



MINI BEE

PERSONAL AIRCRAFT

Mini-Bee

2PAX VTOL Hybrid Octocopter



Agenda

- Mini-Bee description
 - Concept and technical description
 - SWOT analysis
- TRL1 project
 - Partners and project history
 - TRL1 Tasks
 - Aerodynamic studies
- TRL2 project launch
(TRL2 = Technology concept and application formulated)
- Annexes : State of the art, Other innovative projects

Mini-Bee : 2PAX VTOL Hybrid



TECHNOPLANE

MINIBEE

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Mini-Bee Project partners



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Coordinator :

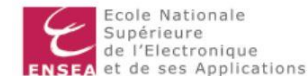


Universities :



POLITECNICO
DI TORINO

Institution & financial partners :



Design:



MINI BEE

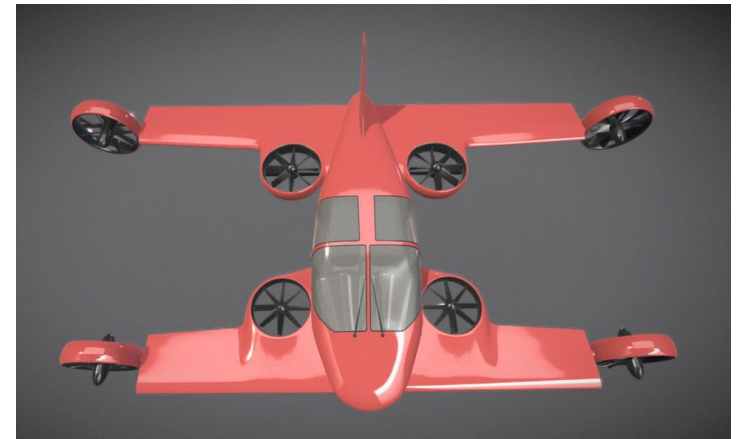
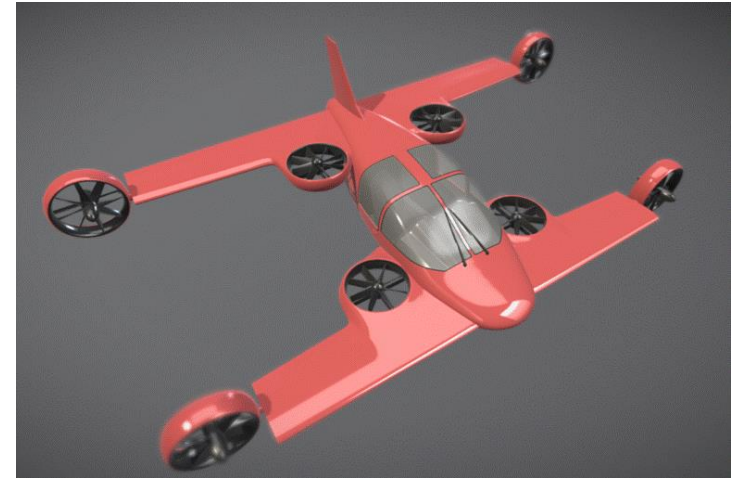
PERSONAL AIRCRAFT

www.mini-bee.com

v8.11 – 21 Oct. 2016
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Mini-Bee description

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



Architecture

External tilt
quadcopter

Central vertical
quadcopter

Rear electric
generator

Gullwing
doors

Fuel
generators

Battery kits

Tailwheel-type
landing gear

Low noise nacelle

Retractable front
landing gear

3D printed
metallic
structure

Biplane

Electric flight
controls



Technical description

Aircraft characteristics

2 seats, VTOL, Short wing for cruise flight
MTOW 1200 kg, Range 800km , Cruise speed 220 km/h
Wing surface 15m², no control surface

Engines

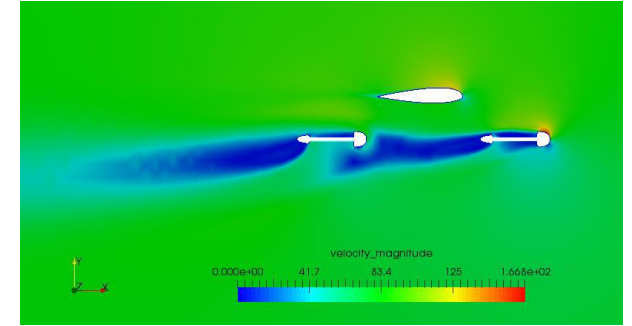
Central vertical quadcopter + External tilt quadcopter
4 hybrid fuel generator for central quad copter
4 electric engines for external tilt quadcopter
Electronic control of engines power and tilt angles

Cockpit interface

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

Take-off and flight transition

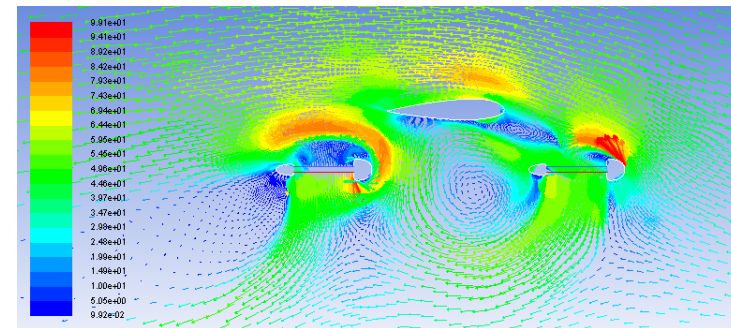
Cruise
flight



Tilt
transition

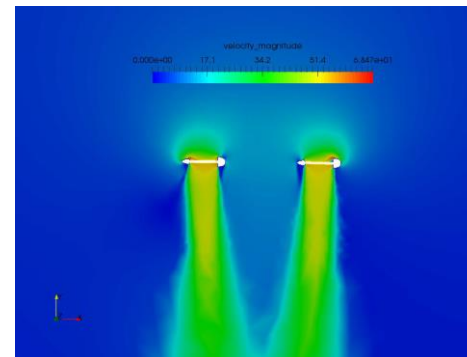


Estaca 2016

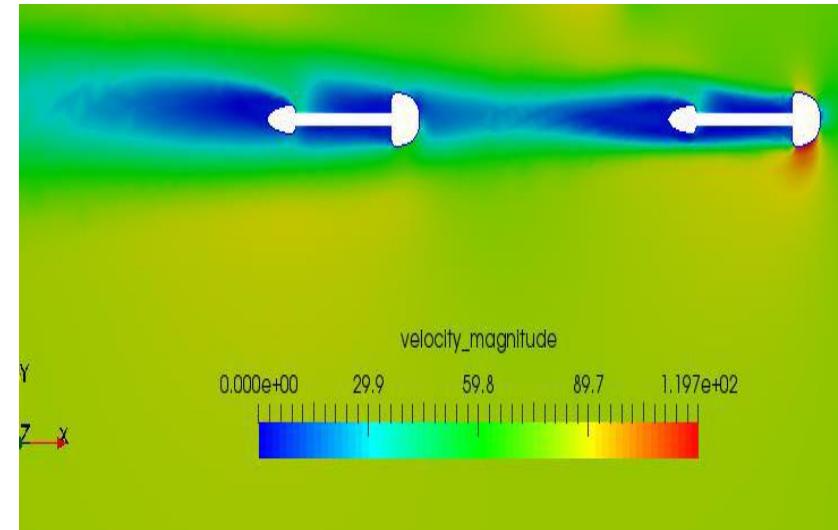


Supméca 2016

Vertical
take-off



Cruise flight



Take-off and tilt transition



By Estaca 2016

Technical data

MTOW : 1200 kg

- Structure : 310kg
- Fuselage : 80kg
- Payload : 220 kg (2 PAX)
- Systems : 125 kg
- Engines : 240 kg (4 * generator + 8 Electric engines)
- Batteries : 90kg
- Fuel : 140kg

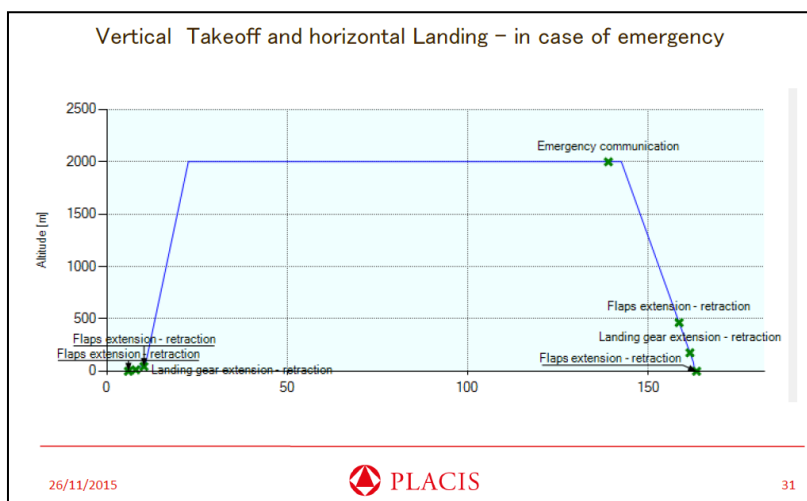
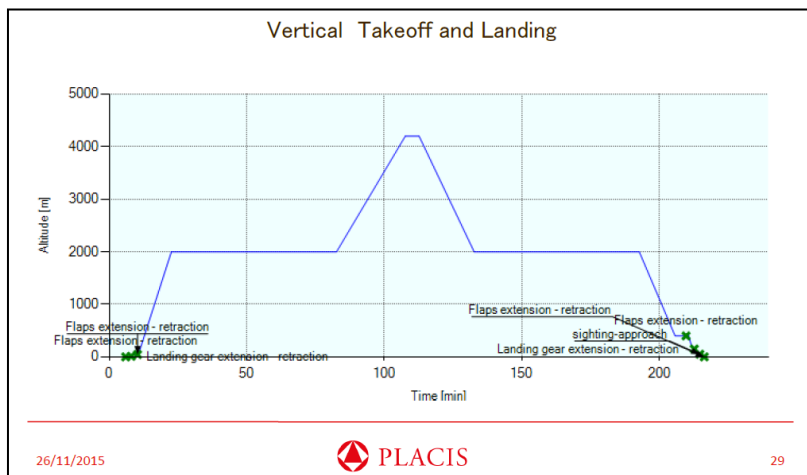
Target for TRL3 : MTOW 1000 kg

Estimated costs

Total costs : **700k€**

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

Mission profile



Phase	Duration		Altitude (start)	Altitude (end)	Speed	Climb rate	Specific Consumption
	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

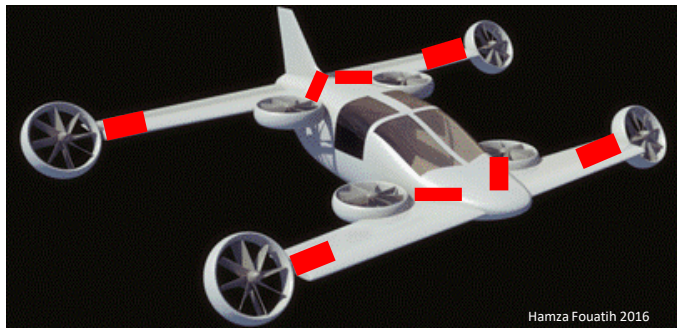
26/11/2015

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

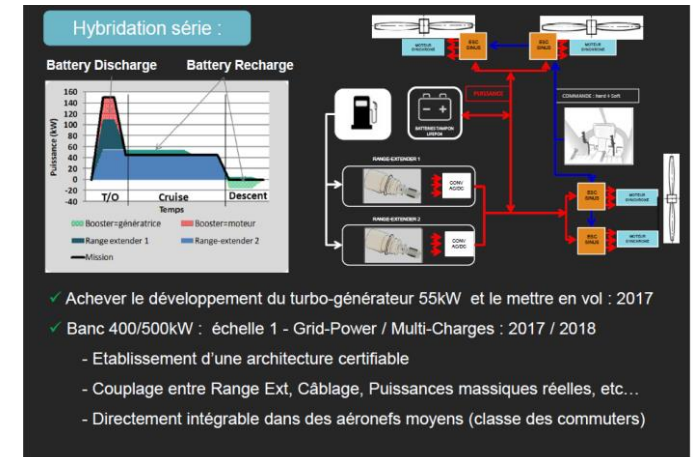
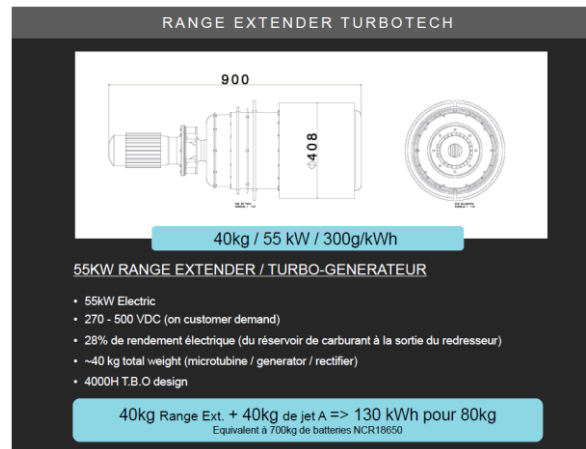
Power needed 220 kW
Installed power 440kW

provided by

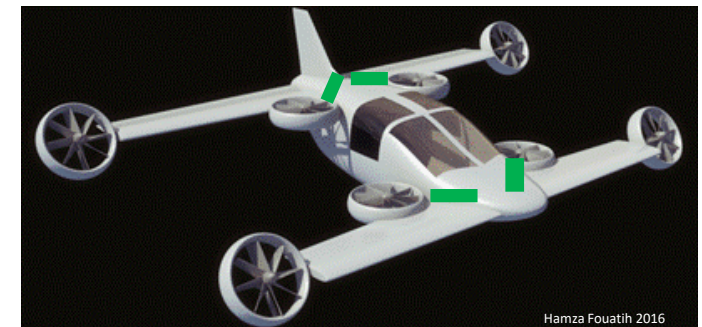
- 90kg of batteries during take-off and vertical flight
- 4 fuel generators during cruise flight

4 Electric fuel generator + Batteries

Equipement proposed : 4 Turbotech 55kW (160kg)



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



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 light 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 helicopter
- All electric aircraft
- Tilt rotor (bi and quadri)
- Hybrid energy
- Others innovative projects

Partners for R&D

Project coordinator



TRL2 Detailed Definition



POLITECNICO
DI TORINO

In launch



TRL1 Basic Definition



POLITECNICO
DI TORINO



Project history

TRL0 Project Launch (2015)



Studies 2015/2016



TRL1 Basic Definition (2016)



Lesser Open Bee
License 1-3

TRL2 Concept (2016) in Process



2016/2017

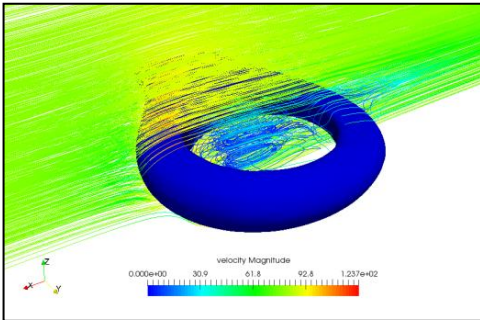


Meet us in
Le Bourget Air Show 2017 !

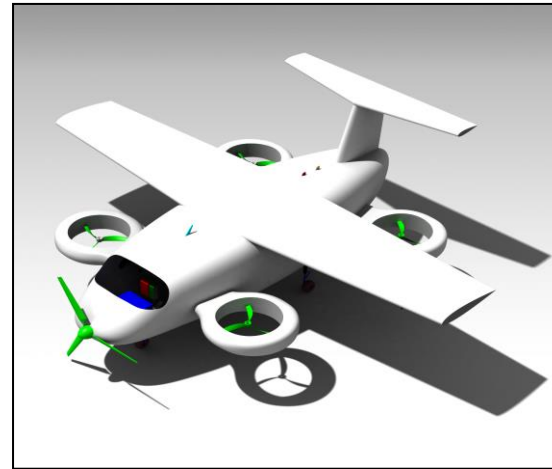
TRL1 project tasks



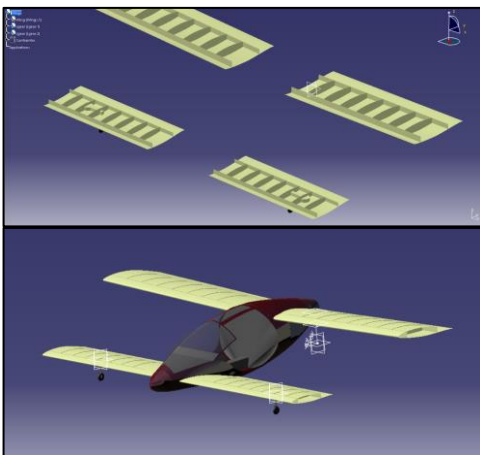
Polito 2015



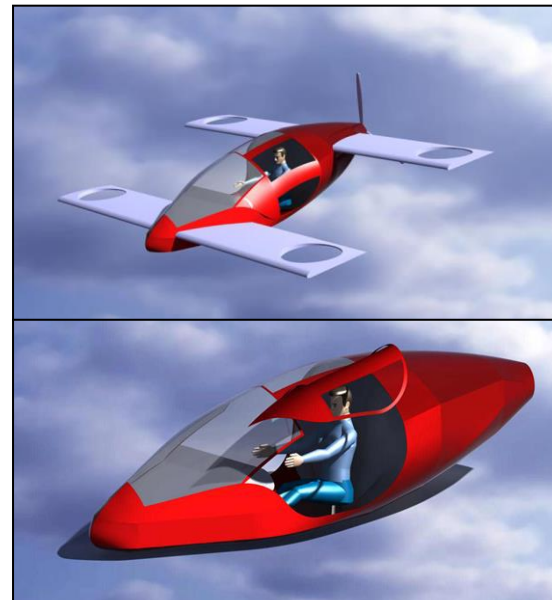
Supmeca
2016



Supmeca & Polito
2016 (Placis)

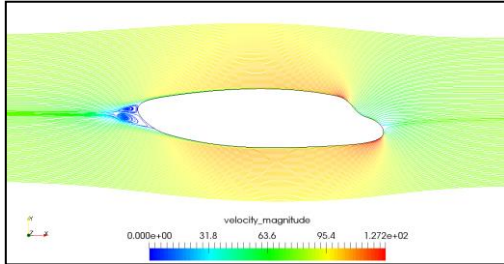


Estaca
2016 group1

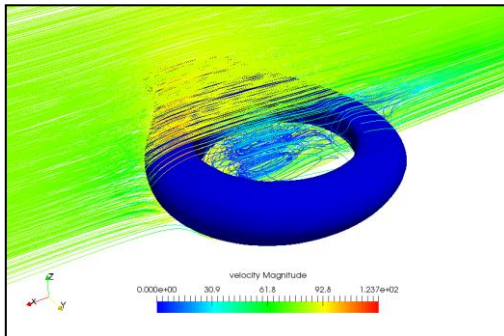


Estaca
2016 group2

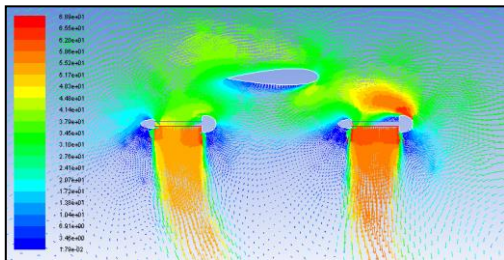
Aerodynamic studies



Cockpit shape optimization
Supmeca 2016

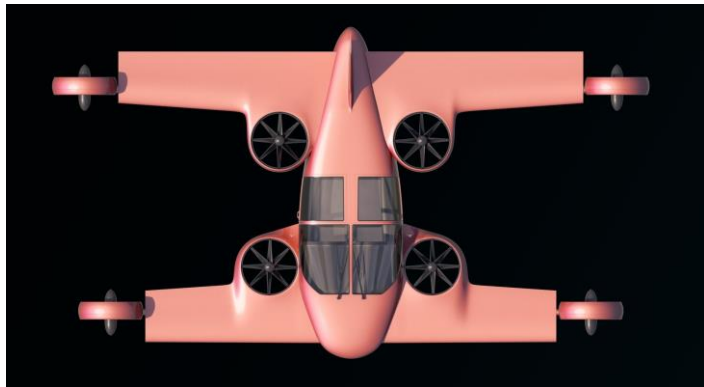


Rotor shape optimization
Supmeca 2016



Vertical rotor air flow studies
Supmeca 2016

Mini-Bee project for TRL2



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



Estaca Laval 2016



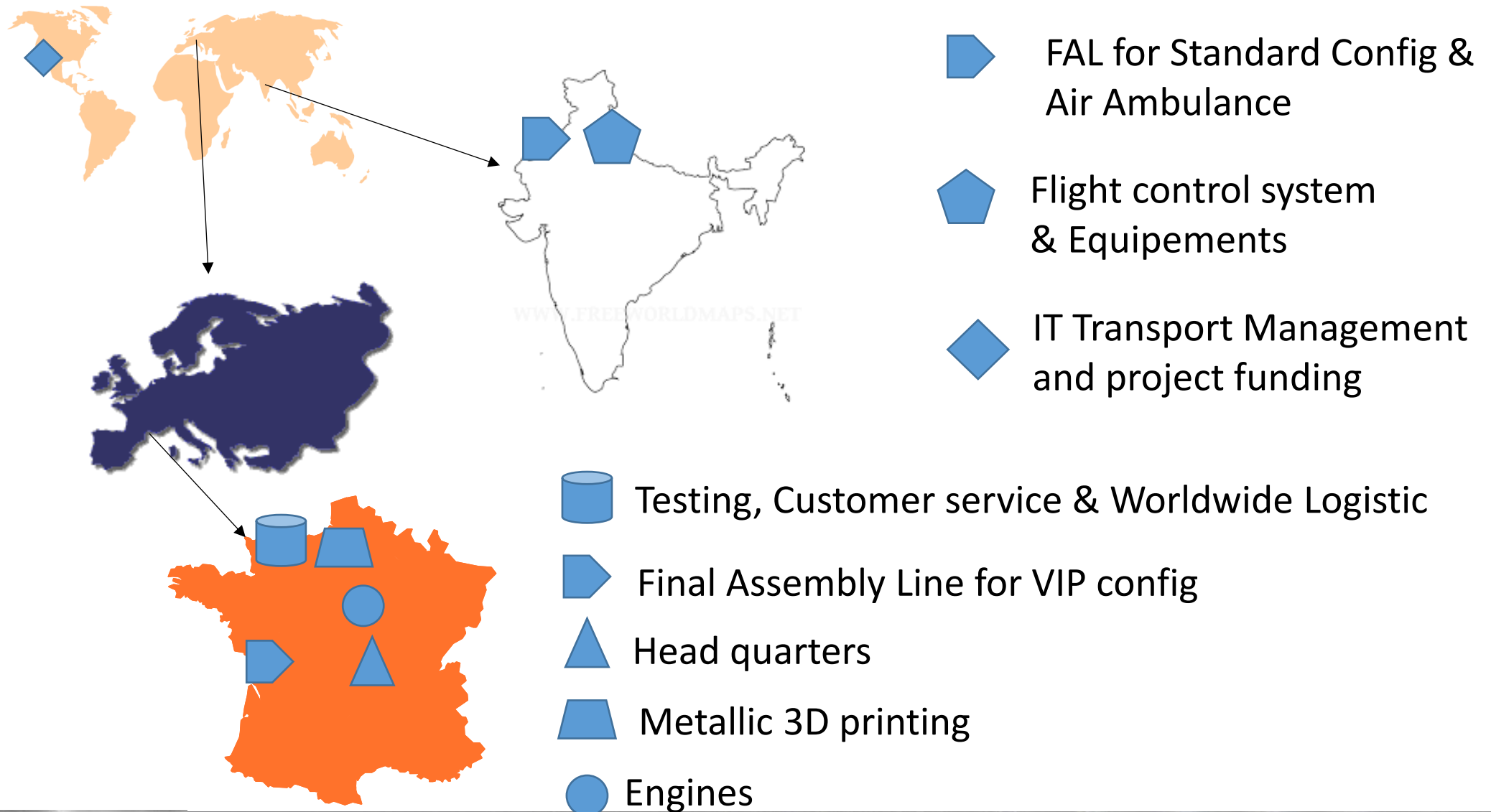
Actions for Mini-Bee TRL2 Project

- Launch Mini-Bee TRL2 project :
 - Assess detailed technical configuration
 - Evaluate market opportunities, production and flight costs
 - Define partnership for TRL2 and TRL3
 - Draw project financial path
 - Investigate for lovemoney phase

Partners to be defined

	World	France	India	US
Project sponsors & finance		★	☆	★
Electronics and equipment integration			☆	
Aircraft flight management control		★	☆	★
Cockpit interface and project integration		★		
Structure metallic 3D printer		★	☆	
Aircraft manufacturer		★	☆	
Luxury firm for VIP configuration		★	☆	
VIP end users	★	★	☆	★
Air Ambulance end user	★		☆	

Targeted Industrial Schem



Financial project path

TRL	Statut	Début	Fin	Montant estimé (k€)
0	Terminé	2014	2015	20
1	Terminé	2015	2016	50
2	En cours	2016	2017	200
3		2017	2019	2 000
4				5 000
5				10 000
6				15 000
7				20 000
8				25 000
9				25 000

Detailed numerical mock-up

First flight

Test flights

Final developments

Qualification

Commercialisation / Operations

Estimated overall project 100m€

Actual step : Lovemoney for 500k€ to 2m€

Annexes

Individual Air Vehicules

State of the art

Cessna Skylane



- Height: 2,84 m
- Wingspan: 10,97 m
- Length: 8,84 m
- Max Take-Off Weight: 1406 Kg
- Power: 230 hp
- Engine: lycoming IO-540-AB-1A5
- Maximum speed: 269 Km/h
- Range: 1695 Km
- Price: 277 300 \$

Robinson R44



- Height: 3,3 m
- Rotor diameter: 10,1 m
- Length: 11,7 m
- Max Take-Off Weight: 1089 Kg
- Power: 248 hp
- Engine: lycoming IO-540-AE1A5
- Maximum speed: 240 Km/h
- Range: 560 Km
- Price: 456 000 \$

X3 airbus



Osprey V22



Cessna TTX



- Height: 2,74 m
- Wingspan: 10,97 m
- Length: 7,68 m
- Max Take-Off Weight: 1633 Kg
- Power: 310 hp
- Engine: turbo TSIO-550-c
- Maximum Speed: 435 Km/h
- Range: 2315 Km
- Price: 733 950 \$

Agusta Westland AW609



- Height: 5,1-6,6 m
- Wingspan: 11,7 m
- Length: 13,3 m
- Max Take-Off Weight: 7200 Kg
- Power: 1900 hp
- Engine: Pratt & Whitney Canada PT6C-67A
- Maximum speed: 616 Km/h
- Range: 1390 Km
- Price: 10 000 000 \$

Airbus H160



Aeromobil 3.0



- Height: 1,50 m
- Wingspan: 8,32 m
- Length: 6 m
- Power: 81 hp
- Engine: rotax 912
- Maximum speed: 200 Km/h
- Range: 700 Km

Ecureuil



X2



Other innovative projects



Trifan 600 XTI (2015)



Helium (2016)



Agusta Westland
Zero (2015)



Airbus E-fan (2015)



E-volo (<2014)



eHang (fin 2015)



Kitty Hawk (2016)



zee.aero (2016)



Joby (2016)



Moler skycar
(<2016)



Urban aeronautics
(<2016)



Xplorair (2016)



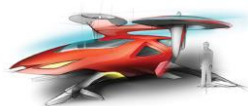
Lilium (2016)



SoloTrek Springtail



Airbus (2016)



Boeing (2016)



Macro industrie (2016)



Trekaero.com



Mini-Bee (2016)

Mini-Bee

2 PAX VIP Hybrid Octocopter



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TECHNOPLANE

AERONAUTICAL INNOVATION