

AC 2007-1658: USING GRADUATE INTERNSHIPS TO ENHANCE GRADUATE STUDENT EDUCATION AND RESEARCH

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Yamilka I. Baez-Rivera was born in Ponce, Puerto Rico on October 3, 1977. Received a Bachelor Degree in Electrical Engineering from the University of Puerto Rico – Mayaguez Campus (UPRM) in 2001. She continues graduate education and in 2003 she finish her Master in Science Degree in Electrical Engineering also from UPRM. After married with Bienvenido Rodriguez-Medina, moved to Mississippi State University in Starkville, Mississippi in where she is currently working on her PhD in Electrical Engineering. Yamilka obtain the Bagley Fellowship for outstanding graduate student in Engineering because of her research work. Her Research work is related to last year internship in Northrop Grumman Ship Systems in Ocean Springs, MS. During that time, Yamilka was a link in a pilot project between the university and the company in where she apply what she learned in class and research at MSU, to the real shipboard power systems problems in the company. Her work is going to continue this summer, when she goes back to Northrop Grumman for second consecutive year as a summer intern. She is an active student in research, courses and extracurricular activities, especially sports. Some research interests include control techniques and the application in power systems, shipboard power systems, neural networks, power system reconfiguration and stability among others.

Lennon Brown, Mississippi State University

Lennon Brown, III, was born in Jackson, MS, on January 22, 1981. He graduated from Mississippi State University in May 2004 and also received his Master's of Science in Electrical Engineering from Mississippi State University in May 2007.

He has worked with many different aspects of Electrical Engineering. During his graduate career, he emphasized in the power engineering field of Electrical Engineering. He also worked in the power industry in regards to increasing his knowledge of power theories being conducted in realistic environments. He is currently working with Mississippi Power Company in Gulfport, MS. He currently holds the position a Distribution Planning Engineer.

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Noel N. Schulz received her B.S.E.E. and M.S.E.E. degrees from Virginia Polytechnic Institute and State University in 1988 and 1990, respectively. She received her Ph.D. in EE from the University of Minnesota in 1995. She has been an associate professor in the ECE department at Mississippi State University since July 2001 and holds the TVA Endowed Professorship in Power Systems Engineering. Prior to that she spent six years on the faculty of Michigan Tech. Her research interests are in computer applications in power system operations including artificial intelligence techniques. She is a NSF CAREER award recipient. She has been active in ASEE and is currently the Women in Engineering Division Chair. She is also active in the IEEE Power Engineering Society and is serving as Secretary for 2004-2007. Dr. Schulz is a member of Eta Kappa Nu and Tau Beta Pi.

Using Graduate Internships to Enhance Graduate Students Education and Research

Abstract

Many universities focus their industrial outreach activities for students at the undergraduate level. Universities have required optional cooperative education programs or promoted industrial internships during the summer months for undergraduates to allow them to gain real-world experience. While these positions are helpful for the students, they often have little impact on faculty or departments. An area that few companies consider relates to internships or cooperative opportunities for engineering graduate students. This program has advantages for all involved. The companies are working with MS or PhD candidates who already have an engineering degree and have an advanced maturity compared to undergraduates. For the students, their maturity allows them to get involved in real-world problems and make a broader impact in a short period. Also, in many cases the industrial activities can be extended into a thesis or dissertation topic. For the faculty member, it provides exposure to the current issues within industry, provides examples for the classroom and sometimes provides funding for research projects. This paper will highlight several recent examples of how graduate internships have enhanced the company, students and faculty in the collaboration. It will discuss dos and don'ts for developing the graduate internships. Impressions by several graduate students will also be included.

How we are exposed to the industry

Normally college students learn about companies through career fairs. Career fairs allow students to meet with a company's representatives. These representatives explain to the students what the company does and some the job positions available. These types of events provide an opportunity for students to make a good first impression with the company. Through the conversations, a student can also get a good understanding of the company and decide whether or not to seek employment opportunities with that particular company. The employment opportunities can consist of internships, cooperative (Co-op) education rotations, and full-time employment. Internships and co-ops are the best way for a student to get a broad exposure to industry while still in school [1].

Another opportunity where student can gain exposure to companies is when faculty members bring industrial representatives to class for presentations. This provides an informal outlet for the students to learn about parts of industry. The students can ask questions about the company as they would at a career fair type of event. This also provides an non-intimidating atmosphere for students to ask questions about companies and careers.

The industrial environment is quite different from being in school. Through the exposure to industry, one can gain knowledge and become appreciative of the material being taught in the classroom. Sometimes students ask themselves whether or not they really need to know the material they are currently studying. It is rewarding to actually see how applications being taught in class are applied in the real world. This tends to help students think about problems in a

different way versus the way they did before their industry exposure. With the exposure to industry, students can gain more confidence and enthusiasm to approach new problems.

One area that allows students to combine coursework and an industrial experience is a graduate internship. A graduate internship involves having a graduate student spend a summer or a semester working for a company. This project could be related to their research or in another area. It would provide the student with a close-up look at the real world. While some students do research related to a company, many times the research is done at the university. The graduate internship provides a total immersion experience where the student gets to test drive an industrial job and see the similarities and differences between school and the industrial setting [2]. References [3-8] provide some insights of internships or industrial related academic experiences.

Challenges as a graduate student in a company

A student is often anxious when starting an internship, but there are some challenges related to the internship for the student must overcome. Since many internships are during the summer, the student needs to make the most of the short time frame. For that reason, the student needs to hit the ground running. One priority is to learn how to prioritize and organize tasks and schedules. As a student we have deadlines for class projects or homework, but it not the same as work-related deadlines. The graduate student has to work with others, do part of the work, incorporate his/her ideas and the ideas of other people in their group, and give the results to others to analyze and comment on. The student may have more than one supervisor, so s/he will need to allow enough time to make corrections and then turn in a final report. It is important to be able to prioritize the tasks according to their urgency and be organized. Being organized can provided many advantages in making sure all the requirements are met in a timely fashion.

Because of time constraints, the graduate student needs to understand the industry's research or project faster to obtain results in a short period of time. One way to do that is to learn how to take advantage of the opportunity to work in groups as well as alone. The student needs to learn how to get the information that is needed by him/her, talk to other people that may help, and look in books or references for previous work. Sometimes the supervisor has meetings or has to travel, so it is the student's responsibility to get the information. Working in groups as an intern can be hard, as the graduate student needs to convince the group about the quality of a graduate student's work, the good that the student contributes to the group and the company. The graduate students need to learn how to incorporate their class-related knowledge with their industrial experience. The student has to be able to work with others. Projects are being conducted that depend on other workers' performances, which can be quite stressful.

Another big challenge for a graduate student intern is to learn the industry language. Some industries have their own language. Depending on the field, workers use acronyms in reference to many topics. There are many more that are used on a daily basis. Many workers have been using these acronyms for years, so this is not going to change. In the experience of several interns, conversations are filled with acronyms at first. This makes it difficult but it is very important for the intern to ask questions and understand the meanings of the acronyms. Becoming part of the corporate culture is an important lesson to experience and learn.

Since the student is a temporary employee, there may be some constraints related to detailed information and using certain computer systems or networks. Sometimes students may be frustrated as paperwork and procedures may take days or weeks to get computer accounts, telephones and computer access. Students should be patient and understand that the temporary nature of their position may impact these tasks.

Another key lesson that can be learned during the internship is understanding the hierarchy and processes in industry. Understanding the “chain of command” and working within the constraints of the organization is a valuable lesson that can pay long-term dividends. Remember, these challenges are going to make a stronger and experienced employee in the future.

How graduate internships enhance the company, students and faculty

Graduate Internships can create a very positive relationship between a company, the university, the student, and the faculty. When the student produces quality work during the internship, this opens the door for other students from that college, opens doors for other faculty to develop new research and other projects with the company, and at the same time increases collaboration between the university and the company. Internships can enhance the students’ impression about working in industry. As an intern, graduate students can provide new ideas and state-of-the art technology knowledge, in comparison with company engineers who may have graduated five to ten years before. This new information from classes provides a way of thinking outside the box and allows fresh minds to suggest new ideas [1].

Also, there can be some synergy between the classes, the internship and the research project as shown in Figure 1. First the student gets a strong background in classes. During the graduate internship, the student gets a deeper background and foundation on the topic. Additionally s/he learns the constraints, limitations and other issues that must be addressed within the industrial environment that might be overlooked in academics. Next, the student takes this industrial relevance and applies it to future classes that enhance the academic foundation and provides him/her with additional knowledge as s/he tackles advanced problems in graduate classes. Then either directly or indirectly the graduate student applies the industrial background and advanced classes to a project and completes the research work. The work is more mature and advanced because the student has a more advanced set of research tools.

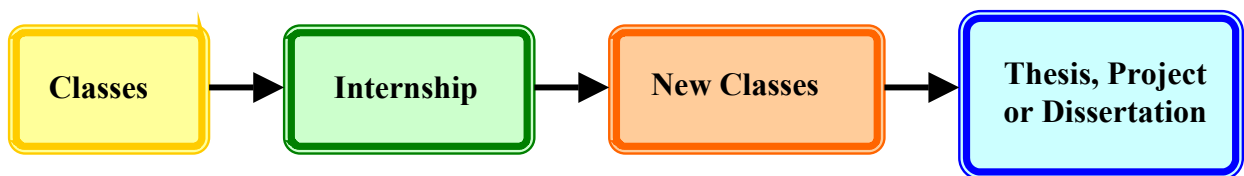


Figure 1: Improved Research Project Timeline

A more direct impact that enhances the experience of the student and faculty is when the company decides to extend the internship into a thesis or dissertation project. At the end of many internships, the companies ask the interns if they would like to continue to work on these activities. Under different scenarios, the graduate student is then able to craft a project that can directly incorporate the knowledge learned in the internship with a research project. This provides a real-world project for the student, an industrial contact and possible research project for the faculty member, and an extension of technical personnel for the company. The company and the student can both gain from this experience.

Often the internship is an effective way to work on longer-term issues in a cost-effective manner. Additionally, through the graduate student, industry has access to a faculty member and his/her expertise.

In over 15 years of experience with graduate internships, one of the authors have found that there were very positive benefits for all involved. In fact, the author did an internship as a PhD student. It is interesting to see the self-confidence transformation in the graduate students during their internship. Graduate students leave the internships with more personal self-confidence, professional self-confidence, and a more realistic feel for the engineering constraints on research solutions.

Job opportunities after graduation

During and after an internship, it is important to make sure the student takes advantage of the opportunity to get to know people from the company and to network. Companies are going to remember an excellent student and his/her work. By providing companies with a good impression, this can lead to opportunities for a potential offer after graduation or sometimes even before graduation. Also, other companies may check with the graduate student's previous employers. If the student has left a good impression after the internship, they can provide a good recommendation. In my fifteen years of internships about half the students went to work for the companies where they interned. In many cases the companies that provided the internship had hiring freezes and were not able to make a full-time offer. In these cases, the graduate students received very positive feedback about their internships from other employers.

The next two sections is some heart-to-heart advice from graduate students to graduate students.

Preparation Guide for a Graduate Internship

When considering a graduate internship here are some bullets of things you need to think about.

- Topics – what can be done in the internship that helps the student and the company?
- Research, Simulations or Project – It's easier to prepare ahead of time if you know what type of work you are going to be doing in the internship.
- Advanced preparation can save you time on the internship. Reading papers related to the research, simulations or project during the semester before your internship will help.
- Home and Away Opportunities – Will the internship be in your same city or in another city? Many companies provide housing benefits to help offset your housing during the

internship. While working close to home is convenient, it's always good to learn about different places and people.

- Schedule and Working Hours – Remember that different companies have different working hours and is not like in college. In college, you can go to your office anytime day or night, but companies have a schedule that you have to follow, be prepared to wake up early morning.
- Your Work Supervisor, who is it going to be? E-mail this person and keep in touch before you start the internship. That's the best way to have some information about what you are going to do, what papers or books you should review before you start working. Remember he/she is going to be working with you during the internship. Do not be afraid to ask questions. Tell him/her if you are happy with the work done, or what you are actually doing, but be respectfully all the time. Remember s/he could be your supervisor when you finish college and get a position in the same company.
- Be ready to start working.

Do's and Don't [3]

- Take initiative.
- Do not be afraid to ask questions.
- Follow your working hours schedule, get used to it. Remember is not the same as a graduate student schedule, but you need to follow it.
- Enjoy the experience.
- Follow the dress code, especially when you need to attend meetings.
- Be organized as much as possible, remember that reports are required and somebody else is going to continue the work that you have done.
- Do not use the Internet for personal matters. The Internet in the office is a working tool.
- Meet co-workers and supervisors, managers, secretaries and even the janitor – everyone can help make your internship a nice experience.
- Leave a good impression of your work, your faculty and your university at the end of the internship. Let them remember you and your good work.
- Take advantage of the opportunity and learn as much as you can.

General experience, impressions (conclusions)

The graduate internship was an amazing experience. Any graduate student can learn a lot from it. A graduate student can learn to work with big groups, and at the same time learn a lot about different topics from different types of engineers and accountants working together as a group to finish a project. The internship allows the graduate student to meet new people. It's always an opportunity to meet new people from different backgrounds. Also, working in groups, the graduate student learns how to develop a solution to a problem, taking in consideration time, budget, and other people's opinions, among other things.

The graduate internship is a good way to apply what you have previously learned in classes to solve real world problems, with limitations in time, equipment and budget. But the experience opened eyes about real problems, how to address them, what to take into consideration, how to

solve the problem and how to present the solution to co-workers and supervisors. In one case, the opportunity to see the construction of the ship, walk around, see the actual size of the equipment, the space, the way they work around the ship, how they manage to keep in touch with all the engineers working at the same time in different area, especially when time constraint is not the same for everyone, but the final product time constraint is.

Another important asset is to provide a real-world experience for graduate students. Sometimes outstanding undergraduate students become graduate students. While these students are excellent in classes and theoretically, they lack a perspective on the real-world and solutions to real engineering and science problems. The graduate internship provides a platform for these outstanding students to experience integrating the engineering and science principles with today's industrial constraints.

In general, some advantages of the graduate internships are job opportunities, work experience, and thesis or dissertation topics. On the other hand, some drawbacks are time limitation and industry working hours, but in general the advantages outweigh the disadvantages. The experience and knowledge learned in the internship was way beyond expectations. In conclusion, an internship is recommended for every graduate student.

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