

Activity Report 2015



CentraleSupélec

Laboratoire Génie Industriel - LGI

Industrial Engineering Research Department

université
PARIS-SACLAY



Laboratoire Génie Industriel - LGI, EA 2606

Industrial Engineering Research Department



"For us, Industrial Engineering is not any more the one and only field focusing on the development of methods to assist the organization of industrial companies. It has become a solid scientific corpus which addresses all kinds of cooperation between companies and of human activities. It aims at understanding, designing, modelling, simulating, optimizing and deploying complex socio-technical systems in which companies, value chains, human agents and social groups live, act and expect value creation."

Year 2015 starts with the creation of CentraleSupélec – merging of Ecole Centrale Paris and Supélec along with the creation of Université Paris-Saclay¹ for which CentraleSupélec is one of the 19 founding members.

Within CentraleSupélec, LGI is one of the 16 research departments (units). Its aim is to understand, design, model, simulate, optimize and deploy complex socio-technical systems. With its 11 industrial chairs and 2 tight partnerships with external research institutes, LGI displays a strong relationship with companies and technical, economic, organizational and social challenges.

In April, Prof. Bernard Yannou becomes the head of LGI, replacing Prof. Jean-Claude Bocquet who has been the founder. A new governance structure is proposed, with a management steering committee (CODIR), a lab. steering committee (COLAB) and a participative commitment of LGI members in regular meetings and working groups.

In June, the annual 3-day lab seminar results in a continuous improvement initiative with the launch of 7 Working Groups "Scientific project", "Communication-Publications-HAL", "Scientific Animation", "Internal Communication", "Integrating newcomers and nationalities", "Accounting", "Innovation and Experimentation platform". These working groups continuously yield results that are implemented.

Finally, LGI has decided to officially show itself as an actor on 5 sectorial axes: (a) Health Systems (b) Mobility Systems (c) Energy Systems (d) Factory of the Future / Connected Systems (e) Industrial Ecology

In 2015 also, two new chairs have been created - Anthropolis chair² & Call centers chair – and two have been successfully renewed – Supply chain & Systems science and Energy challenges -.

In June, Pascal da Costa and Julie Le Cardinal are nominated as heads of IE academic department.

In September, the IE Master of Science of CentraleSupélec has been transformed into a Université Paris-Saclay IE MSc (from 2 to 9 Master-2 tracks with partners as ENS Cachan and Université d'Evry-val-d'Essonne).

In October, our PhD doctorates register now in the new Doctoral School Interfaces of Université Paris-Saclay. Prof. V. Mousseau (DA research group) becomes the leader of Interfaces Doctoral School's Complex Systems Engineering topics.

The reader is invited to discover hereafter:

- The research activity of the 4 research groups: Design Engineering (DE), Decision Aid (DA), Safety and Risks (SR), Sustainable Economy (SE),
- The research activity of the 11 industrial chairs and the two external partner research institutes,
- The who's who of LGI faculty members, technical and administrative staff.

Bernard Yannou, head of LGI

¹ <https://www.universite-paris-saclay.fr>

² <http://www.chaire-anthropolis.fr>

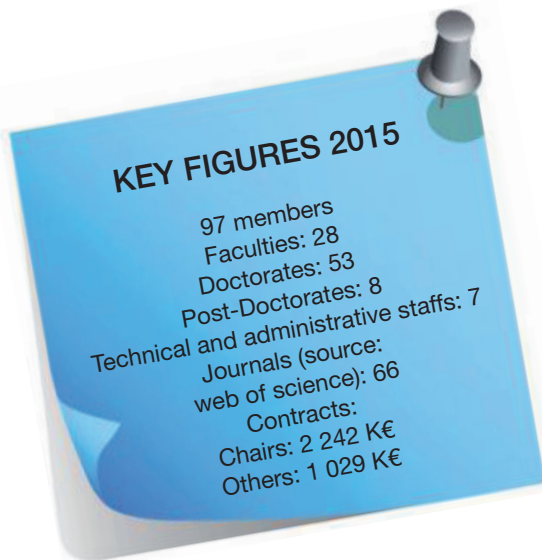
Laboratoire Génie Industriel - LGI

Industrial Engineering Research Department

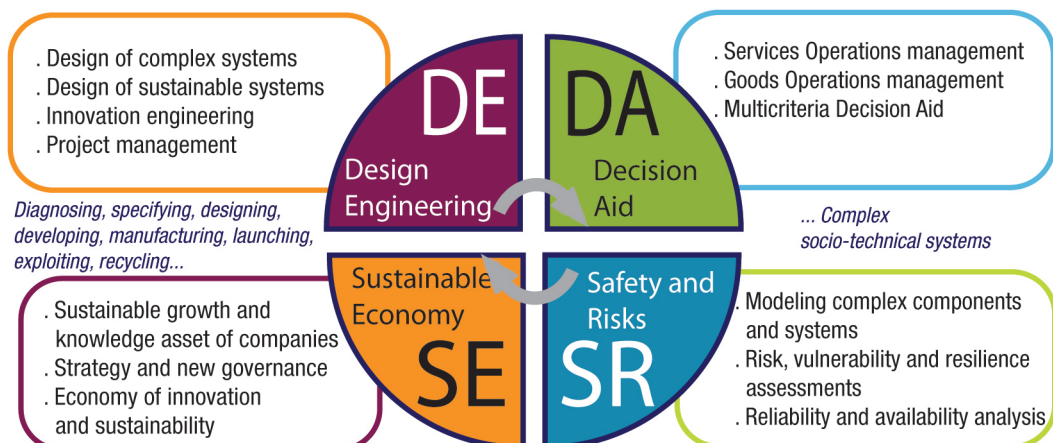
The goal of the Industrial Engineering (IE) Department (Laboratoire Genie Industriel, LGI) is to **develop models, methods and tools for diagnosing, specifying, designing, developing, manufacturing, launching, exploiting, recycling at best socio-technical systems**. These systems are industrial systems (production systems, value chains, eco-parks), complex products (airplanes, cars...), complex factories, transportation systems, health systems, energy networks, service systems and construction systems. Key principles of our research are: **multidisciplinarity, life-cycle thinking, societal issues, model-based engineering approaches**.

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...)
- a system feedback on its components and the emergence of macroscopic properties.



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. 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 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, design, validation, manufacture and market launch or startup), system management (its regulation, its maintenance, its failure modes, its upgrade), its dismantling and end of life.

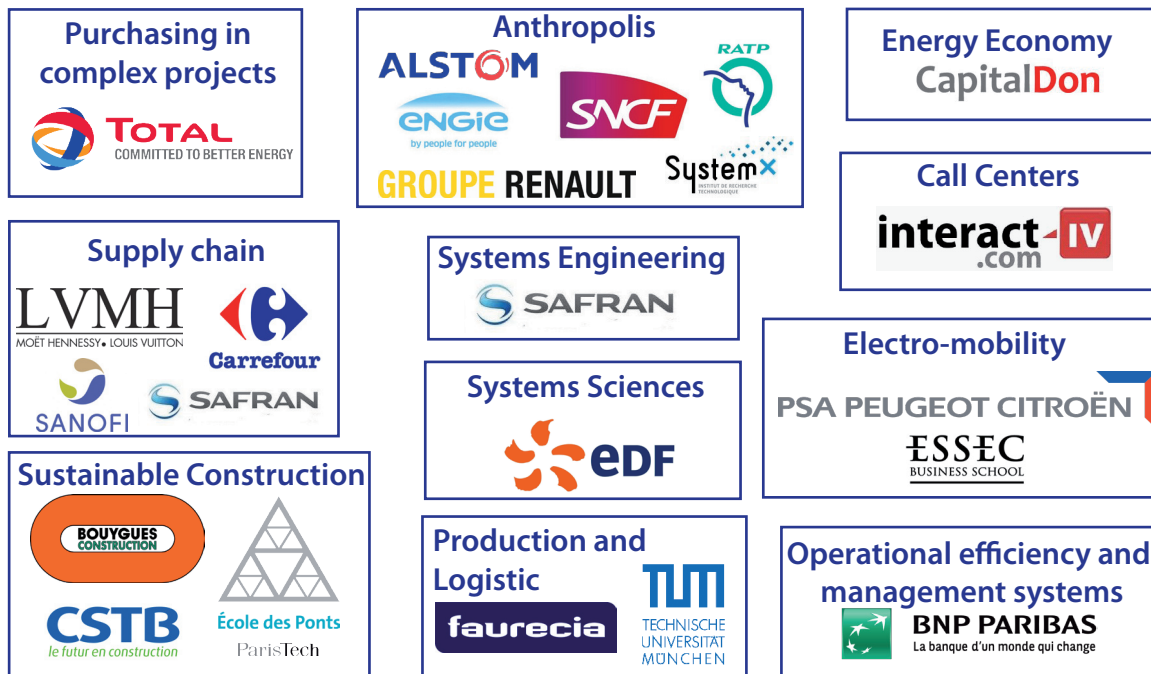


The 4 research Groups of the IE department and corresponding research topics

Eleven industrial chairs and two research institutes reinforce the 4 research groups.

The **11 industrial chairs** are about:

Sustainable Construction (Bouygues Construction), Operational Excellence (BNP Paribas), Production and Logistic (Faurecia), Supply Chain (LVMH, Sanofi, Carrefour, Safran), Electro-mobility (PSA Peugeot Citroën), Energy Economy (Capitaldon), Systems Engineering (Safran), Purchasing in complex projects (Total), Systems Sciences (EDF), Anthropopolis (Alstom, Engie, IRT SystemX, RATP, Renault, SNCF).



The 11 industrial Chairs associated with IE department, see <http://www.lgi.ecp/pmwiki.php/Chairs/HomePage>

The **two research institutes** for which the department is a founding member are: IRT System X (Digital Engineering of Complex Systems) and PS2E (Paris Saclay Energy Efficacy).



ACADEMIC PARTNERSHIPS

Europe: University of Stavanger-Norway, DTU-Denmark, University of Liverpool-England, Universidad Politecnica de Valencia-Spain, ETHZ-Switzerland, Politecnico di Milano, Aalto University-Finland, Magdeburg University-Germany, TU Munich, University of Bath-UK, Université de Louvain-Belgique

America: Northwestern University-Chicago, MIT, Penn State University, Georgia University of Technology, University of Minnesota, UFRJ-Brazil, PUC-Brazil

Asia: Beihang University-China, Ecole Centrale Beijing, City University-Hong Kong, Wuhan University of Technology-China, Chiba University-Japan

Africa: ENIT-Tunis, ENIM-Monastir

INDUSTRIAL PARTNERSHIPS

Air Liquide, BNP Paribas, Bouygues Construction, Capitaldon, Carrefour, CEA, Danone, Dassault Aviation, DHL, EADS, EDF, Eurodécision, Établissement Français du Sang, Faurecia, Hôpital Georges Pompidou, Hôpital Henri Mondor, IBM, Interact'IV, Lafarge, LVMH, Michelin, Place des Leads, PSA Peugeot Citroën, Renault S. A., Safran, Sanofi, Schneider Electric, Siemens, Total, Vallourec, Vaélo, Ville de Paris.



Our main research challenges address **modeling, analyzing, simulating and optimizing complex systems** (products, processes and organizations). The aim is to contribute to fostering innovation that will **facilitate economic, environmental and social transformation**. Research projects yield from industrial collaborations anchored in **action-based research**, starting by existing situation diagnosis, in order to propose an academically original and industrially relevant model. The validation and verification of the research is always completed with industrial deployment measuring its efficiency and effectiveness.

1. Design of complex systems aims at developing **methods and tools supporting decision-making** with regard to **design of products and organizations**. The focus is on enhancing numerical capabilities and simulation processes for preliminary and early design stages addressing **system architecture, system configurations, value engineering, trade space explorations, etc.** Design process modeling is therefore a critical issue organized around collaborative design, collaborative simulation, and technology and knowledge transfer.

2. Design of sustainable systems

consists in modeling, measuring and optimizing the environmental and sustainable performance of complex systems to promote and **deploy industrial ecology and circular economy**. We cover numerous sectors such as heavy industry (eco-designing energy stations or automotive recycling chains), building and construction (introducing user behaviors to simulate energy consumption) or innovative agrifood value chains.

4. Project management consists in **developing methods for managing complex design, engineering and infrastructure projects**, coping with relations between product, process and organization dimensions. A particular focus is made on modeling, analyzing and making decisions to **mitigate potential risks associated with complexity**.



27 members
2 research chairs
3 PhDs completed
12 journals
24 conferences

2 post-docs: Andreas Hein, Toufic Zaraket

Publications (selection out of 12 journal papers)

Design of complex systems	Jean, C, M Jankovic, J Stal-Le Cardinal, and J-C Bocquet. 2015. "Predictive Modelling of Telehealth System Deployment." <i>Journal of Simulation</i> 9 (2): 182–94. doi:10.1057/jos.2014.27.
	Sirin, Goknur, Christian J. J. Paredis, Bernard Yannou, Eric Coatanea, and Eric Landel. 2015. "A Model Identity Card to Support Simulation Model Development Process in a Collaborative Multidisciplinary Design Environment." <i>IEEE Systems Journal</i> 9 (4): 1151–62. doi:10.1109/JSYST.2014.2371541.
Design of sustainable systems	Gaha, Raoudha, Bernard Yannou, and Abdelmajid Benamara. 2015. "Selection of a Green Manufacturing Process Based on CAD Features." <i>The International Journal of Advanced Manufacturing Technology</i> , 1–9. doi:10.1007/s00170-015-7499-y.
	Ye, Yun, Marija Jankovic, Gül E. Kremer, Bernard Yannou, Yann Leroy, and Jean-Claude Bocquet. 2015. "Integration of Environmental Impact Estimation in System Architecture and Supplier Identification." <i>Research in Engineering Design</i> , 1–24. doi:10.1007/s00163-015-0208-x.
	Zaraket, Toufic, Bernard Yannou, Yann Leroy, Stéphanie Minel, and Emilie Chapotot. 2015. "An Occupant-Based Energy Consumption Model for User-Focused Design of Residential Buildings." <i>Journal of Mechanical Design</i> 137 (7): 074501. doi:10.1115/1.4030202.
Innovation engineering	Bekhradi, Alborz, Bernard Yannou, Romain Farel, Benjamin Zimmer, and Jeya Chandra. 2015. "Usefulness Simulation of Design Concepts." <i>Journal of Mechanical Design</i> 137 (7): 071412. doi:10.1115/1.4030180.
Project management	Jaber, Hadi, Franck Marle, and Marija Jankovic. 2015. "Improving Collaborative Decision Making in New Product Development Projects Using Clustering Algorithms." <i>IEEE Transactions on Engineering Management</i> 62 (4): 475–83. doi:10.1109/TEM.2015.2458332.

Collaborations

Academic collaborations

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

USA : University of Illinois at Urbana-Champaign, Northwestern University, Penn State University, Georgia University of Technology, University of Texas at Austin, Massachusetts Institute of Technology.

Europe : Erlangen-Nürnberg University (Germany), Technical University Munich (Germany), Norwegian University of Science and Technology, The Open University (UK).

Rest of the world : ENIM Monastir (Tunisia).

Invited Professors

Prof. Harrison Kim, *University of Illinois at Urbana-Champaign*

Prof. Andy Dong, *University of Sydney*

Associated industrial chairs

Sustainable Building and Innovation,
Bouygues Construction

Measure Procurement Risks in
Complex projects, Total

Associated research institutes

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

PS2E (Paris-Saclay Energy Efficacy),
<http://institut-ps2e.com>

Organization of...

Annual Workshop EcoSD
«The challenges of eco-innovation»
12 March 2015

Summer school EcoSD
Eco-design of complex systems
1-5 June 2015



Industrial and institutional collaborations



Our research networks



Useful links

Design Engineering Team website:
www.lgi.ecp.fr/pmwiki.php/Recherche/DesignEngineering
Master in Industrial Engineering,
specialization in Design Engineering
www.universite-paris-saclay.fr/fr/formation/master/genie-industriel





Decision Aid Research Group in 2015

Research

The *Decision Aid for Goods and Services' Systems* Research Group (DA) is composed of 27 members among which 8 faculty members, 3 post-docs and 16 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:

- Service Operations Management (Healthcare systems, Call centers, ...)
- Supply Chain Management (supply chain design and planning, cooperation and competition, flow and inventory management, green supply chain)
- 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,...



5 PhDs completed

Yu Cao «L'optimisation de l'approvisionnement dans des zones géographiquement lointaines»

Manel Maamar «Modélisation et optimisation bi-objectif avec anticipation d'une place de marché de prospects Internet: adéquation offre/demande»

Tengfei Nei «Optimisation du fonctionnement et coordination de contractualisation dans les chaînes logistiques avec prise en compte des éléments comportementaux»

Tairan Wang «Decision making and Modelling Uncertainty for the multi-criteria Analysis of Complex Energy Systems»

Yueru Zhong «Evaluation et gestion de la flexibilité dans les chaînes logistiques : nouveau cadre général et application»

Key figures in 2015

28 members
4 research chairs
5 PhDs completed
1 book
19 journals
17 conferences
h-index : 39 (WoS)
781 citations (WoS)

8 faculties: Chengbin Chu, Yves Dallery, Asma Ghaffari, Oualid Jouini, Vincent Mousseau, Wassila Ouerdane, Jakob Puchinger, Evren Sahin

17 PhD students: Khaled Belahcene, Hicham Benbitour, Amine Boudella, Maxime Claisse, Karim Ghanes, Oumeima Khaled, Siham Lakri, Guillaume Lamé, Jinyan Liu, Shouyu Ma, Ouail Maghraoui, Jing Peng, Manel Maamar, Massinissa Mameri, Olivier Sobrie, Zhe Yuan, Lei Zhao

3 post-doctorates: Omar El Rifai, Benjamin Legros, Bahman Rostami-Tabar



Publications (selection out of 19 journal papers)

- R. Bisdorff, L. Dias, P. Meyer, V. Mousseau, M. Pirlot, «Evaluation and decision models with multiple criteria: Case studies», 643 pages, Springer, 2015.
- M. Sali, E. Sahin, A. Patchong, «An empirical assessment of the performances of three line feeding modes used in the automotive sector: line stocking, kitting, sequencing», International Journal of Production Economics, 2015, Volume 53, issue 5, pp 1439-1459.
- J. Feng, A. Che & C. Chu, «Dynamic hoist scheduling problem with multi-capacity reentrant machines: A mixed integer programming approach», Computers & Industrial Engineering, 2015, 87, 611-620.
- O. Jouini, Z. Aksin, M.S. Aguir, F. Karaesmen and Y. Dallery. Call Center Delay Announcement Using a Newsvendor-Like Performance Criterion. Production and Operations Management, 24:587-604, 2015.
- S. Deparis, V. Mousseau, M. Ozturk, C. Huron, «The effect of bi-criteria conflict on matching-elicited preferences», European Journal of Operational Research, 242(3) 951-959, 2015.
- B. Legros, O. Jouini, G. Koole. «Adaptive Threshold Policies for Multi-Channel Call Centers». IIE Transactions, 47: 414-430, 2015.
- E. Sahin, A. Matta, «A contribution to operations management-related issues and models for home care structures», International Journal of Logistics Research and Applications, 2015, Volume 18, Issue 4, pages 355-385.
- A. Che, J. Feng, H. Chen & C. Chu, «Robust optimization for the cyclic hoist scheduling problem», European Journal of Operational Research, 2015, 240, 627 - 636.

Collaborations

Academic collaborations

France : Université Paris Dauphine, Telecom Bretagne.

USA : University of Minnesota,

Europe : Université de Mons (Belgique), Poznan University of Technology, (Pologne), Politecnico di Milano (Italy), University of Catane (Italy), VU University Amsterdam (The Netherlands), University of Coimbra (Portugal), Université du Luxembourg (Luxembourg), Koç University (Turkey)

Rest of the world : ENIT Tunis (Tunisia), SUTD (Singapore).

Invited Professors

Ozgur Ozpeynirci, Department of logistics Management, Izmir University of Economics, Turkey

Selin Ozpeynirci Industrial Engineering Department, Turkey

Simon Parsons, University of Liverpool, Grande-Bretagne

Marc Pirlot, Université de Mons, Belgique

Associated industrial chairs

Supply Chain Carrefour, LVMH, Safran, Sanofi

Manufacturing and Logistic Chair, Faurécia

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

Call Centers, Interact'IV

Associate editors

Eur. Jour. of Decision Processes, IMA Journal of Management Mathematics; Supply Chain Forum, an International Journal

Editorial boards

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

Industrial and institutional collaborations



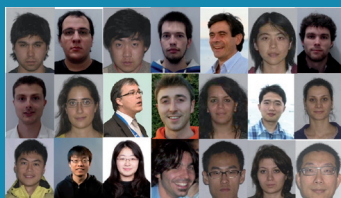
EURODECISION
OPERATIONAL RESEARCH



Our research networks



Best paper award CIE45:
M. Claisse, Z. Jémaï & C. Chu
for the paper
«Production order quantity under
uncertainties and forecasts update:
optimal control quantity using sto-
chastic dynamic programming»



Safety and Risks Research Group in 2015

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, simulation and optimization 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.



4 PhDs completed

Y. Fang «Critical infrastructure protection by advanced modeling, analysis and optimization for cascading failure mitigation and resilience»

J. Liu «Failure prognostics by support vector regression of time series data under stationary/non-stationary environmental and operational conditions»

R. Mena «Risk-based modeling, simulation and optimization for the integration of renewable distributed generation into electric power networks»

T. Wang «Decision making and modelling uncertainty for the multicriteria analysis of complex energy systems»

4 faculties: Yanfu Li, Nicola Pedroni, Antoine Rauzy, Enrico Zio

16 PhD students: Benjamin Aupetit, Tasneem Bani-Mustafa, Yiping Fang, Fangyuan Han, Mélissa Issad, Siwar Kriaa, Benoît Lebeaupin, Anthony Legendre, Yanhui Lin, Xing Liu, Chung-Kung Lo, Muxia Sun, Pietro Turati, Tairan Wang, Zhiyi Wang, Jinduo Xing

4 post-docs: Elisa Ferrario, Elizaveta Kuznetsova, Jie Liu, Rodrigo Mena

1 engineer: Loic Peletan

2 visiting PhD students: Shanshan Fu, Huadong Mo



Publications (selection of 7 out of the 30 journal papers published)

Energy network systems	Fang Y.-P., Pedroni N., Zio E. (2015). Optimization of cascade-resilient electrical infrastructures and its validation by power flow modelling. Risk Analysis, V. 35 (4), pp. 594 – 607.
	Ferrario E., Pedroni N., Zio E. (2015). Analysis of the robustness and recovery of critical infrastructures by Goal Tree Success Tree – Dynamic Master Logic Diagram, within a multi-state system-of-systems framework, in the presence of epistemic uncertainty. ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems, Part B: Mechanical Engineering, V. 1 (3), pp. 14.
	Kuznetsova E., Ruiz C., Li Y.-F., Zio E. (2015). Analysis of robust optimization for decentralized microgrid energy management under uncertainty. International Journal of Electrical Power and Energy Systems, V. 64, pp. 815 – 832.
Aging and failure processes in components of energy production plants	Ak R., Vitelli V., Zio E. (2015). An interval-valued neural network approach for uncertainty quantification in short-term wind speed prediction. IEEE Transactions On Neural Networks and Learning Systems, Vol. 26 (11), pp. 2787 – 2800.
	Lin Y.-H., Li Y.-F., Zio E. (2015). Integrating random shocks into multi-state physics models of degradation processes for component reliability assessment. IEEE Transactions on Reliability, V. 64 (1), pp. 154 – 166.
	Liu J., Vitelli V., Zio E., Seraoui R. (2015). A novel dynamic-weighted probabilistic support vector regression-based ensemble for prognostics of time series data. IEEE Transactions on Reliability, Institute of Electrical and Electronics Engineers, V. 64 (4), pp. 1203 – 1213.
Dependable embedded systems	Rauzy A. (2015). Towards a sound semantics for dynamic fault trees. Reliability Engineering & System Safety, V. 142, pp. 184 – 191.

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, National University of Singapore, North China Electric Power University, Wuhan University of Technology and others.

Invited professors:

Yang Wang, China
Datian Zhou, China

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:

Paris-Saclay Efficacité Énergétique (PS2E), <http://institut-ps2e.com/>
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:

4th PhD School on “Vulnerability, Risk and Resilience of Complex Systems” co-organized by CentraleSupélec and Politecnico di Milano, 14-18 September 2015 at CentraleSupélec, Chatenay-Malabry, France.

International workshop:

International mini-symposium: “Advanced Simulation Methods for Probabilistic Analysis of Complex Engineering Systems”, at the 12th International Conference on Applications of Statistics and Probability in Civil Engineering ICASP 12, Vancouver, Canada, July 12-15, 2015.

International conferences:

Information and Digital Technologies 2015, July 7-9, 2015, Zilina, Slovakia.

Quality, Reliability, Risk, Maintenance, and Safety Engineering (QR2MSE 2015), July 21-24, 2015, Beijing, China.

European Safety and Reliability ESREL 2015, September 7-10, 2015, Zurich, Switzerland.

Industrial and institutional collaborations



Our research networks



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Sustainable Economy Research Group in 2015

Research

‘Sustainable Economy’ (previously known as ‘épocc’) research aims at articulating economics and managerial issues taking into account both macro and microeconomic levels; and within the scope of sustainability and innovation.

The research is articulated around two major directions:

1) **New Models of Economic Growth and Firms’ Organization**: Here we prioritize modelling of sustainable complex systems (related to energy, management of mineral resources, climate change and other natural resources, economics of growth based on innovations, economics of electro mobility...) in order to propose optimal paths of sustainable growth and to manage in the optimal way the knowledge assets of firms. The methods that are used are quantitative with the optimal control and stochastic modelling, or qualitative with the global value chains approach, etc. After this step of modelling and diagnosing: the question is now HOW to implement such new models of growth into organizations and sectors? This is in line with the second direction.

2) **Regulation and Governance of Firms and Organizations**: Developing empirical methods for management and working on the properties of incentives and managerial economic tools (level and dynamic, recycling, etc.) for firms and sectors transformation. This direction deals with the issues of innovation incentives and fiscal constraints, public economics and theory of externalities, the strategy and innovation economics, the design of recycling systems, etc. It implies to the well know the characteristics of agents (firms and consumers) and the technologies they use in order to design tools, prices and methods for the ‘decentralization’ of the optimal results the first line above. In order to do so, ‘Sustainable Economy’ team members collaborate with both academic and economic institutions : for example firms that innovate radically in the sectors of energy are natural playgrounds for our studies...



2 Phds completed

W. Tian, «Energy Transition and Carbon Inequality: Prospective analysis of technology roadmaps for China, France and the United States of America».

H. Idjis, «The recovery network of end-of-life batteries from electric vehicles. Contribution to the modeling of an emerging complex organizational system», PSA.



7 Faculties

D. Attias, J.C. Bocquet, P. Da Costa, A. Minzoni, S. Mira-Bonnardel, E. Mounoud, M. Senouci.

7 PhD Students

C. Cany, Y. Chen, M. Dernis, M. Leurent, R. Molinier, J. Pigneur, W. Tian.

1 Post-Docts

H. Idjis.



Highlights:

First article published by Yurong (Phd Student in the team) in The International Journal of Robust and Nonlinear Control : Yurong Chen with M.J. Carrizosa et al. Nonlinear Control of Multi-Terminal VSC-HVDC Systems Based on Control Induced Time-Scale Separation with «Plug and Play Property».

Enlargement of the Team with the association of the new researcher : Y. Chen, S. Mira-Bonnardel and I. Nicolai

The partnership with VEDECOM (mobility issues) and the scheduled arrival of 2 post-docs.

Collaborations

Scientific Network:

England: London School of Economics and Political Science: monthly workshops on Energy Economics.

Japan: Research Institute of Innovative Technology for the Earth (RITE).

France: Strate College, ESSEC, CEA Saclay, Paris School of Economics, University of Montpellier, Toulouse Business School, PS2E Paris Saclay: Institute of Energy Efficiency, Club de l'Orme: the energy experts of Paris Saclay...



Member of:

- SFM, AIMS, AFSE, EAERE, FAERE, FAEE...
- International Scientific Committee of the Conference on the European Energy Market...



3 Chairs:

2 Research Chairs:

Chair Operational Efficiency by BNP Paribas.



BNP PARIBAS
La banque d'un monde qui change

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



PSA PEUGEOT CITROËN

1 Patronage: by endowment fund CapitalDon on Sustainable Growth.

CapitalDon

Organisation of

International Conference: "Electromobility : Challenging Issues - Chair Armand Peugeot", 1-4 december 2015, Singapore.

Workshop 4th Edition: "New Mobility : issues and answers of public policies", 25 juin 2015, ESSEC, France.

Our 11 industrial chairs and 2 partner research institutes

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



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.

Chair Bouygues Construction « Sustainable Construction and Innovation »



Bernard Yannou

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Infos:

The chair started in Sept 2010 and ended at August 2015.

In addition to the chair holder, the chair is composed of a researcher, a Ph.D. doctorate, a post-doctorate and several M.Sc. students in internships.

The Chair « Sustainable Construction and Innovation » aims at modeling domestic activities in households of residential type. A so-called SABEC model (« Stochastic Activity-Based approach of occupant-related Energy Consumption ») is developed to model parametric envelopes of energy and water consumptions issued from occupants' activities, starting from family features (number, people age/gender/occupation, sociological features). A simulation platform allows to compare different household occupants profiles so as to (a) simulate robustness of consumptions regarding variability of occupants patterns, (b) generate more precise Energy Performance Contracts, (c) test the influence of some pre-installed technical solutions, (d) obtain good heat estimation for as entries of Thermo Dynamic Simulations.

Models of « Memories (consumption and uses) of a building » have also been proposed in view of the advent of connected buildings to the service of users, building managers and builders.



In addition to CentraleSupélec, two other partners contribute to conduct the research: Ecole des Ponts ParisTech and Centre Scientifique et Technique du Bâtiment (CSTB).

The chair with its 3 partners covers 5 research topics: (1) Occupants' Usage, (2) Life Cycle Assessment of Buildings, (3) Control and Energy Efficiency, (4) Digital Mockup of Existing Buildings, (5) Innovative Materials and Structures.

LGI leads topic (1) and participates to topic (2).

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



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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.



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 two 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



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



Supply Chain Chair



Yves Dallery
Supply Chain Chair
Director
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Chair team
- Laurent Grégoire
Head of Enterprise Partnership
- Zied Jemai
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

Associated universities and 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).



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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.



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.



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



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



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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.



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 sustainability.

Operational efficiency and management systems

Chair Holders :



Angela Minzoni (angela.minzoni@centralesupelec.fr) ,



Eléonore Mounoud (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.



The chair is jointly operated with BNP Paribas



BNP PARIBAS
La banque d'un monde qui change

Paris-Saclay Energy Efficiency institute PS2E

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Infos:
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PS2E is an Institute for energy transition devoted to the efficiency and flexibility of factories and urban areas. CentraleSupélec is one of the nine founding members. The LGI (DE, SR, SE teams) is actively involved in several of its programs: Eco-industrial parks, Energy flexibility, Heat networks, Audits and metrics.



Collaboration with PS2E involves 4 permanent researchers of LGI, supports 2 full-time postdocs and provides annually research internship subjects to Master students.



The Technological Research Institute SystemX (IRT SystemX)

Bernard Yannou, Jakob Puchinger, Marija Jankovic, Julie Le Cardinal, Jean-Claude Bocquet

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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.



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.



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