individuals and major systems, we do need to rethink security-related models, strategies and tools.

Research activities

Research teams involved

- Autonomous Networks & Environments (UTT-ERA)
- System Modelling & Security (UTT-M2S)

Platforms

CapSec

CapSec is a platform equipped for research on communication, on-board sensor networks specifically designed and used for security related purposes. It provides a setting for industrialists and academic laboratories to experiment, assess and validate various technological solutions.

CyberSec

CyberSec is a platform supporting the cyber-security research programme. It comprises a development-conducive environment with test equipment and certification of various technical solutions for ensure the security of EDP systems and to fight cybercrime. CyberSec will encourage the signing and development of university and industrial partnerships in this area.

The platform focuses on three priority themes:

- **DIF** [Digital image forensics] proposing an access to a data base with digitized support files including all the parameters needed for characterization. This theme covers development of ID (identification) tools and protocols.
- **Dej@Vu** where the objective is to make use of data analysis to better understand the life cycles and 'trajectories' of events in interconnected systems (e.g., in social networks).
- **CloudSec** is an environment for experimentation, based on data-centred architecture. Its objective is to enable reproduction of malicious behavior as well as the implementation and assessment of solutions employed to detect attacks and the counter-measures to be used in service and network architectures.

The UTT Hacklab

Le HackLab is a pedagogical platform for 'ethical' hacking. The 'lab' covers 100m² and has two networks and a server capable of delivering brute-force attacks (close on 75 billion access code tests/second. A virtual environment allows you to test a variety of computer hacking attacks on operational equipment, on virtual machines and on industrial-scaled systems.

Presages

Presages, a research, experimentation and modelling platform for security-related events, comes as a modular, adaptive and fully equipped space, designed to reproduce activities going on in both public and private emergency crisis units. It is essentially a research and training tool, with equipment allowing video-assisted pedagogy.

Innovation

There are innovation-related projects under way with ADEME (energy and environment), **Enedis** (Venteea), BPI and a FUI (single interministerial fund) supported by **Thales**.

Creation of the **Aquilaë** start-up who proposes video-surveillance adapted to customer needs, ranging from detection of abnormal behaviour or of suspicious objects to the possible malfunction of the metering system itself (via a network of smart sensors).

Collaboration with enterprises

- Preventive maintenance of hydro-electric dams with **EDF-France** and **Hydro-Quebec**.
- **UTT Chair for Global Security – Anticipate & Act**, collaboration with the University of Lyon III, Jean Moulin and the national school for police training (ENSP)
- **Chair of 'Crisis Management'**
Security-related concerns generate new needs in terms of scientific research, initial training and continued education. Any solutions here, in order to be valid and effective, must be transverse and interdisciplinary, and a partnership has been signed between UTT-Troyes and the École nationale supérieure des officiers de sapeurs-pompiers (ENSOSP) [Fire-brigade officers]. The Chair created aims at developing, transmitting and promoting a knowledge base that covers two main challenges for crisis management. The partnerships extend to 4 companies: **Devryware, Atos, Diginext** and **Airbus Industries**.
- LabCom In-Fine with the company **Surys**
The LabCom In-Fine is oriented to answer global security questions, developing optical processes to safeguard personal IDs, products or banknotes (security holograms)
- SURICATE-Nat : a citizens' "watch-tower" to detect natural risks
SURICATE-Nat collects and analyses messages posted on Twitter® to accelerate the upstream transmission to authorities of data related to natural disasters. This is a collaboration with the **BRGM**, UTT (M2S et Tech-CICO) and the **MAIF** (insurance company) **Foundation**.



Training packages

MASTER'S DEGREE IN ENGINEERING AND MANAGEMENT IN AN APPLIED GLOBAL SECURITY FRAMEWORK

In a collaboration with the INHESJ [acronym for French National Institute for Advanced Studies in Security Issues and Judicial Affairs], the IMSGA specialist Master's degree proposes a global approach to security issues. This training package will enable future users to combine all available human resources, as and where needed, to ensure conditions for maximum security.

SPECIALIST MASTÈRE EXPERT IN FORENSIC SCIENCES AND CYBERSECURITY®

This specialist course examines and analyses the technical, functional and legal aspects of the security measures envisaged/applied to EDP systems and provides for an efficient control of security and system safety audit techniques.

This training course on cybersecurity facilitates managerial understanding of the technical and technological environments in which industrial companies operate today. It allows the corporate heads to secure their information/EDP systems with cutting-edge tools, techniques and methodologies. The course processes have been certified "SecNumEdu" by the French national agency for EDP system (ANSSI or Agence nationale de la sécurité des systèmes d'information).

MASTER'S DEGREE IN EDP SYSTEMS SECURITY

This Master's degree provides training in the identification and assessment of risks when implementing prevention solutions: referring to governance parameters to ensure security (assessment of risks, taking into account the legal constraints, policy definitions, continuing improvement processes) and cyberdefence (detection and counter-measures when incidents/attacks occur).

PHD MATERIAL SCIENCES, MECHANICAL ENGINEERING, OPTICS AND NANOTECHNOLOGIES

PHD OPTIMIZATION AND SYSTEM SECURITY

PHD SOCIO-TECHNOLOGICAL SYSTEMS

VOCATIONAL DEGREE COURSE DIGITAL TECHNOLOGY INVESTIGATOR

This is a unique training course in France, in a partnership with the national centre for judiciary police forces (CNFPJ), aimed at fighting cyber criminality and offenses according to laws on new digital technologies. The course addresses members of the national police force; it takes into account the continuously increasing international factors in the professional Ntech investigators' work.

UNIVERSITY DIPLOMA (DU)

DATA PROTECTION OFFICER

This diploma course aims at enabling persons with a first company/business experience (legal, EP or management) to acquire the skills needed to hold a professional position as a Data Protection Officer (DPO). It is a programme designed to train professionals capable of developing and managing a data protection strategy in a corporate/business setting, with a better overall data protection policy, coming from the system design itself.

UNIVERSITY DIPLOMA (DU)

SEARCHING FOR DIGITAL PROOF

This diploma course aims at preparing prison staff for computer assisted cell search operations, in their fight against the influx of new technologies in prisons. It provides the technical and legal skills needed to carry out digitized investigations. The prison staff undertake this training course in parallel with members of the national police force. The course was set up as a follow-on to a partnership with the Gendarmerie Nationale.

UNIVERSITY DIPLOMA (DU)

OPERATIONAL CRIMINAL INVESTIGATIONS AND ANALYSIS

This diploma course is intended for analysts in charge of research into, and structured analysis of, data collected during investigations [phone, bank, legal background procedures] to help formulate hypotheses to be used by Criminal Investigators. The course is organized in a partnership with the Gendarmerie Nationale.

UNIVERSITY DIPLOMA (DU)

EMERGENCY AND CRISIS UNIT COORDINATOR

This diploma course is intended for middle management executives and strategists in companies, in administrations and local authorities in charge of organizing security matters, or who are participating and making decisions in an emergency & crisis unit. The training provided will add the managerial skills needed to handle various exceptional events (festivities, demonstrations) or crisis situations (natural disasters, or large-scale accidents/incidents).



On average, a cyberattack costs a SME 240 k€ and a large company 800 k€. As the frequency of attacks increases – over 120 000 per day world wide cybersecurity will continue to be a major challenge for society. The concept of 'global security' must be invoked to accompany the development of today's "instant, mobile, society", imbedded in the trend of globalisation, with new nanotechnologies round the corner, climate change and global warming... the aim must be to prevent and manage crises.

Expertise

Design & Use of Digital Technologies

Organization 4.0, cloud computing and storage, artificial intelligence (AI), Internet of things (IoT), big data, social media and networks faced with digitization on a massive scale in both business concerns and in society at large, we can no longer separate questions of technological design from the uses thereof and their social consequences.

Research activities

Research team involved

– Technologies for co-operation, Interaction and Knowledge Bases in Collectivities (UTT-Tech-CICO)

Innovations

InnoVENT-E aims at creating units and communities capable of contributing to improving SME skills in terms of innovation and exports. The course on offer is a complete, 'mutualized' package running from Bac+2 to Bac+8 levels, base on a skills referential, jointly assembled with entrepreneurial partners, which can be followed online or face-to-face. InnoVENT-E proposes a series of innovative digitized learner-based training courses,

PEPS, this interdisciplinary project code-named "Learn & Make", looks at apprenticeship schemes in co-working areas, focusing on design and production of material object using digital-numerical tools.

The launch phase for **COST CA16121**, the assigned objective of which is to develop a network – at a European level – of players (research scientists, practitioners, local communities, SMEs) interested in the development of co-working collaborative platforms and models and in terms of their social and technological impact.

Collaboration with enterprises

- Connect serves to integrate digital transformation at the core of **Air Liquide France Industrie**'s activities, for the purpose of creating efficient, "smart", innovative and competitive operations.
- Biomist: development of a tool enabling multiple access to complex, heterogeneous data banks. This research was conducted in close liaison with the **Cadesis Group** (software editor and expert integrator in CAO / PLM / BI) and in a collaboration with the Gin-Bordeaux laboratory (bio-imaging).



Training packages

ENGINEERING DIPLOMA IN

COMPUTER SCIENCES AND SYSTEMS-ORIENTED APPLICATIONS

This is a specialist training course in computer sciences and their applications enabling engineers who qualify to control a company's data/information retrieval, storage, transmission and circulation practices. They will constantly seek the best fit between end-user needs and the available computer/EDP tools.

3 professional elective specializations focus on project management:

- Software induced innovation
- Data and knowledge promotion
- Accompaniment for digital transition

PHD

MATERIAL SCIENCES, MECHANICAL ENGINEERING, OPTICS AND NANOTECHNOLOGIES

PHD

OPTIMIZATION AND SYSTEM SECURITY

PHD

SOCIO-TECHNOLOGICAL SYSTEMS

SPECIALIST MASTÈRE

EXPERT IN BIG ANALYTICS AND METROLOGY®

Specialists trained in this course learn to design, implement and operate innovative solutions to help handle and analyse big data. These solutions call for skills in computer science, mathematics and statistics as well as in social science and humanities. They may be heading a team of data scientists in charge of promoting corporate data, ensuring – as they do – an advisory mission as data strategists for the development of relevant processes or applications pertaining to operations involving exploration of huge volumes of data or to counsel/advise large industrial groups, SMEs or State services and local authorities when it comes to controlling and governing the use of their data sources and production.

SPECIALIST MASTÈRE

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It allows the corporate heads to secure their information/EDP systems with cutting-edge tools, techniques and methodologies. The course processes have been certified "SecNumEdu" by the French national agency for EDP system (ANSSI or Agence nationale de la sécurité des systèmes d'information).



Data has now become a precious raw material, organized and handled by active, productive, predictive algorithms, for better or for worse. They will help us to enjoy better health care, to make better energy management decisions, to continuously improve our knowledge bases, etc. But they will also control in parallel what we do and how we live, with the promise that it is all designed for our safety and security, but making us, at the same time, dependent. The challenges here are every bit as societal as they are technological.

Expertise

Monitoring/Surveillance and Operational Security Data Management Predict and Prevent

IoT (Internet of Things) technology is driving industrial sectors into strongly connected worlds. It is now possible – using advanced analytical techniques and artificial intelligence (AI) – to characterize “bills of health”, so to speak for technology-intensive or sociotechnical systems and thereby predict their current life expectancies. Ensuring proper functioning can then be guaranteed by way of “smart” predictive maintenance policies and the performance monitoring of systems can be improved through rapid detection of any abnormal events.

Research activities

Research team involved

– System Modelling & Security (UTT-M2S)

Innovations

Provisional maintenance scheduling for wind turbines: development of a digital mock-up twin to predict the remaining life span of the blade angle regulators of operational wind turbine installations.

Processing chain for automatic camera control of agricultural produce – appearance i.e., how they look), detection of illnesses and the level of seriousness of an outbreak.

Data analysis tools specific to aircraft during the landing phase – detection of atypical landings.

Detection of suspicious behavioural patterns, crowd movement analysis and tracking targeted persons via a camera network.

Geo-localization of connected indoor/outdoor objects.

Collaboration with enterprises

- **EDF-Hydro-Quebec**: contribution to top modelling of reliability factors and to prediction of residual operational life span for a hydro-turbine.
- **EADS**: feasibility studies on MOSFETs made from Silicon Carbide (SiC)
- **Renault Automobile Group**: qualifying reliability factors for the road perception and on-board decision functions for driverless cars.
- **Thales**: “smart” maintenance scheduling for equipment installed in series.
- **ENEDIS**: assessment of the contribution of wind-turbine electricity production on the behaviour of grid & distribution equipment.
- **Centre Hospitalier de Troyes** to geo-localize patients, equipment and to detect abnormal behaviours
- **Aquilaë**: Patented TT (technology transfer) in the area of object tracking via a camera network.
- **Damavan**: ‘reconstruction’ modelling of radioactive sources and design of Compton cameras.

Training packages

ENGINEERING DIPLOMA IN INDUSTRIAL ENGINEERING

When training is completed, this category of engineer will be able to design and implement various industrial and logistic processes. He/she ensures a seamless transition to the Factory of the Future (FoF) configurations. He/she will plan production lines, optimize flow of materials, parts and goods and likewise guarantee correct operational functioning for plant installations and associate services. He/she will be able to control costs, improve performance ratings and to discuss/negotiate with the various players in the system as a whole (customers, suppliers, end-users).

3 professional elective specializations, focusing on logistics, system and service security, are offered:

- On site, plant logistics and production
- External logistic and transportation
- Reliability, Availability, Maintenance and Safety

ENGINEERING DIPLOMA IN INDUSTRIAL AUTOMATION, CONTROL AND EDP

The professional responsibilities of these engineers will lie in designing innovative on-board systems and smart production systems. They must be able to intervene at any level of a production chain, and/or in the processing of associate data and in automated control processes. This specialist training course was created jointly by UTT-Troyes and URCA-Reims for the purpose of training engineers for the "Factory of the Future (FoF)".

2 professional elective specializations focus on design of automated systems:

- Smart production systems;
- On-board technologies and Interoperability.

MASTER'S DEGREE IN OPTIMIZATION AND SYSTEM SECURITY

The UTT's specialist Master's degree, code-named OSS, provides aids to decision making to control and optimize industrial processes. The course contents will help engineering managers to integrate new economic, technological, environmental and social constraints prevalent in today's industrial activities. The course proposes a multidisciplinary approach and modelling techniques. The students will acquire professional skills, modelling research methodologies and a reinforced knowledge base for potential applications.

PHD OPTIMIZATION AND SYSTEM SECURITY

SPECIALIST MASTÈRE

EXPERT IN BIG ANALYTICS AND METROLOGY®

Specialists trained in this course learn to design, implement and operate innovative solutions to help handle and analyse big data. The solutions here call for skills in computer science, mathematics and statistics as well as in social science and humanities. They may be heading a team of data scientists in charge of promoting corporate data, ensuring – as they do – an advisory mission as data strategists for the development of relevant processes or applications appertaining to operations involving exploration of huge volumes of data or to counsel/advise large industrial groups, SMEs or State services and local authorities when it comes to controlling and governing the use of their data sources and production.



“Smart” maintenance policies enable cost reductions of between 10 % and 40 %, likewise for the number of breakdowns and increased operational life expectancy of today’s machines. Savings here – for all companies on a global scale – are estimated to be approximately 630 billion US dollars by 2025.²²

²².McKinsey Global Institute Report: The internet of things: mapping the value beyond the hype, 2015.



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