AC 2011-1983: EVOLUTION AND ASSESSMENT OF AN INDUSTRY/ACADEMIC PARTNERSHIP TO ENABLE MULTIDISCIPLINARY, PROJECT-BASED LEARNING

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EVOLUTION AND ASSESSMENT OF AN INDUSTRY/ACADEMIC PARTNERSHIP TO ENABLE MULTIDISCIPLINARY, PROJECT-BASED LEARNING

Abstract

The MEDITEC program is a multidisciplinary industry and academic partnership at our university that provides the forum and mechanism to enhance biomedical research and design through collaborative partnerships. This program serves to improve health and quality of life while educating the next generation of industry-ready engineers. As part of this program industry sponsors populate a database with projects that provide students with an opportunity to work on real world problems in a University setting. Students involved in the program hail from various disciplines across the College of Engineering, such as biomedical, general, mechanical, electrical, industrial and manufacturing, computer engineering, and computer science and software engineering. The consortium currently consists of three industry partners and our university, and they have provided over 20 projects per year.

Previous work reported the initial formation of the program. This paper will discuss the evolution of the program and organizational structure and will include qualitative assessment of the program based on industry feedback and evaluation.

This program has helped to further industry/university relationships and has been extremely successful from both the university and company viewpoints. Students have gained valuable experience working with industry and participating as part of a multidisciplinary team. Some of these projects have evolved into co-ops or full time employment. This has served as an effective recruiting tool for the companies by providing them with the opportunity to interact with students prior to graduation to discover future employees. In addition, students work on projects the companies are unable to devote time to, provide an additional resource for company engineering projects, and contribute to creative and innovative project solutions.

Background

The Medical Engineering Development and Integrated Technology Enhancement Consortium (MEDITEC) is a partnership between industrial partners and academia that matches undergraduate and master's-level engineering students with the project needs of biomedical device developers. MEDITEC currently consists of three industrial consortium members along with our university. Membership in the consortium requires each of the industrial partners to make an annual donation of $50,000, which enables each company to populate a project database with projects. Depending on the needs of each project, a single student or team of students can then be paired with a project. These donations support nominally 10 projects per company over all engineering disciplines per year.

A major concern for many industry-sponsored projects is intellectual property ownership. The MEDITEC program has policies in place so that all IP from the projects that are proposed by the industrial partners is property of the company. Students and faculty must sign a non-disclosure

agreement before learning the project details and initiating work on the projects. As intellectual property concerns can be a major obstacle to industry-sponsored projects, this overcomes the problems and allows for successful partnerships. This policy is acceptable to our university due to the fact that the company is generating the ideas as well as providing the technical expertise.

The pilot program of MEDITEC began in 2005[1,2]. At the time, there was only a single industrial partner involved in the program. The company identified 34 potential projects, and 16 of them were successfully completed. It is important to note that while a company can submit as many projects as it would like, submission of a project does not ensure the project will be taken on by a student. In order for these projects to be successful, projects need to have students who are enthusiastic and personally interested in the projects. Projects are staffed by students based primarily on their interests and technical background, and not all projects garner sufficient interest. The program only had a single faculty member who oversaw the program as well as acted as the faculty advisor to the projects. There were no formal program policies or structure in place. Due to the large number of projects, it was difficult to closely supervise all projects and ensure student accountability. Over the past few years, two additional industrial partners have joined the consortium. Due to the increased participation and feedback provided, it became necessary to implement more defined procedures. This paper addresses the new formal program policies and structure that have evolved to address earlier problems.

Participants

The MEDITEC program currently consists of three medical device companies – Abbott Vascular, Edwards Lifesciences, and St. Jude Medical. In addition to the companies, there are several categories of participants in the program. Overseeing the program at the university are two faculty members from the biomedical engineering department that are referred to as the faculty liaisons. The faculty liaisons are responsible for working directly with the companies to solicit projects. They explain the process, ensure the scope of the projects is appropriate for the program, and are initially the direct interface with project. An initial visit to the company is usually necessary by the faculty liaisons to explain the entire program, policies, and logistics. The faculty liaisons are also responsible for overseeing the project database, staffing projects with students, and signing off on all paperwork, such as timecards, purchase requisitions, travel requests, and reimbursements. Each faculty liaison is assigned to particular companies.

For each submitted project, there must be a technical advisor from the company. Often times, this is the engineer who has initiated the project. The technical advisors provide background and supporting information necessary for the project. They need to be available for consultation and review. In addition, they are responsible for ensuring that the necessary resources from the company are available. In the past, the lack of participation or availability of the technical advisor has created problems as the students do not receive necessary feedback to complete the project. In these cases, the students eventually move on, and the project is never completed. Thus, it is crucial for technical advisors to understand their roles.

For each project, there is either an individual student or team of students. The number of students is dictated by the scope and needs of each project. As our university is a non-PhD granting institution, students are typically seniors or Master's students. However, younger

undergraduates can also sometimes get involved. Students from many different engineering disciplines are involved, such as biomedical, computer, electrical, industrial and manufacturing, mechanical, computer science, and software engineering. Students are responsible for the work done on the project. Initially the student works with the technical lead and faculty liaison to determine the project deliverables and timeline. Once those are established, the student commences work on the project and communicates directly with the technical lead.

Each project also requires a faculty advisor. The faculty advisor plays a purely advisory role and does not perform work on the project. Often the faculty advisor is from the home department of the students involved. The faculty advisor provides the students with input, logistical guidance, access to necessary resources, and helps them meet their academic requirements, such as with their senior project or Master's thesis. The faculty liaison works with the various departments to identify faculty advisors for the projects. In some cases, the faculty liaison and faculty advisor are the same person. Projects that require technical expertise from the faculty are outside of the scope of this program. In cases where significant technical expertise is required from the faculty, a separate contract-based project can be established directly with the industrial partner.

Project Submission Process

Once the annual donation is made, the first step is for the companies to populate a project database with project abstracts. Companies are provided with a project abstract template for the technical leads to complete. The information needed on the project abstract template includes project title, technical lead contact information, abstract, completion date, milestones and deliverables, final deliverable, required skill sets, and equipment needed. In order to generate student interest, abstracts should include more than just information on the project itself. Successful abstracts provide information as to how the individual project fits into the bigger picture for the company. Technical leads work with the faculty liaisons to include all relevant information for the abstracts and ensure all necessary resources are available to the students. In addition, the faculty liaison ensures the scope of the projects is appropriate for the students. If the project scope is too big, typically the project can be divided into smaller projects. The typical length of a project is 2 quarters for senior projects (10 weeks per quarter) and 3 – 4 quarters for Master's theses. It is also important to note that all projects are done primarily on the university campus. Work is not typically performed at the company.

There are a wide variety of projects that the MEDITEC program has facilitated. These projects include literature assessments, development of tools, automation, statistics and data analysis, materials evaluation, physical simulation systems, database development, and software and computer engineering needs.

There is no central database that is shared among the companies. Each company has its own project database. This is due to intellectual property concerns. The faculty liaisons are in charge of their respective companies' databases, and all students or faculty have to sign a non-disclosure agreement with the company before viewing the abstracts. Each company is responsible for drawing up their own NDA, and each has a different NDA generation process. While students are required to sign the NDA to read the abstract, this is not a commitment by the student to work on the project. Occasionally upon learning about the project, students decide they are not

interested, and it is better to find another project than work on one they are not completely committed to.

In addition, each company decides how to generate projects for the project databases as they all have different company cultures. One company solicits projects from all departments across their company by sending out a general call for projects. Other companies have all projects coming from a single department, such as manufacturing or research and development.

Recruiting for Projects

Once there are projects in the database, the faculty liaisons begin staffing the projects with students and a faculty advisor. Depending on the necessary skill sets for the projects, the faculty liaisons determine the appropriate department to advise the project and secure a faculty advisor. Typical methods to attract students are by sending emails through each department's student announcements, class announcements, or word of mouth. The MEDITEC program is well-known, and participation in the program is highly desired by students, so there is often a large pool of students to choose from. Some faculty advisors may choose to run a project in a classroom environment, such as in a capstone design sequence. Student recruitment in those cases is dependent on the instructors.

Once students have been identified by the faculty liaisons or advisors for the projects, the resumes of the students are sent to the technical leads. Next, an interview is arranged between the student and the company either through a phone call or in-person meeting. While an interview is most often a formality, this does ensure the students have the appropriate background for the project, and that, after learning more details about the project, the students are still interested.

Once a project is staffed with the necessary student(s), the project officially begins. This is initiated by a kick-off meeting at the company. The MEDITEC program pays for the students to travel to the company to meet their technical leads, learn all relevant information about the project, obtain necessary parts or equipment, and see the facilities.

Finances

The donation from each company is used to support the MEDITEC projects. The money allocated per project is nominally $5,000. Any funds that are not used remain in the MEDITEC fund. This covers student stipends, site visits and travel, project materials, laboratory usage costs, and general MEDITEC laboratory infrastructure. Students on each project are paid a small stipend for their involvement in the program. The maximum amount for each project stipend is $2,000. Students are paid an hourly rate of $10 per hour and fill out timecards recording their hours. If there are multiple students on a project, they will split the maximum stipend among the students. Once they meet the maximum amount, students are still expected to continue the project until it is completed. There has never been a case in which a student receives the entire stipend but does not complete the work. If the project is run through a class, such as a capstone design class, the students on the project will not receive a stipend.

While MEDITEC provides funds for project materials, this typically covers consumables, minor prototyping supplies, etc. If any major equipment or resources are necessary, the companies are responsible for providing it. Examples of resources provided by the company are specialized equipment (e.g. ultrasound machine, heart simulator), access to specialized software, machining by the company machine shop, and medical devices or parts necessary for the project. Since the overall funds for the program are in the form of a donation, there are no implied contractual obligations. However, there are many benefits from partnership in the MEDITEC program that will be discussed in a later section.

Facilities

As most of the projects have intellectual property involved, it is necessary to maintain the security of the projects. Thus, each MEDITEC company is provided with their own secure cubicle space to house their projects. Each room provides space for students to work on their projects, have internet access, and store materials. In addition to a secure room, students at the university also have access to many state-of-the-art facilities. These facilities include computer labs, wet labs, and electronics labs. In addition, students have access to a variety of resources, such as various Instron machines, two student machine shops with access to mills, lathes, and other standard machine shop equipment, rapid prototyping machines (e.g. FDM, three-dimensional printing, Objet), laser cutters, chemical fume hoods, microscopes (e.g. widefield, fluorescence, confocal, and multiphoton), histology, cell and tissue culture, sand casting, desktop CNC machines, optical comparator, National Instruments Elvis, SolidWorks, Pro-Engineer, Abaqus, P-Spice, LabView, and Matlab.

Completion of the Project

Students work with the faculty advisors and liaisons as well as the technical lead to determine the final deliverables. Once the project is complete, the student is responsible for transferring the knowledge and deliverable to the company. A final meeting is set up to deliver a final presentation to the company. This is normally conducted as a site visit. It is important that the project be evaluated and compared to the initial statement of work. This will allow all the parties involved to determine whether the project was a success. It is also an opportunity for the project team to discuss lessons learned and potential improvements. A separate discussion is arranged between the faculty liaison and technical lead to discuss the overall progress of the project and evaluation of student performance.

Benefits

The MEDITEC program provides many benefits for the industrial partners. Companies gain access to our university's expertise through our students and facilities. In addition, companies have access to consortium equipment and are allowed proprietary development. The MEDITEC program provides a resource for engineering projects at the companies. They are able to utilize students to supplement heavy peak loads and work on areas that may not be a priority for the company but are avenues they would still like to pursue. In addition, companies can use this as a recruiting mechanism to identify and recruit promising candidates early. They have the opportunity to interact with students prior to graduation to discover potential employees. In

addition, the companies have significantly lower expenses for project completion in academia compared to completion in industry.

Our students gain many benefits, too. The MEDITEC consortium enables students to work on open-ended industry projects. They gain valuable real-world experience. They often work closely with the technical lead, travel to the company, get valuable feedback from the technical lead and other engineers, and observe what it is like at a medical device company. As our students are required to do senior projects or Master's theses, the projects provided by the MEDITEC companies provide an excellent opportunity to fulfill the students' educational requirements.

Our university has a good relationship with these companies, and our students are routinely recruited for internships or co-ops. The MEDITEC program also enables students who have completed a co-op or internship at one of the companies to bring their project back to campus afterwards and continue work. This provides an opportunity for expanded company projects on our campus. Because of the infrastructure of the program, this enables continuity for more complex, longer-term projects.

Although the University and faculty do not typically gain intellectual property or publications from this program, the benefits for students contribute to the program's value. In addition, the industrial collaborators provide valuable feedback concerning our student's capabilities and skill sets developed through our curriculum. The availability of projects and involvement of technical leads also helps support our program by alleviating some of the potential project workload.

Conclusions

Overall, the MEDITEC program has been a great success. We have been successful in obtaining three consecutive years of funding from the companies and continue to generate more MEDITEC projects each year. Due to the changes that have occurred to this program as the procedures have been formalized, we have seen increased faculty participation, student involvement, and project completion. Whereas the program initially had a single faculty advisor/liaison, the program now has two faculty liaisons and ten faculty advisors across five departments. In addition, the program now includes over 50 students involved in projects and over 20 projects successfully completed per year.

It is important to note that this opportunity is different than co-ops or internships primarily because work is conducted on campus. The projects can be integrated into the academic experience in various ways, such as course projects, senior projects, Master's theses, and relevant industry experience. The experiences are connected though, as participation in the program has led to several students being hired for co-ops, internships, or full time employment.

We have also obtained valuable feedback from the companies. Student evaluations by the technical leads were provided to the faculty liaisons. The evaluations discussed student communication (e.g. emails, phone calls, site visits, etc,), technical preparation, project success, assessment of the MEDITEC program, and potential or desire to work with or hire the student. These evaluations were largely anecdotal; however, there were many recurring themes.

Most evaluators were satisfied with the technical abilities of the students. In addition, students were praised for their ability to be resourceful and generate new and creative ideas. Students were also noted as being enthusiastic and excited to work on the projects. Evaluators valued the "free" research and investigation, with students working on projects that the engineers wanted done but did not have time for, and saving the evaluator time so that they could move on to next step. The majority of evaluators indicated that they would work with the student again or would consider hiring the student in the future. A few indicated they would not hire the student again but typically this was due to the student's lack of technical skills or knowledge in the area of the project.

While overall the students had good communication skills and evaluators were satisfied with their efforts, several noted that presentation skills could be improved. The necessary information was presented, but the students could have had more confidence in the delivery. In addition, a few students did not provide sufficient detail in their presentation slides. They had the knowledge when questioned but did not adequately recognize the information that would be of most interest to the audience. A few students were noted to demonstrate a lack of professionalism or an understanding of industry expectations.

Several of these shortcomings can be addressed by the faculty advisors for future projects. Before beginning a project, the faculty advisors can prepare the students for what to expect in a company environment. They can work with the students so that they understand how to conduct themselves professionally. In addition, the advisors can work closely with the students to prepare their presentations. They can hold practice presentations and give feedback regarding content. One additional area would be helpful to the companies. The faculty liaisons should make the technical leads aware of the academic schedules. They should be made aware of midterms, finals, and academic breaks so that the technical leads are aware there may be breaks in the progress of the project. The schedules of MEDITEC projects typically can be worked around these events with prior knowledge.

1. Crockett R, Whited J, Walsh D. "MEDITEC: an industry/academic partnership to enable multidisciplinary, project-based learning in biomedical engineering," Proceedings of the 2007 ASEE Annual Conference and Exposition," June 2007, Honolulu, Hawaii.

2. Crockett R, Whited J, Walsh D. "Overcoming the hurdles associated with industry sponsorship of multidisciplinary, project-based learning," Proceedings of the 2007 ASEE Annual Conference and Exposition," June 2007, Honolulu, Hawaii.