MINI BEE PERSONAL AIRCRAFT

Mini-Bee

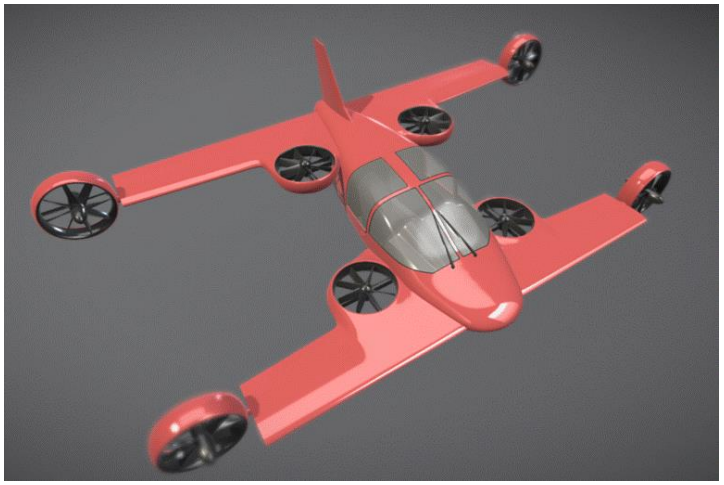
2PAX VTOL Hybrid Octocopter

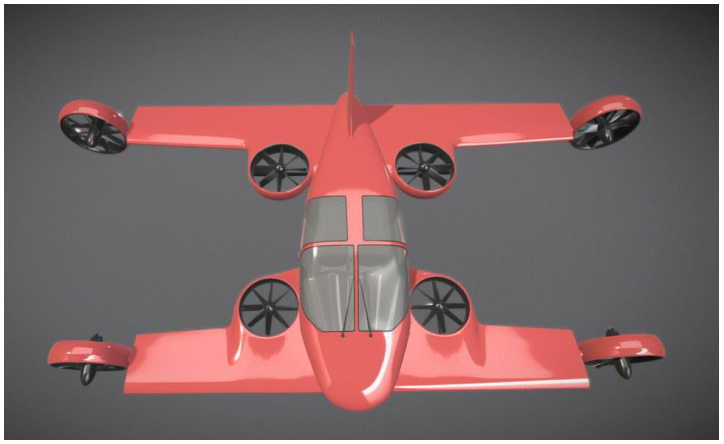
Annexes

Mini-Bee : 2PAX VTOL Hybrid

Mini-Bee description

- Project state : TRL2
  - Electric octocopter : 4 vertical + 4 tilt
  - Hybrid energy : fuel + batteries
  - 2-3 seats
- Characteristics :
  - VTOL capacity, short wings, 1.2 ton
  - Range 600km, max speed 300km/h
  - Electric controls and engines
- Goals and market
  - VIP, Taxi, Air Ambulance
  - Estimated price 1m€ (0,7 to 2m€)





Architecture

External tilt quadcopter

Central vertical quadcopter

Rear electric generator

Gullwing doors

Fuel generators

Biplane

Battery kits

Electric flight controls

Tailwheel-type landing gear

Low noise nacelle

Retractable front landing gear

3D printed metallic structure

Technical description

Aircraft characteristics

2 to 3 seats, VTOL, Short wing for cruise flight
MTOW 1200 kg, Range 600km , Cruise speed 220 km/h
Wing surface 15m², no control surface

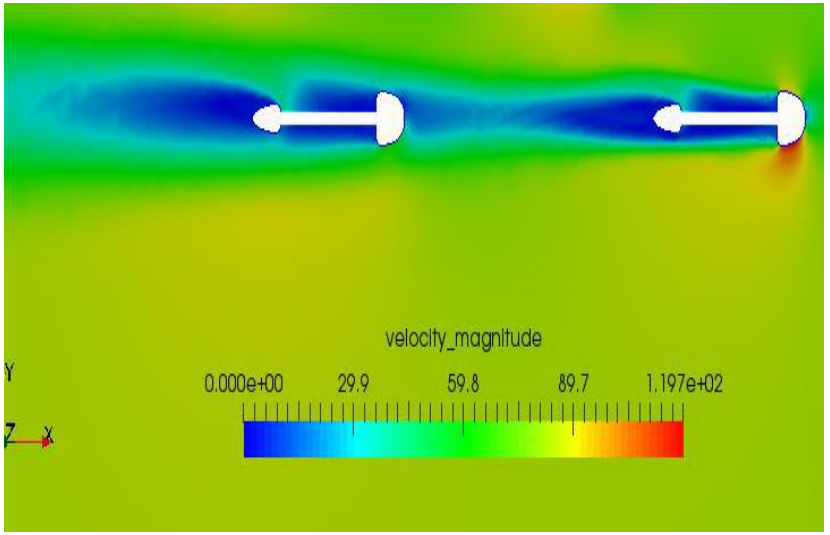
Engines

8 electric engines : Central vertical quadcopter + External tilt quadcopter
4 fuel generators + Batteries
Electronic control of engines power and tilt angles

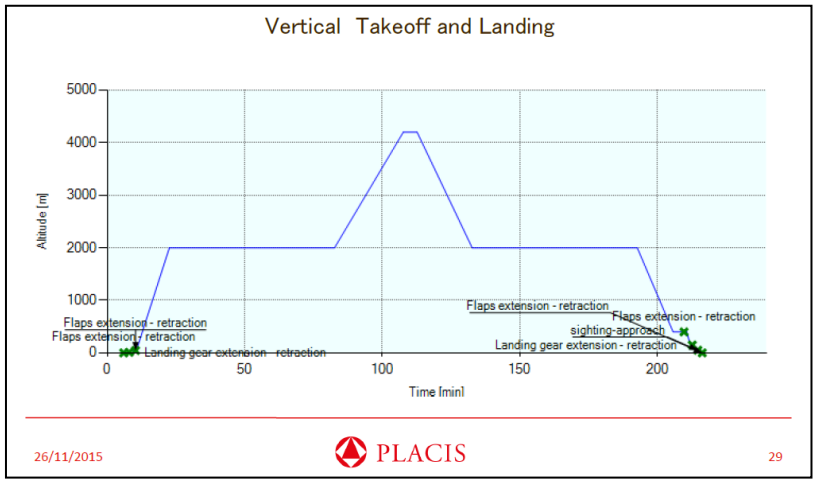
Cockpit interface

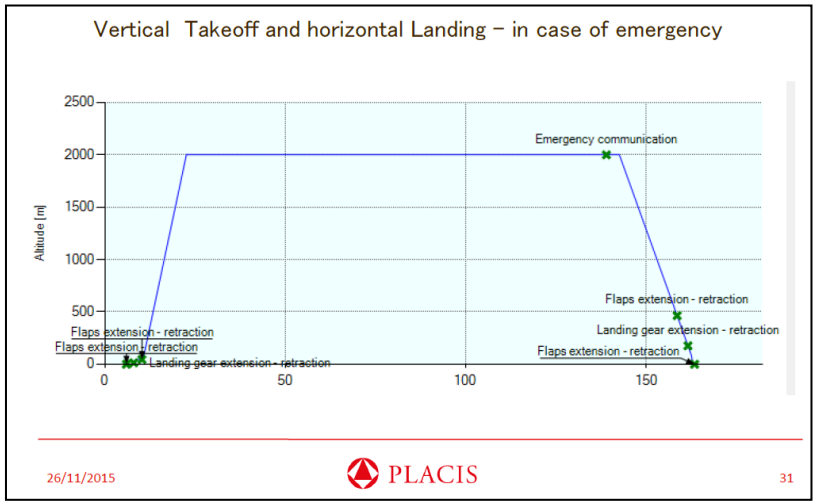
« Car like » pilot interface : Steering wheel, foot pedals, central screen

Cruise flight



Mission profile



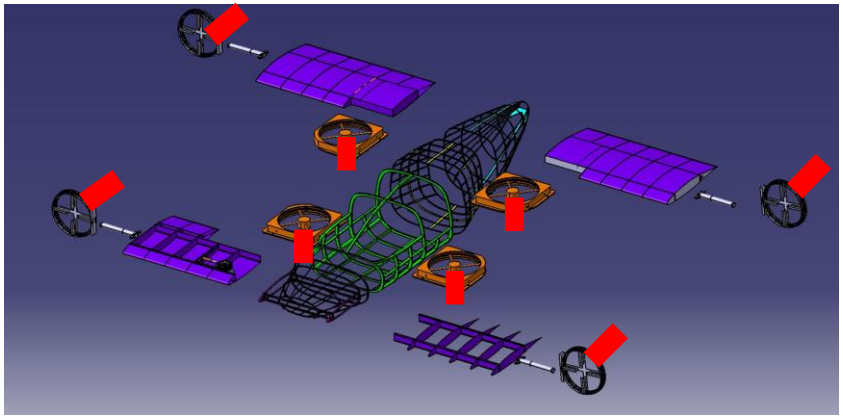


Phase	Duration		Altitude (start)	Altitude (end)	Speed	Climb rate	Specific Consuption
	hour	Min	m	m	km/h	m/s	lb/Hp/h
Engine start-up	0	0,3	0	0	0	0	0
Taxi out	0	4,5	0	0	60,0001	0	0,44
Flaps extension - retraction	Start time	60	-	-	-	-	-
Vertical Take off	0	0,8	0	45	0	0,9375	0,46
Landing gear extension - retraction	Start time	25	-	-	-	-	-
Rotors orientation	0	2	45	45	100,0001	0	0,45
Flaps extension - retraction	Start time	85	-	-	-	-	-
Climb	0	12	45	2000	200,0002	2,7153	0,45
1° cruise	1	0	2000	2000	299,9999	0	0,4299
obstacle deviation (climb)	0	25	2000	4200	249,9998	1,4667	0,45
Mini-cruise	0	5	4200	4200	249,9998	0	0,44
obstacle deviation (scent)	0	20	4200	2000	270	-1,8333	0,435
2° cruise	1	0	2000	2000	300	0	0,4299
Descent	0	13	2000	400	240	-2,0513	0,435
Holding	0	5	400	400	200	0	0,4331
Flaps extension - retraction	Start time	80	-	-	-	-	-
2° rotors orientation	0	1	400	200	100	-3,3333	0,45
Vertical Landing	0	4	200	0	20	-0,8333	0,447
Landing gear extension - retraction	Start time	25	-	-	-	-	-
sighting-approach	Start time	75	-	-	-	-	-
Taxi in	0	2	0	0	60	0	0,44
Flaps extension - retraction	Start time	30	-	-	-	-	-
Engine shutdown	0	0,2	0	0	0	0	0

26/11/2015 PLACIS 30

8 Electric Engines

Equipement proposed : 8 electric engines 55k (50kg)



55kW special designed engines (12kg/engine)
Or 8 engines Yuneec Power Drive 60kW

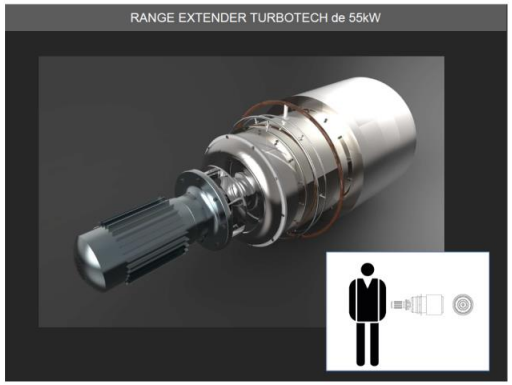
Power needed 220 kW
Installed power 440kW

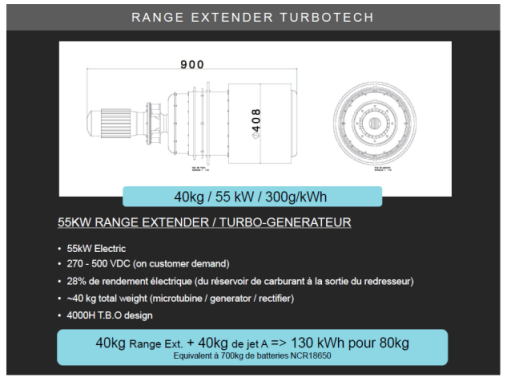
provided by

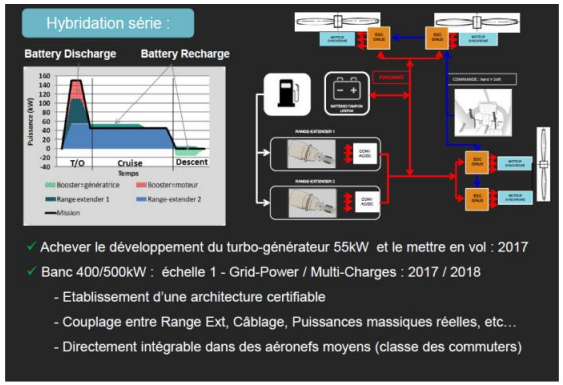
- 90kg of batteries during take-off and vertical flight
- 4 fuel generators during cruise flight

4 Electric fuel generator + Batteries

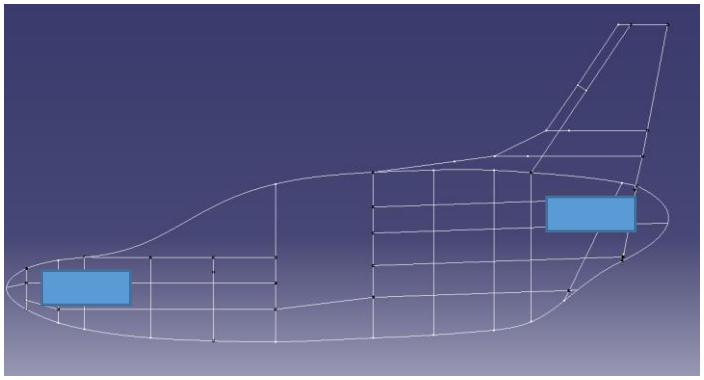
Equipement proposed : 4 Turbotech 55kW (160kg)

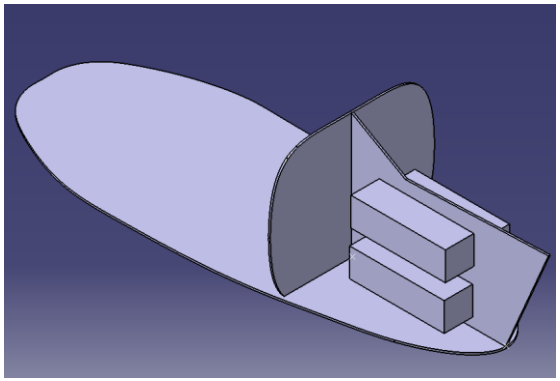






Batteries : 1800 NCR 180650 in 10C (90kg)





Data

MTOW : 1200 kg

- Structure : 310kg
- Fuselage : 80kg
- Payload : 220 kg (2 PAX)
- Systems : 125 kg
- Engines : 240 kg
- Batteries : 90kg
- Fuel : 140kg

Target for TRL3 : MTOW 1000 kg

Total costs : **700k€**

- System : 200k€
- Fuselage : 150k€
- Wing : 100k€
- Engines : 100k€
- Landing gear : 50k€
- Interior : 50k€
- Other : 50k€

Target for standard configuration :
Price = 700k€

SWOT analysis

Strengths

- VTOL capacities
- Speed of an aircraft
- Double quadcopter back-up in case of engine failure
- Fuel energy range
- Aircraft Design and configuration
- Lesser open source collaborative project

Weakness

- New configuration
- Project at low TRL
- Aerodynamic and leight weight structure
- Propulsion and energy storage
- Project implementation
- Project funding

Opportunities

- Cost reduction :
  - Overall flight cost reduction compared to helicopter
  - Low purchasing & maintenance cost of engines
- New design space: tilt, octocopter
  - Weight / VTOL
- Project investment

Threats

- All electric helicopters and VTOL vehicules
- All electric aircrafts
- Drones
- Tilt rotor
- Hybrid energy
- Others innovative projects

Partners for R&D

Project coordinator TECHNOPLANE AERONAUTICAL INNOVATION

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TRL2 Detailled Definition

CentraleSupélec

ESTACA ÉCOLE D'INGÉNIEURS Groupe ISAE

supméca

POLITECNICO DI TORINO

NAE Normandie AeroEspace La passion de l'Excellence

PLACIS

EISTI Ecole Internationale des Sciences du Traitement de l'Information

ENSEA Ecole Nationale Supérieure de l'Electronique et de ses Applications

LYCÉE DIDEROT PARIS

ENSTA Bretagne

In process

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES ROUEN

iut ROUEN

Le Havre iut L'EXPERIENCE de la réussite

iUT caen

TRL1 Basic Definition

PLACIS

supméca

POLITECNICO DI TORINO

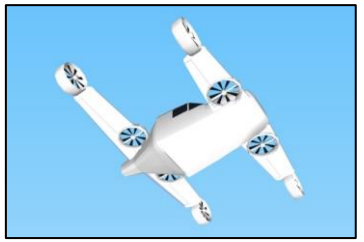
ESTACA ÉCOLE D'INGÉNIEURS Groupe ISAE

Project history

TRL0 Project Launch (2015)

Studies 2015/2016

TRL1 Basic Definition (2016)



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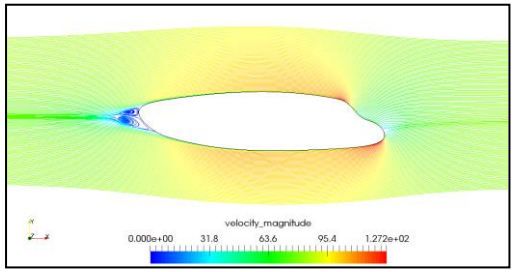
TRL2 Concept (2016) in Process

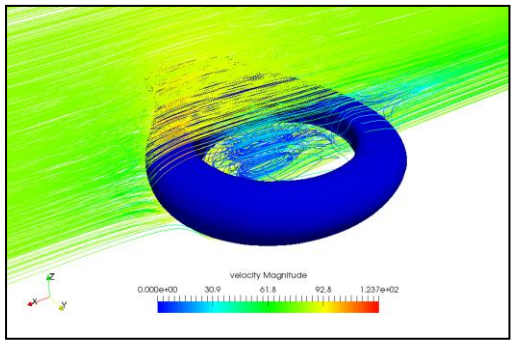
2016/2017

Meet us in **Le Bourget Air Show 2017** !

Aerodynamic studies



Cockpit shape optimization
Supmeca 2016



Rotor shape optimization
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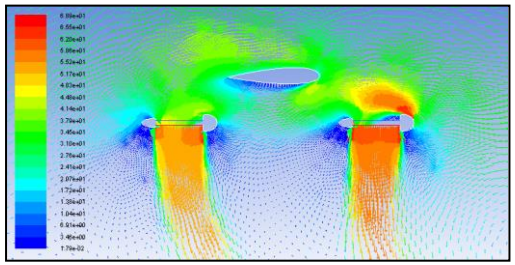
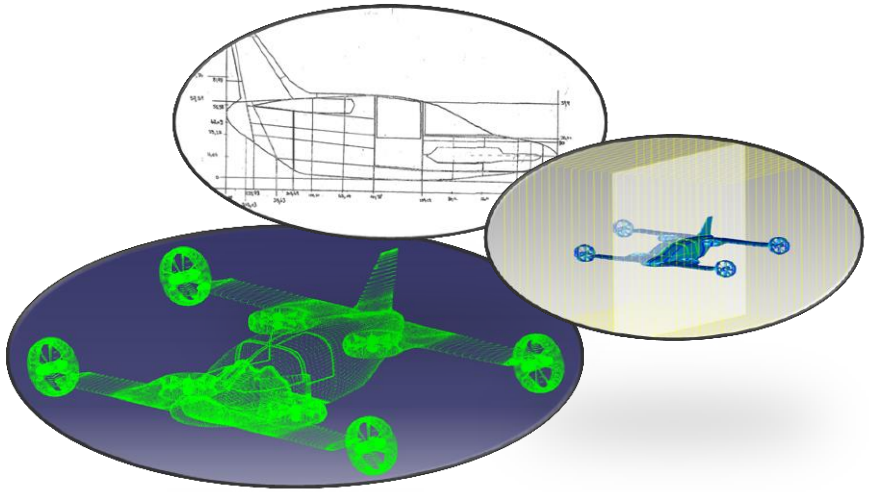
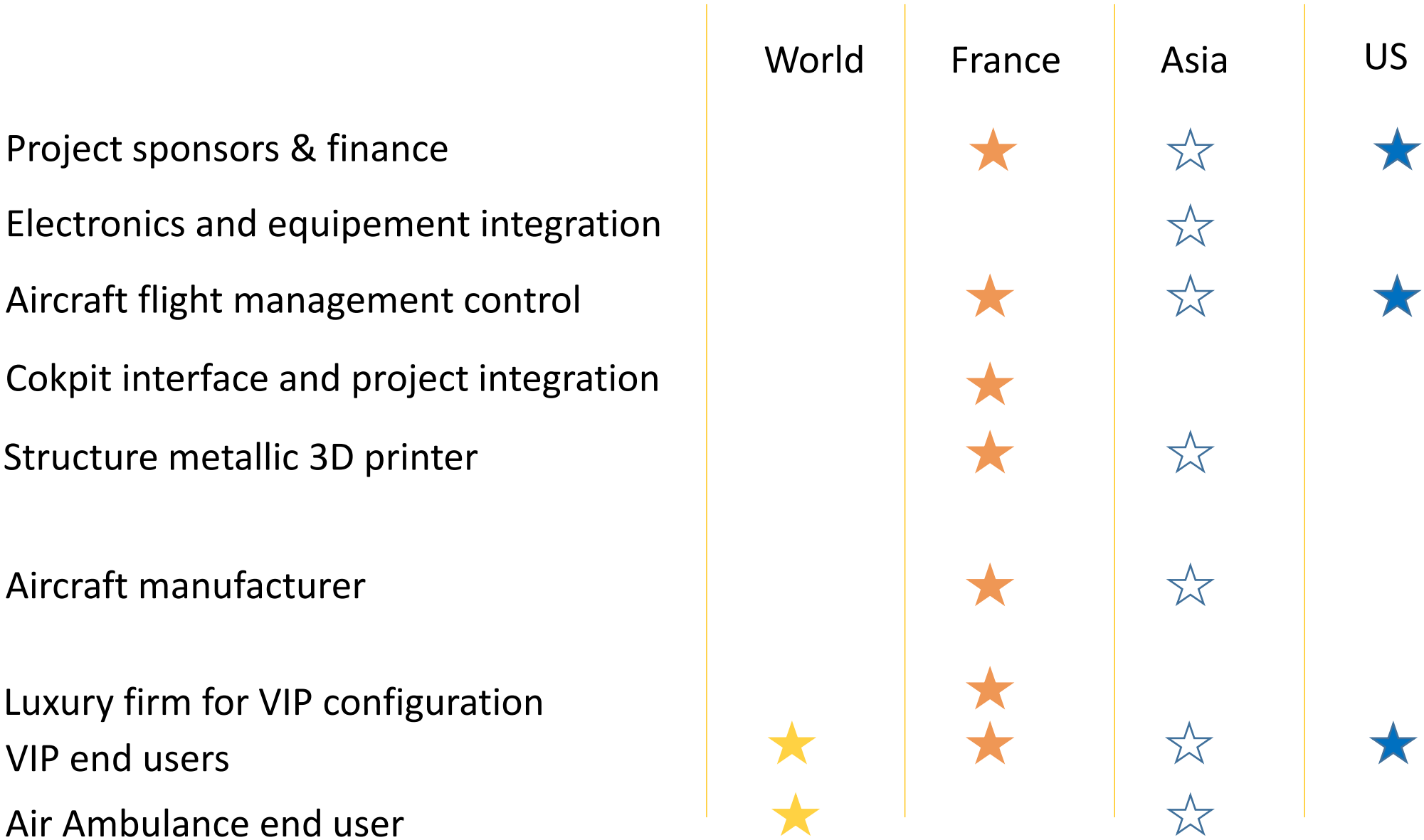


Vertical rotor air flow studies
Supmeca 2016

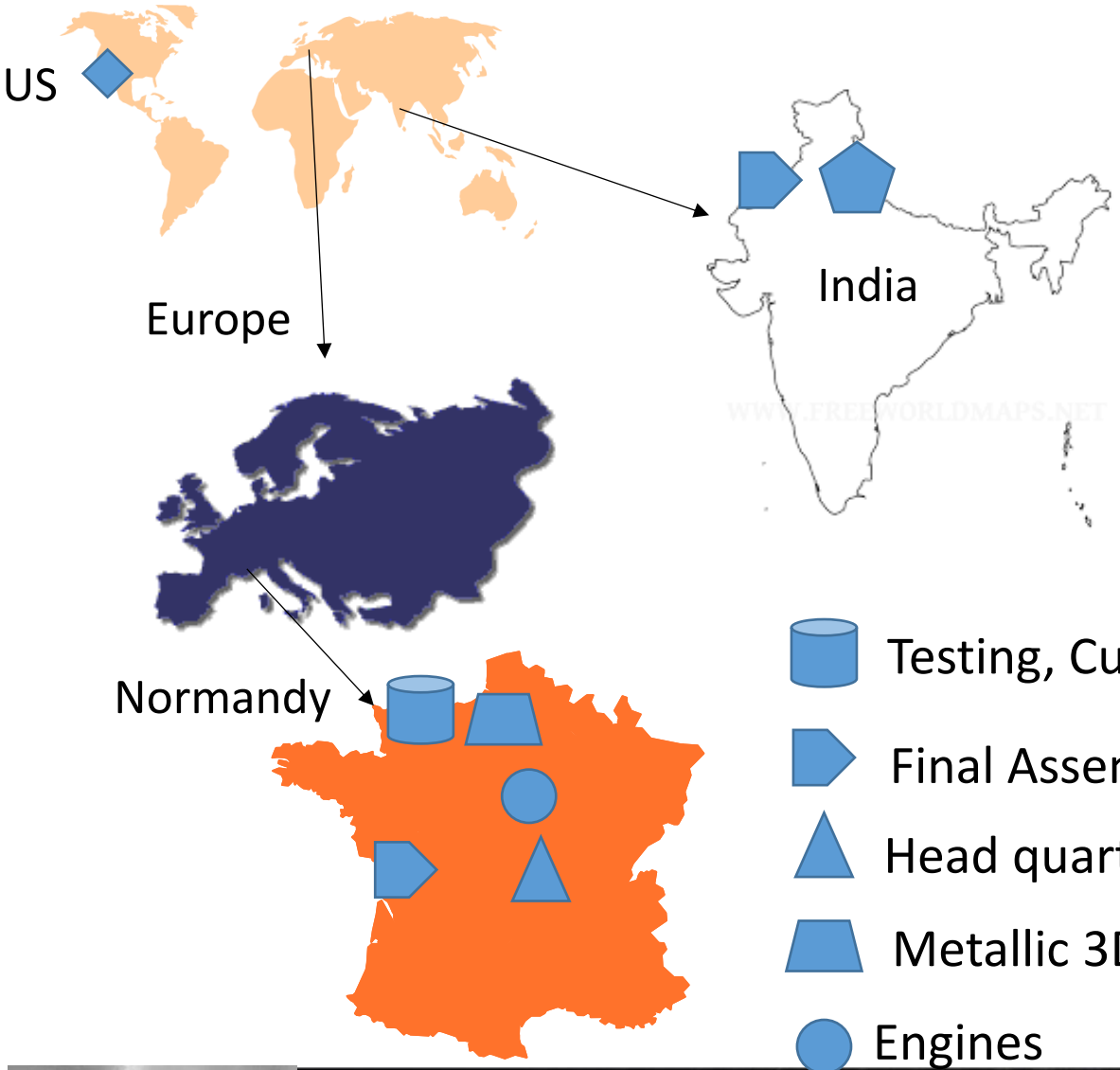


Numerical studies
Supmeca, end of 2016

Partners to be defined



Targeted Industrial Schem



FAL for Standard Config & Air Ambulance

Flight control system & Equipements

IT Transport Management and project funding

Testing, Customer service & Worldwide Logistic

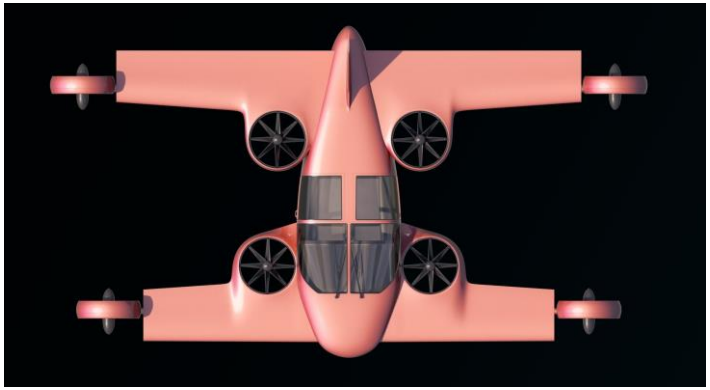
Final Assembly Line for VIP config

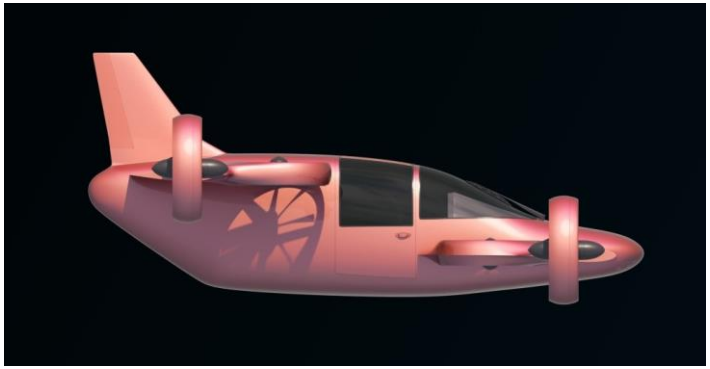
Head quarters

Metallic 3D printing

Engines

Mini-Bee project for TRL2





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TECHNOPLANE
AERONAUTICAL INNOVATION

Mini-Bee (at end of TRL1)
2 PAX VIP
Electric Octocopter
Tilt quadcopter & vertical quadcopter
Hybrid energy : batteries & fuel

Estaca Laval 2016

Take-off and tilt transition





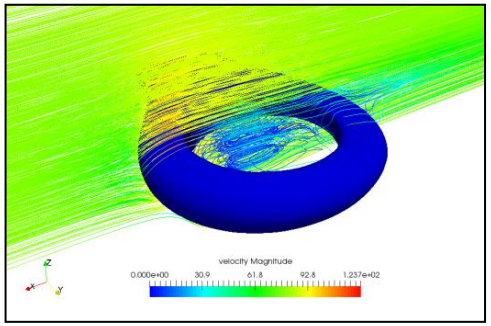




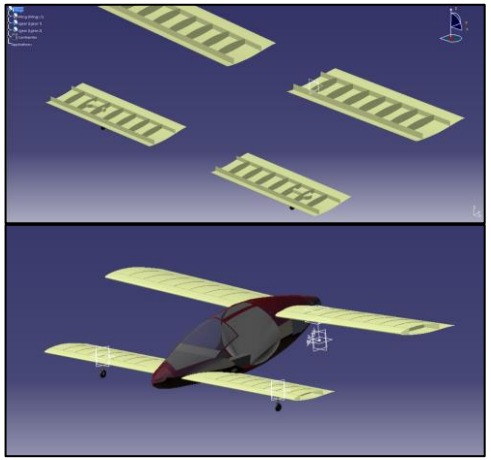
By Estaca 2016

TRL1 project tasks (2015/2016)

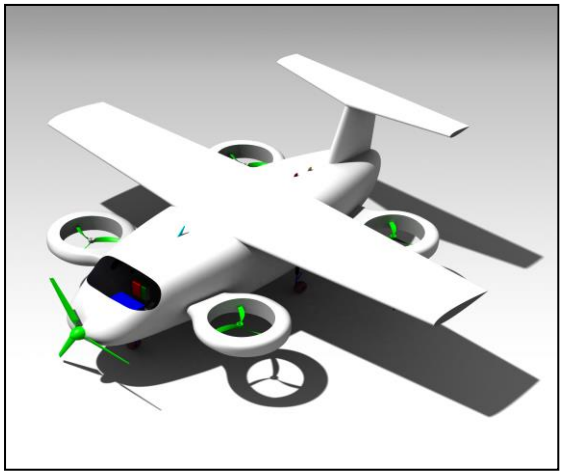
Polito 2015



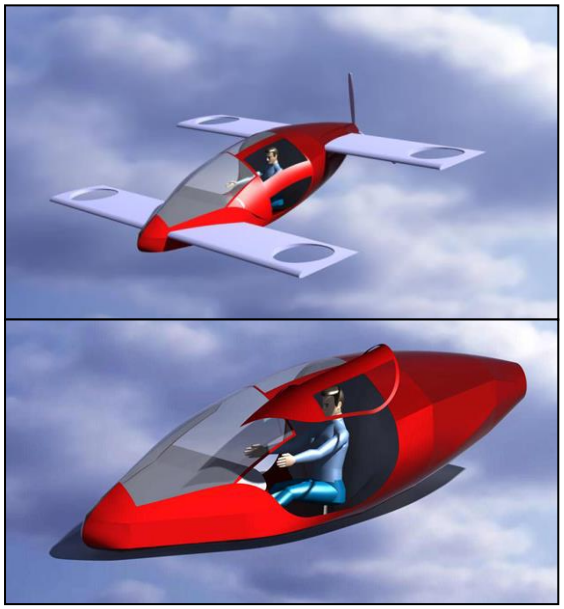
Supmeca
2016



Estaca
2016 group1



Supmeca & Polito
2016 (Placis)



Estaca
2016 group2