

BOOK
LE **Innovations**

INTRODUCTION

To address the technological and societal challenges of each era, engineering has always relied on its ability to innovate, particularly in the design, study, or construction of structures, equipment, or products.

Regardless of the field where SEGULA Technologies operates - Automotive, Aeronautics, Energy, Naval, Rail, or Oil and Gas - our group's DNA is to find solutions to bring these projects to life and support their implementation as competitively as possible. Therefore, we naturally place innovation at the core of our development strategy and growth dynamics.

In highly competitive markets, our clients must innovate rapidly. To assist them, we are constantly a source of permanent proposals for innovative solutions, relying on:

The efficiency of our organization: our Research and Innovation (R&I) is located at the heart of our agencies, close to clients and operational teams, and is essential for understanding our clients' needs. This proximity also allows collaboration with SMEs, start-ups, laboratories, and competitiveness clusters, promoting cross-fertilization and creativity.

The talent of our engineers and the passion that drives them: our R&I teams develop more than 200 projects each year. These projects bring together skills to address major challenges in designing new products and systems, new services, or new methods.

Open innovation: significant partnerships and collaborative projects are established with renowned clients and partners, allowing us to innovate rapidly by capitalizing on new synergies.

Our engineers contribute to shaping the world of tomorrow in 3 main areas :



Smart Industry

Industry 4.0

Connected and
autonomous mobility



Green Industry

Weight reduction /
Materials recycling

Sustainable mobility
and logistic

Water management /
Clean water

Reduction of energy
consumption

Energy storage



Industry for Life

Bio printing

New materials

Maturity Level of Innovations

Research

Testing

Roll Out

The objective of our book on innovations is to present in a simple manner
some of the innovations that are currently developed by our teams.

SEGULA'S ACTIVITIES

GLOBAL ENGINEERING GROUP

SERVING THE COMPETITIVENESS OF ALL MAJOR INDUSTRIAL SECTORS



Automotive



Aerospace



Energy



Rail



Naval



Life Sciences



13 000 +
Employees



30 +
Countries



140 +
Locations



300 +
Customers



200 +
R&D projects every year

OUR VALUES

Responsiveness

Proximity

Ambition

Innovation

SUMMARY



Green Industry

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Weight reduction
Energy storage
Sustainable mobility & logistics
Water management / Clean water
Reduction of energy consumption
Material recycling



Smart Industry

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Industry 4.0
Connected and autonomous mobility



Industry for Life

30

Bio-printing



GREEN INDUSTRY

“Environmental problems pose a growing threat to our planet and the life on it. Collective action, focused on sustainability and environmental preservation, is essential to mitigate these threats and promote a more planet-friendly future.

We are working with ours customers and partners to find viable solutions, to address this critical issue, to help find solutions that work towards a greener future.”

Anne-Christine Lombardi, Head of Open Collaboration Projects



Weight reduction

- 8** TOLDO
Increased resistance of composite structures
- 9** COMPOSITE CAB
Truck cabin mass reduction solution



Energy storage

- 10** CUVE
Increased resistance of composite structures
- 11** REMORA
Truck cabin mass reduction solution



Sustainable mobility & logistics

- 12** MULTI-STACK FUEL CELL
Fuel cell increased sizing and performance
- 13** ZERO
Green liquid hydrogen-powered aviation
- 14** H2 BIMODO
Fuel cell increased sizing and performance
- 15** GREEN DELIRIVER
Green river-based urban logistics solution



Water management / clean water

- 16** BIOFILTRATION
Biological filtration system for industrial effluents
- 17** ATARA
Water resources management tool



Reduction of energy consumption

- 18** STABILOAD
On-board load and stability AI model
- 19** BIOPTÉ
Energetic uses of biomass processing
- 20** INNOVATIVE THERMAL MANAGEMENT
Complete thermal management tool



Material recycling

- 21** CIMENT I3D
3D-Printed concrete using industrial waste

TOLDO

INCREASED RESISTANCE OF COMPOSITE STRUCTURES

As impacts can compromise composite structures' integrity, TOLDO project **strengthens like-carbon structures** in the event of a collision.

Following the project validation, a technological solution has been developed to **enhance impact resistance** of composite structures even in a very hard ecosystem.

TOLDO advanced composite structure is a cross-sectorial solution that can **bolster durability** of automotive vehicles and aerospace systems.



PARTNERS
ISAE, ICA, Airbus, CNRS,
ArianeGroup



MATURITY
TESTING
TRL : 7



COMPETENCIES
Aeronautics, Laminates,
Numerical modelling



COMPOSITE CAB

PATENT



TRUCK CABIN MASS REDUCTION USING NEW MATERIAL

COMPOSITE CAB is a **lightweight truck cabin** designed to minimize fuel consumption while retaining an optimal load capacity.

The use of composite materials in the cabin **reduces its weight (30% lighter cabin)**. This cabin also offers various internal features to enhance passenger comfort, including a sleeper configuration.

Our **patented sleeper concept** is currently used by Renault Trucks, but can also be proposed for application in other cross-sectoral domains.



PARTNERS
Solvay, PO, Altair,
Mecaplast, Saertex,
Addiplast, Insa, Isat



PLANNING
PoC in 2016
Now Industrial part



MATURITY
ROLLOUT
TRL : 9

CUVE

PREDICTION OF TANK EXPOSURE TO EXTERNAL FORCES

CUVE is a **predictive tool** designed to assess risk of damage to tanks due to liquid sloshing and optimize their structure accordingly to enhance their safety.

- This tool considers various scenarios, including fluid-liquid interaction and liquid overflow, to **prevent potential accidents** that could compromise the integrity of the tank.
- By **optimizing the tank conception**, this solution not only **reduces the risk of harming people** and goods but also allows **better cost control** by extending the tank's durability.



PARTNERS
LUSAC (University
of Caen Normandy),
LRAHE
(University of Bejaïa,
Algeria)



PLANNING
Seismic loads: 2023,
Sloshing reduction
solution: 2024,
Tank design
optimisation: 2025



MATURITY
ROLL OUT
TRL : 8



COMPETENCIES
Fluid-Structure
Interaction, Sloshing



REMORA

PATENT



EFFECTIVE AND DURABLE ENERGY STORAGE SOLUTION

REMORA addresses the **storage** issue of electrical energy, especially from renewable sources.

Our **patented** solution offers a **compressed air system** that enables more durable and very effective energy storage (up to 70% yield) compared to other storage solutions.

The first demonstrator designed to harness solar energy is expected for beginning of 2024.

REMORA offers a **flexible, high-yield, durable** storage solution tailored to meet renewable energy needs, for mid and long-term daily storage (>10-hour), also using recycling materials.



PARTNERS
IMTA, CETIM, Nantes
Université, ADEME,
CORIA, LEMNA, LTEN,
IREENA



PLANNING
Prototype: 2019,
Demonstrator: 2023,
200 Kw container pilot:
2025



MATURITY
TESTING
TRL : 5



COMPETENCIES
Energy efficiency,
Multi-physics
simulation, Experimental
development



MULTI-STACK FUEL CELL

FUEL CELL INCREASED SIZING AND PERFORMANCE

The project introduces an innovative fuel-cell system architecture that provides **enhanced autonomy** and **reduced recharging time**.

This program will allow us to develop tools to facilitate the sizing of optimized fuel cell systems integrated into a powertrain of any type of vehicle and adapted to their use cases.

As a result, this multi stack fuel cell solution **drives down the vehicle's maintenance costs** by extending of its internal components' **lifespan**.

As part of the project, a **test bench** is developed to validate small-scale fuel cell systems and also validate technical solutions for light mobility applications.



PARTNERS

LUSAC (University of Caen Normandy), LRAHE
(University of Bejaïa, Algeria)



PLANNING

Seismic loads: 2023,
Sloshing reduction solution: 2024,
Tank design optimisation: 2025



MATURITY

ROLL OUT
TRL : 8



COMPETENCIES

Fluid-Structure
Interaction, Sloshing



ZERO

GREEN LIQUID HYDROGEN-POWERED AVIATION

ZERO's project ambition is to bring to market the **world's first hydrogen-powered commercial aircraft** by 2035.

ZERO explores a variety of configurations and technologies options for liquid hydrogen (LH2) storage, distribution and integration in the aviation sector. The project includes mockup **1:1 scale tests** to validate hydrogen combustion in real conditions.

By overcoming operational hurdles and safety implications, ZERO paves the way to **reduce aviation's carbon footprint** with up to 900,000 tons of CO2 avoided every year by 2050.



PARTNERS

IMTA, CETIM, Nantes Université,
ADEME, CORIA, LEMNA, LTEN,
IREENA



PLANNING

Prototype: 2019,
Demonstrator: 2023,
200 Kw container pilot: 2025



MATURITY

TESTING
TRL : 5



COMPETENCIES

Energy efficiency,
Multi-physics simulation,
Experimental development



H2 BIMODO

THE WORLD'S FIRST LIQUID HYDROGEN TRAIN

H2 BIMODO promotes use of new traction technologies for the railway lines in order to make Europe climate neutral by 2050.

H2 BIMODO project transforms an **electric railcar** into a new **bimodal traction** system by combining **liquid green hydrogen** and batteries.

The project offers a **100% sustainable and disruptive solution**, making it possible to reach two European goals: decarbonation and revitalization of capillary lines.



PARTNERS
RENFE (operator), Enagás,
H2Vector, TACTICA TIC



PLANNING
Operational in 2025



MATURITY
TESTING
TRL: 7



COMPETENCIES
Liquid Hydrogen (LH2)



GREEN DELIRIVER

GREEN RIVER-BASED URBAN LOGISTICS SOLUTION

GREEN DELIRIVER is a boat designed to facilitate **clean logistics** from outer cities to urban areas, reducing road traffic CO2 emissions.

Hybrid electric/biogas (Compressed Natural Gas, CNG) propulsion allows for very low polluting emissions.

Notably, GREEN DELIVER has been selected to participate in the **opening ceremony of the 2024 Olympic Games** on the Seine River.



PARTNERS

GRDF, COALIS, NGV Powertrain,
CCI78, SYCTOM, HAROPA, SIGEIF
(syndicate), VNF, GPS&O, Total
Energies



PLANNING

Demonstrator: 2024



MATURITY

TESTING
TRL: 7



COMPETENCIES

Compressed Natural Gas
(CNG),
Hybrid propulsion

BIOFILTRATION

BIOLOGICAL FILTRATION SYSTEM FOR INDUSTRIAL EFFLUENTS

BIOFILTRATION offers an **alternative biological filtration** method for more efficient purification of effluents.

This method utilizes the natural capacity of some **microorganisms** and their **resistance to high temperatures**, pressures, radioactivity and hazardous environments.

BIOFILTRATION is an **eco-friendly solution** that helps industries grow more environmentally compliant with **cleaner effluents** at a lesser cost.



PARTNERS
MAP laboratory M2E
team (INSA LYON)



PLANNING
Started in 2019
PoC in 2019



**MATURITY
TESTING**
TRL: 2-3



COMPETENCIES
Waste recovery,
Depollution,
Biotechnologies





ATARA

WATER RESOURCES MANAGEMENT TOOL

The Assistance Tool for Water Resources Management (ATARA) is a set of **multifaceted modelling tools** that simulate and enhance water management, storage and related services.

ATARA uses field monitoring methods, including satellites and in-situ monitoring units. Once collected, the data is analyzed and leveraged through 1D, 2D, or 3D modelling, which assists in the creation of **forecast scenarios**.

ATARA supports hydroelectric energy producers and other stakeholders in **improving water access and usage** in a context of scarcity that directly impacts the quality and quantity of water resources.



PARTNERS
Lacs Sentinelles, EDF,
Polytechnic University
of Catalonia, University
of Córdoba, French
Biodiversity Agency
(OFB)



PLANNING
Started in 2016



MATURITY
ROLL OUT
TRL: 9



COMPETENCIES
Simulation,
Limnology,
Water quality

STABILOAD

ON-BOARD LOAD AND STABILITY AI MODEL

Our Loading calculator provides more efficient management of the **freight mass distribution** on board to comply with stability criteria and **distribution of stresses on the structure**.

STABILOAD is **customizable and connected** on-board, it can **simulate** unusual and **specific configuration** to make a quick and safe loading of the boat.

It has a **Safe Return To Port module** which simulates flooding due to damage, calculating liquid hulls and the resistance of the structure connected to the ship's sensors increasing safety.

Utilizing advanced algorithms, this tool can achieve **up to a 5% reduction in energy consumption** during shipment, adjusting the boat's trim.



PARTNERS
STX France, Brittany
Ferries, EU H2020



MATURITY
ROLL OUT
TRL: 9



COMPETENCIES
Naval architecture,
Stability,
Algorithmic



BIOPTe

ENERGETIC USES OF BIOMASS PROCESSING

Harnessing new energy sources like biomass, is a growing priority. Yet, its conversion into usable energy requires specific processing steps.

The BiOpTE tool **identifies the most efficient processing methods for transforming specific biomasses** into actionable energy sources such as roasting, pyrolysis, or gasification.

BiOpTE helps reduce industrial gas emissions (GHGs) and offers access to more sustainable energy sources, such as dihydrogen (H₂).



PARTNERS
LATEP (UPPA)



MATURITY
RESEARCH
TRL: 6



COMPETENCIES
Energy,
Industrial processing,
Algorithmic

INNOVATIVE THERMAL MANAGEMENT

COMPLETE THERMAL MANAGEMENT TOOL

Innovative Thermal Management develops a complete tool to **simulate and optimize the thermal management** of all types of vehicles and architectures.

By taking into consideration the vehicle architecture, the materials used, the climatic conditions and the phases of use, SEGULA has developed a comprehensive tool that makes it possible to perfect the thermal management of vehicles without any architectural limitations. All this while ensuring the best possible passenger **thermal comfort**.

This **adaptable and predictive tool** allows to increase autonomy, to **reduce energy consumption**, and increase thermal comfort.



PARTNERS
St Jean Industries,
CETHIL(INSa LYON)



MATURITY
ROLL OUT
TRL: 9



COMPETENCIES
Thermodynamic



CIMENT I3D

PATENT



3D-PRINTED CONCRETE USING INDUSTRIAL WASTE

CIMENT I3D focuses on designing tools and techniques for **producing concrete from waste materials** while maintaining the same final properties as cement.

Ongoing studies aim to master the processing phase and prevent reactions that could alter the composition of the waste-based concrete.

This **eco-friendly** solution helps diminish energy consumption in the construction industry but can also provide **significant cost reduction** from unused and accessible industrial waste.



PARTNERS
SUEZ Recycling and
valorization, IMT Mines
Ales



PLANNING
Started in 2020



MATURITY
TESTING
TRL: 5



COMPETENCIES
Additive manufacturing,
Innovative processes,
Materials chemistry



SMART INDUSTRY

"In order to make your operations safer, more convenient, more efficient and productive, system automation (or autonomous system) have become a requirement.

These systems are found in robotics, security, predictive maintenance, autonomous vehicles, energy management... SEGULA contributes to smart industries' progress and adoption, particularly in the fields of artificial intelligence, robotics and sensors."

Soeren Muller, Head of Software and Digitalization, Segula Germany



Industry 4.0

- 24** ANAXAGORE
Design & development process 4.0
- 25** SMARI
Plant digitalization and object recognition
- 26** TOPONE
Safe autonomous underground gallery inspections



Connected and autonomous mobility

- 28** PREMCO
On-board load and stability AI model
- 29** DESIS
Contactless and remote vital signs detection

ANAXAGORE

DESIGN & DEVELOPMENT PROCESS 4.0

Industry 4.0 demands that industrial system design and **development processes** become more flexible, adaptable, and resource-efficient to respond quickly to the market in a personalized and cost-effective manner.

ANAXAGORE is a software that offers a standardized framework and tools to streamline the development of these systems. It integrates digital technologies into various design operations to **automatically generate executable codes** and deliverables.

This solution increases the **productivity of industrial designers & developers** and enhances the flexibility and reliability of design and development processes by shortening design times and efforts.



PARTNERS
LabSTICC, IRISA
LIAS, CRISTAL



PLANNING
2024: Demonstrator



**MATURITY
TESTING**
TRL: 6



COMPETENCIES
Thermodynamic

**SMARI**

PLANT DIGITIZATION AND OBJECT RECOGNITION

Industrial plants need to evolve towards Industry 4.0, using reliable and up-to-date plans.

SMARI provides **AI tools to speed up 3D-modelling of complex industrial installations**, from on-site acquisition to CAD modelling, in a semi-autonomous manner, using a 3D-scan and object recognition model.

This project enables **time reduction** to redesign plans of existing installations, **minimization of risks** linked to human intervention for maintenance on installations and offer **high fidelity data** which can be used to construct digital twins.



PARTNERS
Lab STICC



PLANNING
Prototype in 2024
User test in 2025



MATURITY
RESEARCH
TRL: 4/5



COMPETENCIES
3D Scan, AI,
Object Recognition

TOPONE

SAFE UNDERGROUND GALLERY INSPECTIONS

TOPONE is a prototype **drone** that can **autonomously inspects** any underground power line.

TOPONE solution combines **thermographic camera** to detect hot spots on the damaged cables, and an RGB camera that checks for breaks or cracks. Information on the environmental conditions (O2 and harmful gas concentration, temperature) are also collected via on-board sensors.

TOPONE solution allows for **avoiding** -sometimes deadly- **accidents** of inspection missions and securing eventual technical intervention.



PARTNERS
CATEC



PLANNING
Prototype in 2024



MATURITY
TESTING
TRL: 5



COMPETENCIES
Data processing





PREMCO

PREDICTING DANGEROUS MOVEMENT FOR TRAINS

PREMCO provides a **monitoring system** designed to **anticipate hazardous situations**, particularly when objects or humans approach the train.

This system utilizes image processing and AI, that **can accurately predict the trajectory of objects in motion**.

The solution not only **diminishes** the **cost** associated with **equipment downtime** periods but also ensures **better traffic management** by avoiding day-to-day incidents.



PARTNERS
IRSEEM



PLANNING
2022-2026: Prototyping
2026-2027: Rolling Out



MATURITY
TESTING
TRL: 5



COMPETENCIES
Modeling, Robotics, AI





DESIS

CONTACTLESS AND REMOTE VITAL SIGNS DETECTION

DESIS **collects vital data signs** to detect any problematic health conditions that could affect train conductors and their passengers.

By analyzing parameters such as heart rate DESIS plays a crucial role in ensuring the safety of train conductors and customers on board.

This **cost-effective solution** helps railway companies avoid tragic accidents and potential lawsuits which can tarnish the company's reputation.

The project can also be used for **other usages**, such as : remote medical surveillance, or monitoring of incidents for other drivers (truck drivers, airplane pilots).



PARTNERS
IFSTTAR/IEMN



PLANNING
2022-2025: Prototype
2025-2026: Roll Out



MATURITY
TESTING
TRL: 4



COMPETENCIES
Modeling, Electronic,
Signal processing



INDUSTRY FOR LIFE

“Progress in life science is important and necessary, as it helps improve human health (e.g. population aging), with new and safer technology. It can also solve the issue of human organs and cells’ donations scarcity and in saving natural resources also preserve biodiversity, and avoid harming the environment.

Our collaborations with renowned laboratories allow us to have life sciences and new technologies meet, for promising projects for the future”

Damien Convert, *Chief Commercial Officer*



Bio-printing

32

NEW ART

3D-Printed polymer for artery substitution

33

BIOPREENT

3D-Printed vegetal cells bio-ink

NEW ART



3D-PRINTED POLYMER FOR ARTERY SUBSTITUTION

The growing demand for arteries prosthesis, coupled with the limited availability of donor organs, requires the exploration of alternative materials.

NEW ART introduces a **method for crafting customized biomaterials** (arteries substitutes) through additive manufacturing with no risk of patient rejection.

This artery prosthesis solution enables more **vital organ availability** and faster delivery for hospitals that usually wait long times for an available donor.



PARTNERS
3d FAB Platform,
Lyon 1 University



PLANNING
Started in 2018



MATURITY
TESTING
TRL: 4/6



COMPETENCIES
Polymer additive
manufacturing, Controlled
polymer degradation, Cell
regeneration



BIOPREENT

3D-PRINTED VEGETAL CELLS BIO-INK

As 3D printed vegetals hold significant promise for creating sustainable structures, BIOPREENT develops a **bio-ink based** on vegetal cells serving as a primary material for designing 3D printed structures like wood.

The technology lies in the utilization of **biosourced hydrogel**, a material also used in the production of bio-medical tissue.

This approach enables the fabrication of structures with low carbon cost. If successful, this solution could enable **significant cost savings**, notably in the construction industry.



PARTNERS
3d FAB Platform,
Lyon 1 University



PLANNING
Started in 2020



MATURITY
TESTING
TRL: 5



COMPETENCIES
Additive Manufacturing,
Plant Biochemistry

THEMATIC SUMMARY PER INDUSTRY



AUTOMOTIVE

9 TOLDO
INCREASED RESISTANCE OF COMPOSITE STRUCTURES

13 MULTI-STACK FUEL-CELL
FUEL CELL INCREASED SIZING AND PERFORMANCE

21 INNOVATIVE THERMAL MANAGEMENT
COMPLETE THERMAL MANAGEMENT TOOL

25 ANAXAGORE
DESIGN & DEVELOPMENT PROCESS 4.0



RAIL

15 H2 BIMODO
THE WORLD'S FIRST LIQUID HYDROGEN TRAIN

25 ANAXAGORE
DESIGN & DEVELOPMENT PROCESS 4.0

28 PREMCO
HAZARD ANTICIPATION SOLUTION FOR TRAINS

29 DESIS
VITAL SIGN REMOTE DETECTION SOLUTION



BUS & TRUCKS

9 TOLDO
INCREASED RESISTANCE OF COMPOSITE STRUCTURES

10 COMPOSITE CAB
TRUCK CABIN MASS REDUCTION SOLUTION

13 MULTI-STACK FUEL CELL
FUEL CELL INCREASED SIZING AND PERFORMANCE

29 DESIS
VITAL SIGN REMOTE DETECTION SOLUTION



AEROSPACE

9 TOLDO
INCREASED RESISTANCE OF COMPOSITE STRUCTURES

14 ZERO
GREEN LIQUID HYDROGEN-POWERED AVIATION

25 ANAXAGORE
DESIGN & DEVELOPMENT PROCESS 4.0

29 DESIS
VITAL SIGN REMOTE DETECTION SOLUTION



CONSTRUCTION

- 22** CIMENT I3D
3D-PRINTED CONCRETE USING INDUSTRIAL WASTE
- 26** SMARI
PLANT DIGITIZATION AND OBJECT RECOGNITION
- 27** TOPONE
SAFE UNDERGROUND GALLERY INSPECTIONS



NAVAL

- 12** REMORA
DURABLE ENERGY STORAGE SOLUTION
- 16** GREENDELIRIVER
SUSTAINABLE LOGISTICS SOLUTION
- 19** STABLOAD
FREIGHT MANAGEMENT SOLUTION



LIFE SCIENCE

- 32** NEW ART
3D PRINTED BIOMEDICAL SOLUTION
- 33** BIOPREENT
3D PRINTED VEGETAL CELLS



ENERGIES & UTILITIES

- 6** CUVE
PREDICTION OF TANK EXPOSURE TO EXTERNAL FORCES
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EFFECTIVE AND DURABLE ENERGY STORAGE SOLUTION
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