My Summer Industry Internship Experience

Zhongming (Wilson) Liang
Purdue University Fort Wayne

I. Introduction

I call my work at local companies in the last two summers as industry internship because of the type of the employment. As the companies stated, the purpose of hiring me was twofold: the company could benefit from my expertise but also support engineering education by helping faculty gain practical experience.

While engineering technology faculty working in local industry in summer time is not new, this paper discusses my experience from the point of view of internship rather than of summer employment.

I had a good record of industrial experience before these two summers. I worked for ten years in a manufacturing company as a mechanical engineer from 1968 to 1978. I became a registered professional engineer in my state in 1993. Nevertheless I felt that I gained a lot of new knowledge and new ideas during the summer interns.

The four areas in which I benefited from the summer interns were:

- Teaching method improvement
- Teaching material enrichment
- Continuous professional development
- Application of mathematics in manufacturing technology

Each of them will be slightly discussed in the following sections.

The summer interns were in two large orthopedics manufacturing companies. The working areas were automated production.

II. Summer intern outcome one: teaching method improvement

Through my own practice during the interns I came to realize that some of my teaching methods should be improved in order to better prepare students for their jobs.

Let me use the robotics course to explain it. Part of my robotics lab teaches how to use the Mitsubishi RV-M1 robot with Movemaster control. I taught the students how the commands worked using examples in the robot manual and examples of my own. For example,

- Command MJ is to move joint. The line

  MJ +90, -30, 0, +20, 0

  moves the robot about the first, second and fourth joints.
- Command HE is to assign a position number to the current location. The line

  HE 11

  defines the current location as position 11 and records it in the memory.

- Command MA is to move the robot to a distance from a defined position. In the following:

  PD 5, 0, 0, 30, 0, 0
  MA 1, 5

  the first line defines Position 5, which is a dummy position, and the second line moves the robot to a point whose incremental distance to a predefined Position 1 is the coordinates of Position 5 in the first line.

Students were able to use the commands in small exercise assignments. However, mostly in course projects, they only used the command MO (move) to teach-and-playback.

In one of the summer interns I developed a robotic project. Fortunately it was also a Mitsubishi robot and it also used Movemaster control. The robot needed to go through a number of positions. The positions must be accurately on one geometry surface but the location of the whole surface with respect to the processing tool needed to be tuned by trial-and-error because of many process variables. If the common method of teach-and-playback were used, in each tuning for the process tool, many positions would need to be accurately taught again. Instead, I figured out a different method. I taught only one position, which could be called as the parent position. I then used commands MJ, HE, MA etc to set up a number of children positions that, through coordinate assignments, have accurate relations with the parent position. In this way, I had only need to change the single parent position in each turning of the process tool. The method was very effective for the speed and the quality of the project.

In doing the project I fully realized that I did not teach my students the real power of some of the commands. When I teach the course the next time, I will go much beyond the basic use of the commands and explore how the commands can help in different types of industrial robot applications.

III. Summer intern outcome two: teaching material enrichment

The summer intern practice let me gain new knowledge, new information and new teaching examples.

Dynamics is one of the most difficult courses in the mechanical engineering technology curriculum. There are several reasons for the difficulty. The course materials are indeed quite analytical with little or no laboratory. The authors of the textbook are scholars in mechanics so that some wordings are very theoretical. Some students were not interested in the course because they did not see much connection between the book examples and their current or future jobs.

During a summer intern, the company wanted to use a ceramic cutter for higher cutting speed on a CNC lathe but needed to make sure that the work and the chuck would be safe at the high speed. I was asked to do some safety checks based on the centrifugal forces.

This project gave me the idea that there were many dynamics application examples in real manufacturing environments. If we teachers in mechanical engineering technology can go more beyond the book examples, students would be much more interested and their study would be more successful.

IV. Summer intern outcome three: continuous faculty development

It was twenty some years ago when I was a full-time mechanical engineer in a manufacturing company. The summer interns let me fully realize the need for my continuing education especially in some areas.

For example, material science is not my specialty. Before the interns, I had already read about and heard about plastic materials and composite materials. Because of my limited knowledge and practical experience with them, however, I tended to skip contents on new materials in my courses of machine elements, basic machining, tool design and manufacturing processes.

During the summer interns, I was really impressed by how much and how effectively plastic materials and composite materials were being used or considered to be used in product design and fixture design and was shocked by how advanced cutter materials were pushing the cutting speeds to their limits.

I have formed a plan of professional development in this and other similar areas and gradually incorporate more and more about new industrial development into my teaching;

V. Summer intern outcome four: application of mathematics in manufacturing technology

Mathematics is typically a weak area for engineering technology students. The summer interns gave me some nice example to demonstrate to the students how math can make big differences in manufacturing engineering environment.

In our ABET accredited MET program, students here take five semester credit hours of college algebra and trigonometry plus four semester credit hours of calculus for an associate degree and another four semester credit hours of advanced calculus for a baccalaureate degree. Still, many of the students do not like to struggle with mathematics. For example, when I asked students in my manual CNC programming class to find the end points of a few cutting tool paths using trigonometry, some resented to the requirement and used a CAD drawing to determine the coordinates. I found myself not very successful in convincing students that mathematics was really important for their future.

During the interns, I have seen many examples where command of mathematics made obvious differences. For example, development of the robotics program as discussed in the above required mathematical modeling of complex three-dimensional movements of the work with respect to the processing tool. While the modeling did not involve too much mathematical manipulation, the ability to put the problem into the mathematical frame required a mathematical background. My way of writing the robotics program based on mathematics impressed some young engineers in the company and motivated them to pursue further study in college.

I plan to incorporate more practical examples into teaching of my courses where mathematics seems less important or can be substituted. For example, in fixture design projects, students tended to guess or ask the instructor to suggest the sizes of some components. In fact, doing stress calculations on some selected components would take only half an hour or so. The time investment should be very worthwhile for their future.

VI. Acknowledgement

I thank Professor Ken Rennels and Professor Jack Zecher at Indiana University-Purdue University Indianapolis for their valuable comments and suggestions to this paper.

Biblography

1. User's Manual, Mitsubishi RV-M1 Industrial Robot, Mitsubishi Electric Corporation.
2. User's Manuals, Mitsubishi RV-1A Industrial Robot, Mitsubishi Electric Corporation.
3. James A. Rehg, Introduction to Robotics in CIM Systems, fourth edition, Prentice Hall, 2000.
4. Ferdinand Beer, Russell Johnson Jr., Vector Mechanics for Engineers, sixth edition, McGraw-Hill, 1996.
5. Fundamentals of Tool Design, fourth edition, SME, 1998.
6. Serope Kalpakjian and Steven Schmid, Manufacturing Engineering and Technology, fourth edition, Prentice Hall, 2001.

ZHONGMING (WILSON) LIANG
Wilson Liang is an Associate Professor of Mechanical Engineering Technology at Indiana University-Purdue University Fort Wayne. He is a registered Professional Mechanical Engineer in Indiana. Wilson received a B.S. degree in Mechanical Engineering from South China University of Science and Technology in 1966, an M.S degree in Mechanical Engineering from Huazhong University of Science and Technology in 1981 and an M.E. degree in Mechanical Engineering from the City College of New York in 1982. He did very well in the Ph.D. program at Stevens Institute of Technology from 1983 to 1987.