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

Sky Sartorius
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

<table>
<thead>
<tr>
<th>Credited coursework</th>
<th>Extracurriculars</th>
<th>Department projects</th>
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<tbody>
<tr>
<td>Aircraft design lecture</td>
<td>AkaFlieg</td>
<td>Student assistantships</td>
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<td></td>
<td>AkaModell</td>
<td>Student theses (bachelor, semester, &amp; master)</td>
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<td>Euroavia/symposium</td>
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**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

Analyze requirements

Solve iterative/open-ended problems

Appreciate history

Make decisions

Communicate
Course content – structure

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

<table>
<thead>
<tr>
<th>Design activity</th>
<th>Weeks</th>
<th>End milestone</th>
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</thead>
<tbody>
<tr>
<td>Recruiting &amp; selection</td>
<td>~10</td>
<td>Annotated concept sketches</td>
</tr>
<tr>
<td>Design basics &amp; “first shot” design</td>
<td>3</td>
<td>Individual sizing project submission</td>
</tr>
<tr>
<td>Concept exploration issue reports</td>
<td>3</td>
<td>Initial design review (IDR)</td>
</tr>
<tr>
<td>Preliminary design</td>
<td>7</td>
<td>Preliminary design review (PDR)</td>
</tr>
<tr>
<td>Refinement</td>
<td>4</td>
<td>Design report submission</td>
</tr>
<tr>
<td>Revision</td>
<td>8</td>
<td>AIAA proposal submission</td>
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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

<table>
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<tr>
<th>Team environment</th>
<th>Communication</th>
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<tr>
<td>• Management</td>
<td>• Writing</td>
</tr>
<tr>
<td>• Collaboration</td>
<td>• Technical drawing</td>
</tr>
<tr>
<td>• Data control</td>
<td>• Audio/visual presentation</td>
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<tr>
<td>• Specialization</td>
<td>• Technical conversation</td>
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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’

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