

Internship Program in the Electrical Engineering Department at The University of Tulsa

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Abstract:

For the past five years, the electrical engineering department at The University of Tulsa has participated in an internship program that is partly funded by the State of Oklahoma and partly by the participating companies. The intent of this internship program is to provide hands-on engineering work experience to undergraduate students. There are currently four companies that are hosting a total of nine students. The host companies are Qual-Tron Inc., Railroad Signal International, Centrilift and John Zink Company. The interns work part-time during the school year and full-time during the summer break. The interns are required to write progress reports and technical reports on their work assignments. The interns also make a poster presentation at Oklahoma regional Universities Research Day hosted every year at the University of Central Oklahoma in Edmond, Oklahoma. The internship program has not only provided work experience to the students but also helped the companies in developing new products.

I. Introduction:

In a standard four-year engineering curriculum, leading to a B.S. degree, students have to take almost two years of math, physics, humanities and other required courses, thereby, leaving the junior and senior years for courses in their major. Some programs include a two-semester sequence of senior design course [1], which allows the students to design and build circuits or systems. There is hardly a component in the education process where the students are able to get practical work experience. Of course, some students find summer employment in their hometown or get an internship in one of the national laboratories. But for the most part, there is no formal work experience built in the educational process. To quote Zdunek [2], “*Formal course work is only part of an engineer’s education; training for engineering practice is also necessary.*” The internship program in the electrical engineering department at The University of Tulsa falls outside the educational requirement. It is not required for the students to undergo the training. Rather, students who are interested in getting industrial experience are welcome to participate. The importance of providing industrial experience to the students while in school has been recognized by the educational as well as the industrial community. Several schools have been successful in establishing such programs [3],[4]. But how to fit such an experience in the tightly knit four-year curriculum is still an open question. Some schools that have a co-op

program usually end up extending the academic time from four to five years for a B.S. degree. With increasing competition in the job market, employers would prefer the freshly graduating engineer to have some sort of work experience. From an employer's perspective, less time spent in training a new hire means that person can be a productive engineer sooner than later.

In this paper an internship program is described that has been in existence since 2002. The paper is organized as follows - In section II, we outline the purpose of the internship program and the potential benefits. The internship projects completed and the ones currently on-going are described in section III. In section IV, some of the comments from the interns and industrial partners are provided. The comments reflect how the students and the host companies have benefited from the internship program. The impact of the internship program on the department, the participating companies and the state of Oklahoma is outlined in section V. Finally, the main conclusions of the work are provided in section VI.

II. Internship Program:

The agency that offers the internship program is Oklahoma Center for the Advancement of Science and Technology (OCAST), an agency of the State of Oklahoma State. It administers several programs, one of which is the R & D Faculty and Student Internship Program (FSIP). The agency solicits proposals twice a year and awards are made after a peer review process. The primary purpose of the program is to improve the state's R&D base by increasing the number of well qualified and trained workforce. The program provides funding for one- or two-year projects requiring a minimum of \$10,000 per year and maximum of \$30,000 per year of state funds. The funding amount has to be matched at least dollar for dollar by the proposing entity based in Oklahoma. Only undergraduate students are eligible to participate in the internship. There is also a provision for a faculty member to serve as an intern. So far, none of the faculty has participated. The program requires that a suitable mentor at the company be identified, who will guide and supervise the intern's work. The mentor will also submit an evaluation form that will provide feedback to the student on several aspects of his/her internship work. The interns are required to write monthly progress reports as well as extensive technical reports. The reports are evaluated and the interns get feedback on their report writing skills. At the time the program was setup, it was anticipated that the internship experience will have far reaching benefits, some of which are listed below:

- A. Student interns will interface with prospective employers and the experience will better prepare them for the job market after graduation. The interns will be motivated to pursue advanced degrees in science and engineering.
- B. Oklahoma companies will benefit from an increase in well educated and experienced workforce. The increase in the number of well trained professionals could serve as a driving force for other high tech companies to move to Oklahoma or open a regional office in the state.
- C. The higher education institutions gain improved status through increased number of graduates who receive advanced degrees or get well paying jobs.

D. The development of products and services in Oklahoma will lead to increased revenues for Oklahoma companies, thereby, enhancing employment opportunities for local graduates.

III. Internship Projects:

In this section, we provide a description of the various projects that have been funded so far. Over a five year period beginning in 2002, nine projects have been funded for a total funding of about \$400,000. This amount has been matched dollar for dollar by the participating companies. The intern host companies include Tucker Technologies, Qual-Tron, Inc., Century Geophysical Corporation, Railroad Signal International, Centrilift, and John Zink Company. With the exception of Centrilift, which is located in Claremore, OK, all other companies are located in Tulsa, OK. Upon receiving the funding award notification, the principal investigator advertises the internship positions in the department. The resumes received in response to the advertisement are then forwarded to the host companies. The mentors or the human resource department at the company arrange the interview and make the final selection. This provides the students with a real job interview experience as well as allows them to polish their resume writing skills. The interns normally work an average of 10 hours per week during the school year and 40 hours per week during the summer. The work schedule is mutually agreed upon in consultation with the mentors. The interns are paid \$20 per hour for a one year total of \$23,000

For the internship program to be successful, it is essential that the students obtain valuable experience and the host company receives productive work from the interns. The student interns need to be willing to learn, ask questions and make an effort to work with minimum supervision. The projects need to be interesting to the student as well as meaningful to the company. Here is a partial list of projects that the interns have either completed or currently working on:

- A. Chlorine Tool for Well-logging Application (Completed)- The interns worked on several sub-assemblies of this tool as well as on Universal Power Supply Test Fixture, Magnetic Susceptibility tool, Dipmeter and Depth Simulator.
- B. Telemetry Tool (Completed) - The existing down hole to surface telemetry tool had a baud rate of 9600 bps. The company wanted to develop a telemetry system to operate at a minimum of 256k baud for up hole communications and 19.2k baud for down hole communications. The interns were able to design, integrate, and deploy a complete telemetry system.
- C. Single Burner with Multi-loop Controller for Combustion Control Firing Natural Gas or Fuel Oil (In Progress) – This is a dual fuel, low NO_x burner system. It is a microprocessor based burner management control system designed to provide proper burner sequencing. The control loop includes air flow, fuel flow, FGR flow, and Hyper-Mix steam flow control for controlling NO_x. The interns will assist in the design and change in configuration of the system for more rigorous operating conditions.
- D. Railroad Signaling System – The interns are designing/upgrading railroad crossing control mechanism by using newer circuit boards and controllers.

IV. Comments from Interns and Industrial Partners:

It is important to get feedback from the students who have completed the internship program and find out in what ways they have benefited from their experience. The comments have always been very positive and tend to reinforce the importance of having the work experience in an industrial setting. Here are some sample comments from the interns:

A. "I am currently working for Public Service Company of Oklahoma (PSO) as a Project Design Engineer. My involvement with OCAST helped me transition from being an intern to a full-time employee. My experience at Tucker Technology gave me a glimpse of what it was like in the work field. It also gave me an idea of what I was looking for in my career path. I gained some useful skills working as an intern for Tucker Technology, but the job was more technical than what I was interested in. I realized that my interests lay more in human relations and less in the technical area. After Tucker, I did an internship with PSO and found my niche. I do enjoy the technical side of my work, but more importantly I get to work with lots of different people including customers, contractors, and engineers. After three months as an intern, I was offered a full-time position and have been with the company for almost 2 years."

B. "I found the program to be a great introduction to the corporate world, and invaluable to an undergraduate student. The additional work experience has not only helped me learn, but has also been a fortunate addition to my resume; when applying to companies who have equations for determining starting pay. The extra year of experience has added probably \$5,000 to my starting pay offers."

C. "I learned a lot about project management and task delegation. The engineers approved the project and set us loose on it. I also learned many technical skills in the project. Not only did I learn more about power management and C programming, but I also learned about wiring schemes. I learned that I need to think about the next person down the road who may work on or modify my design. The internship overall was very eye opening and quite a learning experience. I learned a lot of actual engineering, refined some of my technical skills, and learned a lot of people skills. I think all engineering students should be required to have an internship at some point in their education. There are many things that differ from the classroom theory and bookwork to actual application. I would recommend the internship experience to anyone. I would like to thank Tucker Technologies and OCAST for making this opportunity possible."

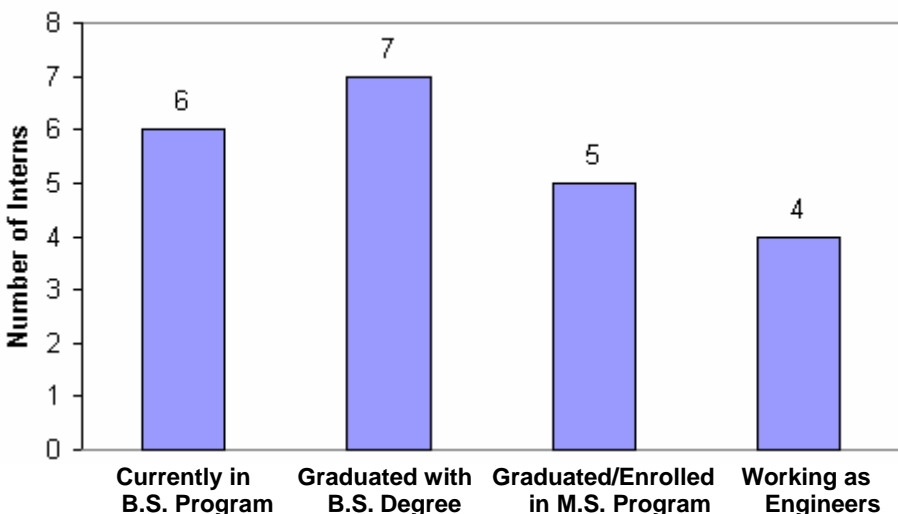
The following comments are from the companies hosting the interns:

A. "There was an immediate impact for all of the 2004 projects and production issues the interns were involved in. Their direct involvement attributed to \$ 1 M in extra sales that were realized by cutting component costs, improving productivity, and improving quality. Interns' direct participation in projects like MOBS Production, MRLY-Satcom, GPS Mapping, and other productivity enhancements will boost Qual-Tron Inc. sales into \$8 M range. Qual-Tron hired a new engineer."

B. “Tucker Technologies estimates that this project has increased their gross sales by an amount of \$250,000 for the first year and total of \$1,250,000 over a 5-year period. The 5-year impact on productivity is estimated to be \$250,000. At least two engineering jobs have been retained in Oklahoma as a result of this internship program. The company hired an engineer as a result of increased revenues.”

V. Impact of Internship Program:

The internship program has involved students from sophomore level to senior level in disciplines not only from electrical engineering but also from engineering physics and chemical engineering. A total of 22 interns have participated in the program with about half going to graduate school and the other half in the industry, after completing their B.S. degree. Six students are currently interning at four different companies. The students get valuable software and hardware work experience. They learn to work in a team environment and also get well versed with workplace demands and expectations. The host companies are able to complete projects that would otherwise require additional manpower or extra workload for the employees. The department is able to showcase the internship to prospective students as a means of added value to the educational experience. This has helped the department in recruiting new students to the program. The University gets visibility in the industrial community as a source of talented pool of engineers who can be employable locally. Overall, the State of Oklahoma benefits by increasing the pool of engineers with work experience who can contribute to State’s economy. The following bar graph gives an overview of the current academic and professional status of interns.



VI. Conclusions:

The internship program is a win-win situation for the university as well as the host companies. The companies have found a good return on their investment. At least two companies renewed the internship program, which means they were in the program for four years. A total of 9 internship projects have been funded so far allowing 22 students to get hands-on work

experience while in school. The students have benefited by getting “real-world” engineering experience. The companies have been able to boost their sales and enhanced their product line with minimal investment.

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Biographical Information:

Surendra Singh received the Ph.D. degree in electrical engineering from the University of Mississippi in 1985. Since then, he has been a faculty member in the electrical engineering department at The University of Tulsa. He is the principal investigator on the internship projects described in this paper.