Brno University of Technology

Research and Development Projects as Education Support

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Motivation:

*Do we need projects for education?*

- knowledge
- financial sources

Contents

- BUT and IAE review
- Education plan
- Projects presentation
- Project contributions
Established 1899 as a second oldest and biggest
technical university in the Czech Rep.

16,000 students
2,473 employees (1,015 academics)

8 faculties

Faculty of Civil Engineering
Faculty of Mechanical Engineering
Faculty of Electronics and Communication
Faculty of Information Technology
Faculty of Business and Management
Faculty of Architecture
Faculty of Chemistry
Faculty of Fine Arts
Educational activities

• Bachelor graduate studies (Bc.)
  – Airline transport pilot school (CAA Czech Republic approval)
• Master graduate studies (Ing.)
  – Aircraft design
  – Aeronautical Transport
• Post graduate studies (Ph.D.)

Scientific and research activities

• Aerodynamic analyses
• Stress analyses
• Design and computer modeling of aircraft and aircraft structures
• Static and dynamic testing of aircraft structures (CAA Czech Republic approval)
Personal capacity

employees 35

total work load 32

<table>
<thead>
<tr>
<th>Position</th>
<th>Quantity</th>
<th>Work Load</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prof.</td>
<td>3</td>
<td>2</td>
<td>0.6667</td>
</tr>
<tr>
<td>Assoc. Prof.</td>
<td>6</td>
<td>5.25</td>
<td>0.875</td>
</tr>
<tr>
<td>Ph.D.</td>
<td>10</td>
<td>10</td>
<td>1</td>
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<tr>
<td>Ph.D student</td>
<td>11</td>
<td>9.55</td>
<td>0.868</td>
</tr>
<tr>
<td>Worker</td>
<td>5</td>
<td>5</td>
<td>1</td>
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<tr>
<td>Total</td>
<td>35</td>
<td>31.8</td>
<td>0.909</td>
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</table>
Personal capacity versus Sources

**Personal capability**
- ARC; 14.85; 46%
- IAE; 10.5; 33%
- EU projects; 6.85; 21%

**Sources**
- ARC projects; 494.3; 42%
- IAE projects; 341.4; 30%
- EUI projects; 171.3; 15%
- Salaryes; 139.5; 12%
- Service; 6.5; 1%

Do we need projects for education?
<table>
<thead>
<tr>
<th>Aircraft design</th>
<th>1. year</th>
<th>2. year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>winter semester</td>
<td>summer semester</td>
</tr>
<tr>
<td>Aerodynamics I</td>
<td></td>
<td></td>
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<tr>
<td>Aerodynamics II</td>
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<tr>
<td>Flight Mechanics I</td>
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<tr>
<td>Flight Mechanics II</td>
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<tr>
<td>Aircraft Design I</td>
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<td>Aircraft Design II</td>
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<tr>
<td>Aircraft Design III</td>
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<td>Computer Aided Design and Manufacturing</td>
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<td>Aircraft Structure I</td>
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<td>Aircraft Structure II</td>
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<td>Aircraft Composite Structures</td>
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<td>Fatigue of Aircraft Structures</td>
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<td>Aeroelasticity</td>
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<tr>
<td>Aircraft Materials</td>
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<tr>
<td>Aircraft Manufacture I</td>
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<td></td>
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<tr>
<td>Aircraft Manufacture II</td>
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<td></td>
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<tr>
<td>Aircraft On-Board Systems I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aircraft On-Board Systems II</td>
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</table>
Master graduate studies (Ing.)

<table>
<thead>
<tr>
<th>Aircraft design</th>
<th>1. year</th>
<th>2. year</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>winter semester</td>
<td>summer semester</td>
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<tr>
<td>Aircraft P</td>
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<tr>
<td>Propulsion</td>
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<td>Aviation L</td>
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<td>Law and Regulations</td>
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<tr>
<td>Reliability</td>
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<td>Reliability and Maintainability of Aircraft</td>
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<tr>
<td>In-Flight E</td>
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<tr>
<td>In-Flight Experiments</td>
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<tr>
<td>Semester</td>
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<tr>
<td>Semester Project</td>
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faculative lectures

<table>
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<tr>
<th>Principles</th>
<th>1. year</th>
<th>2. year</th>
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<tbody>
<tr>
<td>Principles of Space Flight</td>
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</tr>
<tr>
<td>English in</td>
<td>1. year</td>
<td>2. year</td>
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<tr>
<td>English in Aviation</td>
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<tr>
<td>Aeroplane</td>
<td>1. year</td>
<td>2. year</td>
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<tr>
<td>Aeroplane Propellers</td>
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<td></td>
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<tr>
<td>Helicopter</td>
<td>1. year</td>
<td>2. year</td>
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<tr>
<td>Helicopters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aeroacoustics</td>
<td>1. year</td>
<td>2. year</td>
</tr>
<tr>
<td>Aircraft Testing</td>
<td></td>
<td></td>
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</tbody>
</table>

| Diploma S         | 1. year | 2. year |
| Diploma Seminar (M2325) | | |
| Diploma P         | 1. year | 2. year |
| Diploma Project (M2325) | | |
Subject groups rate

- Diploma Projects: 39; 4%
- Aero+FM: 208; 19%
- Other: 208; 19%
- Materials and Manufacture: 130; 12%
- Structure and Design: 442; 39%
- On-Board Systems: 78; 7%
History of the projects

- CVVL
- FOREMADE
- RIntencion
- ARC
- EV 55

Timeline:
- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007
- 2008
- 2009
Are projects necessary for education?

Yes!

- We have got a financial sources for teachers.

- We have a opportunity for self learning. We can a new trends, knowledge, technologies transferred into education and passed to students.

Examples?
Aerodynamics and Flight Mechanics

CFD (Fluent, CFX) => 3D aerodynamics progress

• stalling behavior

• flowfield solution of aircraft body ....(nacelles)

• calculation with propeller stream influence
Aerodynamics and Flight Mechanics

FOREMADE

Analysis of internal flow in turboprop engine intake
Aerodynamics and Flight Mechanics

Detailed aerodynamic design (shape optimization) of landing gear and engine nacelles

EV – 55
Aerodynamics and Flight Mechanics

VELA – “Very Efficient Large Aircraft” 5FP project

Aerodynamic optimization of flying wing configuration for transsonic speeds
Aircraft Design and Structure


KP 2- U
VUT 100 VUT 100
EV 55 EV 55
G304S

VUT 001 Marabu

FEM (MSC.Nastran, Dytran, Fatigue....) => nonlinearity

• landing gears
• aircraft aeroelasticity
J.A. Komensky:

„It's better only to view one than listen several tomes about it.“
Aircraft Design and Structure

FEM (MSC.Nastran, Dytran, Fatigue....) => nonlinearity

- landing gears
- aircraft aeroelasticity
Aircraft Design and Structure

FEM (MSC.Nastran, Dytran, Fatigue....) => crash analysis

Inpact velocity \( v = 15 \text{ ms}^{-1} \)
Glider Fuselage

Simulation by MSC.Dytran

The ground impact - static test at IAE laboratory
Glider landing gear development
Aircraft Design and Structure

Composites structures
- new wing production technology
- buckling tests
- new test methodology (test with temperature influence)
Aircraft Design and Structure
Materials and Manufacture

New materials and processes

- CARE materials and forming
- RFI technology (propeller cone)
Aircraft Systems

• hydraulic stand
In-Flight experiments


RIntencion
ARC
L-13 SEH Vivat
KP-2 U Sova
L-13 AC
G304 C

Brno University of Technology
Thank You for your attention!