

Challenges of Starting a New Aerospace Engineering Program at a Polytechnic University

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Abstract – There are several challenges with starting a new program of study at an established educational institution. A new Aerospace Engineering program has been started at Southern Polytechnic State University in Marietta, GA. In this paper, we discuss the challenges faced and how those challenges are overcome. It is discovered that once the initial barriers are overcome, and the community sees the value of the program, there is usually a significant amount of support available.

Keywords: New Program, Minor, Aerospace Engineering

INTRODUCTION

The purpose of this paper is to describe a few challenges faced with starting a new Aerospace Engineering program at Southern Polytechnic State University, which is a Masters level university with predominantly undergraduate engineering programs. The challenge is not that engineering basics do not exist, but on the contrary, the challenge is that several disciplinary engineering programs already exist at the university. These include engineering and engineering technology programs. Several duplicate majors exist within both programs including mechanical engineering and mechanical engineering technology, electrical engineering and electrical engineering technology etc. Overall, there are currently more than a dozen flavors of engineering disciplines offered within the school of engineering and engineering technology. This poses a unique challenge in terms of starting yet another engineering program. The challenge for Aerospace Engineering programs, like in other STEM (Science, Technology, Engineering, and Mathematics) disciplines is that there are fewer and fewer young people interested in entering this field. However the bottom line is that Aerospace Engineering is one of the fundamental disciplines that need to exist and flourish. One of the mankind's greatest accomplishments is the ability to create vehicles that provide the ease, comfort, and timeliness of long distance travels that is affordable and safe. The need to design, develop, and produce safer, more economical aerospace vehicles will continue to exist. The future goal is to further reduce the travel times for long distance travels. It is hard to imagine going back to any other mode of transportation for inter-continental and other long distance travels. In the author's opinion, the aerospace industry is expected to bounce back from its current trough – so it is important to develop new programs and train future engineers who will continue to further develop and push the science to the next level.

BACKGROUND AND MOTIVATION

Southern Polytechnic State University (SPSU) is located a little over 10 miles north of downtown Atlanta in the city of Marietta, Georgia. SPSU has historically been an engineering and technology school. After Georgia Institute of Technology, SPSU is the only engineering school in the state (at the time of this writing, other state universities are starting small engineering programs). Georgia Tech has had the only Aerospace Engineering program in the state since the early 1930s. There are several Aerospace Engineering employers in the state including Lockheed Martin, Gulfstream, Boeing, Northrop Grumman, BAE Systems etc. The number of graduates produced by one university is

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not enough to meet the demand of all of these large industries. So the companies have to look outside the state to hire new employees. The potential Georgia jobs end up being taken by non-Georgians.

Georgia Tech's Aerospace Engineering program is rather small. GT is a world class university and therefore has very high admission and graduation standards. To attract research funding, the university has to attract the highest caliber students and faculty from around the country and around the world. For a few hundred freshmen seats, several thousand students apply every year. Needless to say, a lot of very good and promising students are turned away. These excellent students, who are interested in pursuing Aerospace Engineering, end up either going out of state or changing their majors. Once they have made that decision, it is very unlikely for them to come back to the Aerospace field. This further creates a need for another institution that offers Aerospace Engineering that will increase the number of fresh Aerospace graduates in Georgia.

SPSU is located right across of the street from Lockheed Martin. Lockheed is one of the biggest employers of SPSU graduates. It only makes sense to have an Aerospace program at SPSU. Several academics and industries have realized the need for a second aerospace program in Georgia.

Starting a new program can present many challenges. It is critical to get all the constituents' support from the beginning by anticipating potential naysayers and educating them about the history and known benefits of the program. Learning from the experience of others who have started programs can benefit those who are considering starting a new program [1]. There is high demand and limited supply for Aerospace engineers in Georgia. This translates to a need for another Aerospace program. Starting a new program has several challenges. These challenges are identified and methods used to overcome them are described.

PROGRAM CHALLENGES

In the current economic situation, the Board of Regents (BOR) is hesitant to start new programs that require funding. New program also requires new faculty members, space for classes and laboratories, and other resources. Although the long term plan is to have a four year degree program at SPSU, it may take several years to get there. In the meantime, a set of few Aerospace courses have been approved and started. These courses were initially started in the fall 2011 as a concentration within the Division of Engineering (DOE). The program became instantly popular. Several students showed interest. It was decided to expand the program to make it a minor. The minor is open to all engineering and engineering technology majors. Several departments have approved the aerospace courses as technical electives that they accept as part of their degree program. There are several Aerospace industries that require students with expertise from various engineering and pure sciences backgrounds including physics, mathematics, computer science, electrical, mechanical, civil etc. The Aerospace minor is of great interest to all students interested in acquiring that extra knowledge that would help them get the job of their interest. This approach particularly attracts students who are interested and motivated about acquiring additional knowledge beyond what is required for them to earn the degree.

Students face numerous challenges when enrolling in the minor program. The barriers include financial strains, trying to maintain a job and school with a full workload, lack of available financial aid, expense of program, and housing issues. Most of the students take the additional course load because they are self-motivated and interested in the field of study. Minor programs present a variety of challenges for the faculty and administration due to increased workload. It is imperative that faculty members are prepared for students who are more engaged and challenging in the classroom. Students in new minor programs are highly motivated and often bring a wealth of academic, personal, and prior educational and work experiences to the learning environment. They are eager to learn and are highly engaged in the classroom. Minor seeking students can present challenges for faculty as they tend to be highly inquisitive and tend to challenge the norms and status quo teaching and learning [1, 2].

Administrators must also juggle scheduling issues and obtain financial resources for start-up and maintenance of the new program. Start-up cost could include those associated with the program coordinator, office space, equipment, recruitment material, and support staff. Another challenge for program administrators who work within university systems is coordinating with other department on campus [1].

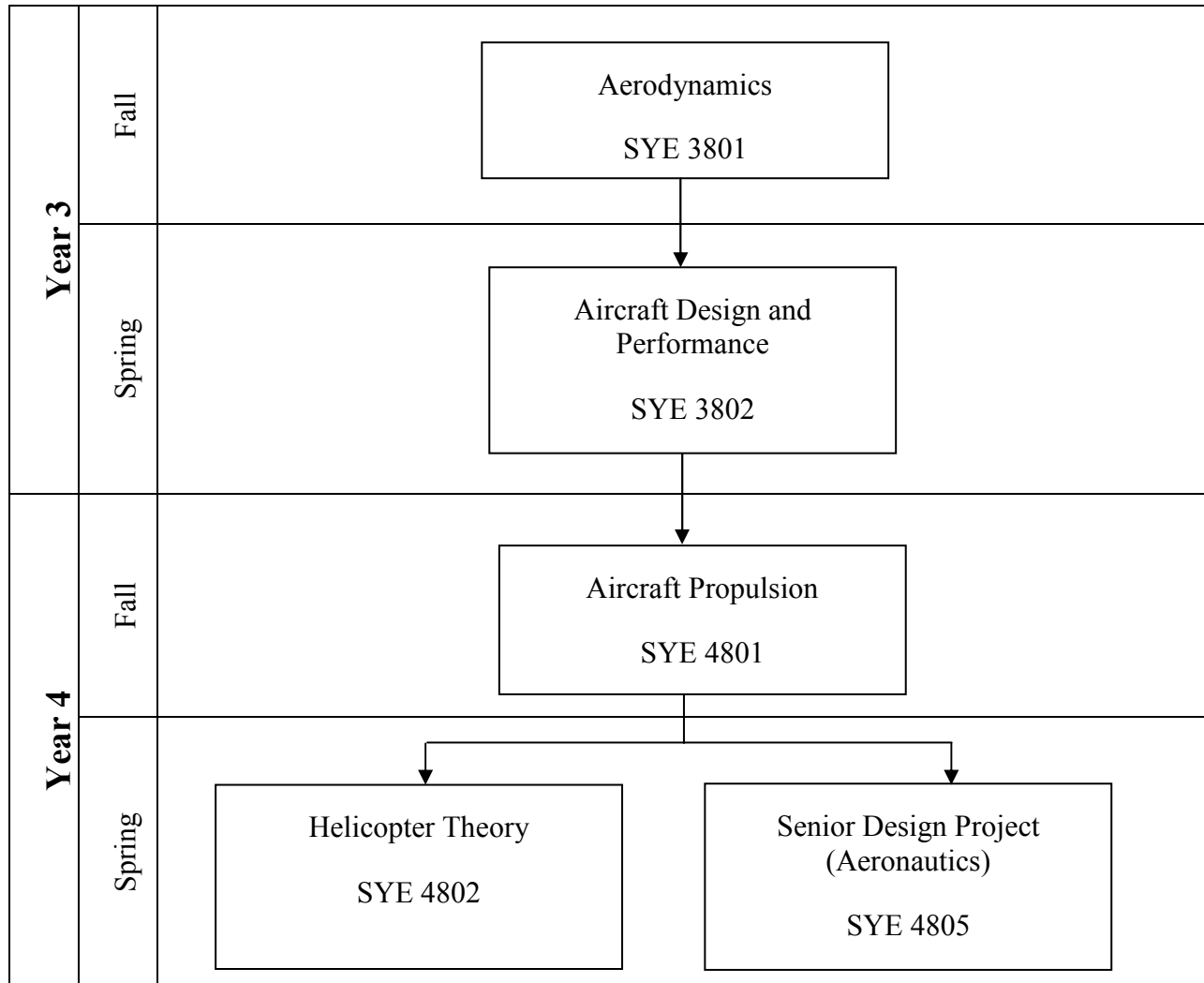
Based on anecdotal reports, employers indicate that they prefer to hire graduates with expertise in multiple disciplines and that these students move more quickly into management roles than their traditional program

counterparts [1]. The multidisciplinary programs provide them the resources and support they need to succeed academically and professionally [3].

AEROSPACE MINOR / CURRICULUM DEVELOPMENT

The focus of aerospace minor is to provide a comprehensive education to prepare graduates for productive careers with special emphasis on the needs of aviation, Aerospace Engineering, and related fields. The option will qualify students for entry level engineering jobs in the aeronautics, aviation, aerospace industry or related fields, for admission to graduate programs in aeronautics, aviation, Aerospace Engineering or related fields, and for continued learning throughout their lives. In order to achieve these objectives, a set of courses are offered. These courses are specific to aerospace program. They provide the basic knowledge to an undergraduate student for them to successfully enter either an aerospace industry or a graduate program and ‘hit the ground running.’ The curriculum is based on the most common courses taught in the major aerospace degree granting institutions across the U.S. The courses and their tentative schedule are shown in table 1. Depending on the demand, more courses may be offered and the same courses may be offered more frequently. Two additional courses in the pipeline for development and approval are the ‘Fundamentals of Astronautics’ and ‘Space Dynamics.’ With the introduction of these courses, two tracks will be available within the AE minor i.e. Aeronautics and Astronautics. These courses will give students additional options. The AE minor details are also listed on the corresponding website [2].

Table 1: Aerospace Minor Program



These courses will provide students with the essential fundamental knowledge required to work in an aerospace industry or to pursue a graduate degree in Aerospace or Aeronautical engineering. The last course that a student must take before qualifying for the minor is the Senior Design Project. The course is designed to teach student engineers how to solve real world Aerospace Engineering related problem. The course requires technical communication, project administration, and the design, development, or refurbishment of an aerospace system.

A minor program provides numerous benefits to students, faculty, and the educational institution. For students, the minor program provides the opportunity for rapid entry into workforce and a chance to dramatically increase their earning potential [1]. Students prefer shorter programs because these programs minimize the students' financial burden and are less disruptive to their personal lives.

Faculty members describe students enrolling in similar programs as being self-directed and highly motivated with a desire to learn. These students often bring prior experience and knowledge to the classroom, resulting in more advanced critical thinking skills. They view education more critically and often use business-related style, focusing on a goal that will result in job advancement [4].

A minor program like this provides the institution with the opportunity to ease issues created by the shortage of workforce in a timely manner. When graduates of similar programs are enticed to remain employed locally following graduation, the local and regional economies benefit as well.

RECRUITMENT EFFORTS

Recruitment efforts focused on students who had called and expressed interest, as well as students who were already registered in other degree programs at SPSU. The course title, schedule, minor requirements, and eligibility requirements were posted on a website [2]. Existing programs (e.g. Mechanical engineering, Mechanical Engineering Technology etc.) were contacted to explain the program. Many of these programs willingly shared information about the program with qualified students. Information about the minor program was also posted on the university's website. The college student newspaper published a report about the beginning of the new program.

In the brief few weeks of recruitment activities, several dozen students expressed interest. The first class 'Aerodynamics' was limited to 20 students and the class filled up in the first week of open enrollment. This confirmed that the student interest for the minor program was high even with minimal marketing and recruitment.

LABORATORIES

Most applied engineering courses need laboratories. Student learning is greatly enhanced when a theoretical course is accompanied by corresponding hands on laboratory experiments [5, 6]. Several courses in Aerospace Engineering are particularly applied in nature. With the budget cuts and other restrictions from the Board of Regents, it is necessary to find solutions to establish a new laboratory with the minimum possible resources. To overcome this problem, as part of their design projects, students are encouraged to design and build equipment that could be used in the laboratory for future generation of students. Several students get very excited about building something that others will get to use in the years to come. It is a great learning experience because students get to design and build something that uses the newly gained knowledge. It gives them an experience that may end up being valuable at their job after graduation. One of the other items needed for a new program is program specific software and computer hardware [7]. For Computer Aided Design (CAD), an existing package called SolidWorks was used. An NSF grant helped purchase the Computational Fluid Dynamics (CFD) software called Fluent for an unrelated research project. Fluent was used to introduce students to CFD.

FUNDING

To start any new program, considerable funding is needed. SPSU is a state university. The funding comes from the state, grants, student fees, endowments, alumni and private sources. In the current financial crisis, funding is very limited and several programs compete for the same sources. This poses a unique challenge, which students can and should be taught to deal with. There are often similar circumstances that engineers have to deal with in real world complex problems. Often time's large problems need to be solved with limited resources. Students are taught to

design and build the laboratory equipment with the minimum cost. The author is often surprised by the innovative ideas that students come up with to solve the unique problems.

PERSONNEL

To run any academic program, several personnel are required including the administrative staff, faculty, counselors, advisors, web master etc. Since the program is new and small, a limited number of people are performing multiple roles. The Division of Engineering administrative assistant also answers general queries about the program. The Aerospace Engineering faculty serves the role of the advisor, web master, counselor, and the instructor of multiple courses at the same time. This approach is required to take the program off the ground. Once the program is well established, more staff and faculty can be hired to share the load. It is expected that the second time these courses are offered, there will be enough demand to justify the hiring of an additional faculty member.

SPACE

Like any growing university, finding space is always a challenge. The university recently completed the construction of over four million dollar engineering technology center. Even before the center was open for occupancy, all the space was reserved. The limited equipment used in conjunction with the aerospace courses is placed in the instructor's offices or store rooms. As students complete their projects, and we get more equipment for the aerospace laboratory, a permanent space will be needed to house all the equipment. One of the ways to find space is to get other established programs on campus involved and interested in the new program. This may open opportunities to share space with other engineering and non-engineering programs. Mechanical engineering is closely related with aerospace. A number of mechanical engineering and mechanical engineering technology students enrolled in the first course i.e. Aerodynamics, and are interested in obtaining the aerospace minor. This opens up opportunities for collaboration with the well-established mechanical programs. For example, the fluid mechanics laboratory houses a wind tunnel, which is also important equipment used in the aerospace laboratory. Similarly the computer science program has a well-funded simulation laboratory. This provides opportunities for collaboration for the establishment of flight simulation laboratory.

PROGRAM EVALUATION

Students in the minor program participate in the same course, faculty, and program evaluations as students in other programs. Towards the end of the first course, students are also given an unofficial survey by the faculty member to gather information about their perceptions of the program and the instructor. Sample questions in the survey include:

- What did you like most about this course / program?
- What are some of the things that could be improved?

Most of the student feedback received was encouraging. Following are some examples of qualitative feedback received at the end of the first course in aerodynamics.

'...[I liked] the frequent use of real world examples and the enthusiasm about subject...'

'...[I liked] learning about how everything around us is influenced by aerodynamics, [and] learning how to improve the current design of items...'

'It is extremely interesting. I like learning about planes...'

'The course is a great course. I do like the interactive side '

'The subject matter is very very interesting. I really enjoy understanding how aircraft move through the air'

Detailed performance rubrics with targeted questions need to be developed for the new educational programs [8]. In order to determine the successes and challenges, more extensive evaluations need to be conducted. When the first batch of students have graduated with their minor, review panels consisting of faculty from various engineering and non-engineering disciplines, staff, and external practitioners from the industry and the academic community need to

be engaged to evaluate the full spectrum of program activities. Recommendations and findings resulting from the evaluations will be provided to the program director to guide program adjustments and revisions [9].

IMPLICATIONS FOR FUTURE RESEARCH

There is a paucity of empirical literature regarding starting new engineering minor programs. In addition, there is a lack of literature regarding the efficacy of such programs. Empirical studies that examine the demographics of new minor programs, the experiences of faculty and students during these programs, the performance of students, and the outcomes of students who graduate from these programs are needed. In addition, research is needed that examines the effectiveness of innovative curriculum designs and teaching strategies used in accelerated programs [1, 10].

CONCLUSION

We are faced with shortage of graduates with aerospace education in the U.S. in general and the state of Georgia in particular. In this paper, the author discusses the need for another aerospace program, the initiatives, the challenges and how these are overcome. The new aerospace program provides many benefits to Georgia students, institutions, and the industry. Students, administration, and faculty have to face a variety of challenges with starting a new program. This article discusses the challenges undertaken during the start-up of a new program to enhance its success. The evaluation of the new program is also discussed. In addition, implication for future research and aerospace programs are discussed.

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