





Academic Course in Aircraft conceptual design and onboard system preliminary design at Politecnico di Torino

M. Fioriti, N. Viola, R. Fusaro, L. Boggero









Course title: Integrated Aerospace Systems Design

When: 2nd year of Master degree

Who: 25 – 30 students and 4 teachers

Duration: 6 months (8 ECTS)

Aim of the course:

- to provide students with the capability to carry out a conceptual design of a given aircraft
- to give knowledge to perform the preliminary design of the on-board systems in an integrated way
- to enhance students' teamwork experience

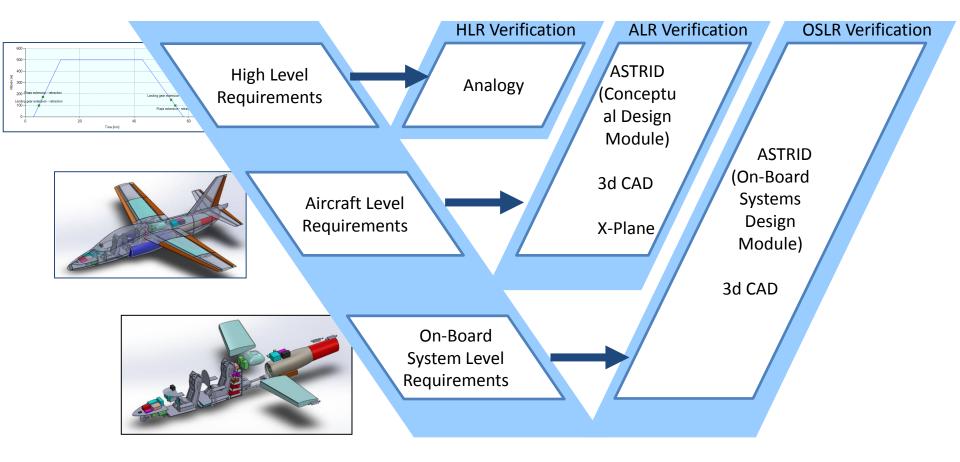




- $\checkmark~$ The attending students are divided in 6 -8 teams
- ✓ Each team is composed by around 5 students
- ✓ Each team will design an aircraft starting from some high level requirements. The aircraft test cases are changed yearly
- ✓ The requirements are adequately detailed to easy individuate the aircraft class but students have enough freedom in design choices
- ✓ During every lesson the students' work is checked and evaluated
- Once a month students present their work to the other teams and teachers

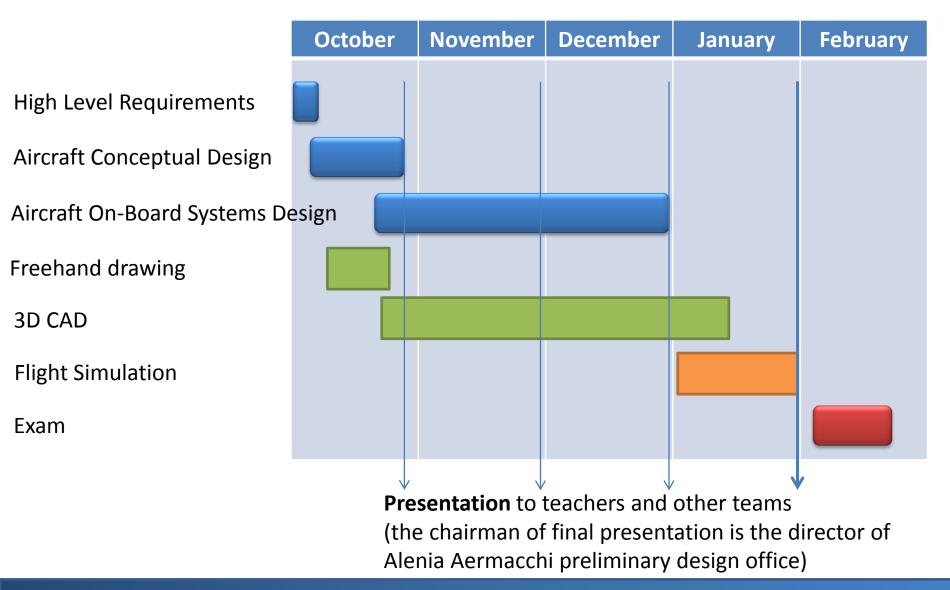






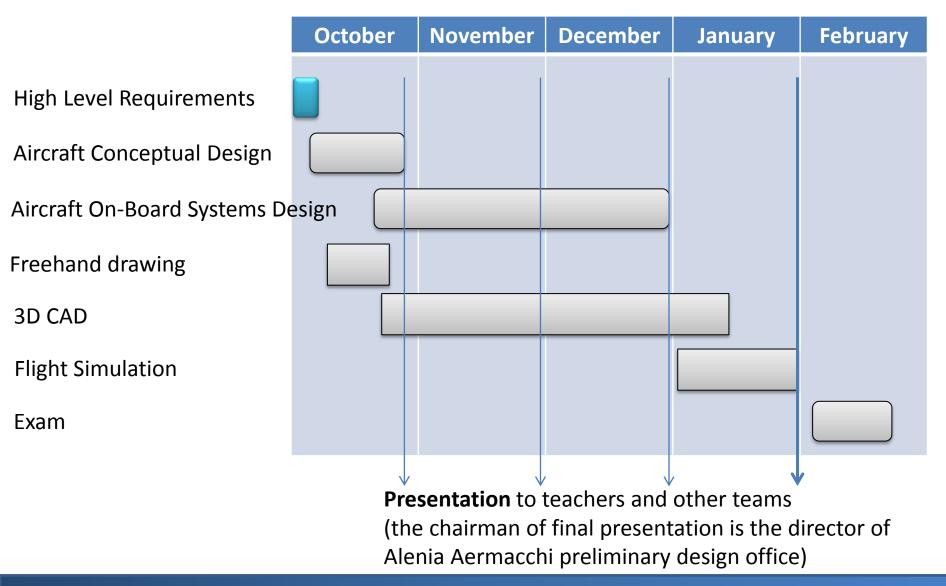














Test cases – High Level Requirements



1st Team: Conventional jet-liner with innovative on-board systems

- Number of passenger 132+4
- Single aisle 6 abreast
- Max range 5000 km
- Max speed (@ 10000 m) 880 km/h
- Field length 2000 m
- Innovative on-board systems



2nd Team: General aviation long range

- Number of passenger / pilot : 4 / 2 or 5 / 1
- Max range 3500 km
- Max speed (@ 3500 m) 350 km/h
- Field length 1000 m
- Galley, toilet
- Relative high passenger comfort (cabin luminosity, noise reduction)



4th Team: Regional turboprop advanced architecture

- Number of passengers: 90
- Max range 1500 km
- Max speed (@ 8000 m) 650 km/h
- Field length 1000 m
- Laminar wing and fuselage





3rd Team: acrobatic general aviation / Screener

- Number of passenger / pilot: 1/ 1 or 0/2
- Max range 2500 km
- Max speed (@ 7000 m) 400 km/h
- Field length 900 m
- Acrobatic flight envelop
- Hybrid propulsion (piston + electric)







5th Team: Light jet-trainer

- Number of pilot: 2
- Tandem configuration
- Max range 1100 km
- Max speed (@ 7000 m) 750 km/h
- Field length 500 m
- Rate of climb (s.l.) 22 m/s
- Load factor: +7 / -3
- Low weight, low dimensions, low fuel consumption and operating cost



6th Team: MALE UAV civil missions

- Payload weight: 650 kg
- Max endurance: 33 hours @ 14000 m
- Field length 1600 m
- Advanced on-board system architecture (more or all-electric)



7th Team: BeePlane

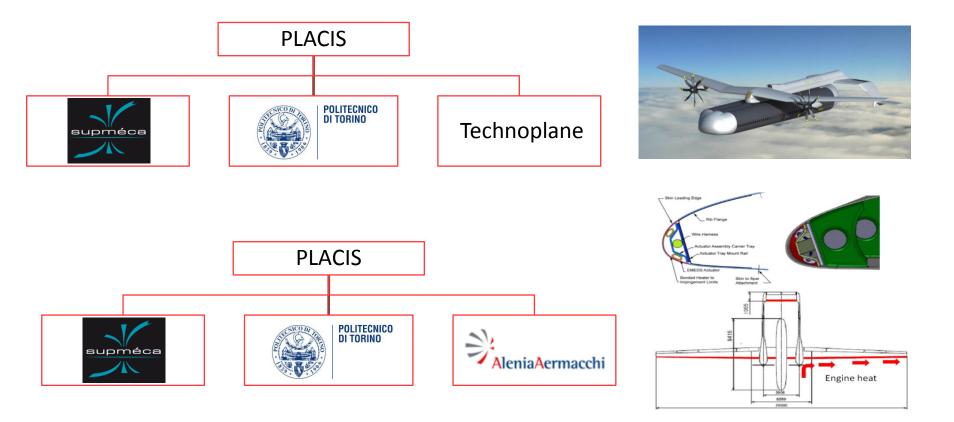
- Number of passenger: 220
- Max range 5000 km
- Max speed (@ 10000 m) 880 km/h
- Field length 1700 m
- Detachable fuselage





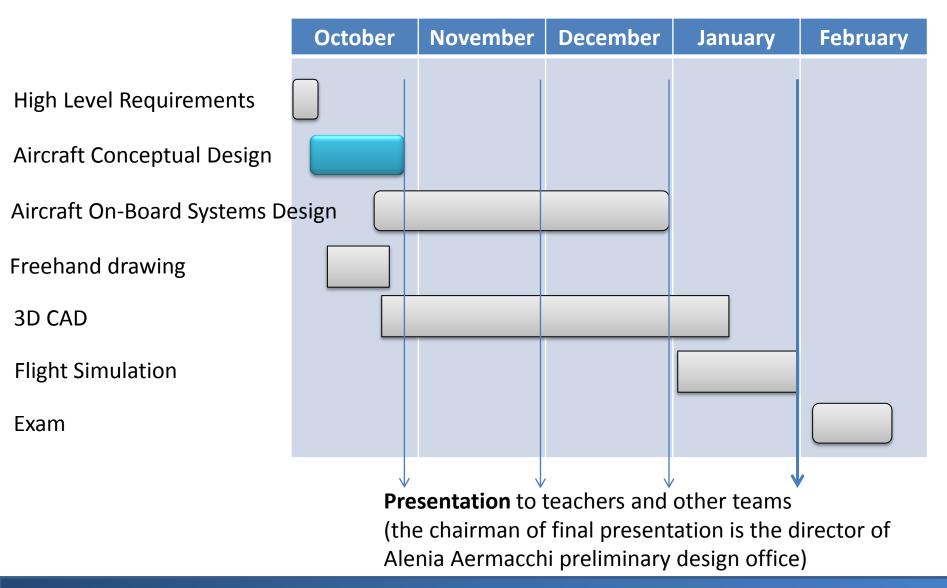


Collaboration with university Supméca (Paris) and other industries (in 2014, Alenia Aermacchi and Technoplane)



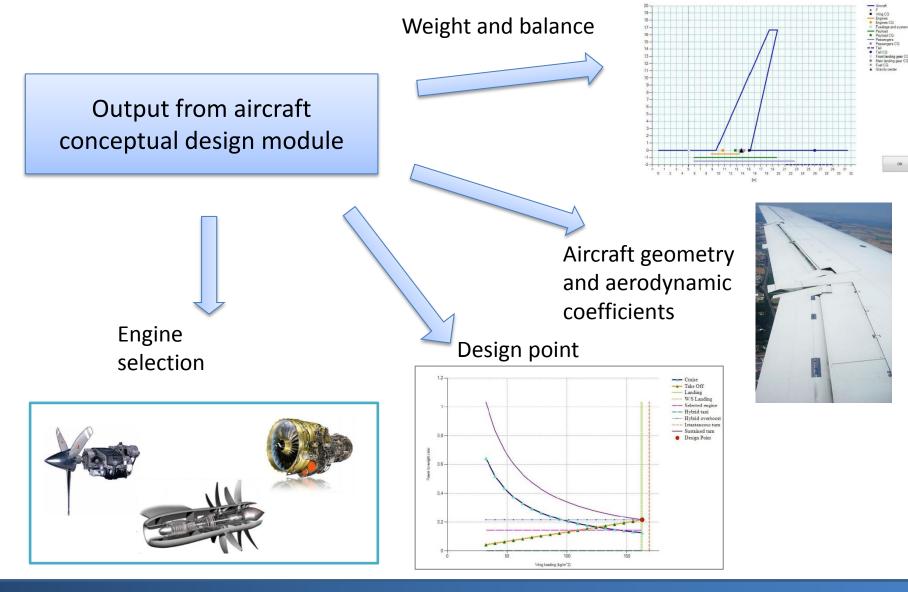








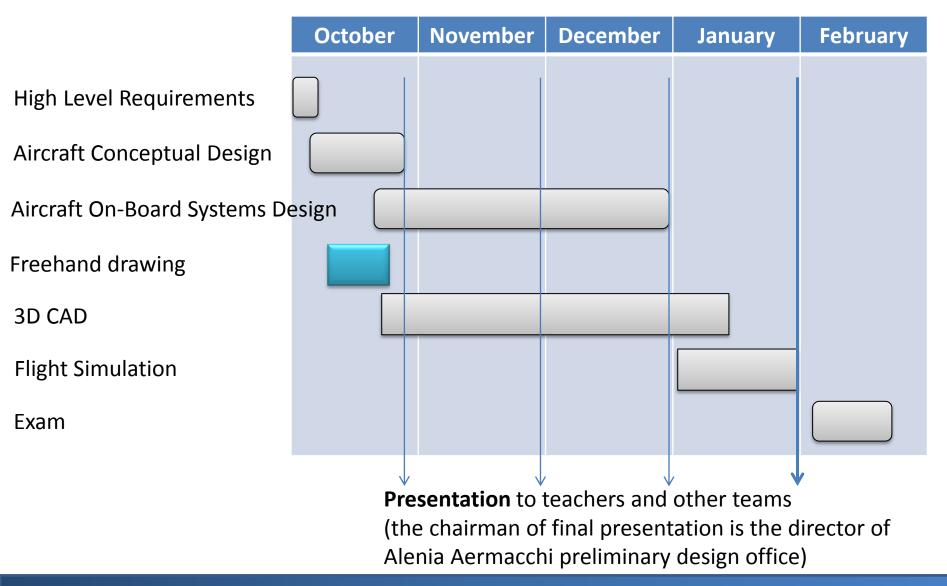




Academic Course in Aircraft conceptual design and on-board system preliminary design at Politecnico di Torino



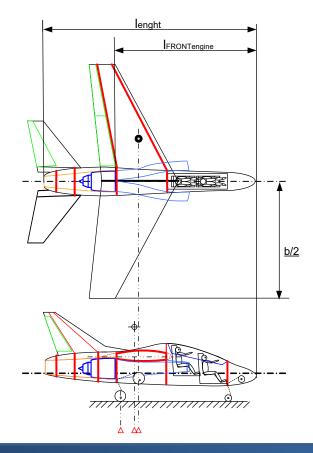


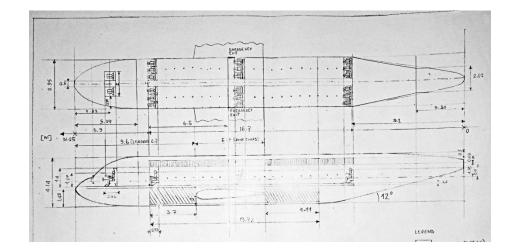


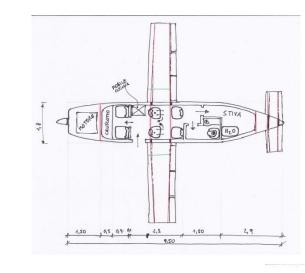




- Aircraft configuration
- Main dimensions
- Position of main elements (payload, engines, main structural elements, etc..)



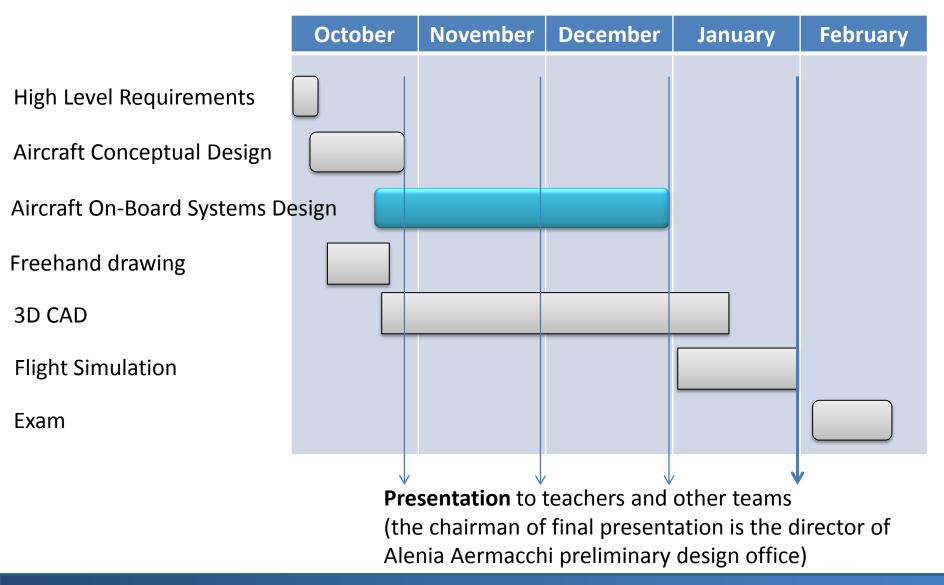








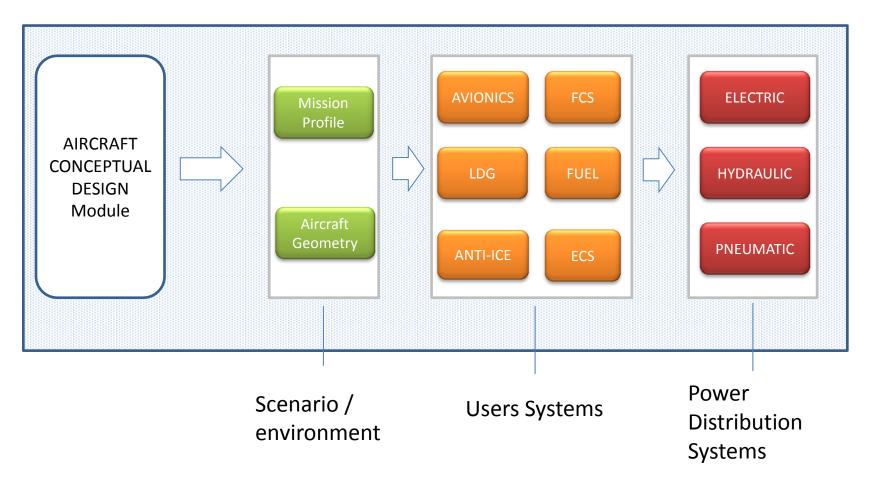








ASTRID software ----- Internal Modules

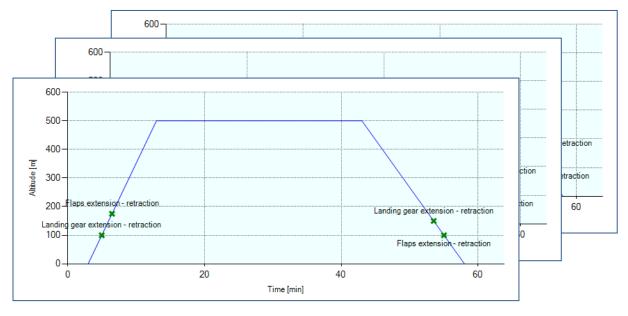




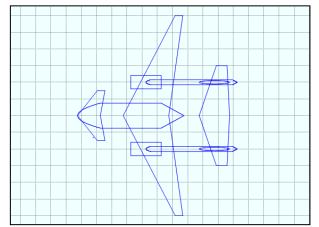


ASTRID global input

Aircraft **mission profiles** designed to take into account the on-board systems utilization



Aircraft geometry. Needed for subsystems design (e.g. distance between fuel tanks and engines etc.)



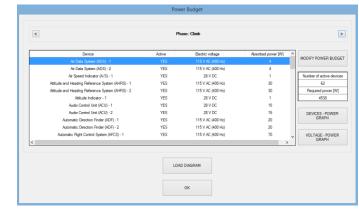


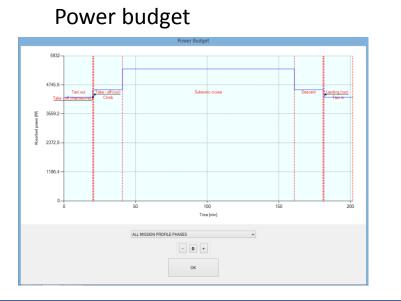
Selection of avionic equipment starting from functional analysis

data base

	Avionic system				
Select an avionic subsystem:	Avionic subsystem: Displays and Controls				
Navigation Flight Control	Device	Number of devices	Number of redundancies		
Displays and Controls	Bectronic Flighr Instrument System (EFIS)		0		
Attack Altro sottosistema 1	Head Up Display (HUD)	1	0		
Altro sottosistema 2	Multi Function Display (MFD)	1	0		
DEFINE AVIONIC	<		Number of devices:		
SUBSYSTEM	ADD AVIONIC DEVICES DEFINE AVIONI	C DEVICES	+ -		

Equipment utilization within mission profile phases







Academic Course in Aircraft conceptual design and on-board system preliminary design at Politecnico di Torino



Second approach (for FCS, LND, Brakes, ECS, Fuel,

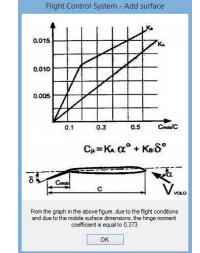


Users (flight control surfaces) definition

anti-ice...)

		Flight Con	itrol System			
le sufaces data Actuators sizing	Actuators data					
Surface name	Area [m ²]	Area [th^2]	Mean chord [m]	Mean chord [ft]	Mobile surface chord [m]	Mc ^
Left aileron	1,95	20,99	1,9	6,23	0,64	
Right aileron	1,95	20,99	1,9	6,23	0,64	
Left elevator	4.3	46,285	2,28	7,48	0.74	
Right elevator	4,3	46,285	2,28	7,48	0,74	
Rudder	8	86.111	3.79	12,43	1.24	
Left speedbrake 1	1,05	11,302	-	-	0,64	
Right speedbrake 1	1.05	11.302			0.64	
Left speedbrake 2	1,05	11,302			0,64	
Right speedbrake 2	1,05	11,302	-	-	0,64	
Left speedbrake 3	1,05	11,302			0,64	
Right speedbrake 3	1,05	11,302	-	-	0,64	
Left speedbrake 4	1.05	11.302			0.64	
Right speedbrake 4	1,05	11,302	-	-	0,64	
Left speedbrake int	1.05	11.302			0,55	
Right speedbrake int	1,05	11,302			0,55	
t als Read tak	E /	00.070			1 000	>
	ADD I	NOBILE SURFACE	REMOVE MOI SURFACE			
	Piesuks					
	GLOBAL I	RESULTS POWER	BUDGET EXPO	RT xlsx		
			рк			

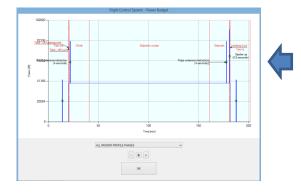
Estimation of the key design factors



Selection of technology (electrical, hydraulic...)

	Actuator power supply:	Hydraulic	~	
	Electric voltage		Hydraulic alimentation nomina	al pressure
	28 V DC	C O 230 V AC wild freq	206,8966	bar
	115 V AC const freq (400Hz	z) 💿 115 V AC wild freq	20689655.1724	Pa
	O other:		3000	psi
	Actuators Num actuators: 2	Num redundancies: 0	Presence of mobile sur	
			Mobile surfaces with the sa	me sizing:
	1' type Retative motion with	-		×
		adaptor		
	2" type			
	Linear motion (screw	v drive system)		
	C drive unit			
	motor-actual	stor (1:1)		
	3° type			
	Cylinder (inear)		REM	IOVE SURFACE
		CANCEL	ок	
	Power	•		
	Power i dimens	•		
		ions e		
		ions e	stima	
	dimens	Flight Control Syst	stima tem - Global results Total weight [kg] 10.34	Required power by the mobile surface actuation [W] 2 313.16
	dimens Suface Left aleron Right aleron	ions e Flight Control Syst	stima tem - Global results Total weight [kg]	tion
	Suface Left aleron Right aleron Left devator	ions e Flight Control Syst Category Hydraulic Hydraulic Hydraulic	stima tem - Global results Total weight [kg] 10.34	Required power by the mobile surface actuation (W) 2.313.16 2.313.16 8.189.31
	dimens Suface Left aleron Right aleron	Flight Control Syst Category Hydraulic Hydraulic	stima tem - Global results Total weight [kg] 10.94 10.94	Required power by the mobile surface actuation (W) 2313.16 2313.16
	Suface Left aleron Right aleron Left devator	ions e Flight Control Syst Category Hydraulic Hydraulic Hydraulic	stima tem - Global results Total weight [kg] 10,94 10,94 13,14	Required power by the mobile surface actuation (W) 2.313.16 2.313.16 8.189.31
	Surface Left alleron Right alleron Left elevator Right elevator	ions e Flight Control Syst Category Hydraulic Hydraulic Hydraulic	stima tem - Global results Total weight [kg] 10.94 10.94 10.94 13.14 13.14	Required power by the mobile surface actuation (W) 2.313.16 2.313.16 8.189.31 8.189.31
	Surface Left alleron Right alleron Left elevator Right elevator Right elevator Right elevator	Flight Control Syst Category Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic	Stima tem - Global results Total weight [kg] 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94	Prequired power by the mobile soffice adduction (W) 2 313.16 2 313.16 8.189.31 8.189.31 18.141.57
¢	Saface Left aleron Right aleron Right aleron Right elevator Right elevator Right elevator Right elevator	ions e Flight Control Syst Category Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic	stima tem - Global results Total weight [kg] 10.94 10.94 10.14 13.14 19.35 4.26	Required power by the mobile surface actuation (W) 2.313.16 2.313.16 2.313.16 2.313.16 18.93.31 8.189.31 18.141.57 2.254.68
¢	Surface Left alleron Right alleron Right alleron Right allerator Right speedbrake 1 Right speedbrake 1 Left speedbrake 2	tions e Flight Control Syst Caeegory Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic	stima tem - Global results Total weight Roj 10.94 10.94 13.14 13.14 19.35 4.26 5.07	Required power by the mobile suffice exclusion (W) 2.313.16 8.189.31 8.189.31 18.141.57 2.244.68 2.264.68 8.266.23
¢	Surface Surface Left alleron Right alleron Left elevator Right elevator Right speedbrake 1 Left speedbrake 2 Right speedbrake 2	Flight Control Syst Flight Control Syst Category Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo	Stima terr - Global results Total weight Rg] 1034 1034 13.14 13.14 13.14 13.14 13.15 25 25 25 25 75 207	Required power by the mobile surface actuation (W) 2 2.313.16 2.313.16 2.313.16 2.313.16 2.83.31 8.189.31 1.8141.57 2.264.68 2.264.68 2.264.68 2.264.68 2.264.63 2.206.23 8.206.23
(Suface Left alleron Right alleron Right alleron Right elevator Right elevator Right speedbrake 1 Left speedbrake 2 Right speedbrake 2 Left speedbrake 2 Left speedbrake 3	ions e Flight Control Syst Category Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic	stima tem - Global results Total weight Roj 10.54 10.54 13.14 13.14 19.35 4.26 5.07 5.07 5.1	Pecuated power by the mobile surface actuation (W) 2 313.16 8.189.31 18.141.57 2.244.68 8.264.68 8.266.23 8.206.23
\	Suface Left aleron Right aleron Held elevator Right seedtrake 1 Left speedtrake 1 Left speedtrake 2 Left speedtrake 3 Right speedtrake 3	ions e Flight Control Syst Category Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс	Stima ren - Global results Total wegit [62] 10.94 10.94 13.14 13.14 13.14 13.25 4.26 5.07 5.07 5.1 5.1	Prequered power by the mobile surface actuation (W) 2.313.16 2.313.16 2.313.16 2.313.16 2.345.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.63 8.206.23
¢	Suface Left aleron Regit aleron Left aleron Regit aleron Regit elevator Redit elevator Redit elevator Redit speedbrake 1 Left speedbrake 2 Regit speedbrake 3 Left speedbrake 3	ions e Flight Control Syst Category Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo	Stima ten - Global results Total weight Rg] 10.94 13.14 13.14 19.35 4.26 4.26 5.07 5.1 5.1 5.03	Resured power by the mobile surface actuation (W) 2 2313.16 2.313.16 2.313.16 8.188.31 8.188.31 18.141.57 2.264.68 2.264.68 8.265.23 8.266.23 8.206.23 8.206.23 8.206.23 6.347.04
(Suface Left aleron Right aleron Held elevator Right seedtrake 1 Left speedtrake 1 Left speedtrake 2 Left speedtrake 3 Right speedtrake 3	ions e Flight Control Syst Category Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс Нубзийс	Stima ren - Global results Total wegit [62] 10.94 10.94 13.14 13.14 13.14 13.25 4.26 5.07 5.07 5.1 5.1	Prequered power by the mobile surface actuation (W) 2.313.16 2.313.16 2.313.16 2.313.16 2.345.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.63 8.206.23
\	Suface Left aleron Right aleron Left devictor Right aleron Left apeedrake 1 Left apeedrake 1 Left apeedrake 2 Left apeedrake 3 Right speedrake 3 Right speedrake 4 Right speedrake 4	ions e Flight Control Syst Category Нубзайс Нубзайс Нубзайс Нубзайс Нубзайс Нубзайс Нубзайс Нубзайс Нубзайс Нубзайс Нубзайс Нубзайс Нубзайс	Stima ren - Global results Tetal wegit [62] 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10	Prequent prover by the mobile surface actuation (W) 2.313.16 2.313.16 2.313.16 2.313.16 2.345.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.63 6.306.23 6.306.23 6.347.04
\	Suface Left aleron Right aleron Left devictor Right aleron Left apeedrake 1 Left apeedrake 1 Left apeedrake 2 Left apeedrake 3 Right speedrake 3 Right speedrake 4 Right speedrake 4	ionsse Flight Control Syst Category Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo	Stima ten - Global results Tetal weigit Rg] 10.34 10.34 13.14 13.14 13.25 4.26 4.26 4.26 5.07 5.07 5.1 5.03 5.03 5.03 9.04 9.04 9.04 9.04 9.04 9.04 9.04 9.04	Prequent prover by the mobile surface actuation (W) 2.313.16 2.313.16 2.313.16 2.313.16 2.345.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.63 6.306.23 6.306.23 6.347.04
•	Suface Left aleron Right aleron Left devictor Right aleron Left apeedrake 1 Left apeedrake 1 Left apeedrake 2 Left apeedrake 3 Right speedrake 3 Right speedrake 4 Right speedrake 4	ionsse Flight Control Syst Category Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo	Stima ren - Global results Tetal wegit [62] 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10	Prequent prover by the mobile surface actuation (W) 2.313.16 2.313.16 2.313.16 2.313.16 2.345.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.63 6.306.23 6.306.23 6.347.04
\	Suface Left aleron Right aleron Left devictor Right aleron Left apeedrake 1 Left apeedrake 1 Left apeedrake 2 Left apeedrake 3 Right speedrake 3 Right speedrake 4 Right speedrake 4	ionsse Flight Control Syst Category Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo Hydraulo	Stima ten - Global results Tetal weigit Rg] 10.34 10.34 13.14 13.14 13.25 4.26 4.26 4.26 5.07 5.07 5.1 5.03 5.03 5.03 9.04 9.04 9.04 9.04 9.04 9.04 9.04 9.04	Prequent prover by the mobile surface actuation (W) 2.313.16 2.313.16 2.313.16 2.313.16 2.345.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.63 6.306.23 6.306.23 6.347.04
•	Suface Left aleron Right aleron Left devictor Right aleron Left apeedrake 1 Left apeedrake 1 Left apeedrake 2 Left apeedrake 3 Right speedrake 3 Right speedrake 4 Right speedrake 4	Flight Control Syst Flight Control Syst Category Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic	Stima ten - Global results Tetal weigit Rg] 10.34 10.34 13.14 13.14 13.25 4.26 4.26 4.26 5.07 5.07 5.1 5.03 5.03 5.03 9.04 9.04 9.04 9.04 9.04 9.04 9.04 9.04	Prequeed power by the mobile surface actuation (W) 2.313.16 2.313.16 2.313.16 2.313.16 2.345.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.63 6.306.23 6.306.23 6.347.04
\	Suface Left aleron Right aleron Left devictor Right aleron Left apeedrake 1 Left apeedrake 1 Left apeedrake 2 Left apeedrake 3 Right speedrake 3 Right speedrake 4 Right speedrake 4	Flight Control Syst Flight Control Syst Category Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic Hydraulic	Stima tem - Global results Tetal weight [kg] 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.94 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.95 10.	Prequeed power by the mobile surface actuation (W) 2.313.16 2.313.16 2.313.16 2.313.16 2.345.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.68 2.264.63 6.306.23 6.306.23 6.347.04

System power budget



Utilization within the mission profile phases



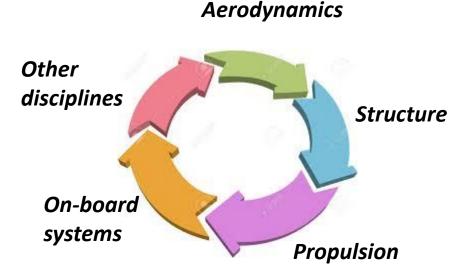
Academic Course in Aircraft conceptual design and on-board system preliminary design at Politecnico di Torino





After this design step, students' team should redesign the aircraft

Be familiar with the impact of each discipline on the other should be a primary task within Aircraft MDO optimization



Aircraft On-board systems represent:

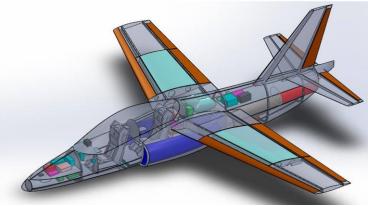
- 15% (liner) ÷ 30% (fighter) of aircraft empty weight
- 30% ÷ 50% of aircraft cost

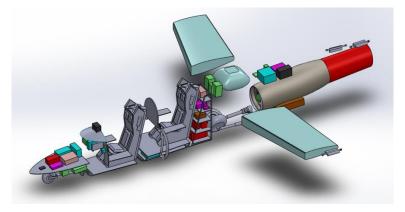
ATA 21	AIR CONDITIONING AND PRESSURIZATION
ATA 22	AUTO FLIGHT
ATA 23	COMMUNICATIONS
ATA 24	ELECTRICAL POWER
ATA 25	EQUIPMENT/FURNISHINGS
ATA 26	FIRE PROTECTION
ATA 27	FLIGHT CONTROLS
ATA 28	FUEL
ATA 29	HYDRAULIC POWER
ATA 30	ICE AND RAIN PROTECTION
ATA 31	INDICATING / RECORDING SYSTEM
ATA 32	LANDING GEAR
ATA 33	LIGHTS
ATA 34	NAVIGATION
ATA 35	OXYGEN
ATA 36	PNEUMATIC
ATA 37	VACUUM
ATA 38	WATER/WASTE
	ELECTRICAL - ELECTRONIC PANELS AND
ATA 39	MULTIPURPOSE COMPONENTS
ATA 40	MULTISYSTEM
ATA 41	WATER BALLAST
ATA 42	INTEGRATED MODULAR AVIONICS
ATA 44	CABIN SYSTEMS
ATA 45	DIAGNOSTIC AND MAINTENANCE SYSTEM
ATA 46	INFORMATION SYSTEMS
ATA 47	NITROGEN GENERATION SYSTEM
ATA 48	IN FLIGHT FUEL DISPENSING
ATA 49	AIRBORNE AUXILIARY POWER
ATA 50	CARGO AND ACCESSORY COMPARTMENTS



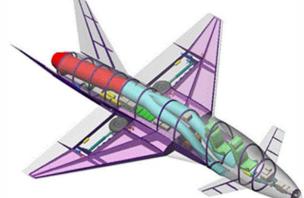


Some examples of the impact of on-board systems on the other design disciplines :





- On-board systems integration:
 - Impact on aircraft stability (influence on aircraft C.G.)
 - Position constraint and volume allocations (e.g. fuel tank for liner, landing gear, flight control actuator, radar etc.)
 - Reduction of power / thrust available
 - Handling qualities (moment of inertia)
 - ➢ RAMS
 - Cost (Development, Production and Operating)

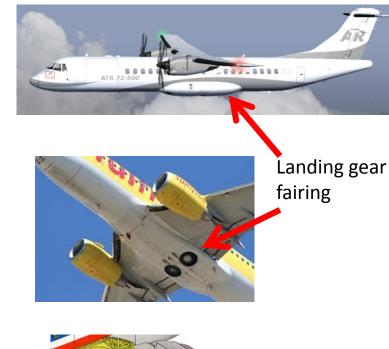


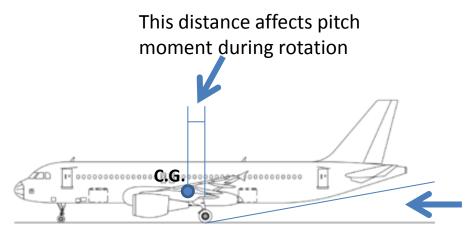


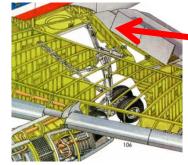


Landing gear integration

- Influence on wing or fuselage geometry
- Aerodynamics (external vane)
- Take-off / landing performance
- A/C stability on ground







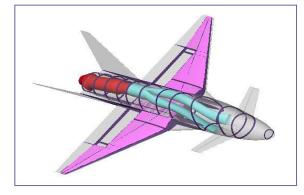
Structure arrangement

Landing gear length affects tail shape (tail clearance)

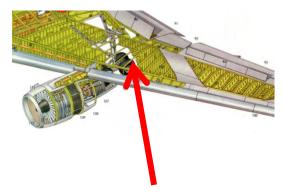




Some example of the impact of on-board system on the other design disciplines :



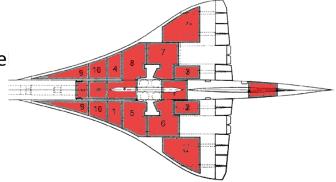




- Distance between spares
- ribs geometry

Fuel system integration:

- Impact on fuselage and wing geometry
- Aircraft performance range / endurance (quantity of fue storable)
- Aerodynamics (when external fuel tanks are needed)
- Influence on aircraft stability



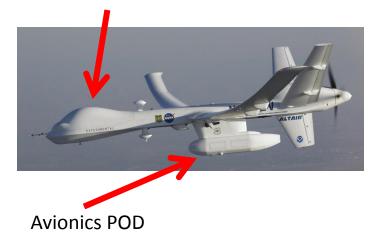




Some example of the impact of on-board system on the other design disciplines :

- Avionic system integration:
 - Aerodynamics (Air intakes, antennas, external POD)
 - Wing / fuselage geometry
 - Airframe material (radome, EM transparent material)

Fuselage enlargement needed to store satcom antenna





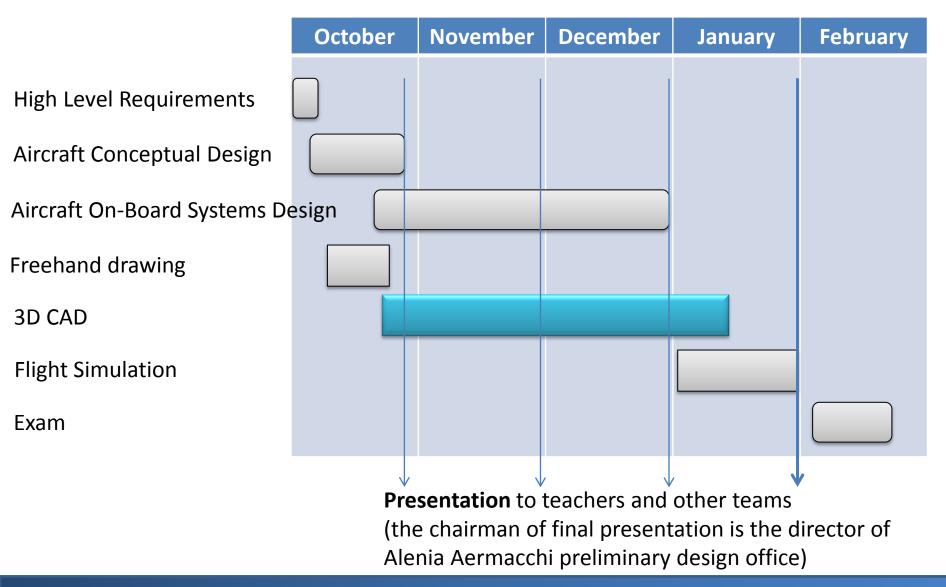
Flight control system (e.g. actuator speed, actuator

dimensions, etc.)

- Influence on aircraft handling qualities
- Wing aerodynamic drag



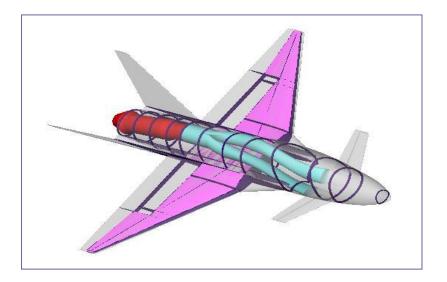


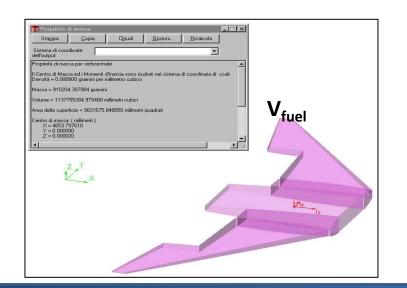


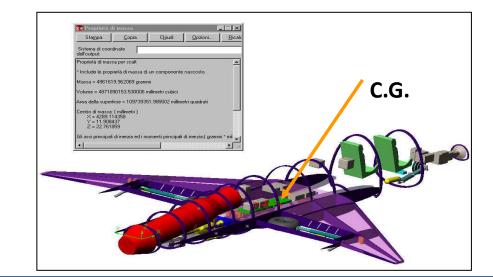




- Physical aircraft components integration
- Verification of fuel storable
- > C.G. position
- Aircraft wet area



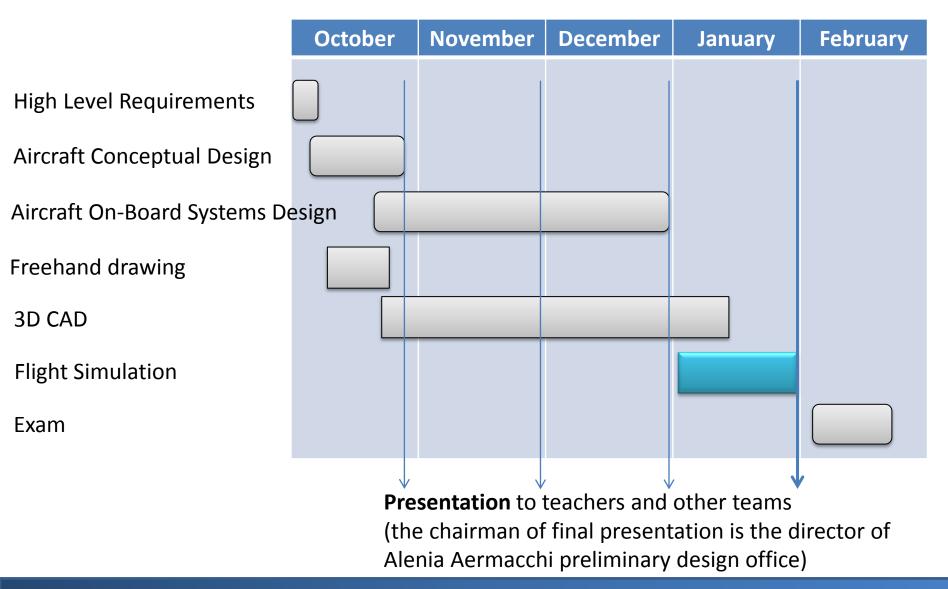




Academic Course in Aircraft conceptual design and on-board system preliminary design at Politecnico di Torino



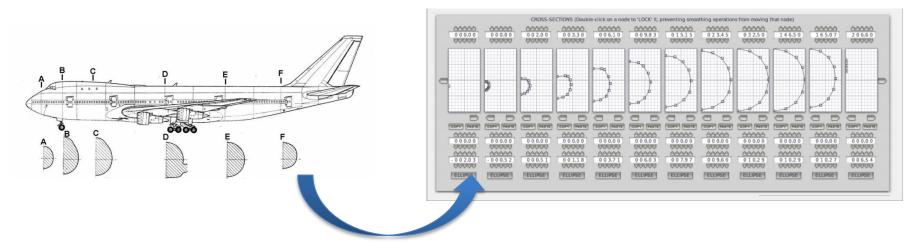








Fuselage layout



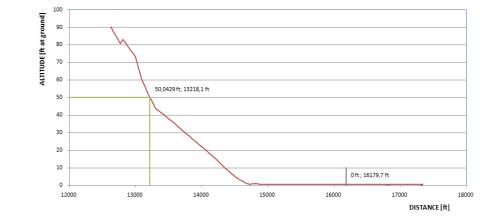
Wing layout

FOIL SPECS
semi-length 0 0 0.0 0 (wing semi-length, root to tip, ALONG THE 25% CHORD, not span (ft) long arm 0 0 0.0 0 (ft)
noot chord 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
tip chord 0 0 0.0 0 (ft) dihedral 0 0 0.0 vert arm 0 0 0.0 0 (ft)

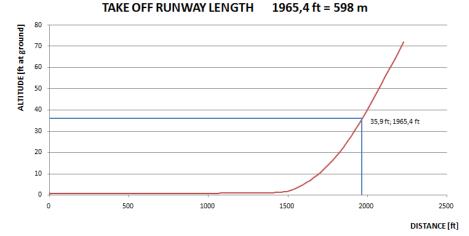
Impacts of a Prognostics and Health Management System on Aircraft Fleet Operating Cost During Conceptual Design Phase by Using Parametric Estimation

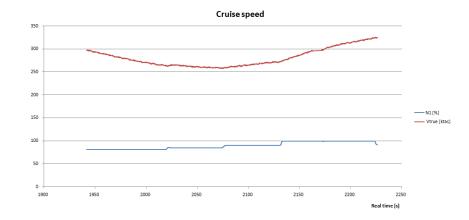






LANDING RUNWAY LENGTH: 2962 ft = 903 m





Impacts of a Prognostics and Health Management System on Aircraft Fleet Operating Cost During Conceptual Design Phase by Using Parametric Estimation

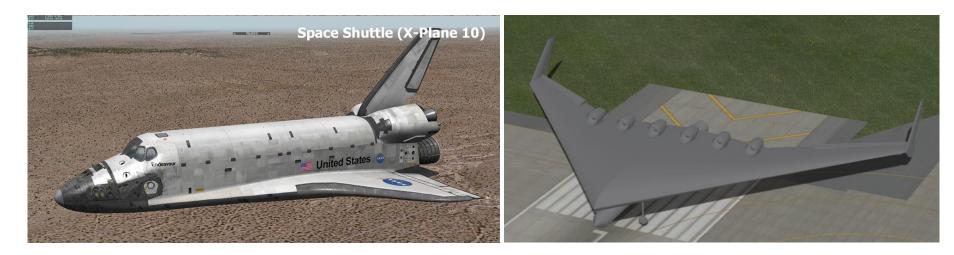








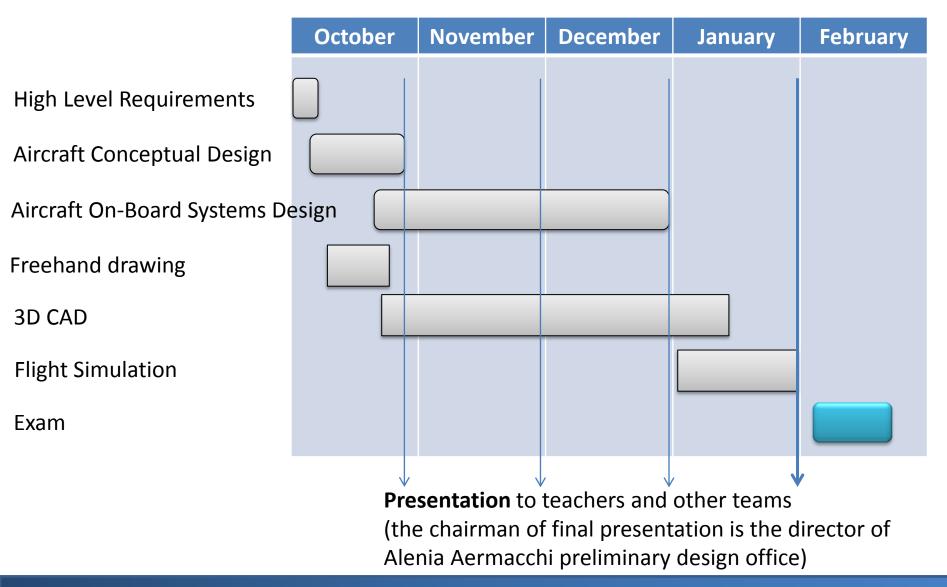
Examples of software's capabilities



Impacts of a Prognostics and Health Management System on Aircraft Fleet Operating Cost During Conceptual Design Phase by Using Parametric Estimation











1st Team: Conventional jet-liner with innovative on-board systems

- Bleedless engine
- 270 V DC primary power
- Reduction in on-board system weight



2nd Team: General aviation long range

- Diesel engine to improve fuel efficiency
- Electric de-icing
- High voltage electric system



4th Team: Regional turboprop advanced architecture

- All-electric on-board system
- Uneven passenger's seats disposition



Academic Course in Aircraft conceptual design and on-board system preliminary design at Politecnico di Torino

3rd Team: acrobatic general aviation / Screener

- Hybrid propulsion
- 270 V DC electric system, electric motor and batteries for propulsion



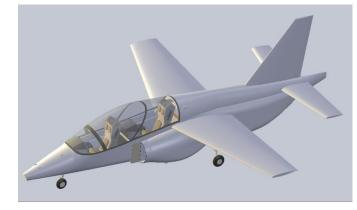


Students results



5th Team: Light jet-trainer

- Difficulty of comply with takeoff requirement
- Engine selection, fuel efficiency limited by engine installation and available volume



6th Team: MALE UAV civil missions

- Diesel engines to obtain endurance required
- New (TMEDS) de-icing system to reduce electric consumption



7th Team: BeePlane

- Difficulty of achieving required cruise speed and altitude

