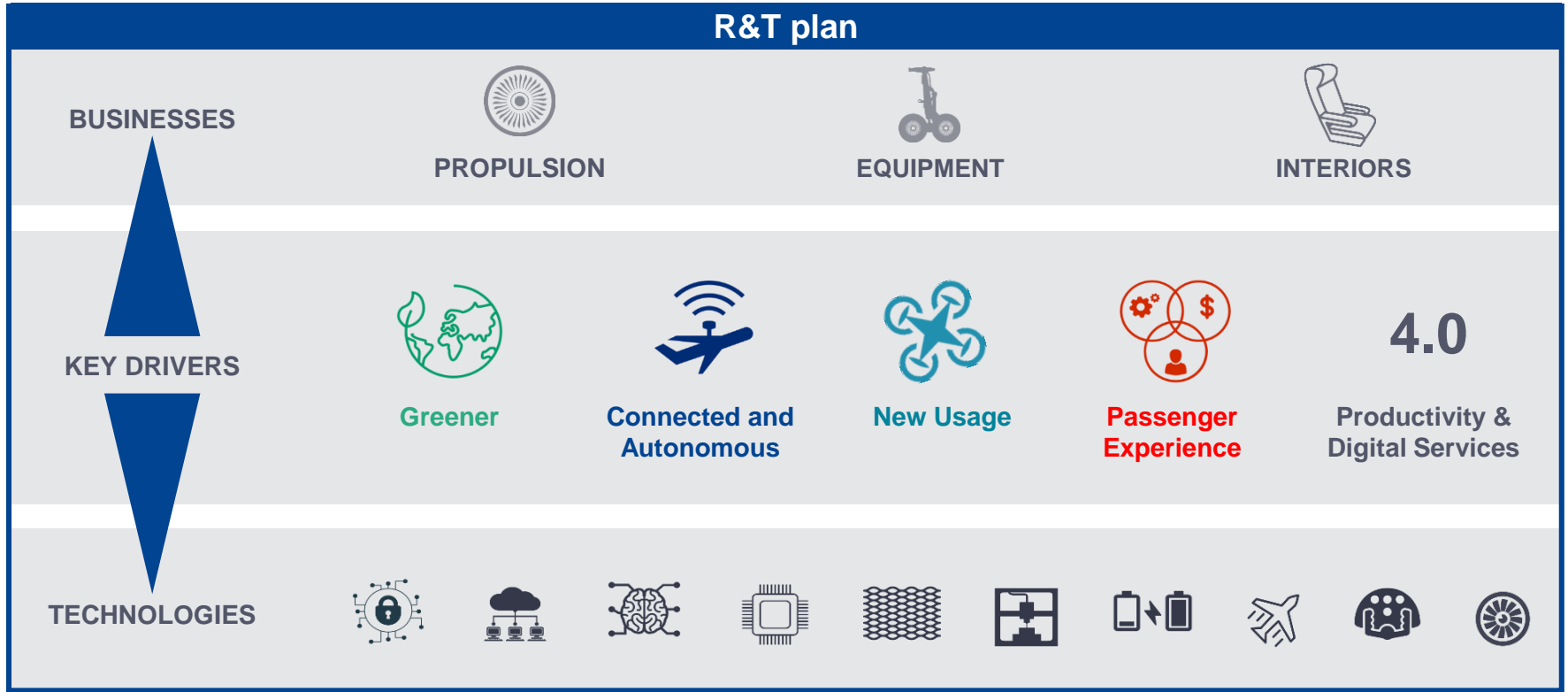


INNOVATION POWERING SAFRAN

Stéphane CUEILLE,
Chief Technology Officer

Technology, key to our competitiveness



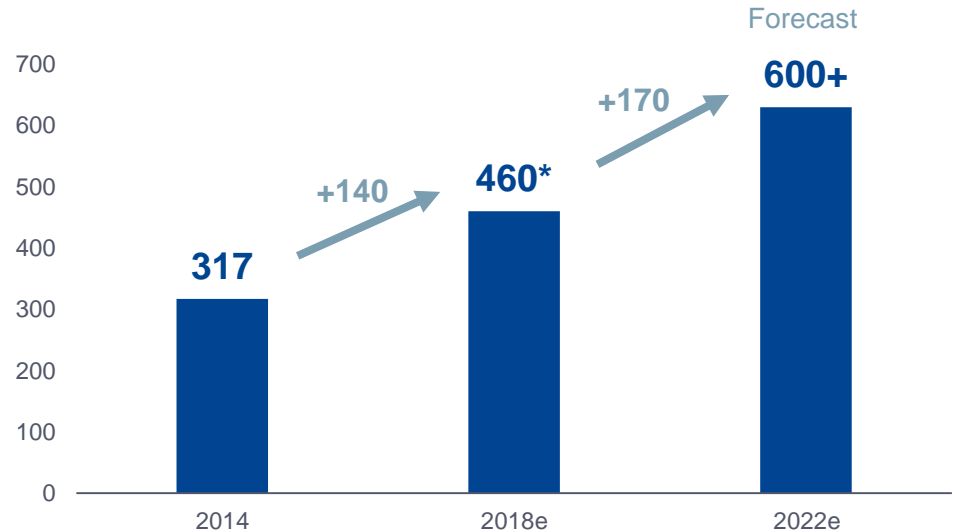
A growing investment in R&T and Innovation

**SAFRAN
RT&I**

€460M*

~3,000 FTE | 900 patents / year

Self-funded R&T and Innovation (€M)



* Self-funded R&T 2018 – including Zodiac Aerospace (€30M)

SAFRAN R&T and Innovation: state of the art organization and processes

**CAPITAL
MARKETS
DAY/2018**

R&T roadmaps

40

Safran roadmaps

Products

Innovation

Methods & Tools

Technologies

Shared resources

600

Corporate Scientists



SAFRAN TECH
R&T CENTER



SAFRAN
ANALYTICS

**INTELLECTUAL PROPERTY
CENTER OF EXCELLENCE**

Corporate initiatives

4

Initiatives On Going



HYBRID
PROPULSION



AUTONOMOUS
SYSTEMS



ADDITIVE
MANUFACTURING



DIGITAL

Ecosystem

30

Strategic partnerships



SAFRAN
VENTURES



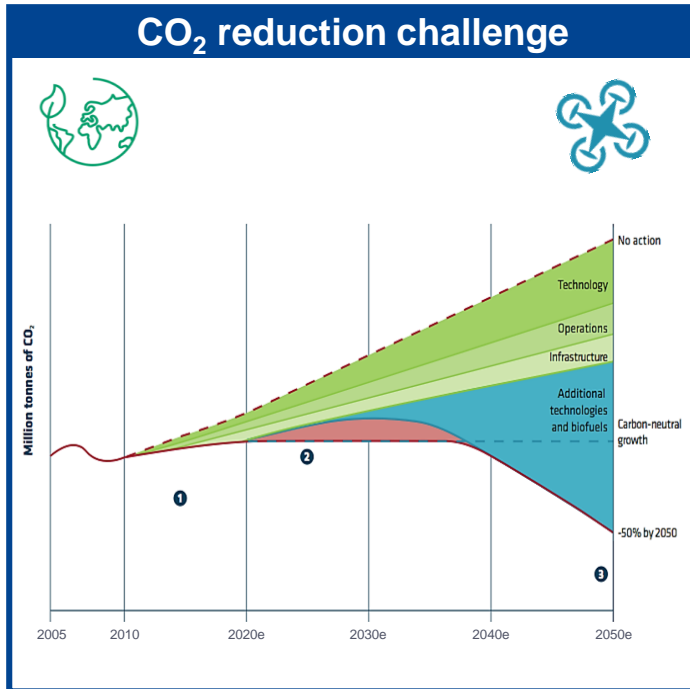
SCIENTIFIC
PARTNERSHIPS



TECHNOLOGY
PARTNERSHIPS

SAFRAN at the core of energy & propulsion challenges

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Ultra-efficient gas turbine propulsion



Hybrid propulsion and Electrification



Use of Low Carbon Fuels





High efficiency advanced turbine propulsion

Open Rotor: a key milestone achieved – a true option for the future

Clean Sky SAGE2 Full-Scale Open Rotor Ground Test Demo



The only engine architecture allowing a 15% reduction of fuel consumption and CO₂ emissions compared to the LEAP Engine

- 3D-woven carbon fiber blades
- Same performance in terms of emitted noise as the LEAP engine
- Specific control system with Pitch Control Mechanism





Optimizing energy onboard the aircraft



Jet Engines



**Transmission
Systems**



**Generators
& Motors**



**Power
Electronics**



Wiring



**Electrical
Distribution**

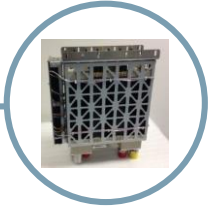


**Ram
Air Turbines**



**Auxiliary
Power Units**

+ **BOEING**



Fuel Cells



Electric Taxiing

+ **AIRBUS**

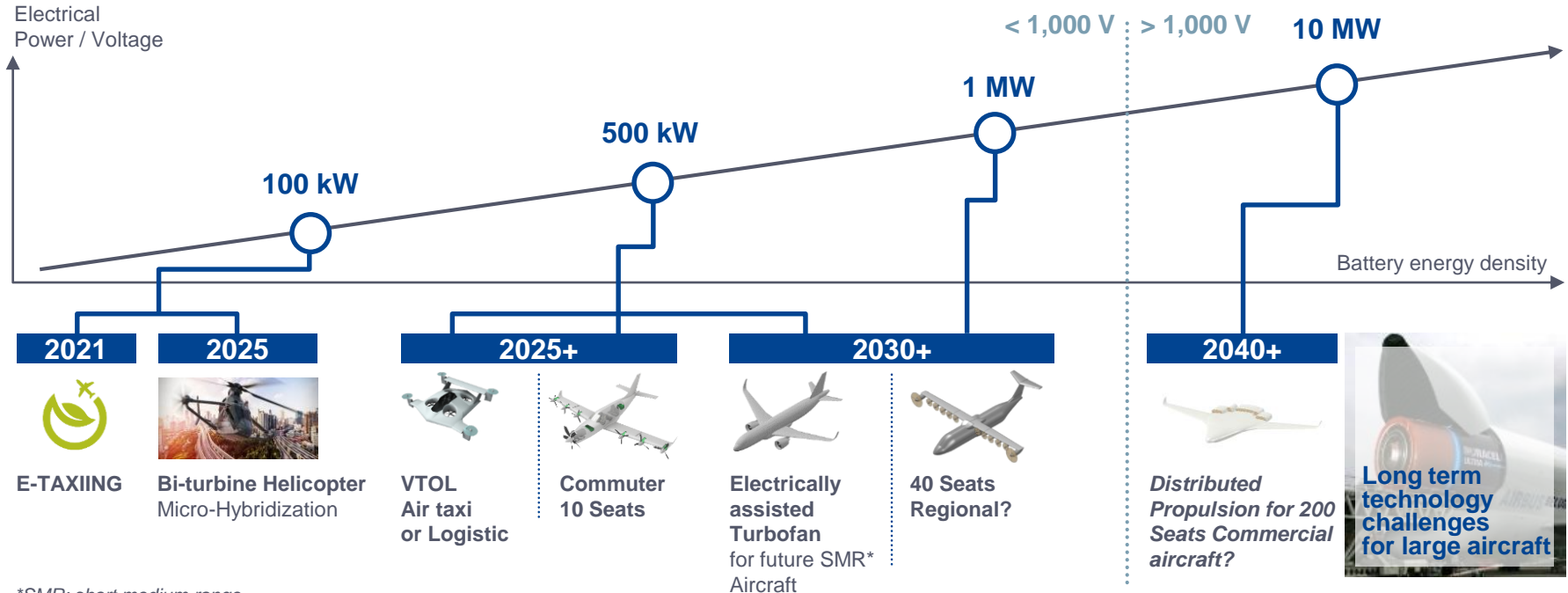


SAFRAN pioneering hybrid electric energy & propulsion

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A stepped approach

Potential of new usage, lower electrical power, shorter distance



*SMR: short medium range



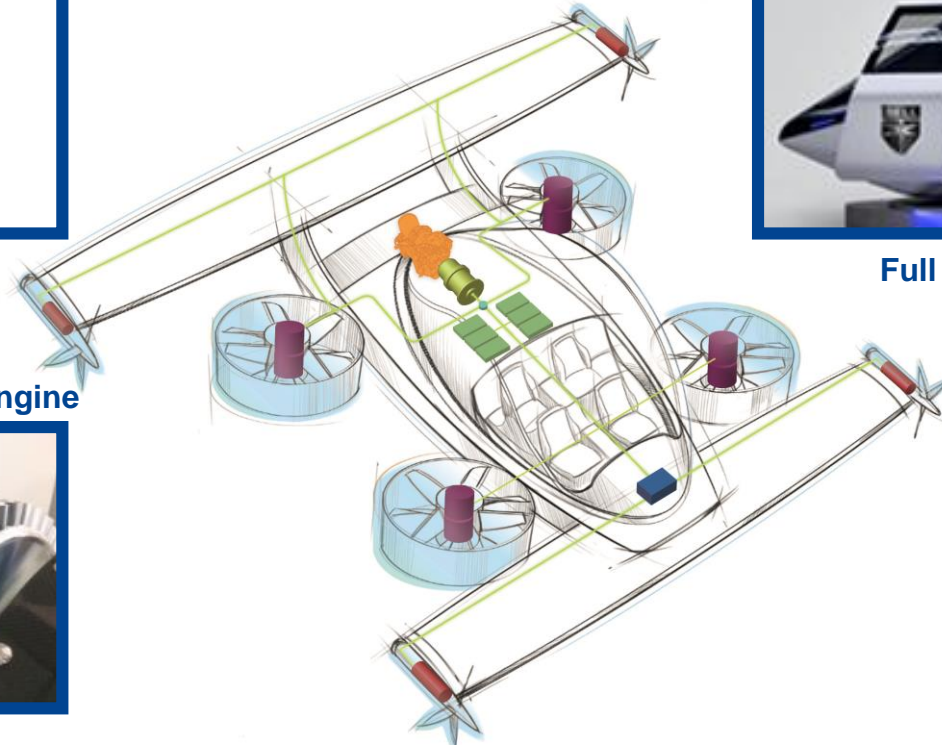
Vtol hybrid electric distributed propulsion

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DAY/2018**



Generator

**High power density
integrated electrical engine**



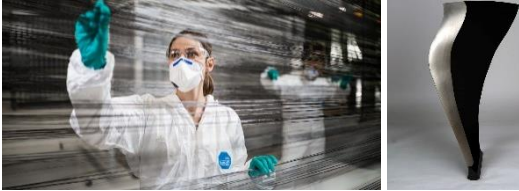
Full scale flight demo 2021 with Bell

**First test of a full hybrid
propulsive system (June 2018)**



Advanced materials & manufacturing processes

Polymer matrix composites



10% weight benefit, enabling advanced propulsion efficiency

Ceramic matrix composites



*+200°C & -60% weight:
A game-changing class of material*

**A core capability
for product
performance
and industrial
competitiveness**

High performance alloys



*+20% strength and x2 durability
for critical equipments*

Advanced non destructive testing



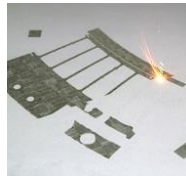
*20% cost reduction
and improved process control*

Turbine airfoil technologies



5-10% engine fuel burn benefit

Additive manufacturing: making it a reality



Accelerating transition
from R&T
to Product insertion
across Safran



Ambitious targets for new designs / products

Supported by full scale demonstrators



Engine

50 parts to 1 Weight -25%
Cost -15% Lead time / 6

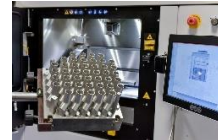


Equipment

Certified parts

Arrano

LEAP, APUs ...



Benefits

- ▶ Weight
- ▶ Lead time
- ▶ Performance
- ▶ Supply-chain dependency
- ▶ Reduction of assemblies

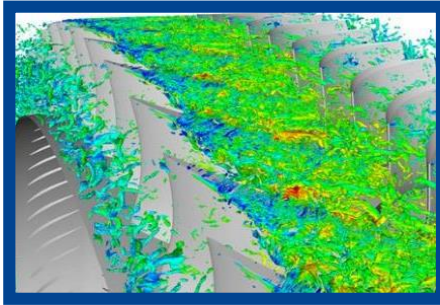
Additive campus project

Mutualized
R&T and
production
Center

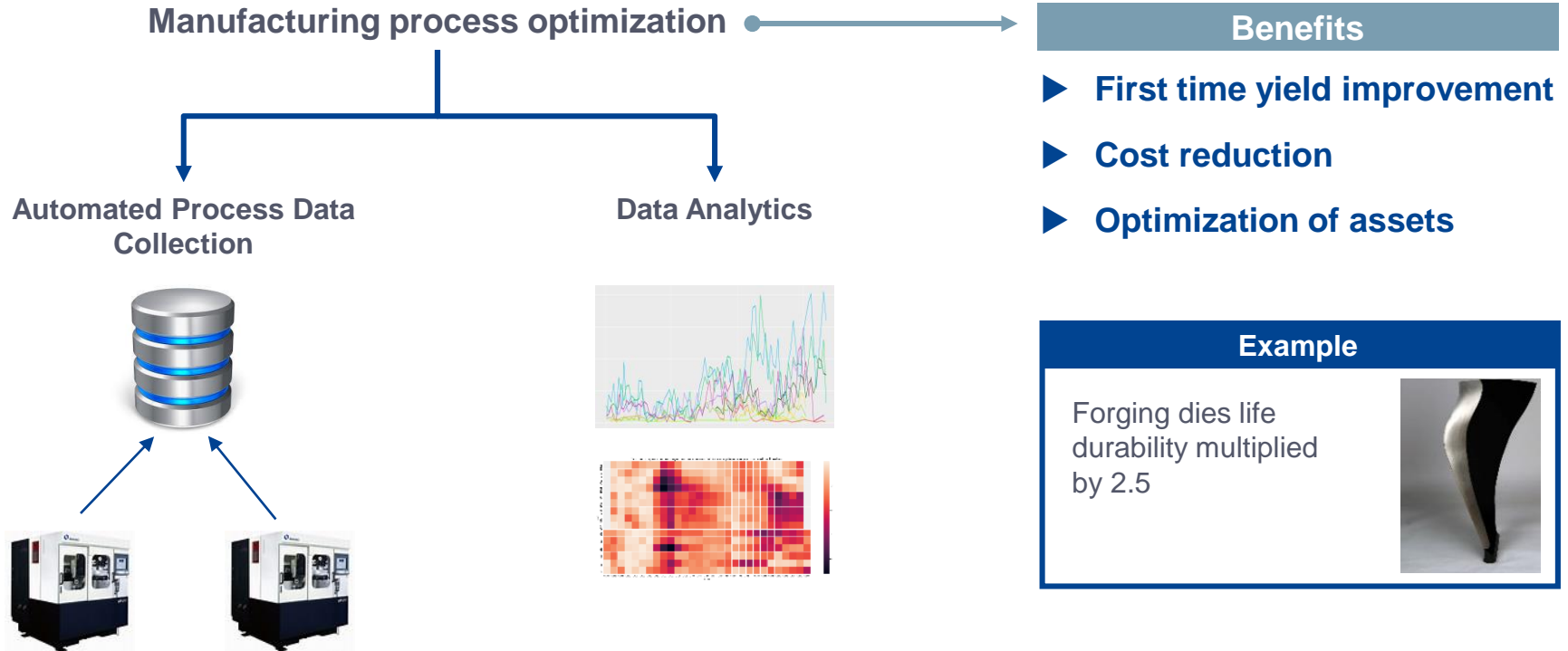


Digital at the core of our business processes

Manufacturing – Services – R&D



Data Analytics supporting the ramp-up of LEAP



Autonomous systems



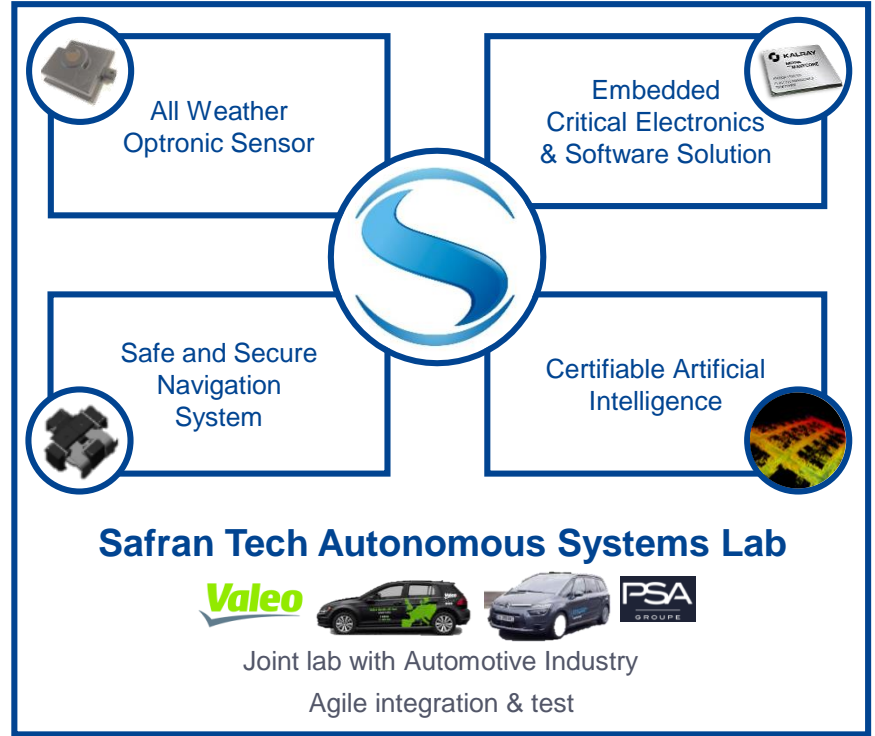
Defense Robotics



Drones



Pilot Assistance





Innovation in cabin

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Connected cabin

- Passenger experience
- Operations & maintenance
- New revenue generation



ZEO: Safran design studio

- A unique combination of industrial design, advanced concept engineering and a mockup & prototype shop
- An open, collaborative environment dedicated to innovation

