

# RESEARCH & INNOVATION FRANCE

Nadine GRALL – Recruitment and schools,  
universities relationships – R&I France  
direction

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April 11th April





## R&I FRANCE

- Driven by sustainability & social responsibility use cases,
- we explore the future of industries with 8 R&I Programs,
- that federate 100+ internal or collaborative projects.
- 200 full-time PhD experts, who carry out the projects and coordinate the expertise of more than 1000 engineers each year & publish research results (+ 100 publications per year)







# 8 RESEARCH PROGRAMS

## Future of mobility



*Environmental footprint  
Autonomous & Intelligent Systems  
User experience*

## Future of Energy



*Optimize conventional energy units  
Imagine intelligent systems for energy  
Energy transition & green energy*

## Future of healthcare



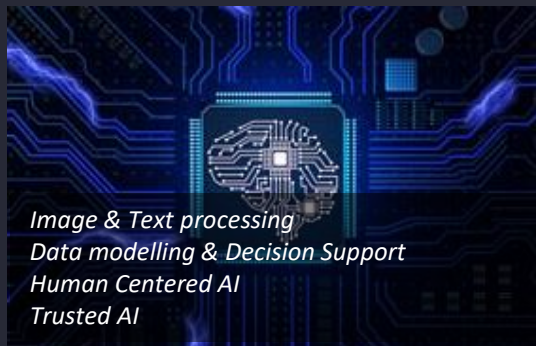
*« 4P » Medicine  
Disruptive technologies  
Multidisciplinary co-design*

## Future of Industry



*New tools, process, technologies  
Make factory more responsible  
Manage the performance of the factory*

## Applied AI



*Image & Text processing  
Data modelling & Decision Support  
Human Centered AI  
Trusted AI*

## Future of Engineering



*Extended System Engineering  
Performance Engineering  
Physical & Multi-physical*

## Future of Networks & Compute



*Data knowledge extraction  
5G & IoT  
IT Protection & Virtualization*

## Future of people at work



*Towards a socially responsible company  
Employee centered management  
Agile project management*



# PROJECTS EXAMPLES



## SISTER

How to design, more reliable, safer and cheaper solutions for hydrogen storage, whatever the production mode and the field of application ?



## MIND & ACT

How can brain-computer interfaces (BCI) support the future of Industry and Healthcare?



## E-COCKPIT AI

Perception refers to the ability of a given system to collect information using a set of sensors and then extract relevant knowledge from the environment.



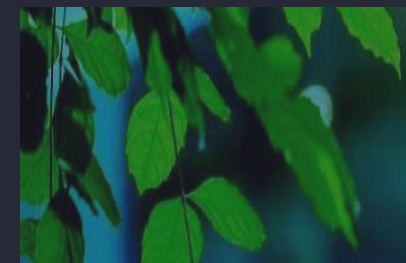
## MODINS

How to support and optimize Maintenance Repair & Operation on industrial sites?



## INSIDE

How to use biomimeticism to develop and design smart and automated aerodynamic systems for road transport ?



## DEEFI

How to implement circular economy in companies and territories?





“

Our mission :  
Bring values

”







## A MISSION IN 3 MAIN AXES

- Build R&I Partnerships
- Provide R&D enablers for innovation purpose
- Recruit & train tomorrow experts  
(recruitment of +100 PhDs per year)

Contribute to the transformation of our partners from research & innovation phases to scaling.





## PARTNERSHIP

# Capgemini Engineering to address ecodesign of plastic wastes collector ships with the EcoPlex consortium.

Program : Future of Industry | Project : EEE

### Partnership ambitions

EcoPlex (Ecodesign of complex ships) consortium involves 7 industrial/academic partners (Obeo, Efinor, Stirling Design, Manta Innovation, The SeaCleaners, LS2N-CNRS and Capgemini Engineering) for the development of an ecodesign tool in order to manufacture sustainable plastic waste collector ships. Capgemini Engineering is working on the coupling of Model-Based System Engineering (MBSE) and Life Cycle Assessment (LCA) methodologies for the development of this ecodesign tool.

### Capgemini involvements

- *Development of unique tool with the coupling of LCA and MBSE*
- *LCA of the ships,*
- *Highlight of the ship parts with main environmental impact*

### Capgemini expertises

- *Life Cycle Assessment (LCA)*
- *Model-Based System Engineering (MBSE)*





## Capgemini Engineering to work on the development the next generation of brain computer interface to support operators in their dangerous interventions.

Program : Future of Healthcare | Project : Mind&Act

### Partnership ambitions

The future of prevention at work Explore needs and work environments and propose a BCI to support the next generation of safety at work tools such as monitoring stress, cognitive load or vigilance, to prevent human errors in dangerous and/or complex industrial or operational settings.

### Capgemini involvements – in close proximity with operational partner' teams

- *Explore work environments and risky situations*
- *Design associated protocol experiments and neurophysiological data collection*
- *Develop, test and optimize adapted algorithmic solutions*
- *Prototype and test associated Brain-Computer Interface*

### Capgemini expertises

- *Cognitive neuroscience and neuroimaging techniques (Experimental methods & data acquisition)*
- *Machine Learning and Signal Processing*
- *Embedded systems*







## • Train Léger Innovant

- **Coût global du projet** : 90 M€
- **Durée** : 51 mois
- **Localisation de la R&D** : France
- **Localisation de la production** : France

Le consortium du projet TRAIN LEGER INNOVANT, mené par SNCF avec un ensemble de partenaires de premier rang, propose une démarche inédite pour faire émerger les innovations nécessaires pour construire un système ferroviaire modulaire et frugal adapté aux lignes de desserte fine du territoire.

Ce nouveau système ferroviaire complet s'appuie sur un train léger innovant et une approche de l'infrastructure adaptée, pour une exploitation simplifiée, économique et performante. La nouvelle plateforme de matériel roulant intégrera des briques techniques formant un ensemble optimisé, sans compromis sur la sécurité : des aménagements intérieurs adaptés, une cabine de conduite digitale, une liaison au sol garantissant confort et faible usure de la voie, une motorisation à faibles émissions et une intégration des technologies du train autonome.

L'approche système du projet comprendra également la signalisation et le contrôle-commande, la surveillance de l'infrastructure et du matériel roulant. Elle sera mise en œuvre à court terme sur une ou plusieurs lignes et un train laboratoire. Pour maximiser le potentiel industriel du projet, le consortium met en œuvre une démarche d'innovation sur un calendrier serré, offrant deux ans après le démarrage du projet un panel de solutions potentielles qu'il peut ensuite proposer en conditions réelles dans des territoires d'expérimentation ayant confirmé leur intérêt :

- **Phase 1, 2022-2024** : études et démonstrations sur maquettes
- **Phase 2, 2024-2026** : réalisation d'un démonstrateur train léger

L'échéance de mise en circulation de ce nouveau système ferroviaire est prévue à l'horizon 2029.

L'objectif est de **réduire de 30% les coûts totaux** du système pour une desserte donnée.

## ○ **Partenaires :**



# ICMLT: Exploratory study of battery aging analysis with machine learning models to complete multi-physical ones for more adaptable systems

Machine Learning

Lithium Ion batteries

Supervised learning

Open data

Capgemini proposes an exploratory study designed to estimate the State of Health (SoH) of lithium-ion batteries.

This study highlights the various models used to find the State of Health of a battery and shows that these models do not consider the actual use of the battery and do not include contextual information. It also shows that artificial intelligence models have not been applied to our specific situation of using only easy-to-measure values such as the Voltage, Current and Temperature.

Hence, this study will focus on exploring a vast number of Machine Learning algorithms in order to find the most suitable ones.



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Scientific book chapter

# Springer Nature: A comprehensive study on 5G: RAN architecture, enabling technologies, challenges and deployment

5G

Radio Access Network

Virtualization techniques

Network slicing

Capgemini proposes a relevant and complete survey on the 5G eco-system.

This survey highlights the most cited 5G projects, the most stable HW and SW developed for 5G R&D, the challenges and the issues on the key enabling 5G technologies: RAN, SDN (software-defined networking), NFV (network function virtualization), network slicing and edge computing.

This survey studies in-depth the various 5G architectural frameworks deployed by 5G Telecom stakeholders and validated by standardization institutes for public and private 5G networks.



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## Conference paper:

Hydrogen vehicle solar: This work aims to study the modelling and the feasibility of a new type of hybridization between fuel cells, photovoltaic panels and Li-ion batteries.

Fuel cell

Battery

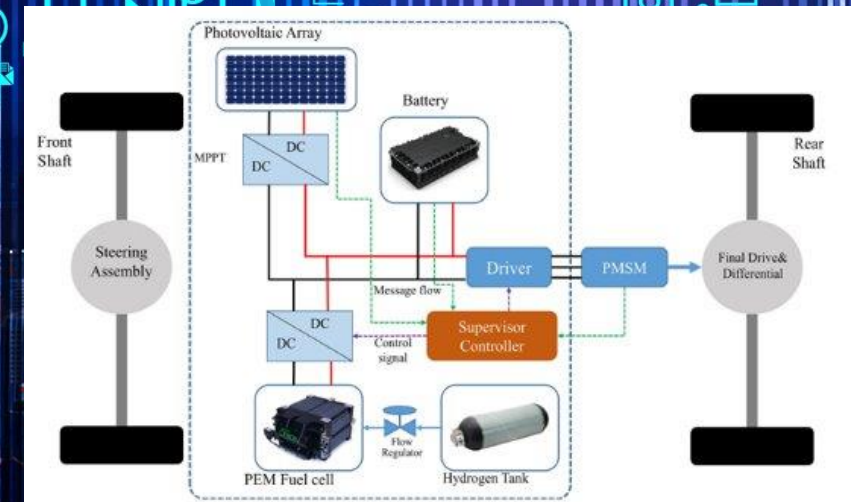
Photovoltaic

Dimensioning/Sizing,

EMS, Simulation

Hybridization

The paper is mainly focused on the dimensioning of the fuel cell hybrid electric vehicle and development of an energy management strategies using Matlab/Simulink platform. The main objective was to study the integration of photovoltaic panels in the fuel cell hybrid electric vehicle and to propose an optimal sizing for the available power sources. The obtained results have been compared with that of Toyota Mirai. It has been observed that the proposed model is efficient in terms of hydrogen consumption (0.58kg/100 km) as compared to that of Toyota Mirai (0.76kg/100 km).



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# Magnetic cooling: Study of the magnetic entropy change of $\text{SmNi}_{3-x}\text{Fex}$ intermetallic compounds using Maxwell's relation and the phenomenological model

Magnetic cooling

Phases transitions

Phenomenological model

Intermetallic compounds

Capgemini offers a relevant and comprehensive study on the magnetic cooling system.

In this paper, we investigate the crystal structure and the magnetic and magnetocaloric properties of  $\text{SmNi}_{3-x}\text{Fex}$  intermetallic compounds using a phenomenological model based on Landau's mean field theory and Maxwell's relation.

The phenomenological model is in good agreement with the experimental method.

The phenomenological model used in this study allows a rapid characterization of the magnetocaloric effect. The  $\text{SmNi}_{3-x}\text{Fex}$  compounds were prepared under high purity argon by arc melting. Structural, magnetic and magnetocaloric studies show that these compounds are candidate for magnetic cooling based on a small amount of rare earth.



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# OUR we.lab NETWORK

Our we.labs are innovation labs, open spaces for meeting and collaboration where we experiment with **new working methods**, disruptive technologies and **co-create new concepts**.

We break down silos to **innovate differently** with all Capgemini Engineering players and its ecosystem.





# OUR we.lab : A NETWORK OF 8 INNOVATION SPACES

Our we.labs are innovation labs and open spaces for meeting and collaboration where we experiment with **new working methods**, **disruptive technologies** and **co-create new concepts**. We break down silos to **innovate differently** with all Capgemini Engineering players and its ecosystem.

## OUR MISSIONS

### #DISCOVER

*Promote our projects and assets, both internally and externally, through special events*

### #CONNECT

*Create connections, sources of new collaborations through visits and events for our partners and collaborators*

### #INNOVATE

*Co-create to go from idea to prototype through workshops dedicated to co-creation and spread a culture of innovation*

### #TRANSFORM

*Improve the employee experience by stimulating collective intelligence and different ways of working*

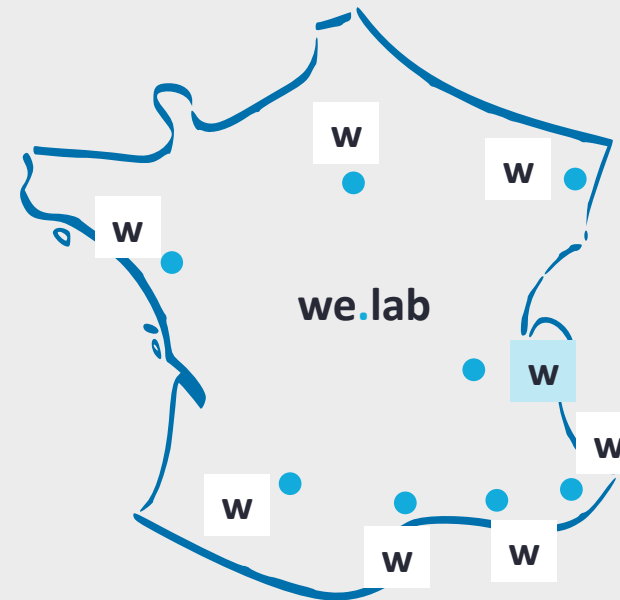
## OUR SERVICE OFFER

WORKSHOP FACILITATION

PROTOTYPING

SHARE EXPERIENCES

INNOVATION BOOSTER



we.lab Meudon

we.lab Strasbourg

\*we.lab Lyon (no physical place)

we.lab Sophia

we.lab Aix-en-Provence

we.lab Montpellier

we.lab Toulouse

we.lab Nantes



**GET THE  
FUTURE  
YOU WANT**

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