Activity Report 2017

CentraleSupélec

Laboratoire Génie Industriel - LGI

Industrial Engineering Research Department

université PARIS-SACLAY

Laboratoire Génie Industriel CentraleSupélec

Laboratoire Génie Industriel - LGI, EA 2606
Industrial Engineering Research Department

Industrial engineering is a well-established discipline worldwide. Despite the variety of names of research departments, curricula and doctoral schools in international universities, it often amounts to "Industrial, System Engineering and Management". The objects of study of our scientific discipline are (1) Product-Service Systems and (b) as-is and to-be production or activity systems. These systems purposely exist to deliver adapted and optimal performances and create values to users through functions and services. These systems are designed, manufactured and delivered, exploited, maintained, updated and recycled. These systems are described by their architecture, are made of components, are configurable and demonstrate different properties like robustness, flexibility, agility, resilience, safety… Our ontology is also made of processes, resources, performances, costs, risks, business models, decisions, needs, preferences, competencies, projects, tasks, flows, stakeholders, value chains, supply chains, innovation, strategy, investments, economic and societal impacts…

Year 2017

Our colleagues have had notable results and awards this year, let us mention:

- Danielle Attias published "The Automobile Revolution. Towards a New Electro-Mobility Paradigm", Springer
- Oualid Jouini was awarded an IBM Faculty Awards for his innovative research project on improving the management of patients with severe trauma
- Camille Cany was awarded the prestigious Paul Caseau prize by EDF and the Académie des Technologies for her thesis work on Interactions between nuclear energy and renewable energies in the energeticy transition in France
- Guillaume Lamé won the thesis prize of the Doctoral School Interfaces in the «Complex Systems Engineering» division
- Pascal da Costa defended his Habilitation Thesis in economics on the theme «Climate policy and energy transition: tests in energy economics on the decarbonisation of electric mixes»
- Enrico Zio was elected Distinguished Guest Professor of Tsinghua University, Beijing, China. He also founded the Sino-French Laboratory of RIsk Science and Engineering (RISE) at Ecole Centrale Pekin, Beijing, China and was named co-Director.

In September, we all moved onto the brand new campus of Paris-Saclay.
The Master of Science Complex Systems Engineering[1] of Université Paris-Saclay celebrated its first promotion.

Hereafter, the reader is invited to discover:

- The research activity of the 4 research groups: Design Engineering (DE), Decision Aid (DA), Safety and Risks (SR), and Sustainable Economy (SE)
- The research activity of the 10 industrial chairs
- LGI has also organized its activity through 5 sectorial axes: (a) Health Systems (b) Mobility Systems (c) Energy Systems (d) Factory of the Future / Smart manufacturing (e) Industrial Ecology
- The who's who of LGI faculty members, technical and administrative staff.

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1 Master mention Ingénierie des Systèmes Complexes (ISC), cf. https://www.universite-paris-saclay.fr/fr/formation/master/ingenierie-des-systemes-complexes#mention

Bernard Yannou, head of LGI

Laboratoire Génie Industriel - LGI
Industrial Engineering Research Department

KEY FIGURES 2017

94 members
Faculties: 34
Doctorates: 49
Post-Doctorates: 4
Technical and administrative staff: 7
Journals Papers: 79
Contracts:
Chairs: 2 242,5 K€
Others: 280 K€

The Industrial Engineering (IE) Department (Laboratoire Génie Industriel, LGI) studies production, activity or socio-technical systems along their life cycles. These systems are engineered by humans and must be observed, diagnosed, specified, designed, improved, manufactured, deployed, exploited, regulated, maintained and recycled. These systems (see Figure 1) are industrial systems (production systems, value chains, eco-parks), complex products (airplanes, cars…), complex factories, transportation systems, health systems, energy networks, service systems and construction systems.

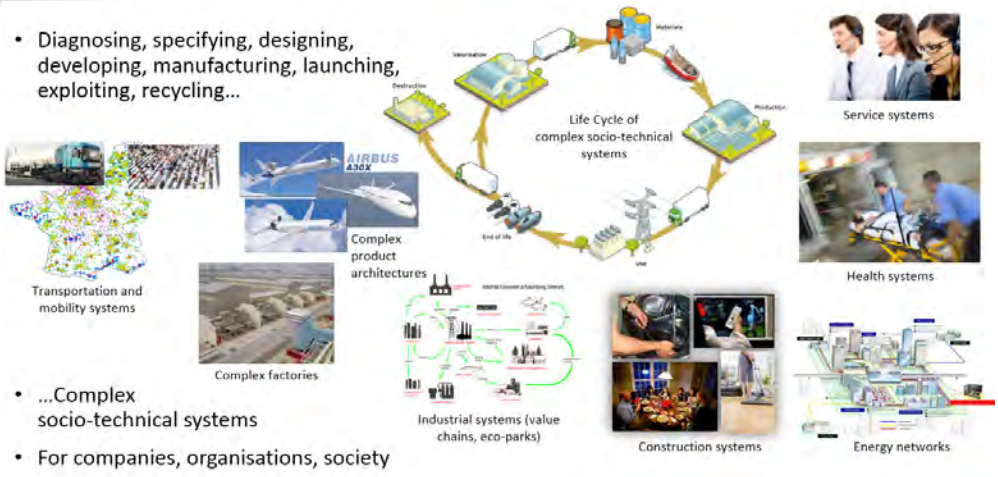

Figure 1: LGI studies production, activity or socio-technical systems along their life cycles

Key principles of our research are: multidisciplinarity, life-cycle thinking (see Figure 2), societal and economical issues, model-based engineering approaches.

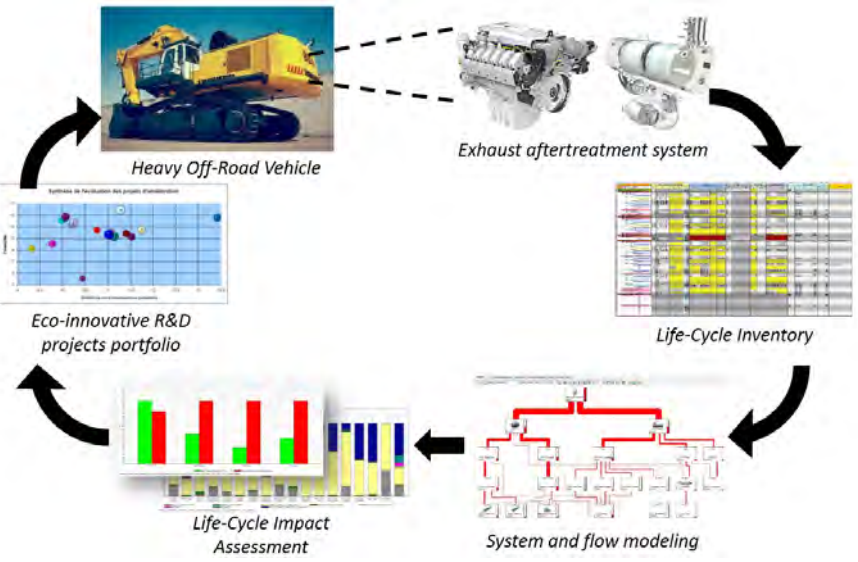

Figure 2: Life Cycle Assessment & Eco-Design of complex industrial systems

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Studied systems are often characterized by the following:

- the presence of sophisticated technical components but also of human agents (organizations, policy makers, operators),
- a large number of individual components that interact,
- heterogeneity of these components, each with specific individual behavior,
- systems that must often be analyzed at different physical, spatial and temporal scales and from different points of view (technical performance, cost, environmental impacts, material flows, skills...), see for instance Figure 3,
- a system feedback on its components and the emergence of macroscopic properties.

Figure 3: Simulation of a kitting automated cell (robot-operator collaboration upstream of an assembly line)

Figure 4: Optimization of patient flows in emergency services

The control of such systems presents many challenges and issues from both a technical and scientific point of view as well as practical and application perspectives like financial profitability, efficiency, continuity and reliability of service, security, resilience. The integration of technical systems is already challenging regarding, for example, aerospace, automotive or energy systems, but it is even more complex when it comes to inter-network systems («System of Systems» paradigm) such as health systems, human mobility infrastructure, distribution of products and services, transport and regulation of energy, gas, water, and other socio-technical systems including human or various agents such as organizations with different and even contradictory strategies, goals and preferences.
Our scientific approach consists in adequately modeling for analyzing and simulating (see Figure 4) in order to better understand the system behavior through virtual experiments on models and, ultimately, finding optimal solutions for the design, deployment and monitoring. Often many life cycle phases of these systems must be modeled and analyzed: collection of needs and requirements specification, development (architectural design, dimensioning, validation, manufacture and market launch or startup), system management (its regulation, its maintenance, its failure modes, its upgrade, its dismantling and end of life).

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Design Engineering Research Group in 2017

Research

Our research aims at assisting complex system design and engineering activities, combining the product/service, process and organization dimensions. The main topics are about diagnosing, modeling, designing, analyzing, simulating and optimizing those complex systems. The aim is to foster innovation to facilitate combined economic, environmental and social transformations. Research projects mostly yield from industrial collaborations, in order to propose academically original and industrially relevant solutions. Our team is organized around 3 axes:

1. Design of complex systems aims at developing methods and tools supporting decision-making with regard to design of products/services, high-level systems, and organizations. The focus is on preliminary and early design stages addressing system architecture, value engineering, product-project trade space explorations, lifecycle tradeoffs, etc. Design process modeling and more broadly complex project management are therefore critical issues organized around collaborative design, agile project management and lateral coordination, technology and knowledge transfer, risk and opportunity management, …

2. Design of sustainable systems consists in modeling, measuring and optimizing the environmental and sustainable performance of complex systems in their environment. The aim is to promote and deploy Eco-design, Industrial Ecology and Circular Economy. Numerous sectors are covered, such as industry, building and construction or innovative agrifood value chains.

3. Engineering innovation consists in bridging the gap between business strategy, R&D planning, product roadmap, innovation processes and conceptual design of architecture solutions. In addition, we work on a structured need seeker innovation methodology, named Radical Innovation Design®, for pulling disruptive innovations from the observation of painful usage situations.

5 PhDs completed

Guillaume Lamé *«Integrating Hospital Departments: An Operations Management Approach for Cancer Care»*, Hôpital Henri Mondor

Thierry Biard *«From modeling to automation of operational decision-making with an Enterprise Architecture Approach»*.

Massinissa Mammeri *«Decision aiding methodology for developing the contractual strategy of complex oil and gas development projects»*, Total

Sonia Ben Hamida *«Innovate by Designing for Value - Towards a Design-to-Value Methodology in Early Design Stages»*, ArianeGroup

Laura Roa Castro *«Managing Organisational Complexity in MBSE design projects: Use of a Sociotechnical Perspective to improve Collaboration»*, IRT-SystemX

Key figures in 2017

28 members
2 research chairs
5 PhDs completed
11 journals
27 conferences
1 book

10 faculties: *Franck Marle, Jean-Claude Bocquet, François Cluzel, Marija Jankovic, Julie Le Cardinal, Yann Leroy, Flore Vallet, Ludovic-Alexandre Vidal, Bernard Yannou, Gwenola Yannou-Le Bris*

16 PhD students: *Ouail Al Maghraoui, Alexandre Bekhradi, Sonia Ben Hamida, Thierry Biard, Youssef Damak, Mathieu Dernis, Tianjun Hou, Guillaume Lamé, Rim Louhichi, Yiming Ma, Massinissa Mammeri, Diya Moubdi, Laura Roa Castro, Michaël Saidani, Timothé Sissoko, Réza Vosooghi*

2 post-doc: *Andreas Hein, Julien Ventroux*

Research Group Design Engineering Laboratoire Génie Industriel

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Publications (selection out of 11 journal papers)

Innovation	Guillaume Lamé, Bernard Yannou, François Cluzel. *Usage-driven problem design for radical innovation in healthcare* *BMJ Innovations*, Published Online First: 24 November 2017. doi: 10.1136/bmjinnov-2016-000149.
Design	Hadi Jaber, Franck Marle, Ludovic-Alexandre Vidal, Lionel Didiez. Criticality and propagation analysis of impacts between project deliverables. *Research in Engineering Design*, Springer Verlag, 2017
	Audrey Abi Akle, Stéphanie Minel, Bernard Yannou. Information visualization for selection in Design by Shopping *Research in Engineering Design*, Springer Verlag, 2017, 28 (1), pp.99-117. (10.1007/s00163-016-0235-2)
	Julien Ventroux, Ludovic-Alexandre Vidal, Franck Marle. Assistance in selecting a project contracting strategy by combining complex systems theory and risk and vulnerability analysis. *Journal of Modern Project Management*, 2017
Sustainability	Andreas Hein, Marija Jankovic, Wen Feng, Romain Farel, Jeremy Yune et al. Stakeholder Power in Industrial Symbioses: A Stakeholder Value Network Approach. *Journal of Cleaner Production*, Elsevier, 2017,
	Anne Petit, Gwenola Bertoluci, Gilles Trystram, Amrine Lallmahomed. Sustainability for the actors of a food value chain: how to cooperate? *International Journal of Sustainable Development and Planning*, WIT Press, 2017, 12 (8), pp.1370-1382
	Michael Saidani, Bernard Yannou, Yann Leroy, François Cluzel. How to Assess Product Performance in the Circular Economy? Proposed Requirements for the Design of a Circularity Measurement Framework. *Recycling*, 2017, 2,

Collaborations

Academic collaborations

France: Université de Technologie de Compiègne, Université de Technologie de Troyes, ESTIA, Ecole Centrale de Nantes, IRSTEA, Université de Toulon, Supmeca, Mines ParisTech, Lorraine INP, AgroParisTech.

International: Erlangen-Nürnberg University (Germany), Technical University Munich (Germany), Norwegian University of Science and Technology, The Open University (UK), University of Illinois at Urbana-Champaign, Northwestern University, Penn State University, Georgia University of Technology, University of Texas at Austin, Massachusetts Institute of Technology, ENIM Monastir (Tunisia), American University of Beyruth. McGill University (Canada), Ecole de Technologie Supérieure (Canada), American University of Kuwait, Wuhan University (China).

Invited Professors

Dr. Hadi Jaber, *American University of Beyruth, Lebanon*
Pr. Michael Kokkolaras, *McGill University, Montréal, Canada*
Pr. Hirohide Haga, *Doshisha University, Kyoto*, *Japan*

Associated industrial chairs

Development of user centered eco-innovations in the context of urban mobility systems and their interactions with other urban systems, Alstom, Engie, Groupe Renault, RATP, SNCF, SystemX

Managing Procurement Risks in Complex projects, Total

Associated research institutes

IRT-SystemX (automotive, aeronautical & urban complex systems), www.irt-systemx.fr

Organization of...

Spring school EcoSD
Eco-design of complex systems
29 may-2 June 2017

Industrial and institutional collaborations

Our research networks

Useful links

Design Engineering Team website:
www.lgi.centralesupelec.fr/pmwiki.php/Recherche/DesignEngineering
Master in Complex Systems Engineering, specialization in Design Engineering
www.universite-paris-saclay.fr/fr/formation/master/ingenierie-des-systemes-complexes#mention

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Decision Aid Research Group in 2017

Research

The *Decision Aid for Goods and Services' Systems* Research Group (DA) is composed of 30 members among which 10 faculty members and 20 PhD students. The permanent members of the team come under the two ``CNU sections'': *Computer science* (27) and *Computer engineering, automation and signal processing* (61).

Research conducted refers to the scientific fields of Operational Research and Decision Analysis. The focus is related to decision support in operations management, and concerns both systems of goods and systems of services. Scientific issues are positioned at two levels (i) At an application domain level, research issues are related to performance evaluation and optimization of systems of production and distribution of goods and services (ii) Conceptual, methodological, procedural and algorithmic issues are tackled to meet application challenges.

The development of methods to optimize various aspects of organizational systems, leading to mobilize, adapt, reformulate or even develop formal tools so to effectively answer to the questions to which decision makers are confronted. These works often lead to developing new concepts, tools and decision support methodologies decision whose validity extends way beyond the application for which they were initially designed.

Our research is structured into three main research projects:

1. Service Operations Management (Healthcare systems, Call centers, ...)
2. Supply Chain Management (supply chain design and planning, cooperation and competition, flow and inventory management, green supply chain)
3. Multiple Criteria Decision Aid (preference modeling and elicitation, multiobjective optimization)

The models and resolutions methods considered in our research refers to Decision Aid/Operational Research: discrete event simulation methods, combinatorial optimization and mathematical programming, game theory, value based and outranking based preference models, argumentation models, preference learning, stochastic models, dynamic programming,…

3 PhDs completed

Oumeima Khaled *«A generic multi-criteria repair/recovery framework for optimization under uncertainty: Application to planning and assignment problems»,* IBM

Massinissa Mammeri *«Decision aiding methodology for developing the contractual strategy of complex oil and gas development projects»,* Total

Guillaume Lamé *«Integrating Hospital Departments: An Operations Management Approach for Cancer Care»,* Hôpital Henri Mondor

Key figures in 2017

28 members
4 research chairs
3 PhDs completed
24 journals papers published
3 book chapters
9 conferences
h-index : 42 (WoS)
815 citations (WoS)

11 faculties: *Walid Behiri, Chengbin Chu, Yves Dallery, Asma Ghaffari, Zied Jemaï, Oualid Jouini, Benjamin Legros, Vincent Mousseau, Wassila Ouerdane, Jakob Puchinger, Evren Sahin*

17 PhD students: *Khaled Belahcene, Hicham Benbitour, Selmen Boubaker, Amine Boudella, Junfei Chu, Maxime Claisse, Mathieu Dernis, Oumeima Khaled, Guillaume Lamé, Ouail Maghraoui, Abood Mourad, Massinissa Mammeri, Gustavo Santamaria-Acevedo, Haythem Selmi, Reza Vosooghi, Shaohua Yu, Zhe Yuan*

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Publications (selection out of 24 journal papers published[2])

Yann Bouchery, Asma Ghaffari, Zied Jemai, Zied, Tan Tarkan. «Impact of coordination on costs and carbon emissions for a two-echelon serial economic order quantity problem», *European Journal of Operational Research*, 260(2), 520-533, 2017

Benjamin Legros, Oualid Jouini and Ger Koole. «A Uniformization Approach for the Dynamic Control of Queueing Systems with Abandonments». *Operations Research*, 66(1):200-209, 2017.

Valentina Ferretti, Jingyan Liu, Vincent Mousseau, and Wassila Ouerdane. «Reference-based ranking procedure for environmental decision making: Insights from an ex-post analysis». *Environmental Modelling & Software*, 99:11 – 24, 2018.

Oumaima Khaled, Michel Minoux, Vincent Mousseau, Stéphane Michel, and Xavier Ceugniet. «A compact optimization model for the tail assignment problem». *European Journal of Operational Research*, 264(2):548–557, 2018.

Eda Ersek Uyanik, Vincent Mousseau, Marc Pirlot, and Olivier Sobrie. «Enumerating and categorizing positive boolean functions separable by a k-additive capacity». *Discrete Applied Mathematics*, 229:17–30, 2017.

Khaled Belahcène, Christophe Labreuche, Nicolas Maudet, Vincent Mousseau, and Wassila Ouerdane. «Explaining robust additive utility models by sequences of preference swaps». *Theory and Decision*, 82(2):151–183, 2017.

Mohamed Amine Boudela, Evren Sahin and Yves Dallery, "Kitting optimisation in Just-in-Time mixed-model assembly lines: assigning parts to pickers in a hybrid robot–operator kitting system", *International Journal of Production Research*, 2018

Shoyou Ma, Zied Jemai, Evren Sahin and Yves Dallery, "The News-Vendor Problem with Drop-shipping and Resalable Returns". *International Journal of Production Research*. 55 (22). pp. 6547-6571, 2017

Collaborations

Academic collaborations

France: Université Paris Dauphine, Université Pierre et Marie Curie, Université Paris-Sud, Telecom Bretagne.
International: University of Minnesota, Université de Mons (Belgique), Poznan University of Technology, (Pologne), Politechnico di Milano (Italy), University of Catane (Italy), VU University Amsterdam (The Netherlands), University of Coimbra (Portugal), Université du Luxembourg (Luxembourg), Koç University (Turkey), ENIT Tunis (Tunisia), SUTD (Singapore).

Invited Professors

Marc PIRLOT, *Université de Mons, Belgique*

Associated industrial chairs

Supply Chain Carrefour, LVMH, Safran, Sanofi

Manufacturing and Logistic Chair, Faurecia

Anthropolis Alstom, engie, RATP, Renault, SNCF, SystemX

Call Centers, **Interact'IV**

Editor in Chief

Vincent Mousseau
EURO Journal of Decision Processes

Associate editors

IMA Journal of Management Mathematics;
Supply Chain Forum, an International Journal
Flexible Services and Manufacturing Journal
Queueing Models and Service Management

Editorial boards

4OR, International Journal of Information Systems in the Service Sector

Industrial and institutional collaborations

Our research networks

Oualid Jouini was awarded an IBM Faculty Awards for his innovative research project on improving the management of patients with severe trauma

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Safety and Risks Research Group in 2017

Research

Aim and Scope

Our team develops new methods, frameworks and modeling architectures, techniques and algorithms, for the safety and risk analysis of complex engineered systems, based on a holistic and systemic viewpoint. The modeling, simulation and optimization methods, frameworks, architectures, techniques and algorithms that we develop, integrate a number of competences for viewing and solving the problems from the different, multidisciplinary system perspectives (topological and functional, static and dynamic, etc.) that are needed, and giving due account to the existing uncertainties. In-house softwares implement the problem solutions developed and their applications on industrial systems like aircrafts, nuclear power plant components, renewable energy systems, electric power grids, smart grids, oil and gas systems, automotive and railway transportation systems.

Topics

Our research is organized around 3 main topics:

1. **Energy network systems**, focusing on modeling, simulating and optimizing of electrical network systems, i.e., power grids, microgrids, smart grids. The analysis of these systems cannot be carried out only with classical methods of system decomposition and logic analysis; a framework is needed to integrate a number of methods capable of viewing the problem from different perspectives (topological and functional, static and dynamic, ...) and properly treating the related uncertainties by probabilistic and non-probabilistic methods.
2. **Aging and failure processes in components of energy production plants**, aiming at modeling and assessing component degradation, analyzing and building maintenance solutions, and carrying out system simulation for reliability, availability, maintainability and safety (RAMS) analysis by multi-state, physic, Bayesian and Markov chains models, Monte Carlo simulation. A particular focus is on failure prediction and prognostics of critical components, by data-driven approaches, e.g. adaptive artificial neural networks, support vector machines and the like.
3. **Dependable embedded systems**, consisting in developing concepts, methods and tools to design dependable embedded systems, with a special focus on avionic systems. The state-of-the-art Fault Tree assessment tools Aralia (now commercially distributed by Dassault Systemes) and now XFTA have been created and are continuously developed and updated.

Key figures in 2017

21 members
2 research chairs
5 PhDs completed
35 journals
16 conferences

5 PhDs completed

Mélissa Issad *«Reverse engineering of system specifications: appication to the railway systems of Siemens»*, Siemens
Pietro Turati *«Adaptive simulation methods for complex system risk assessment»*, Chair EDF
Anthony Legendre *«Ingénierie système et sûreté de fonctionnement : méthodologie de synchronisation des modèles d'architecture et d'analyse de risque»*, CEA
Xing Liu *«Analysis and Optimization of the resilience of interdependent critical infrastructures»*, China Scholarship Council
Benoît Lebeaupin *«Towards a high-level language for agile requirements engineering in the context of aeronautical embedded systems»*, Chair Safran

5 faculties: *Yiping Fang, Zhiguo Zeng, Antoine Rauzy, Jean-Marc Roussel, Enrico Zio*
15 PhD students: *Islam Abdin, Benjamin Aupetit, Tasneem Bani-Mustafa, Léo Chartier, Fangyuan Han, Mélissa Issad, Xiangyu Li, Benoît Lebeaupin, Anthony Legendre, Hoang-Phuong NGuyen, Muxia Sun, Daogui Tang, Hongping Wang, Zhiyi Wang, Jinduo Xing*
1 engineer: *Loïc Peletan*
1 visiting professor: *Juan Chen*
1 visiting PhD students: *Xiangyu Li*

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Publications (selection of 7 out of the 35 journal papers published)

Energy network systems	Abdin, I., Li, Y. F., & Zio, E. (2017). Risk assessment of power transmission network failures in a uniform pricing electricity market environment. Energy, 138, 1042-1055.
	Sun, M. X., Li, Y. F., & Zio, E. (2017). On the optimal redundancy allocation for multi-state series–parallel systems under epistemic uncertainty. Reliability Engineering & System Safety
	Ferrario, E., Pedroni, N., Zio, E., & Lopez-Caballero, F. (2017). Bootstrapped Artificial Neural Networks for the seismic analysis of structural systems. Structural Safety, 67, 70-84.
Aging and failure processes in components of energy production plants	Liu, J., & Zio, E. (2017). System dynamic reliability assessment and failure prognostics. Reliability Engineering & System Safety, 160, 21-36.
	Zeng, Z., & Zio, E. (2018). Dynamic Risk Assessment Based on Statistical Failure Data and Condition-Monitoring Degradation Data. IEEE Transactions on Reliability.
Dependable embedded systems	Aupetit, Benjamin; Batteux, Michel; Rauzy, Antoine; Roussel, Jean-Marc. (2017) Safety Analyzes of Mechatronics Systems: a Case Study. IFAC-PapersOnLine. vol. 50 (1)
	Legendre, Anthony; Lanusse, Agnes; Rauzy, Antoine. (2017) Toward model synchronization between safety analysis and system architecture design in industrial contexts. Lecture Notes in Computer Science. vol. 10437 LNCS

Collaborations

Academic collaborations

Europe : ETH Zurich, Liverpool John Moores University, Manchester University, Norwegian University of Science and Technology, Politecnico di Milano, Technical University of Denmark, Universitat Politècnica de València and others.

Rest of the world : Alzahra University, Iran, Beihang University, City University of Hong Kong, Idaho National Laboratory, MIT, National University of Singapore, North China Electric Power University, Wuhan University of Technology and others.

Invited professors:
Juan Chen, Beihang University, China
Michael Gerard Pecht, University of Maryland, USA

Associated industrial chairs:
Chair on Systems Science and the Energy Challenge, Fondation Électricité de France (EDF), www.ssde.fr
Chair Blériot-Fabre, SAFRAN

Associated research institutes:
Critical infrastructure reliability and Safety Center, Beihang University, http://cresci.cn
European Commission Joint Research Center (JRC) Ispra, https://ec.europa.eu/jrc/en/about/jrc-site/ispra
Institute de la Science de Risque et Incertitude (ISRI), CentraleSupélec
Laboratorio Analisi di Segnale e Analisi di Rischio (LASAR), Politecnico di Milano, www.lasar.polimi.it

Organization of...

International PhD School:
6th PhD School on Vulnerability, Risk and Resilience of Complex Systems and Critical Infrastructures, 23-27 Oct, 2017, CentraleSupélec, Paris, France
International conferences:
IEEE-2017 International Conference on System Reliability and Science, 20-22 December 2017, Milan Italy.

International conference Probabilistic Safety Assessment PSA 2017, 24-28 September, Pittsburgh USA.

International conference European Safety and Reliability ESREL 2017, 18-22 June, 2017, Portoroz Slovenia.

Seminar series on system reliability, risk and resilience: Reliability and Maintenance 4.0: the present future of industry development. 13th October 2017, Politecnico di Milano, Italy .

Industrial and institutional collaborations

Our research networks

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Sustainable Economy Research Group in 2017

Research

'Sustainable Economy' is articulated around three major directions:

1) "Economics and Management of Innovation". This topic deals with the evolution of technical progress and with the effectiveness of organizations. We are looking for here for a better understanding of the decisions of economic agents regarding investment and innovation, their microeconomic impacts on the growth of organizations, the organization of production and operational efficiency, as well as the effects on the distribution of income at the macroeconomic level. This research is conducted using optimization methods, econometric studies, as well as case and field studies (interviews).

2) "Economics and Management of Mobility". This topic deals with decarbonated – electrical and autonomous – mobility, as well as with the links with the electricity market (hybrid energy market: electricity + transport) through the challenges of electrical storage (electricity storage/unloading solutions through electrical vehicles). This research is conducted using technico-economic studies, econometric methods and strategic analyses, notably on innovative business models on sustainable mobility.

3) "Economics and Management of Energy". This topic deals with renewable, fossil and mineral energy resources (from the extraction industry to the final use within production of consumption systems), with the aim of reaching the decarbonization of the energy mix of the economy. In this perspective, energy efficiency (co-generation, industrial eco-parks) and the regulation of the markets tied to the energy transition are studied. This axis develops research methods in technico-economics and in forecasting, as well as analyses of global value chains.

Key figures in 2017

18 members
3 chairs
2 books
12 journals
3 book chapters
32 peer-reviewed conferences

PhDs completed

Camille Cany «*Interactions between nuclear and variable renewable energies in the French energy transition: adapting the power mix towards more flexibility*», CEA

Pascal da Costa «*Climate Policy and Energy Transition: Trials in energy economics on the decarbonisation of generation mixes*». HDR (Accreditation to direct research).

9 Faculties

Danielle Attias, Jean-Claude Bocquet, Pascal Da Costa, Angéla Minzoni, Sylvie Mira-Bonnardel, Eléonore Mounoud, Isabelle Nicolaï, Yannick Perez, Mehdi Senouci.

7 PhD Students

Camille Cany, Yurong Chen, Mathieu Dernis, Martin Leurent, Robin Molinier, Judith Pigneur, Olfa Tlili.

2 Post-Doc

Rémy Le Boennec, Georges Vivien Hougbonon

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Publications in 2017

Y. Perez, T. Khanam et ali., “Achievable or unbelievable? Expert perceptions of the European Union targets for emissions, renewables, and efficiency”, *Energy Research & Social Science*, 34.

S. Dantan, J. Bulteau, I. Nicolaï, “Enhancing sustainable mobility through a multimodal platform: Would travelers pay for it?”, *International Journal of Sustainable Development*, Inderscience, 2017, Promote and support eco innovation, 20 (1/2).

C. Cany, C. Mansilla, P. da Costa et ali., “Adapting the French nuclear fleet to integrate variable renewable energies via the production of hydrogen: towards massive production of low carbon hydrogen?”, *International Journal of Hydrogen Energy* 42 (19).

A. Minzoni and E. Mounoud, (eds), *Simplexité et modèles opérationnels*, 224 pages, CNRS Editions Alpha. France.

P. da Costa and D. Attias (eds.), *Towards a Sustainable Economy: Paradoxes and Trends in Energy and Transportation*, Springer.

Collaborations

2 Departments Paris Saclay : MEP (Mécanique, Energétique, Procédé); SHS (Sciences de l’Homme et de la Société).
2 Doctoral schools Paris Saclay : Interfaces; SHS (Economie-Gestion)
2 Masters Paris Saclay : Economie de l’Environnement, Energie, Transports (EEET); Industries de Réseau et Économie Numérique (IREN).

National and International Scientific Network:

France: Strate Ecole de Design, ESSEC, CEA Saclay, University Paris Dauphine, University of Montpellier, Club de l’Orme: the energy experts of Paris Saclay, Le Basic (Paris), VEDECOM: Pubic-private research institute about decarbonized mobility…
International: UNIGE Université de Genève (Suisse), Research Institute of Innovative Technology for the Earth (RITE) Japan, EU-LAC Foundation Germany, Helmholtz-Zentrum für Umweltforschung, Commission Européenne (ETIP-SNET)…

Member of:

- SFM, AIMS, EEM, FAEE, IAEE…
- Florence School of Regulation,
- Conference on the European Energy Market,
- CEESAR,
- Office Parlementaire de l’Evaluation des Choix Scientifiques et Technologiques.

Invited professor:

Bianka SHOAI TEHRANI, RITE, Japon: Electricity market liberalisation and decarbonisation
Mr J. YAKATA SUGANO, Federal University of Lavras, Brazil: 1 month visiting on the smart mobilty.
PhD Students, Fabio Antonialli and Bruna Habib Cavazza, Federal University of Lavras, Brazil
Our PhD Student, Mrs Y. CHEN, 9 months visiting scholar at the Wharton Business School of University of Pennsylvania (Prof. J. P. MacDuffie).

Paul Caseau Prize awarded by EDF and Académie des Technologies to Camille Cany. Topic : development of the uses of electricity and energy efficiency.

3 Chairs:

Chair Operational Efficiency by BNP Paribas.

CORPORATE CHAIR
Operational Efficiency & Management Systems
BNP PARIBAS
La banque d’un monde qui change

Chair Armand Peugeot on Electromobility and Hybrid Technology by Peugeot-Citroën (with Essec).

CHAIRE ARMAND PEUGEOT
PSA PEUGEOT CITROËN

Patronage by endowment fund Capitaldon on Sustainable Growth.

CapitalDon

New European Project : H2020 : AVENUE Autonomous Vehicles to Evolve to a New Urban Experience (Danielle Attias)

Organisation of

5 may 2017 : «Le véhicule autonome, entre fiction et réalité», Workshop, Centrale Pékin, Beijing, China.

14-15 December 2017 : 5th International Conference of the Chair Armand Peugeot : Electromobility : Challenging Issues. Jointly organized with The Chair Gouvernance et Régulation of Université Paris Dauphine and the Institute Vedecom.

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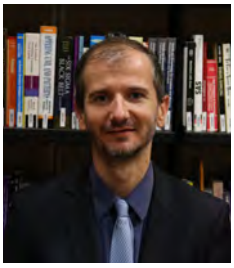
Sustainable Economy
Laboratoire Génie Industriel

CentraleSupélec

Our 10 industrial chairs and 1 partner research institute

TOTAL - Managing Procurement Risks in Complex Projects.



Prof. Franck MARLE

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The Chair aims at identifying, analyzing then treating some risks related to the complex Exploration & Production projects, which are made of multiple interdependent contracts. The research topics are :

- Proposing In-Country Value actions that deliver sustainable value to the Host Country while maintaining the Project Risk Exposure acceptable
- Selecting a Project Contracting Strategy which minimizes risks while execution of the contracts (Engineering, Procurement & Supply, Construction & Installation)
- Proposing a way to coordinate actors during key decisions related to the Project Contract lifecycle

TOTAL

The Chair is connected to Exploration & Production branch of TOTAL. It is co-supervised by two divisions, respectively Projects & Construction and Contracts & Procurement.

The Chair is composed of a holder and 3 PhD students.

ANTHROPOLIS : Development of user centered eco-innovations in the context of urban mobility systems and their interactions with other urban systems.

Prof. Jakob Puchinger

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Infos :
https://www.chaire-anthropolis.fr

The « Anthropolis » chair places the human being at the center of new usages and new mobilities defining its research activities around three major topics:

- State of the art and usage scenarios: the chair will commence its investigations by identifying citizen's usage and behavior typologies and the elaboration of usage scenarios.
- Disruptive technologies and innovation: identifying developments of disruptive technologies at the service of urban systems (experiments, Living Lab...).
- Impact on urban systems: adapting existing simulation tools in order to evaluate the impact of various innovations and identifying the developments they induce on business models and new mobility solutions.

AnthroPOLIS
HUMAN CENTERED URBAN DESIGN

Anthropolis
ALSTOM ENGIE SNCF RATP GROUPE RENAULT SystemX

The chair is jointly operated with IRT-SystemX, unique IRT in Ile-de-France in the field of digital engineering of complex systems. The partners are: Alstom, ENGIE, RATP, Renault, SNCF.

The chair is composed of the chair holder, a researcher and five doctoral students.

The faurecia chair of manufacturing & logistics management

Prof. Evren SAHIN

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The Chair of Manufacturing & Logistics Management aims at developing decision making tools that improve the performances of production and logistics processes of the automotive first tier supplier Faurecia. The objective is to better understand, model, improve and optimize operations, in terms of productivity, responsiveness and flexibility, while controlling costs (space, labor, investments, etc.), by developing innovative solutions (organizational, technological). Recent examples of studies developed in the Chair include:

- optimization of assembly line feeding policies by introducing «kitting» and «sequencing» as new part supply policies
- improvement of the performances of product picking processes by optimizing storage locations and picking routes
- design of a performing internal cross-docking processes within an assembly plant by assessing the performance of different modes of cross-docking
- assessment of the benefits that would stem from the RFID technology
- evaluation of the complete cost stemming from the diversity of finished products existing in a production site

CM&L

The Chair is co-managed with Prof. S Minner, Technical University of Munich, School of Management.

faurecia

TUM

Supply Chain Chair

Prof. Yves Dallery
Supply Chain Chair Director

Contact:
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Chair team
- Laurent Grégoire
Head of Enterprise Partnership
- Zied Jemaï Scientific Head
- Bruno Croizat
Trainer and head of student relationship

The Supply Chain chair includes in a unique partnership four major companies: Carrefour, LVMH, Safran and Sanofi.

The goal of this chair is threefold:
- Develop research and innovation in supply chain,
- Develop skills of managers and best practices in the four companies,
- Stimulate the interests of CentraleSupélec students for supply chain careers.
-

Following are the two core topics of the supply chain chair:
- Agility and resilience in supply chains: how to make supply chains more agile and resilient to cope with uncertain situations,
- Supply chain and enterprise performance: how to put forward the key role of supply chain in the financial and environmental performance of companies.

The supply chain chair was launched in 2008 with a first phase from 2008 to 2013 and renewed in 2014 for a second phase until 2018.
The strategic orientations of the Supply Chain chair are set by a steering committee consisting of:
- The supply chain directors of the four companies
- The supply chain team
- The head of the LGI (industrial engineering research lab)
- The head of the Centrale Alumni in purchasing and supply chain

Call Centers: Optimization of multichannel operations in modern call centers

Prof. Oualid Jouini

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The chair « Call Centers » aims at proposing novel solutions for the operations management and optimization of multichannel call centers. It consists of adapting operations to the exponential growth of the technological progress while accounting for the human element, which is one of the most important features in call centers. In particular, the chair addresses the following research questions:
- Routing with high identification level for customers: In the new context of Web-RTC systems, the classical routing of customers to agents is no longer appropriate. Agents are becoming more and more active in selecting the jobs they handle. The objective is to study the effect of this change on performance and on agent behavior: are we converging toward a situation of hyper-specialization, or a situation with an increasing number of skills per agent?
- Advertizing during waiting: analysis of the impact of advertizing parameters on the customer behavior in commercial call centers. The objective is to understand how advertising may intensify or reduce the abandonment phenomena.

The chair is managed by LGI at CentraleSupélec, and is funded by the industrial partner INTERACT-IV.COM

The chair consists of the chair holder and one junior professor

Chair System Science and the Energy Challenge, 'Fondation Electricite' de France (EDF).

Prof. Enrico Zio

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The Chair "System Science and the Energy Challenge" develops new methods, frameworks and modeling architectures, techniques and algorithms, for the safety and risk analysis of complex engineered systems, based on a holistic and systemic viewpoint. More specifically, the research on energy systems and components involves methods for: simulation, prediction, optimization, degradation and failure modeling, RAM, risk, vulnerability, resilience analysis.

Two main research axes can be distinguished:
- Axis 1: Characterization of the aging and failure behavior of production plant components,
- Axis 2: Energy systems analysis.

These two axes develop into a number of individual researches carried out by: 2 assistant professors, 3 post-docs, 7 PhD students, 2 visiting PhD students, 1 master student and a large number of international collaborators from renowned universities and research institutes.

Chair Blériot-Fabre: Design of robust embedded avionic systems.

Prof. Antoine Rauzy

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The chair Blériot-Fabre is focusing on the science and the engineering of complex systems, with two specific thematic fields: system architecture and safety analyses, both essential for the design of avionic systems.

Models, modeling languages and assessment algorithms are at the core of the scientific and teaching activities developed in the framework of the chair.

The chair plays notably a central role in the design of the AltaRica language and in the development of associated assessment tools.

SAFRAN

The chair is supporting one professor, an associated professor, a research engineer and several PhD students.

Armand Peugeot: A chair in partnership on hybrid technologies and the economy of electromobility.

Prof. Danièle Attias

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https://sites.google.com/a/essec.edu/chaire-armand-peugeot/

The Chair «Armand Peugeot» is a partnership with Essec Business School and covers the multidisciplinary fields necessary to address the complexity of the questions posed by the future of the automotive industry in the context of the development of electromobility.

The aim of the Chair is to create a space for exchanges, training and prospective research to develop technological, economic and strategy scenarios.

CHAIRE ARMAND PEUGEOT

The Chair is a partnership between the University PSA CentraleSupélec, and ESSEC Business School.

PSA PEUGEOT CITROËN

CORPORATE UNIVERSITY

ESSEC BUSINESS SCHOOL

Operational efficiency and management systems

Chair Holders :

Prof. Angela Minzoni

Contact: angela.minzoni@centralesupelec.fr

Prof. Eléonore Mounoud

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eleonore.mounoud@centralesupelec.fr

The aim of the OE&MS Corporate BNPParibas IFS Chair is to radically innovate the operations' management thinking by focusing on the whole operation's environment and system, beyond parcelled operation's optimization. Organization's operating models have a key influence on the organization's governance and strategy.

A main challenge is to produce new knowledge and tools to address specific intangible services' operating models at a time where service systems' operations cannot any more be understood and planned under a mechanistic view of pre-established continuous chains of standardized micro tasks. A major academic stake is to pass from a static and mechanistic middle and back office operation's system view to a dynamic, living system like operation's model.

The design process itself is designed as an iterative action-learning process among bank experts and researchers. Research is conducted under an integrated interdisciplinary approach including operations research, anthropology and organizational sciences.

CORPORATE CHAIR
Operational Efficiency & Management Systems

The chair is jointly operated with BNP Paribas

BNP PARIBAS
La banque d'un monde qui change

Sustainable Growth: the impact of innovation and of market structures, in particular related to energy and the environment, on potential growth and sustainability of economic systems

Pascal da Costa

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Infos :
http://www.capitaldon.org

The Chair “Sustainable Growth” aims to propose models that are workable in a context where industrial, energetic, financial and economic crisis that mark the end of a quantitative growth model, and the rise of a new economy based on innovation and quality as key resources.

The convergence of economics and managerial approaches proves necessary to study these latter new economic and management models:

- Articulating economics and management issues by taking into account both macro and microeconomic levels;
- Challenges linked to energy and environmental sustainability, radical innovation and the size of firms.

CapitalDon

Patronage by endowment fund Capitaldon on Sustainable Growth.

The Chair is composed by one leader and one young researcher, and aims at supporting the whole team of economics and management of LGI/Centralesupélec within its research program of sustanability.

The Technological Research Institute SystemX (IRT SystemX)

Bernard Yannou, Jakob Puchinger, Marija Jankovic, Julie Le Cardinal, Flore Vallet

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Based on the plateau of Paris-Saclay, IRT SystemX is positioned as an accelerator of digital transformation. Focused on digital engineering of future systems, research projects cover the scientific and technological challenges of industrial transport and mobility sectors, energy, security and digital communications. They meet the challenges that manufacturers face in the phases of design, modeling, simulation and testing of future products and services, integrating more and more digital technologies.
The evolution of technology and the need to involve their integration reflect the new paradigm «Digitizing» by a «systems» approach or «systems of systems». The IRT 2016-2020 roadmap focuses on four programs: systems engineering, intelligent territories, autonomous transport and digital infrastructures.
LGI (DE and DA research teams) is actively working on the first three programs with:

- a common Anthropolis Chair (2015-2019) on innovative urban systems and mobility centered on the needs of users,
- participation in several programs on autonomous vehicles and systems engineering,
- presence in the Programs Orientation Committee.

SystemX
INSTITUT DE RECHERCHE TECHNOLOGIQUE

The collaboration with IRT System X involves 5 LGI academics, supports three PhD students and hosts two other PhD students in partnership with partner companies of IRT.

Sectorial Axes

Mobility Systems

Ambassadors

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Isabelle NICOLAÏ
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New mobilities: what ecosystem for tomorrow?

Eco-mobility involves all mobility solutions and encompasses every type of transport – individual and shared, public and private – that contributes to providing a positive response to sustainable development issues. This eco-mobility is also smart and connected.

These new mobilities need to be analyzed with a multi-disciplinary approach, fitting into a context of prospective and disruptive innovation. Research approaches include engineering, economics and social sciences, and employ tools to design and model socio-technical mobility systems.

The models developed attempt to understand and satisfy stakeholder's mobility requirements in a transition context. In more detail, the themes tackled by our research are the following:

- Sustainable urban mobility: we rethink the mobility concept (new usages, new services, multi-modal transport conception system) for the transition ecologic, digital and social of the urban spaces or territories with the integration of the autonomous car.
- Electro mobility economy: we study the link between the business models of new electrical vehicles and the smart grid, and also at the services economy of new mobilities.

Keywords: New business models of eco-mobility system; autonomous car; sustainable urban mobility

Health Systems

Ambassadors

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The Healthcare Research Group of LGI is develops new approaches, methods and tools related to Industrial Engineering, that are relevant for care production systems. For certain problems encountered in Healthcare, Industrial Engineering approaches that were initially developed for manufacturing systems can be applied, by integrating some specific assumptions and adapting the models. Other types of problems necessarily involve the development of new research methodologies for the realistic modeling of healthcare systems. Models we develop aim at achieving patient objective quality of service (by reducing waiting times, process times, etc.) and satisfying caregivers preferences (consultation hours, equitable load distribution, etc.) while avoiding the waste of resources (practitioners time, operational costs, investment costs, etc.).
Our research projects also support the introduction of new technologies and digital solutions (e.g. m-health, health monitoring systems) in healthcare production systems, the objective being the development of innovative, patient & technology driven organizations.
Examples of topics covered in our research team are:

- Modeling and simulation of hospital service operations
- Modeling and simulation of operations in EMS (Emergency Medical Service) systems
- Decision support for Home Care
- Patient pathway and more integrated health departments/structures
- Personalized Care
- Decision support for the design of m-health technologies
- Design of telemedicine systems
- Design of mobile care delivery systems

Smart Manufacturing and Connected Systems

Ambassadors

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Within this axis, we are interested in both new production methods of hyper-connected factories of the future and, more generally, the design of connected systems.
In terms of the industry of the future, the aim is to develop new approaches and to transform production methods in industry and in a broader scope to master «performance 4.0» in companies.

The objective is to support companies in their transition from a traditional industry to the industry of future. This industry must be more respectful of the environment, thanks to less resource-consuming, more intelligent and flexible modes of production generating less waste, while rethinking the man-machine interface.
This research concerns digital transformations of the industrial model such as:

- Transformation of business models by digital enterprises
- Modernization of the production tool
- More integrated design, marketing, supplier and sales functions
- Switching from mass production of standard products to mass production of more personalized products

Moreover, we also consider in this axis the design of any connected system in the broad sense: connected systems of product type (example: health monitoring systems) as well as production systems as already evoked by «industry of future».

Keywords: Factory of Future, Industry 4.0, smart manufacturing, connected factory, smart factory, machine learning, connected systems

Energy Systems

Ambassadors

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Enrico ZIO
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Energy production and distribution systems, and loads

The “energy systems” or “energy” axis brings together all research of the laboratory dealing with the techno-ecomic, the decarbonisation, the electrification of the economy and the digitalisation, etc. within the framework of the energy systems, including:Economic viability, technical reliability, operational security, and the risks related to energy production, transmission, and distribution;

- Economic viability, technical reliability, operational security, and the risks related to energy production, transmission, and distribution;
- Comparative analysis of low-carbon electricity production technologies, such as renewables and nuclear resources, and the investigation of electricity storage solutions;
- Integration of electrical mobility within the electricity supply and demand dynamics, investigation of new forms of low-carbon emission mobility solutions.
- Energy efficiency (eco-parks, co-generation, transmission, distribution, etc.), demand side management (smart grids, curtailments, etc.), and the effect of consumers’ behavior and usages on the energy consumption within the lifecycle of the product.
- Management of the different externalities produced by the energy system (beyond the CO2 emission), including nuclear wastes and the extraction of fossil and mineral resources;
- Digitalisation and the energy industry of the future..

Keys words
Renewable energy systems, Energy production plants, Energy networks, Energy market and regulation, Design of energy market, Energy transition, Energy performance contratcs, Energy efficiency, Eco-designing energy stations, Simulation of energy consumption, Multi-criteria Analysis of Complex Energy System, Techno-Economic Analysis, Energy Economics and Management, Energy in Use Product, Uses and Behaviours in Energy Consumption, Decarbonised Mobility, Smart Grid, Risk Assessment of Energy Systems, Resilience Analysis of Energy Systems, etc.

Industrial ecology

Ambassadors

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Optimize material and energy flows in the design and manufacturing of goods and services

Circular Economy and Industrial Ecology are two complementary notions, **where Industrial Ecology is seen as the scientific field allowing Circular Economy deployment** thanks to strategies like eco-design of products and services, product-service systems, industrial synergies… The objective is **to limit environmental impacts of human activities**, for example by pooling material, water and energy flows in an **integrated metabolism** approach.
The four LGI teams are all particularly implicated on Industrial Ecology issues. Current research themes deal with:

- **Eco-design** and **eco-innovation** methods and tools
- **Life Cycle Assessment** (LCA) of products and services, technologies families, value chains…
- **Industrial symbioses** and **eco-industrial parks**
- **Circularity indicators**
- **Sustainable supply chain** (reverse logistics, ecosystem services and sustainable supply chains…)
- **Energy efficiency**
- Technico-economic studies of **industrial value chains** including **externalities**
- **Decision making** in complex environmental with great uncertainties
- ...

These research projects are applied in numerous industrial sectors, however **sustainable buildings, cities** and **mobility** are particularly targeted.

WHO'S WHO

	Danielle ATTIAS Adjunct Professor danielle.attias@centralesupelec.fr	Sustainable Economy Chair Holder "Electro-mobility" (PSA Peugeot Citroën)	Electromobility, new business models for Automotiv Industry, Innovavite mobility and Public Policies
	Walid BEHIRI Assistant professor (ATER) walid.behiri@centralesupelec.fr	Decision Aid	Supply Chain, Operations research
	Jean-Claude BOCQUET Professor jean-claude.bocquet@centralesupelec.fr	Design Engineering Sustainable Economy	Complex system design, Design process and management, Value chain management, Technico economics of complex systems
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	Oualid JOUINI Associate professor oualid.jouini@centralesupelec.fr	Decision Aid	Stochastic modeling, Service operations management, Call centers, Healthcare systems
	Julie LE CARDINAL Professor julie.le-cardinal@centralesupelec.fr	Design Engineering Head of «Enterprises Sciences» Education Department	Facilitating Decision-Making, Systemic Modeling, Knowledge Management, Choice of actors, Complex System Design, Healthcare System Engineering

	Benjamin LEGROS Assistant professor benjamin.legros@centralesupelec.fr	Decision Aid	Call centers, Stochastic modeling, Service operations management, Healthcare systems
	Yann LEROY Assistant professor yann.leroy@centralesupelec.fr	Design Engineering	Ecodesign, Life Cycle Assessment, Sustainable design, Eco-innovation, Industrial Engineering Life Cycle Engineering, Recycling
	Franck MARLE Professor franck.marle@centralesupelec.fr	Design Engineering Head of DE Team Chair Holder "Purchasing in complex projects" (Total)	Project management, Complex projects, Contracts & procurement, Project risks, Project vulnerability, Complexity modeling, Topological analysis, Propagation analysis, Clustering, Decision-making
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	Pascal MORENTON Adjunct Professor pascal.morenton@centralesupelec.fr		Product Data and Life-cycle Management, Computer Aided Design, concurrent engineering, agile methodologies, additive manufacturing
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	Vincent MOUSSEAU Professor vincent.mousseau@centralesupelec.fr	Decision Aid Deputy director Head of DA Team	Multiple criteria decision aid, Preference modeling, Preference elicitation, Spatial decision, Behavioral decision analysis
	Isabelle NICOLAÏ Professor isabelle.nicolai@centralesupelec.fr	Sustainable Economy	Eco-innovation, disruptive technology, multi agents and criteria decision-making, user-centred design, multimodal mobility, business model
	Wassila OUERDANE Assistant professor wassila.ouerdane@centralesupelec.fr	Decision Aid	Multiple Criteria Decision aid, Preference Modeling, Artificial Intelligence, Argumentation theory, Explanation systems
	Nicola PEDRONI Associate professor nicola.pedroni@centralesupelec.fr	Safety and Risks (Departed to Politecnico di Turino from may 2017)	Computational methods, Risk assessment, Safety-critical energy systems, Monte Carlo Simulation, Uncertainty quantification
	Yannick PEREZ Associate professor yannick.perez@centralesupelec.fr	Sustainable Economy Chair «Electro-mobility» (PSA Peugeot Citroën)	Market Design, Energy Economics, Electromobility
	Jakob PUCHINGER Professor jakob.puchinger@centralesupelec.fr	Decision Aid Chair Holder «Anthropolis» with IRT-SystemX (Alstom, Engie, RATP, Renault, SNCF)	Urban mobility, transport optimization, combinatorial optimization, exact and heuristic optimization methods, operations research
	Antoine RAUZY Professor antoine.rauzy@ntnu.no	Safety and Risks Chair Holder «Blériot Fabre» (Safran)	Reliability Engineering and System Safety, Complex Systems Engineering
	Jean-Marc ROUSSEL Professor jean-marc.roussel@centralesupelec.fr	Safety and Risks Chair «Blériot Fabre» (Safran)	Complex Systems Engineering Reliability Engineering and System Safety

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Decision Aid
Chair Holder «Logistics & Manufacturing» (Faurécia)

Supply Chain Management, Production, Internal Logistics, Operations Management, Service Operations Management, Healthcare Engineering

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Sustainable Economy

Economic growth and fluctuations, economic theory, international financial macroeconomics

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Design Engineering
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Eco-design, Innovation engineering, Eco-innovation, Life Cycle Assessment, Urban mobility, Sustainable mobility, Industrial design

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Design Engineering
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Design automation, design methodologies, product development, innovation engineering, ecodesign, artificial intelligence in design, design processes and management

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Design Engineering

Eco-design, Innovation Management, Modelling, Sustainability, LCA, Food Value Chain.

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Safety and Risks
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Risk, reliability, safety, resilience analysis and maintenance and asset management of complex systems and critical infrastructures; Monte Carlo simulation methods; Soft computing techniques for meta-modeling; Evolutionary and heuristic techniques for optimization. Energy, nuclear, oil and gas systems.

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Research engineer

CAD (Computer Aided Design), Reverse engineering, Rapid prototyping, Product design

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Assistant
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Administrative staff
Research Assistant

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Administrative staff
Chair Assistant

Loïc
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Engineer
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Safety and risks
Research engineer
Chair member of «Blériot Fabre» (Safran)

Complex systems engineering, proofs of concepts, computational methods, optimization

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Technical staff
Information System Manager

Matthieu
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Technical staff
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