Cultivating Senior Design Projects through Internship programs: the NASA-UMES Experience

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Abstract — One of the ways coalitions between industry and academia enhance engineering education and research is through internship opportunities afforded students. Following a successful implementation of a summer internship program funded by NASA which was designed to give some undergraduate Engineering, Engineering Technology and Aviation Science majors very unique professional experiences by matching them with mentors in the NASA Wallops Facilities, a senior design project for Electrical Engineering students was developed to meet real time NASA needs while providing the students with real world experience in addressing open ended design problems. This partnership with NASA provides an opportunity to add new meaning to the internship process.

This paper examines the methodology and concepts of industry-university interactions toward enhancing workforce diversity as well as fostering collaboration between industry and universities as they endeavor to enhance engineering education.

Index Terms — industry-university interactions, enhancing workforce diversity, enhance engineering education

INTRODUCTION

Coalitions between industry and academia can enhance engineering education and research through internship opportunities afforded to students. Demographic trends in the United States suggest an increase in minority population and that the traditional college-age population for white will expand slowly until 2010 and then decline, whereas the traditional college-age population of racial and ethnic minorities will continue to increase. These trends offer a challenge to the United States to educate students who have been traditionally underrepresented in Science and Engineering [1].

This trend brings to focus the need for diversity in the workforce through industry-academia coalitions. NASA and all other governmental agencies as well as the private sector recognize this need and are looking for ways of advancing diversity in the workforce. To paraphrase the former NASA Administrator Daniel S. Goldin upon Receipt of the 2001 Eagle Award ‘Who will take the reins and provide the leadership of tomorrow? African-Americans, Hispanics and Native Americans make up only 7 percent of the total science and engineering workforce, although they make up one-quarter of our population (and that total is rising). That number is only 3 percent of the workforce if you're talking about physical life sciences and engineering. And women, although they make up 50 percent of the total workforce, women comprise less than one-quarter of the science and engineering workforce; 23 percent. The situation is worse in specific areas. Only 9 percent of engineers are women; only 6 percent of aerospace engineers are women. My friends, what makes a glass ceiling so incredibly unfair is that where you're under one, you can see the stars... but you can't reach them. In other words, if we are to discover new worlds, we must break down old barriers. And if we are to replace an older workforce, we must – absolutely must – encourage, recruit and train young explorers. White, black, male and female. If they're talented, if they want to accomplish great things, if they would rather go out and grab the future rather than just wait for it... we want them. We need them. This is a huge challenge for NASA. It is an equally large challenge for national security and industry. Simply put, it is a challenge for America's competitiveness in a global economy and shrinking world.’ [2] To this end, the University of Maryland Eastern Shore (UMES) collaborated with the NASA Wallops facility which is approximately forty miles from the University to provide funded internships to address the issues raised above.

INTERNSHIP CHALLENGES

Beyond the selection process where candidates for the internship positions are interviewed and selected, the major challenges that the program had to address were the following:

• Integrating Students into the NASA Culture: The main challenge here is the need to simulate the cultural environment where the students see themselves not as ten-week temporary members of the NASA workforce but as an integral
component whose responsibilities affect the success of the project assigned to them. For minority students, there is the need for a role-model or a mentor that they can relate to and draw from not just on technical issues but also on social experiences that make the workplace conducive for both productivity and career growth.

- **Providing Meaningful Experience with the ten-week Program Structure:** Equally challenging is the assignment of projects to students whose duration with the agency is ten weeks and the question of what level of success one expects from them. Given the varied background and classification of students, what would be a realistic expectation? For the seniors who might be ready for the capstone design course, can their assignments lead to a senior design project and how does the scoped project affect the overall delivery of NASA deadlines and outcomes?

- **Project Extraction:** Following the evaluation of the students’ summer performance, the need to scope project from existing NASA projects becomes an issue. Critical to this process are the requirements placed on students who can participate in these projects by virtue of the security clearances and citizenship requirements. These constraints make it logistically necessary to initiate the process during the fall semester and have teams ready for the onsite project design and testing for the spring semester.

**PROJECT FORMAT AND EXPECTATIONS**

The inaugural project was drawn from an Unmanned Arial Vehicle (UAV) Project that was scoped to provide an interface of a Pulse Width Modulation (PWM) Board to external control servos and communications with the flight computer. The student design team comprised of two citizens and a permanent resident. The specific expectations from the project from the NASA point of view are:

1. That the design team will provide Electrical Engineering support on the UAV Flight Computer
2. Research and study the application of a PWM PC104 Board
3. Design the software (C code) and the electronics interface circuitry
4. Present a plan for integration into the PC 104 system
5. Attend team meetings
6. Provide Design Presentation and Testing and Interface Procedures
7. Provide PC Spice analysis of design circuit and
8. Assemble and Test PWM board with circuit and supplied servos

The following format was chosen to address the challenges listed by articulating the necessary important factors that are required to achieve success with the collaboration between NASA and UMES. One of these factors is the capability of the students to interact with engineers at NASA on a peer level. This is critical for the students as it helps to provide them with the confidence to apply what they have learned at school to real-time interaction and problem solving. It equally provides the avenue for the students to mature and understand that theory and design need modifications in real-time applications. The scheduled regular meetings went a long way in integrating these students into the NASA culture by adapting them from classroom solution approaches to where design considerations; cost and environmental issues dominate the product development process.

**LESSONS LEARNED**

One of the lessons learned is that the process should be started in a two semester format such that off base activities can begin before the students officially start the project. The time taken to get clearance can be gainfully employed if there is an assurance that it is a routine process. For example if all the students in the team are citizens, then the team can begin preliminary search and design considerations or simply understanding what they will require to accomplish the task. There should be time built in to address the real-time delays introduced by late arrival of components as well as failure of components which may be very expensive to replace or obtain quickly. The fact that the project is an integral part of a long-term project should be taken into consideration to introduce value and a sense of accomplishment on the part of the students. If they can see the end result or have an idea of their product role in the skim of things, even if they don’t work for NASA, they can relate to the success of the whole project by knowing how their contributions were applied. This is a beginning and it is hoped that following successful implementation of this collaboration over a period of years, we revisit our assessment thus far to see how things have changed.
CONCLUSION

The key to the success of this concept lies in the ability of both industry and academia to evolve the process. Because of NASA Wallops facility proximity to UMES and NASA Wallops need to find engineers willing to stay in the eastern shore of Maryland and Virginia, it is our belief that the strengths of both industry and academia can be drawn upon to refine the process as more lessons are learned. The sample of one attempt is not sufficient to draw conclusions but the success of the project from NASA’s point of view leads us to believe that this concept is worth exploring further.

REFERENCES
