

<http://ewade2013.AircraftDesign.org>
<http://dx.doi.org/10.5281/zenodo.546427>

The New Aircraft Design Course at the Technical University of Munich (TUM)

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Design at TUM – a broad topic

- Unique boundary conditions at TUM
- Course content/curriculum/scope
- Prescribed design methods and tools
- Course development, (short) history, past years
- Lessons learned
- Future of aircraft design education at TUM

Presentation overview

- Background
- Goals
- Course content
- Moving forward

Background – student exposure to design

Credited coursework	Extracurriculars	Department projects
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Aircraft design lecture



AkaFlieg

AkaModell

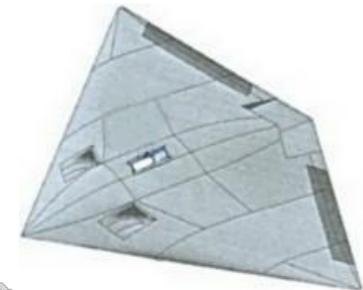
Euroavia/symposium

Student assistantships

Student theses (bachelor, semester, & master)

New: aircraft design practical course

- Project-based (learn by doing!)
- For advance students – lecture course as prerequisite
- Not a compulsory course



Goals – overview

- Goals
 1. Learning value: make each student a capable conceptual designer
 2. Good result: learn by doing... right



- Boundary conditions
 - ‘Customer’-oriented
 - Popular (or else no participants)
 - Appropriate workload
 - ...

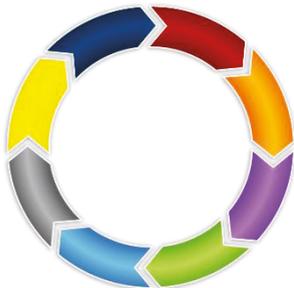


Goals – learning objectives

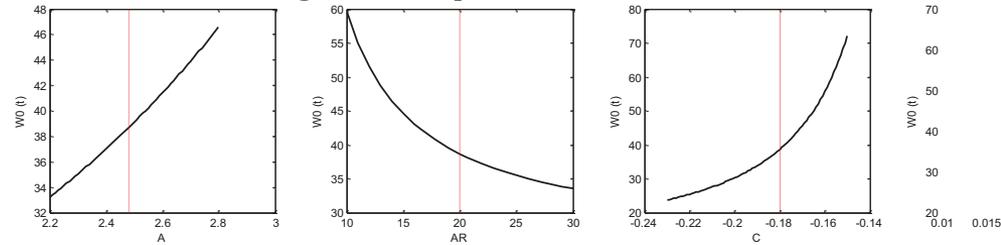
Work in multidisciplinary team



Solve iterative/
open-ended
problems



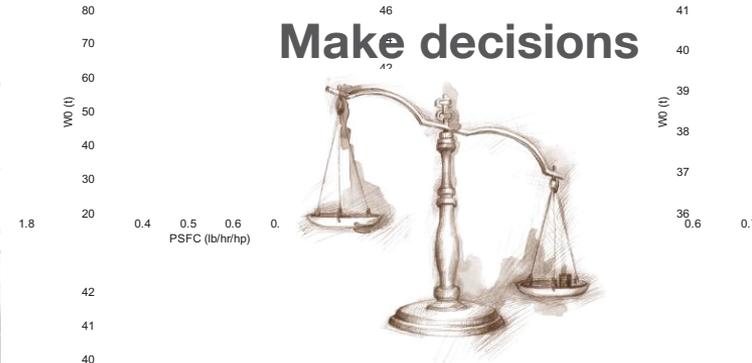
Analyze requirements



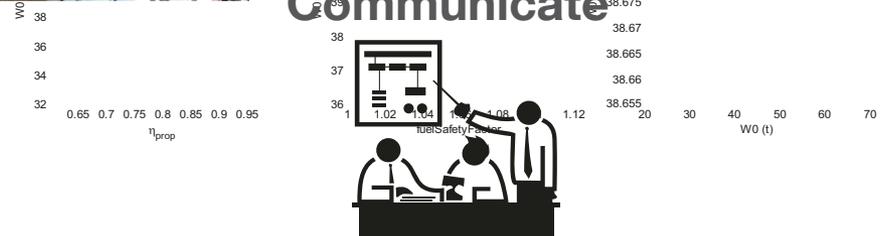
Appreciate history



Make decisions



Communicate



Course content – structure

AIAA design task: HALE UAS for missile defence with directed energy laser



Design activity	Weeks	End milestone
Recruiting & selection	~10	Annotated concept sketches
Design basics & “first shot” design	3	Individual sizing project submission
Concept exploration Issue reports	3	Initial design review (IDR)
Preliminary design	7	Preliminary design review (PDR)
Refinement	4	Design report submission
Revision	8	AIAA proposal submission

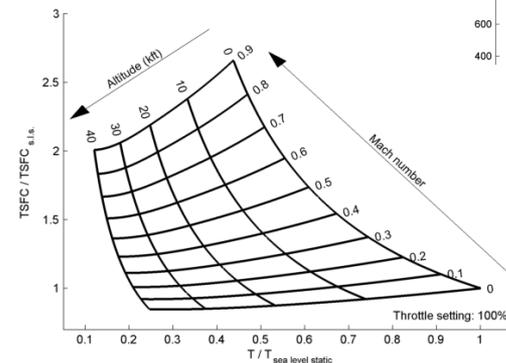
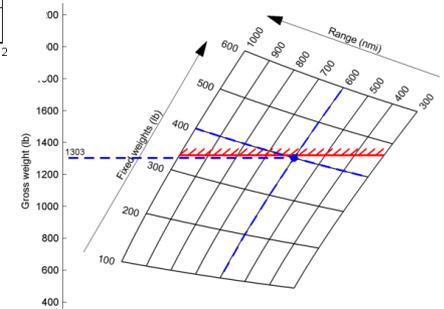
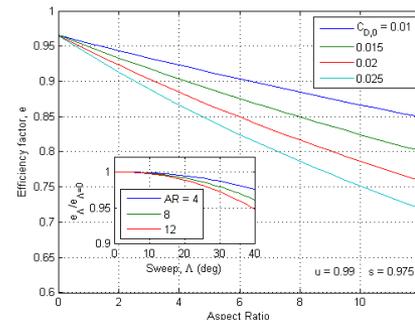


4 ECTS /
15 weeks /
3 contact
hours/week

Course content – prescribed tools & methods

- **No provided tools!** (almost)
 - But many resources

- Some small exceptions:
 - Cookbook for individual project
 - Cookbook for engine modeling
 - Some basic provided software (but almost all open/free)



Course content – soft skills emphasis

Team environment

- Management
- Collaboration
- Data control
- Specialization

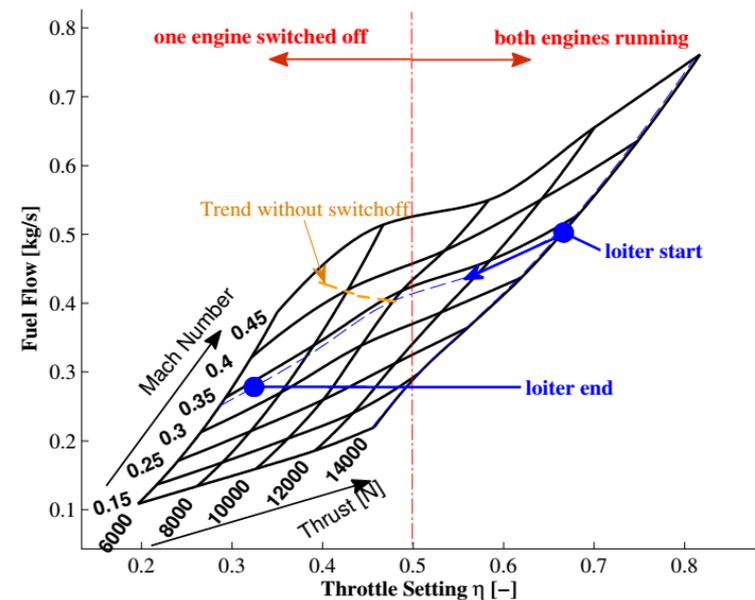
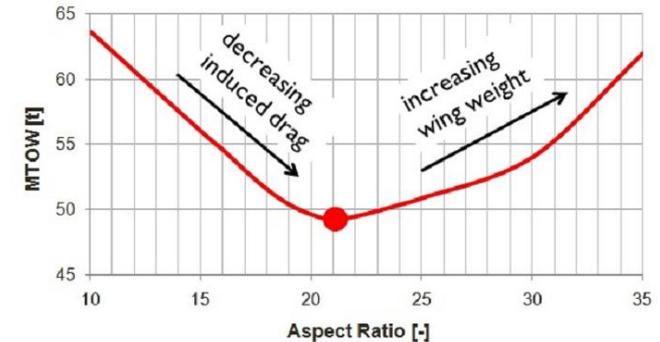
Communication

- Writing
- Technical drawing
- Audio/visual presentation
- Technical conversation

Course content – decision-making emphasis

A good trade study...

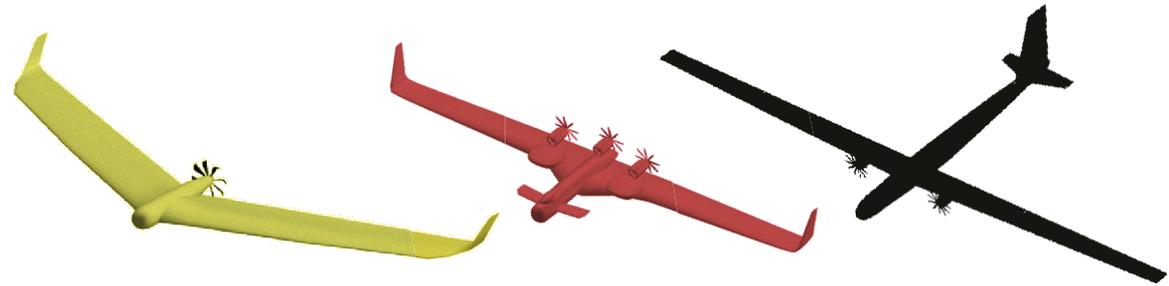
1. is well **chosen**
 - Recognize important trades to be made & where to focus efforts
2. is well **executed**
 - Appropriate tools & methods for study process and technical analysis
3. is well **communicated**
 - Make results clear to the decision-maker and other stakeholders
4. leads to a good engineering design **decision**



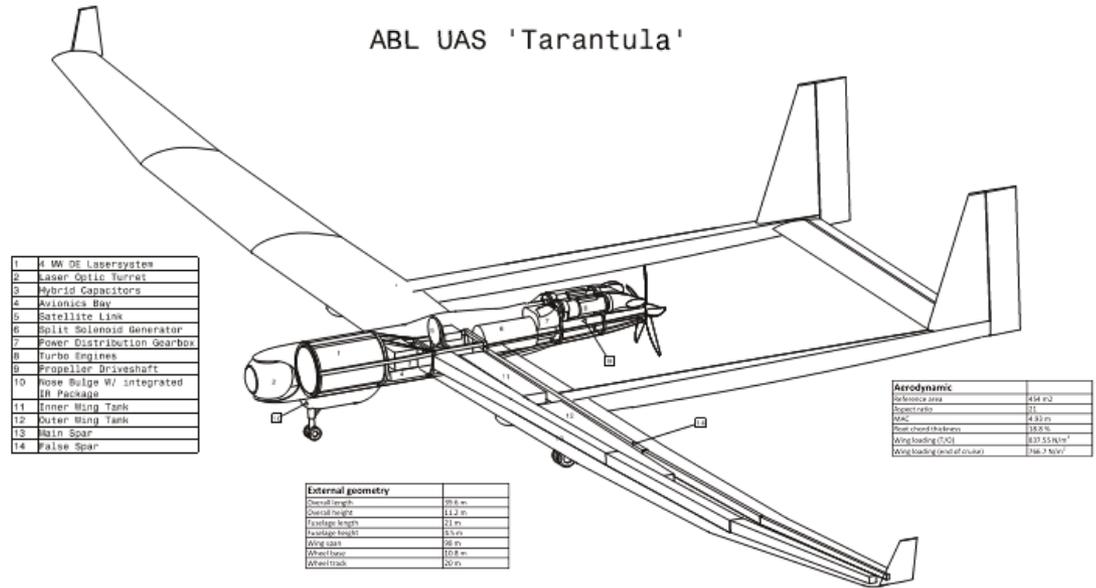
Results

Student feedback:

- “I learned a **LOT!**”
- “I’m proud of our design”
- “It’s too much work!”



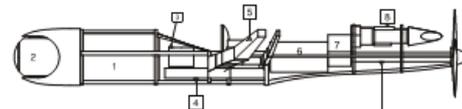
ABL UAS 'Tarantula'



1	4 MW DE Lasersystem
2	Laser Optic Turret
3	Hybrid Capacitors
4	Autonics Bay
5	Satellite Link
6	Split Solenoid Generator
7	Power Distribution Gearbox
8	Turbo Engines
9	Propeller Driveshaft
10	Nose Bulge W/ Integrated IR Package
11	Inner Wing Tank
12	Outer Wing Tank
13	Main Spar
14	Wing Spar

External geometry	
Overall length	95.0 m
Overall height	11.2 m
Wingspan	51 m
Wing sweep	5.5 m
Wing span	58 m
Wheel track	12.0 m
Wheel track	20 m

Aerodynamic	
Reference Area	444 m ²
Aspect Ratio	21
MAC	4.83 m
Mean chord (fuselage)	18.5 m
Wing loading (T.O.S)	837.55 N/m ²
Wing loading (rest of cruise)	786.7 N/m ²



Weights & Loadings	
Wing weight	60,000 kg
Max. wing loading	25,000 kg
Wingtip up weight	15,000 kg
Max. wingtip weight	12,500 kg
Overall aircraft weight	13,000 kg
Empty weight	40%
Max. fuel capacity	40%
Max. payload	10%
Max. fuel capacity	10%

Performances	
Wing loading	1,000 N/m ²



AIAA Graduate Team Aircraft Design Competition 2nd Prize

Moving forward

Evolutionary approach: shrink course scope

- Simpler design task
- Easier and/or fewer deliverables
- Spread workload with largest practical team size
- No competition
- Compensate with gap-semester offering

Revolutionary approach: grow boundary conditions

- Offer thesis credit
- No structured course offering
- Add another milestone (e.g., design review, report)
- Smaller teams
- Competition-focused

Acknowledgements

- Instruction team members:
 - Sebastian Speck
 - Hannes Ross
- Design review attendees
- Design education community
- Students