



ORGANIZED BY ECOSD NETWORK

This summer school is open to 20 people from EcoSD network and the Design Society. It is supervised by Pr. Bernard Yannou, administrator of EcoSD and member of the Design Society.

ECOSD

EcoSD (Eco-conception de systèmes durables, standing for Eco-design of Sustainable Systems) Network is a French association with the objective of **encouraging collaboration between academic and industrial researchers** in order to create and spread **advanced knowledge in eco-design** fields. This initiative aims at helping a global sustainable development process at national and international scales.



ORGANISERS

This summer school is hosted by Ecole Centrale Paris and co-organised by **Ecole Centrale Paris, Supmeca and AgroParisTech**, three French "Grandes Ecoles". It is validated by the doctoral school "Engineering Sciences" (Sciences pour l'Ingénieur) of Ecole Centrale Paris (Doctoral School # 287).



TEACHING STAFF

- Gwenola Bertoluci (assistant professor at AgroParisTech)
- François Cluzel (assistant professor at Ecole Centrale Paris)
- Romain Farel (Research Program Director, PS2E Institute)
- Yann Leroy (assistant professor at Ecole Centrale Paris)
- Benjamin Tyl (PhD, research engineer at Apesa)
- Flore Vallet (assistant professor at Université de Technologie Compiègne)
- Bernard Yannou (professor at Ecole Centrale Paris)
- Pierre-Alain Yvars (associate professor at Supmeca)
- Research program manager (to be defined) of PS2E Institute (www.institut-ps2e.com)



PREREQUISITES

A basic knowledge of eco-design and Life Cycle Assessment is needed.

OBJECTIVES

Eco-designing products and services is already a hard and often ill-defined task since it involves both lifecycle modelling and multi-criteria decision analysis. But eco-designing complex systems is still harder for many reasons. **This doctoral workshop aims at both defining the industrial and scientific issues of eco-designing complex systems** – products, services, plants, socio-technical systems – and presenting practical solutions for modelling, simulating, optimising and making decisions on the best solutions in the design stage.

Our understanding of a complex industrial system is:

- A large-scale system (high number of subsystems and components, mass and resources);
- With a hardly predictable life cycle (lifetime, upgrades, maintenance, end-of-life...);
- Whose subsystems may have different life cycles and lifetimes;
- In close interaction with its environment (super system, geographic site...);
- Supervised by human decisions and management.

Some examples of such complex systems, which are taken all along the doctoral workshop, are:

- Eco-design of an electrical substation of an aluminium plant (9,000 tonnes of metal and concrete lasting 30 to 40 years, costing 80 million Euros, with few idea on how to recycle it);
- Eco-design of food packaging providing the multiple usage conditions and recycling facilities of countries;
- Eco-design of a value chain for recycling automotive glazing;
- Eco-optimisation of a navy shuttle.

The complex systems are dealt through several perspectives:

- Life-Cycle Assessment
- User behaviour modelling
- Technico-economic value networks
- Design and performance optimisation
- Eco-ideation and eco-innovation

This doctoral training alternates theory and practice. More than half of the time is spend on case studies, where participants are asked to apply proposed methodologies and tools, and research workshops, where they are asked to speak about their research issues.

CONTENT

1. INTRODUCTION

This first module introduces **complexity in eco-design** and a brief presentation of participants' issues. Participants are asked to prepare 2 slides on the "complex system" issues they consider to have.

2. CONCEPTS & METHODS FOR ECO-DESIGNING COMPLEX SYSTEMS

Pr. Bernard Yannou makes an **overview of concepts** which are addressed by eco-designing complex systems and **suitable methods of design engineering**.

3. ECO-COMPLEXITY OF AGRIFOOD CHAINS

Dr. Gwenola Bertoluci proposes an overview of the **complex case of agrifood chains** as a way to introduce the stakes of LCA perimeters, economic value models, health and environmental trade-offs.

4. DESIGN FOR USER IMPACT

Pr. Bernard Yannou focuses on issues dealing with **user behaviour modelling** and its impact in eco-design, notably through the example of modelling user behaviour in energy systems.

5. LIFE CYCLE ASSESSMENT OF COMPLEX SYSTEMS

Dr. Yann Leroy and Dr. François Cluzel make a focus on Life Cycle Assessment (LCA) for complex systems. The challenges are here to define a **relevant study perimeter** (e.g. functional unit) and to deal with **data and life cycle uncertainties**. The art of defining probabilized life cycle scenarios is discussed.

6. VALUE NETWORKS OF COMPLEX SYSTEMS

Dr. Romain Farel makes a lecture on value networks of complex systems. The objective of this workshop is to give the participant a **step by step method for designing value chain** from scratch for multi-stakeholder industrial systems.

7. ECO-OPTIMISATION OF COMPLEX SYSTEMS

Dr. Pierre-Alain Yvars proposes a half-day module on eco-optimisation of complex systems. The purpose is to show how to take into account early and various types of requirements in the design process of complex systems to allow **early architecture generation and pre-sizing early simulations of performances**. The techniques used are set-based design tools and methods.

8. ECO-INNOVATION OF COMPLEX SYSTEMS

Dr. Flore Vallet, Dr. Benjamin Tyl and Dr. François Cluzel make a survey on **eco-innovation methods and tools**. Often used within particular development projects, they also show how to use it for **managing product and R&D projects portfolios**.

9. DESIGN OF INDUSTRIAL ECO-PARKS/ DEBATE ON RESEARCH INTO INDUSTRIAL ECOLOGY

Energy is definitely a crucial economical and technical issue for sustainability. It is now required to think in term of energy clusters: at a local level (a dwelling, a flat), at a medium level (eco-district, industrial area), or at a regional level (city, country). **Designing so-called eco-parks** requires sophisticated modelling methods, multidisciplinary simulations, and to take into account social and economic aspects. These issues are presented by a research program manager of PS2E Institute, who further will animate a **debate on which research issues are raised by this industrial ecology stake**.

10. RESEARCH WORKSHOP

The participants are asked to **re-analyze their research issues on complex systems** to the light of the summer school and the bibliographical material provided. Participants are also asked to **propose research leads and a clear roadmap** which are discussed by the group and teachers. A synthesis booklet of the research workshop is finally produced.

	Monday 2 June	Tuesday 3 June	Wednesday 4 June	Thursday 5 June	Friday 6 June
Morning 1	Welcome, introduction, and your research issue	Design for user impact	Value networks of complex systems	Eco-innovation of complex systems	Design of industrial eco-parks
Morning 2		LCA of complex systems	Case Study on designing a recycling chain		Debate on research into industrial ecology
Afternoon 1	Concepts & methods for eco-designing complex systems	Case study on evaluating impacts of a mass-consumer product	Eco-optimisation of complex systems	Case study on designing an eco-event	Research workshop
Afternoon 2	Eco-complexity of agrifood chains		Case Study on eco-optimising navy shuttles		
			Social Event	Personal homework	

TEACHING MATERIAL

All participants will receive:

- The lecture presentations in PDF format;
- A bibliographical list of major scientific publications in relation to each module;
- A synthesis booklet of the research workshop including the contributions of all participants (established a few days afterwards).

Language: English.

ORGANISATION

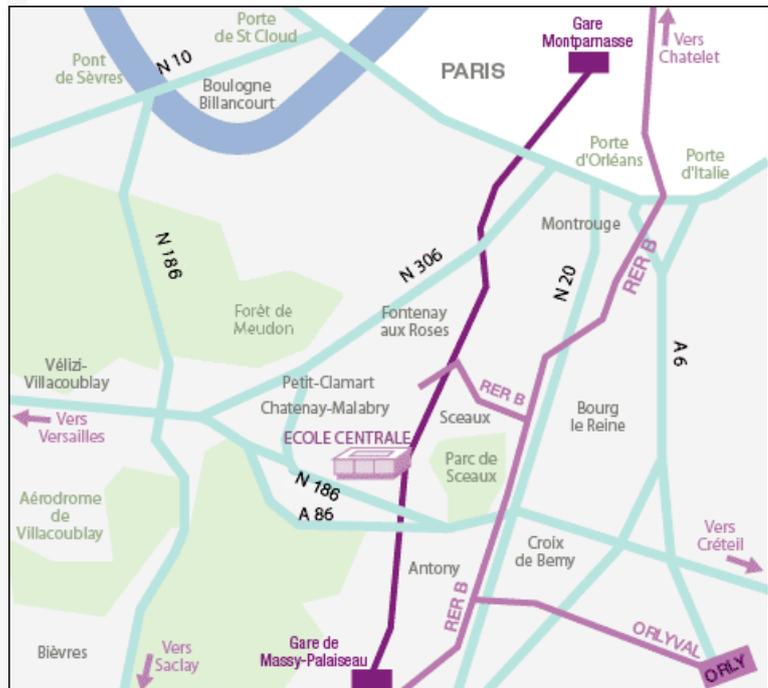
Number of participants:

- 15 participants maximum for EcoSD members or members of the doctoral school of Ecole Centrale Paris
- 5 participants maximum for Design Society members

Location: Laboratoire Genie Industriel, Ecole Centrale Paris, Chatenay-Malabry, France. The school is located 10km to the south of Paris. Access is detailed here:

http://www.ecp.fr/lang/en/home/access_plan

The training is free of charge. Meals and accommodation are the responsibility of participants. A social event is organized on Wednesday evening in a restaurant (offered by EcoSD).



MORE INFORMATION

Please visit our webpage to get more information on this training and possible local accommodation:

<http://www.lgi.ecp.fr/pmwiki.php/Formations/CDEEcoSD>



REGISTRATION & CONTACT

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USEFUL LINKS

Ecole Centrale Paris: www.ecp.fr

• Laboratoire Genie Industriel: www.lgi.ecp.fr

Supmeca: www.supmeca.fr

AgroParisTech: www.agroparistech.fr

EcoSD: www.ecosd.fr

