



## Undergraduate Capstone Projects Integrate Technology and Engineering Programs

Sergey Dubikovsky,  
Alten F. Grandt,  
Thomas A. Goodrich,  
Ronald Sterkenburg

Purdue University

## National and international collaboration in technical curriculum

- Important part of both the learning process and research in academia
- Global economy

## Purdue University in West Lafayette, Indiana, USA



## Purdue University

- **Student Body**  
System-wide enrollment of 69,098 students; West Lafayette enrollment of 38,712 students (Fall 2005); students from 50 states and 130 countries.
- **Location**  
Main campus in West Lafayette, Indiana (126 miles southeast of Chicago, 65 miles north of Indianapolis). Statewide university system includes five campuses and numerous teaching and research sites.

## Purdue University

West Lafayette campus currently offers

- 7,400 courses
- in more than 500 undergraduate majors and specializations
- in the schools/colleges of
  - Agriculture,
  - Consumer and Family Sciences,
  - Education,
  - Engineering,
  - Health Sciences,
  - Liberal Arts,
  - Management,
  - Nursing,
  - Pharmacy and Pharmacal Sciences,
  - Technology, and
  - Veterinary Medicine.

## History of Aviation Maintenance Technology/Aeronautical Technology

- Aviation Maintenance Technology (AMT) began in 1954 with eight students and one full-time instructor.
- The program was a two-year program designed to prepare students to receive the Airframe and Powerplant Mechanics certificate (A&P) given by the Civil Aviation Administration.

## History of Aviation Maintenance Technology / Aeronautical Engineering Technology

- Aeronautical Engineering Technology currently has the capacity for 325 students and has 18 full-time faculty teaching AET courses on the West Lafayette campus and 3 full-time staff at the Indianapolis site.
- ABET (Accreditation Board for Engineering and Technology) accreditation in 2008.

## AT408

- An Advanced Aircraft Manufacturing Processes course (AT 408) is organized as an engineering department and simulates a real world engineering and manufacturing experience for the students.
- The students are going through all steps of the design and implementation process from a need to a final assembly.
- Six Sigma methodology is used (DMEDI).

## DMEDI: Creation Process

- Define Opportunities
- Measure Customers Needs
- Explore Design Concepts
- Develop Detailed Design
- Implement Detailed Design

## AT408

- Went through significant changes over a five year period
- Started as an elective Design/Build/Test course
- New Aeronautical Engineering Technology (AET) program was established and accredited by ABET
- Degree required Advanced Manufacturing course

## Partners

- National
- International
- Academic
- Industry

## School of Aeronautics and Astronautics at Purdue University

- AAE 454 (Design of Aerospace Structures)
  - structural design: failure criteria (fatigue, fracture, buckling, corrosion, etc.), design constraints, loads, materials selection, manufacturing issues, joints and assembly methods, stress analysis, nondestructive inspection.
  - technical communications (oral and written), technology assessment, teamwork issues, economic considerations, creativity and problem solving techniques, engineering ethics, case histories, and personal development skills.

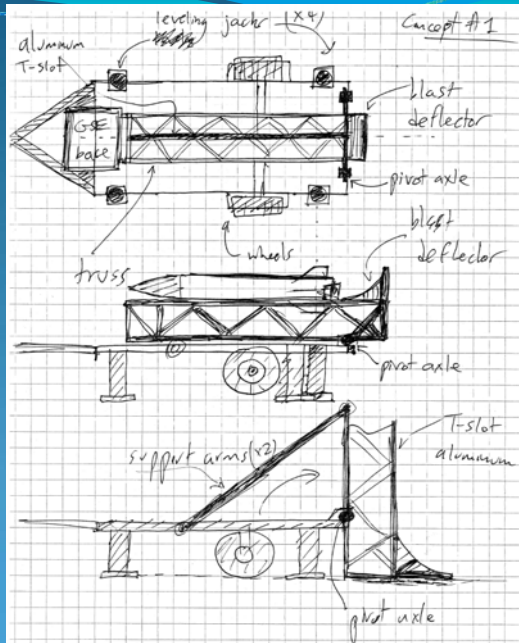
## AT-AAE Collaboration

- Initially, students from both departments worked in teams to design a structural component to fulfill specific requirements, construct it, and test it to those requirements. Ideally, if a component fails a test, the students would re-design the structure and go through the whole cycle again.
- With changes in AET program, engineering students provide “consulting” support to AET students. The intent is to model consultant/client relationships in industry with the engineering students acting as a consulting company for the Aviation Technology “clients.”

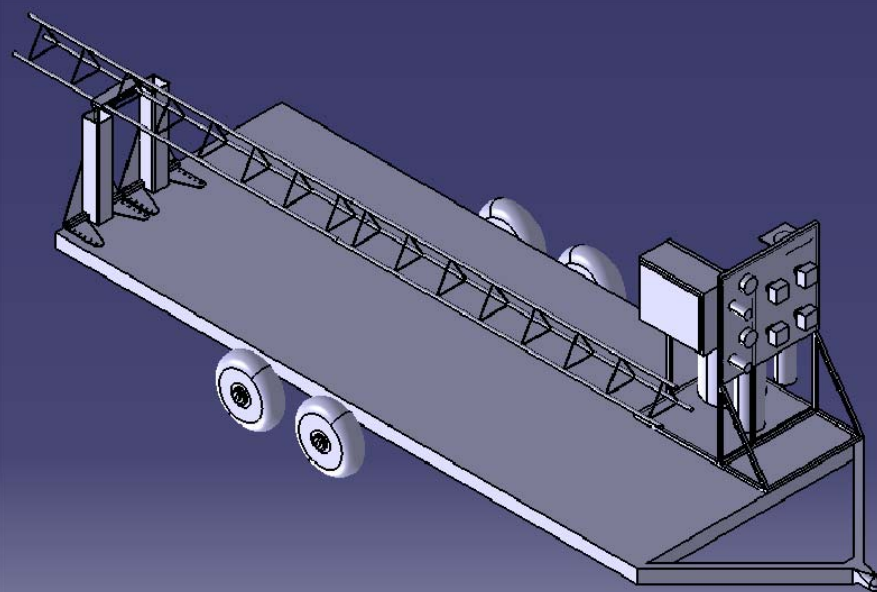
## AT-AAE Collaboration

- Request for Consulting Services
- Statement of Work

# Concept

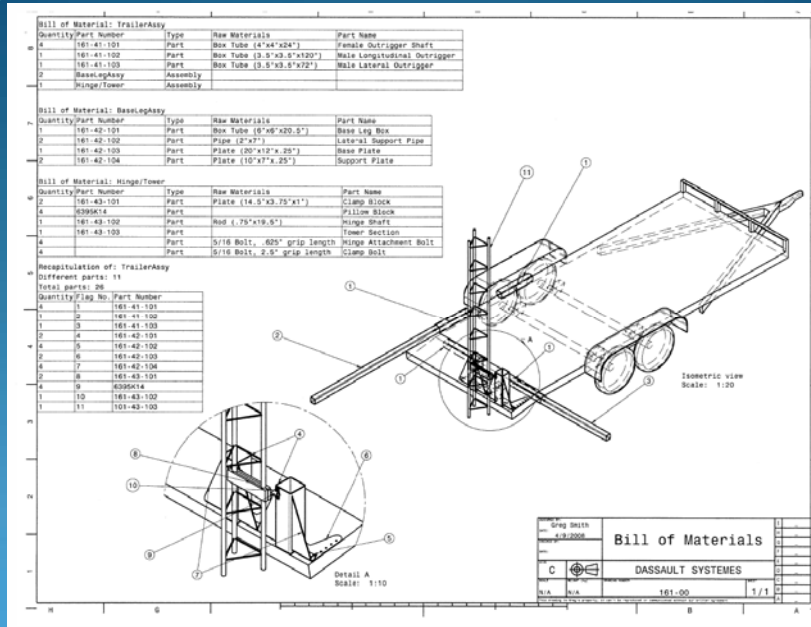


# 3D Modeling





# Drawings



Manufactured  
and  
Assembled



## Test Preparation



## Launch!



# Project

- Problem
- Need
- Requirements
- Constrains
- Previous Attempts

# Project

- Concept Design Review
- Detailed Design Review
- Final presentation and Report

## Conceptual Design

- Brainstorming
- Concept Review

## Concept Evaluation

- After design concepts have been developed they must be reviewed.
- When evaluating concepts, it is the best to start with many concepts and then refine, review process for one conceptual design.
- Evaluation Based on a Basic Decision Matrix method (Pugh's method)

## Detailed Review

- Performance
- Weight and size
- Cost
- Manufacturing processes and tools
- Appearance
- Ergonomic issues
- Safety issues
- Quantity of production
- Maintenance that may be available to the product

## Pre-Manufacturing

- Creation of 3D models, detailed drawings and process sheets for all components and assemblies.
- Filling purchasing requisition forms and ordering raw materials.



## Manufacturing

- The students select all materials and manufacturing processes.
- Full freedom of choice.

## Wanted!

- New partners
- New projects