A Successful Collaboration Between Engineering and Technology

Raymond E. Thompson
Purdue University

Abstract

The Aeronautical Technology major of the Aviation Technology (AT) Department of Purdue University developed significant partnerships with Aeronautical & Astronautical Engineering and Mechanical Engineering. This includes classes with joint classroom and lab meetings, sharing of laboratories, and partnering of students for senior design classes and design-build-test projects.

This initiative for this partnership is multifold. It is driving by industry pressure for engineering students to increase their application skills. Furthermore, tight budgets and a significant change in university culture provide significant reward opportunities for participating departments and faculty.

The advantages of collaboration are numerous. Engineering students are able to learn about manufacturing, service, and repair issues that enhance their ability to truly design for manufacturing. Technology students are able to better understand design constraints and create improved manufacturing and repair techniques. The sharing of facilities allows each group to build on its strengths and not waste resources on materials or equipment that are redundant.

These activities were started by the initiative of interested faculty. A more formalized structure is emerging with the offering of five new minors from Aeronautical Technology in materials and propulsion combined with a joint plan of study for a dual major under development

Introduction

During the past five years, a tremendous change in relationship has occurred between Aeronautical Engineering and Aviation Technology (specifically Aeronautical Technology) at Purdue University. Previously, the departments coexisted with little interaction. The major laboratory facilities for both departments are located adjacent to each other at the university airport. While many of the faculty and staff knew colleagues in the other department, the relationship did not extend beyond that.

The change began to occur when several informal, low-key relationships between faculty began to assume a more formal structure. Aeronautical Technology (AOT) is a combination of application based and engineering technology education. A major strength is expertise in fabrication and repair of aircraft structure. Aeronautical & Astronautical Engineering (AAE) is more concerned with design. Students in AAE have opportunity for application of design into practice on a limited basis compared to AOT. This has become increasingly evident in the AAE design courses.

The collaboration between AOT and AAE developed from the need of AAE students to learn to manufacture parts using composite materials. The attractiveness of composites for high strength and lightweight structures led these students met the design requirements using composite materials. AAE does work in composites, but almost purely from a material and structural research perspective. The AOT department has a comprehensive fabrication and repair facility where students learn to fabricate and repair a variety of advanced composite components utilizing wet and prepreg technology. During the last ten years, a steady stream of AAE students have come to the AOT Advanced Composite Laboratory seeking assistance with their projects.

Generally materials and expertise were supplied to the AAE students by the AOT faculty and AOT students would often assist in the tooling design and fabrication and manufacture of the components. In 1997, the level of activity in this arena increased to include metallic structures as well. In 2000, students in Mechanical Engineering's senior design class followed AAE's example and formed a team with AOT students to design and fabricate the SAE Formula Car for the university. Since then, joint projects with combined class meetings have become the norm for both departments.

As resources in the university have decreased, the level of trust and comfort this collaboration has produces has generated some significant additional benefits with the sharing of facilities. In engineering, there is feedback from industry for students to have additional application skills to supplement their design base. AOT students needed to learn to work with design software and better understand concurrent engineering practices. Rather than duplicate equipment and facilities, the departments are sharing. AAE students and faculty have access to the AOT Design, Build & Test Laboratory and the AOT Advanced Composite Laboratory. AOT has access to a variety of prototyping equipment, software, and wind tunnels. Each department maintains overall control and responsibility for its facilities. However access to the facility and its equipment is granted to the other. Each group is required to supply expendables.

This has turned out to be a true win-win situation for both departments. It conserves resources, meets the Engagement and Interdisciplinary missions of the university, and gives students an opportunity to truly work as teams. Although non-scientific, one of the best indicators of success is to observe a group of students working and being unable to determine which department they belong to.

Sample Project

One very interesting project was the design and construction of the Hyperion Aerobatic Aircraft. This was the project for a group of AAE seniors. Due to significant weight restrictions, the group decided to build the aircraft using graphite composite components.

A concurrent engineering team was formed between the students in AAE 451 (Aircraft Design) and AT 482 (Advanced Composite Tooling Technology). The AAE group performed the design work, based on input on manufacturing from AOT. Numerous test components were fabricated by the total group and tested to destruction. Once the final design was established, the AOT group led in the machining of the large molds from Renwood. Together, the AAE and AOT

students fabricated and assembled the aircraft. The finished aircraft then completed a rigorous flight test program.

Student Benefits

This project is a typical example of the collaborative projects between AAE and AOT. The advantages and benefits are tremendous. First, each group has preconceived notions about the other. The engineering students often consider the technology students to be mechanics and the technology students often feel the engineers don't learn how to work in the real world. In a very short period, both groups see the errors of their perceptions and come to appreciate the talents and skills of the other and understand how important both are to success. They learn to compliment each other's abilities. During a debriefing with a group of mechanical engineering students on the SAE Formula project, they were asked if they would have designed the vehicle geometry different after learning to fabricate tooling and build the parts. Students said yes, understanding the manufacturing issues better would cause them to view the design process differently. Conversely, the technology students gained significant experience in design. Often, one hears the complaint, "why did they do it that way?" The technology students learned to understand and appreciate the limits that constrain the engineer.

Both groups will perform better in the workplace as a result of the experience. Another significant benefit is the groups learned the dynamics of working in a non-homogeneous team. This was a very real simulation of the real work environment. During the SAE Formula project, the team consisted of mechanical engineers, aeronautical technology students, and industrial design students from Creative Arts. As you might expect, the dynamics were very interesting to observe!

Finally each student learned new skills, made friends in other departments, and had a tangible product to point to. Feedback regarding this type of activity from the Aviation Technology Industry Advisory Committee clearly emphasized that this is the type of student activity that prepares outstanding future employees.

Curriculum Support

Both departments desire to improve the educational experience for their students. Advisory panels for engineering are increasing their emphasis on increasing the level of practical experience. Similar panels for technology wish to see more theory added to the curriculum. However resources continue to be a major concern. Neither department has the time or resources available to duplicate what the other already has. In addition, neither department is looking to directly compete with the other. Both attract different students and send graduates to different careers. The solution then is to find ways to support the curriculum of each department.

To accomplish this, Aviation Technology has created five minors to support AAE. These are: Aircraft Electronics and Avionics; Composite Materials; Metallic Materials; Aircraft Reciprocating Engines; and, Aircraft Gas Turbine Engines. These minors range from 12 – 15 credit hours. 300- and 400- level courses may also be used to meet AAE requirements for related

areas.

A joint plan of study is currently being developed between the AAE and AOT programs. A similar joint plan has already been approved between Interdisciplinary Engineering and AOT. This is a 185-credit option with dual BS degrees granted. Three students have completed this option and been highly sought after by industry.

AAE has allowed AOT students to enroll in their lower level courses and utilize facilities and equipment. It is quite common to find students in the laboratories and classes of the other. The net effect is that each department has doubled the available facilities and resources available for its use without the capital cost. Increased opportunities for grants and other industry support have been developed that are specifically related to this collaboration. What started with the mixing of a few students has developed into a multi-level effort.

Summary

This discussion highlighted the development of a truly collaborative relationship between departments in engineering and technology. The sharing of resources allows each department to be more efficient and effective in meetings its mission. Most importantly, the students in each department have expanded opportunities and gain skills and knowledge beyond what is available solely in each individual department.

Universities are placing an increased emphasis on collaboration and interdisciplinary initiatives. At Purdue, bring AAE and AOT together has been a highly successful demonstration of the value of such activities. Everyone is truly a winner when appropriate and considered collaboration takes place.

RAYMOND E. THOMPSON
Raymond E. Thompson is Associate Professor of Aviation Technology at Purdue University in West Lafayette. Prof. Thompson founded the AOT Advanced Composite Laboratory and coordinates student services within the department. His current research includes assessment, technology in the classroom, distance education, and aviation human factors.