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College-Industry Partnerships at its Best

Introduction

This paper describes an integrated graduate program at Gannon University in cooperation with a practicum at GE Transportation leading to a Master of Science in mechanical, electrical, or embedded software engineering degree. Both are located in Erie, Pennsylvania. The program includes the support of GE Transportation engineering mentors for directing the graduate students and Gannon University faculty mentors for administering the program and providing student support. The Program initially started in 1989 with full implementation in 1997.

The program goal is to give the engineering graduates the education and training needed to solve problems related to the design and implementation for GE Transportation. The specific program objectives are:

- Provide GE Transportation with a stream of well-trained engineering workforce.
- Provide GE Transportation with professional expertise and local resources to assist with advanced technologies.
- Provide graduate students with a curriculum focusing on mechanical/electromechanical, thermal/fluid, electrical, electronic, and software systems.
- Provide/develop courses in the subject areas related to the activities and needs of GE Transportation.

Program Description

This is a professional track work study academic program combined with application training on actual industrial problems. At the same time students are exposed to real-world problems through hands-on experience. The program consists of one program coordinator from GE Transportation and one program coordinator from Gannon University. Students are selected for this track based on academic background, self motivation, and leadership, interpersonal and communications skills. Each student is assigned a Gannon University professor as a mentor while working at GE Transportation. The mentor advises the student on his academic work and guides the student on engineering projects related to GE Transportation. The projects are carefully chosen to reinforce classroom work and to develop the student into outstanding engineers. In addition to the mentorship in technical areas, the professor also mentors the student in leadership skills, work and personal ethics, and communication skills that are needed in the industrial workplace. The student is also assigned a mentor from GE Transportation. The mentor assigns the projects to the student including the specific tasks to be completed and directly interacts with the student for day to day activities on all projects. This track requires that the student work on these industrial projects half time during the school year and full time during the summer. Program consists of 12 courses (36 credits) to be completed over a two year period.

The graduate work-study under which the student works provides the following:

- The student works on GE Transportation project(s) 19 hours per week during the academic year and 50 hours per week during the summer. During a full year, the student works on projects a total of approximately 1500 hours.
- The project areas include traction, control, cooling systems, remote diagnostics, propulsion equipment, diesel engines, power electronics, software development, noise and vibration, wind energy, and structures.
- The graduate tuition, fees, and books for the student are paid by GE Transportation (about $16,000-$17,000).
- The student is an intern of GE Transportation with a stipend of $30,000 per year.

Engineering Analysis I and II are taken by all students. The remainder of the typical courses taken by students includes:

Electrical Engineering

Requirements Engineering, Object Oriented Modeling, System Modeling, Electric Machine Modeling, Control of Electric Drives, Power Electronics, and Digital Control.

Embedded Software Engineering

Requirements Engineering, Object Oriented Modeling, Personal Software Process, Embedded Systems Design, Embedded Software Paradigms, Advanced Digital Design, and Embedded Kernel.

Mechanical Engineering

Basic and Advanced Vibrations, Advanced Strength of Materials, Thermal System Design, Advanced Fluid Mechanics, Heat Exchanger Design, Combustion and Emission Control, Computational Fluid Dynamics, Modeling and Simulation of Dynamic Systems, Engineering Optimization, Acoustic and Noise Controls, Finite Element Analysis, and Turbomachinery.

Program Operation

The students send their application to the Gannon University faculty mentors. For initial screening of the applications, the following criteria are used:

- A minimum GPA of 3.0
- Four years of technical experience after graduation, in their discipline or related field (only for international students)
- Strong basic fundamentals and design experience
- Strong recommendation letters

After initial screening of the applications, the following interview process is used:

- Applicants are interviewed by phone by Gannon University mentors.

- Successful candidates from initial phone interview are interviewed by phone with several GE Transportation personnel and GE Transportation program coordinator.
- Based on written feedback from interviewers to Gannon University mentors and GE Transportation program coordinator, final selection is made by GE Transportation program coordinator.
- On an average 15% of initial applicants are accepted into the program.

Implementation Plan

- The student will be evaluated on an ongoing basis by the faculty and GE Transportation mentors.
- The student will be evaluated at the completion of each major project (4-6 month time period).
- In addition to on-going monitoring of student's activities, the faculty and GE Transportation mentors will review the student's progress monthly and report on the status of their progress to the GE Transportation sub-section managers. The student prepares a short report for this review and makes a ten minute oral presentation at a meeting attended by all students and mentors.
- The student is provided orientation and training sessions in several areas. Examples include Visual Basic for Excel, Tollgate Process, CASS, and Six Sigma. Most students obtain a Green Belt Certificate during their two years in the program.
- The student's graduate course work will be selected to relate, as much as possible, to the activities and needs of the GE Transportation sub-section.
- The evaluation methods track progress in areas of technical knowledge and application, leadership, communication, and professional behavior.
- Continual interaction between students, faculty, and GE Transportation mentor/manager is the result of the plan.

Program Assessment

The following methods are used for assessment of the success of the program:

- At the completion of every major project students are assessed on topics such as problem analysis and modeling, design, testing, integration, technical ability, project completion time, project reviews, project documentation, and identification and solution of the issues related to the project.
- Monitoring the percentage of graduates being hired after graduation by GE Transportation. This provides an indication of the success of the program.
- The leadership roles attained by the graduates after graduation and the awards received from GE Transportation for their work indicates the success of the program.
- Students are also assessed for communication and presentation skills during the presentations at monthly meetings.
- Assessment is also being made on a regular basis by having meetings among various mentors. This provides an immediate corrective action if needed.
- Whenever a student holds major project review with high ranking industry personnel, a feedback is collected on student's performance and on resulted action items.

Program Outcomes

The expected outcomes of the program include

- Technical expertise
- Experience in managing and delivering projects
- Proper behavior in the workplace
- Written and oral communication skills
- "Soft-skills" of teamwork, leadership, and aggressiveness

Program Success

Program success is measured in terms of various indicators:

- Project assignments and rotation - Usually after a month or so, students are assigned responsible projects indicating the trust manager put in these students. Students rotate within several groups of the organization to allow them to get a broader perspective of the employer's products and operation. Many times the group does not want them to rotate (considered highly valuable) but have no choice unless the group wants to make an offer before graduation.
- Performance on the assignment - After completing every major project (in 3-6 months), students fill out a detailed "Student Evaluation Form" in terms of
    - How was the assignment performed?
    - Was assignment technically well done?
    - Was assignment completed on time?
    - Were the reviews held as required?
    - Was the documentation completed?
    - Were the correct issues identified and resolved?
    - Was help effectively sought and used?
    - Was creativity employed in performing the assignment?
- Annual Review **-** Every student goes through annual review similar to GE Transportation employee (EMS 360). Over the years 90% of the students have performed at the maximum level to indicate the excellent performance and review for them.
- Appraisal Summary & Analysis - Students fill out an appraisal form on yearly basis. Appraisal Summary & Analysis is performed by their managers/mentors in terms of
    - Self Confidence
    - Initiative
    - Communication
    - Change Facilitation
    - Relationship Building
    - Influence
    - Team Leadership
    - Decisiveness

    - Concern for Effectiveness
    - Technical Ability
- Most of the students score between 5 and 6 out of 6. This analysis is used for merit increase given to the students after finishing 1st year in the program. Over the years 90% of the students have received a maximum merit increase to indicate the excellent performance and review for them.
- Monthly Meetings – At these meetings students make presentations of ongoing projects that allow faculty and industrial mentors to monitor student progress. Also Industry mentors and Gannon faculty regularly discuss student progress.
- Completion of the program – Excluding students entering Computer Science program (discontinued now), 147 students have passed the rigorous academic requirement and multi-phase interview process to be admitted in the past 20 years. Ninety two percent students graduated with a Master's degree from Gannon University.
- Job Offers by GE Transportation - Seventy three percent (73%) of graduated students were hired full-time by the GE after graduation with 81% of them still currently working for GE. The reason this number came out low for hiring is due to the economic downturn of 2000-2002 where 40 students graduated and almost no one was offered the job at GE Transportation. Excluding that period more than 95% of the students were offered job by GE after graduation.

Conclusion

From 1997 until today, 147 students have participated in the program in Electrical and Mechanical Engineering and approximately 2/3 of them have been retained by GE Transportation as full time engineers. Today many of these graduates are in leadership roles at GE Transportation. This program has been so successful in providing a stream of well-trained engineers that other local industries are in discussion with Gannon University to start a similar program. The program is also being explored to bring foreign nationals into the program. Once these students complete most of the degree requirements except one course, GE Transportation will hire them to work in their homeland. The students will complete this course as a distance learning course after returning to their homeland.