Model Sail Car
Project Based Learning for Second Year Students of Mechanical Engineering

Prof. Dr-Ing. Martin Kraska
Didaktik-Forum THB, 5.10.2016

Team:
Prof. Schröder    Hr. Rotsch
Prof. Götze       Hr. Stein
Prof. Goecke      Hr. Schulze
Prof. Kraska      Hr. Schulz
Outline

• Programmes of Mechanical Engineering at THB
• Concept
• Resources
• Impressions
• Lessons learnt
Prof. Dr.-Ing. Martin Kraska

• Since 2012 teaching of Engineering Mechanics, Finite Element Analysis, Material Science for Mechanical Engineers

• In charge of the Mechanical Engineering Program (Bachelor)

• Areas of research and interest:
  • Math software SMath Studio, FEA using ANSYS und CalculiX
  • Material behaviour of metal foam and 3D printed plastic parts
  • Technical toys-metal construction sets
Programmes of Mechanical Engineering

Mechanical Engineering
- General Basics
- Specialism
- Internship
- Capstone Project and Bachelor Thesis

3,5 years
7 terms of 15 weeks each

Process Engineering

Computer Aided Robust Engineering
- General Courses
- Energy Efficiency of Technical Systems

3 terms
1,5 years

Master Thesis

Prof. Dr. Martin Kraska
Technische Hochschule Brandenburg · University of Applied Sciences
03.10.2016
Seite 4
Project Based Learning

Recommended pre-study internship 12 weeks

General Basics

Internal team project (8+6 ECTS)

Internship (usually external, 30 ECTS)

External team project and bachelor thesis (10+15 ECTS)

Bachelor of Engineering

Scientific Projects 12 ECTS

Master Thesis 30 ECTS

Master of Engineering

Oktober

7 terms

3,5 years

März

3 terms

1,5 years
First Year: Fundamentals

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- Lectures, Exercises, Labs
- 1hr per week for 1 ECTS
- Written exams after each term
- Full speed right from start
- Extensive optional support sessions
Second Year Team Project

After so many tough stuff in the first year, some incentive and motivation is overdue.

**Idea: Team project**

- Apply and integrate the knowledge from the first year
- Add more professional skills
- Provide hands-on experience in product development
- Full development cycle from task to product and re-design
- Final competition of the products
Second Year Team Project

**Ressources:**

- 8h teaching per week
- 80€ budget per team
- 500€ per competition (blower rental)
- CAD lab with Inventor, Smath Studio, Excel
- Mechanical workshop (milling, lathe...)
- 3D printer
**Ingredients of the Team Project**

**Mechanical Design**

**Manufacturing**

**Materials Science**

**Strength of Materials**

**Product development**
- Design concept
- Preliminary Design
- Detailed design
- Prototyping
- Testing
- Re-design for series production

**Project Management**

**Presentation**

**Documentation**

**Planning vs. Try and error**
Task

Design and test a wind-driven RC car

- Size limits
- 80€ Budget for COTS parts (excl. RC transmitter and receiver)
- Purchase, inhouse-manufacturing and assembly done by the workshop stuff
  - Students must check if the parts can actually be made
  - realistic requirements to drawings and bill of materials.
  - **Part 1 of the engineering challenge is!**
Competition Track

1-3 m/s wind

Start
Kick-Off and Team Building

Winter term, Oct-Jan

Summer term, April-July
Lectures and Exercises

- Project management
- Basics of sailing and aerodynamics
- Computer aided performance and documentation of engineering calculations

Winter term, Oct-Jan

Summer term, April-July
Preliminary Design Review

- Presentation of the design concept
- Approval for detailed design

Winter term, Oct-Jan

Summer term, April-July
Design Review

- Base: Project documentation
  - Set of drawings,
  - Design report
  - Calculations (proof of strength, stiffness, performance estimates)
- Presentation to the exam committee
- Approval for purchase and manufacturing

Winter term, Oct-Jan

Summer term, April-July
Purchase and Manufacturing

- Students are in exam session and holidays
- Workshop makes the inhouse parts
- Purchase of COTS parts
- Assembly
Test and Competition

Winter term, Oct-Jan

Summer term, April-July
Re-Design for Series Manufacturing

- Review of lessons learnt from tests
- Manufacturing concept including cost estimates
- Defense of the concept as final exam
Observations and Lessons Learnt

• Challenge for teachers and students.
  • Students must cope with individual eagerness and performance
  • Teachers must agree on tasks, requirements and scoring.
• Students complain about high workload but are happy after the competition and the exam.
• Essential ingredient: Students see how important standard-conforming design documentation is.
Discussions

• How about first year projects?
• Variation in tasks: Change the task every year for more creativity or streamline the course for better didactics?
• Material and process restrictions: No wood, no roller bearings, construction sets only...
• Introduction of PLC based functions (line tracking, anti-collision)