PDHonline Course G470 (1 PDH)

Mentoring the Engineering Intern

Instructor: John C. Huang, Ph.D, PE

2020

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5272 Meadow Estates Drive
Fairfax, VA 22030-6658
Phone: 703-988-0088
www.PDHonline.com

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MENTORING the ENGINEERING INTERN COURSE CONTENT

W.N. Weaver, PE and John C. Huang, PhD, PE

INTRODUCTION

Frequently the professional engineer is placed in the position of mentoring an engineering intern. If this were the 1960's the intern would likely have completed his / her freshman year of college and have some high school work experience dealing with some phase of engineering perhaps in light construction, working in a garage or in a local factory or on a farm. Because in today's world the experience of the intern is most likely to be limited to retail, pizza delivery or grocery stores it complicates the task of mentoring to include a basic introduction to the real world of engineering.

Frequently the young complain that they can't decide what they want to be when they grow up. It is a difficult time, usually trying to make a critical decision without enough information. More often than not you see them in a university setting where their professors are not broadly enough experienced in the real world of engineering, economics, chemistry or politics to offer meaningful advice to the student.

Guidance counselors are educated in "academic guidance" and rarely in "practical life" guidance. It is difficult to imagine how a guidance counselor can offer guidance on a career in which he / she has no personal experience. True there is a lot of written work describing what various professions do for a living. Writers physically, emotionally or mentally inexperienced in the tasks involved in a particular profession cannot hope to provide true insight into the daily grind of work they themselves have not done. Yes, a writer can describe ditch digging but not in the detail possible to the ditch digger. That unknown (to the reader) lack of true information about ditch digging makes his / her decision knowledge short of reality at the least.

The young student has limited resources to help him / her to make the decision. What is really needed is some exposure to what working at the various professions is actually like. This is the point at which the mentoring engineer steps into the situation.

ELIMINATING CONFUSION

One of the mentoring engineer's tasks is to remove misconceptions about engineers and scientists. High schools as a rule don't bother with this type of information so the intern needs some specifically directed education from the mentor. What the engineer does and is actually provides the reason for the internship program.

Frequently people confuse the engineer with a scientist and vice versa. Simply put a scientist wants to understand how something works while an engineer wants to apply the scientific principle to making things work.

A scientist may spend years working out an equation to explain gravity and end up with an equation that defines gravity to four decimal places and is 99.9999% accurate. On the other hand

an engineer will take an equation which defines gravity in the simplest terms and is only 90% accurate and use it to design a water wheel powered factory.

Engineers produce facilities which produce products. Generally engineers take over from scientists and convert the scientific principle into a practical item.

Engineers have a variety of products depending on their place of employment. There are several major "classes" of engineer which are independent of the degree taken:

Design engineers	Generally design equipment or facilities to produce products or to house some sort of operations such as buildings for office space, etc.
R&D engineers	Generally work in the newer technology fields (biomed, electronics, metal alloys, space, etc.)and more closely with the scientists
Production engineers	Generally are responsible for the day to day operations of a production facility (chemical plant, food manufacturer, winery, cheese plant, automobile plant, electronics equipment facility, any mass produced product)
Sales engineer	Generally involved in selling engineering services, complex mechanical equipment, etc.
Facilities engineer	Generally responsible for maintaining the equipment and utilities in production or other larger facilities

It's useless to attempt to list all the items produced by engineering efforts but it is safe to say that no product survives without some input from an engineer. That's true even if that input is only the design of the air conditioning system, which allows the production personnel to work in comfort.

DO's and DON'T's forthe MENTOR

The biggest don't is tied to the intern's decision to become an engineer; most likely he has made this decision by talking with a few engineers, some teachers and reading about engineering. Somebody told him / her that they could make good money as an engineer and the title "engineer" sounds impressive.

It is not the mentor's task to convince the intern that he should be an engineer but to help him / her to reach a true understanding of what it means to be an engineer. A student graduating in engineering with no true interest in the field will not be a happy person nor will the make a good engineer. It takes more than knowledge of a subject and how to do the work to make a good engineer. The goal of the mentoring process is to help the young person arrive to the proper educational decision and to give him / her a true understanding of the work.

Don't mother the intern. Provide a task, ensure he / she understands the value of the task, the goal and the basics of how to accomplish the task and then be available to assist.

The "do" portion of the internship covers almost anything that will help the intern understand what engineering is all about. Keep in mind that you are not there as a teacher in a specific

subject matter but as a guide to those things which enhance the intern's experience and their understanding of the field of engineering. Anything meeting those criteria should be on the "do" list.

TYPES OF INTERNS

Depending on many factors the engineer may be working with an intern of the following types.

Level of education	Expected Abilities on the Job
High School Graduate	Clerical work, internet searches for equipment or data, perhaps minor calculations involving geometric shapes, minor CAD work
1st Year of College	Some basic math, perhaps drafting, field data collection (dimensions, etc.)
2nd Year of College	More advanced equipment searches, simple equipment specifications, more advanced math, advanced CAD
3rd Year of College	Specifications, CAD, field data collection, field testing support, calculations, project team

After the first year of college the interns should begin to arrive for mentoring with some course materials in their selected major. This may or may not allow for a proper exposure in your facility; for example your company fabricates steel structures and the intern's major is electrical engineering. A mismatch of this degree does not benefit the intern or the company and needs to be avoided. Internship arrangements need to be reviewed by the mentoring engineer for a proper match and not left up to the college or human resources.

The more years of education the intern has the more they will be expecting to work on real industrial problems. For example assigning a role in a project team to an intern who has completed the junior year of college should match usable educational experience to the project activity.

Frequently the intern who arrives is just beginning to see the real world of engineering and may decide to switch majors based on the exposure you give him / her. That is not to be considered a failure of the internship program but in fact should be considered a success as it indicates a better understanding of the engineering world on the part of the intern.

SAFETY

In most situations the Human Resources Department will have given the intern a thorough safety orientation to the plant. However a recap by the engineer is critical to the intern's safety and an observation of the intern's attitude about safety is essential. A poor attitude about safety is a serious issue requiring correction before anything happens; it may be sufficiently serious to return the intern to Human Resources for corrective action. Your facility has some liability for the welfare of the intern.

It is amazingly easy for the novice to get hurt in an industrial setting in particular if the industry handles chemicals or is filled with high speed equipment. It is critical for the mentoring engineer to take the time to visit the areas where the intern may work in the plant and go over the necessary safety precautions along with the need for Personal Protective Equipment. A helpful approach I've used is for the intern to wear a visitor's hard hat which alerts the production people to the presence of people not familiar with the facility and the safety issues.

EXPOSURES

Remember the goal is to give the intern an exposure to the real world of engineering. This requires some thought and planning and must include the boring as well as the exciting activities of the engineer.

One of the key exposures for the intern is to understand the engineer's position in industrial activity. We generally use the following path today:

1. R&D or an Inventor conceives the product and sales confirms a market
2. An engineer and designer team produces the design and may build the prototype
3. An engineer designs the required production facility and selects the appropriate equipment for the process
4. A construction company (a different engineer) builds the production unit
5. A production engineer runs production providing the product to the market
6. A Quality Assurance engineer may be brought in for product testing

But that listing only covers part of the work we do on a daily basis and doesnot include many of the engineering positions available.Most engineering positions encounter some of the following activities during the business day.

Calculations	Testing	Power supplies
Meetings	Installations	Utilities
Equipment search	Equipment design	Materials handling
Specification writing	Raw material storage	Facility design
Cost estimating	Manufacturing cost estimation	

Depending on the level of education and experience the intern brings the mentoring engineer needs to select appropriate work from the list above. It is not enough to ask the intern "what do you want to learn?" because most interns will not have a good idea of what is available to him / her as learning opportunities. Obviously attempting to cover everything during one summer means most things aren't covered in sufficient detail to be locked into the intern's thinking processes.

A key piece of information, not normally shared in college, is that completing a degree in one major does not prevent the engineer from moving to a different field of engineering. I have supervised mechanical engineers working as process engineers and chemical engineers working

as controls engineers. An engineer working in one field can move to other more interesting fields if the motivation is present.

Finally giving the intern some idea of the total breadth of the engineering world is worthwhile. A listing of the various areas of specialization is generally eye opening to the engineering student. See Attachment A.

WORK SELECTION FOR THE INTERN

Determining what work the intern is capable of based on his education and experience clears the way for the mentor to begin looking for work with **value**. Note the word value in the preceding sentence. Most people do not want to do "busy work" so the task of finding work for the intern is similar to finding work for any employee. The work needs to have meaning and the intern needs to be aware of how it benefits the facility.

The work assignments should deal directly with the maximum exposure to the engineering world. A summer spent filing drawings is of little benefit to the intern but some days spent learning to read those drawings will be useful forever. Each task assigned to the intern needs to lead to a deeper understanding of engineering work, the tasks don't need to be progressively more difficult just more enlightening for the intern.

If your engineering group contains multiple disciplines then the intern should be given the opportunity for some exposure to all the different branches of engineering. This is particularly important if there is any indication that the intern isn't sure which discipline he wants as his / her major. With twenty-five or more fields of engineering selecting the path is difficult.

Frequently engineers working on a project or problem will end up in a "bull" session where numerous ideas and concepts are thrown out while searching for a good design. These informal gatherings are an ideal exposure opportunity for the intern as it shows the benefits of cross discipline interaction in finding a solution to a problem. This bull session approach also exposes the intern to the form and patterns of interactions between engineers which in itself is educational.

Intentionally or not the intern is likely to be exposed to company confidential information. This is not something most high school graduates have experience with and some stress needs to be placed on both avoiding the exposure and of ensuring the intern understands the necessity of protecting this information.

THE ACADEMIC ENVIRONMENT

Most engineers come to the field via a college or university degree program and some smaller number come from the military schools. The academic education isn't the same as required by industry. The concept was that the academic education provides the basics and industry expands on that.

What actually happens varies by industry but more often than not introduces the novice engineer to simpler methods of solving engineering problems than is presented in a classroom setting. Industry is by and large a practical application arena whereas academia is a theoretical environment. The two meet in the engineer's first job or internship. Generally what will happen is industry will calculate a value to perhaps one significant decimal while the academic world in the classroom wants accuracy to four decimals. Industry recognizes that the equations in use have a limit of accuracy and will insert the necessary contingency to ensure the process works; academia doesn't usually need to be that concerned since most of the calculations will never be used to build anything.

Most companies have calculation techniques which match their processes and some of these will not match the techniques given in most text books. The math may not be as rigorous but it works for what industry needs. Understanding this point is important to the intern who must avoid using "industrial math" for his class work.

This exposure to real engineering places the intern / student in a difficult position on occasion. When a professor presents material which the intern has been exposed to out in industry a conflict frequently arises. Industry's approach is practical and academia's is theoretical and the intern may be tempted to explain to the professor how it is done in the real world. Embarrassing a professor is not good for the student's grade point average.

THE INDUSTRIAL ENVIRONMENT

The industrial environment is different in that it functions as a profit making unit unlike academia which exists to teach. So giving the intern an understanding of exactly how the plant accomplishes this presents the foundation for the existence of the facility. Understanding that the goal of the facility is profit puts things in the correct perspective.

Where the first time intern is accustomed to doing paper work for a professor the content and writing approach are different in industry. A report from the intern benefits both the intern and mentor letting the mentor have a better picture of the intern's accomplishments and what might be assigned next. No grading of the report is required but some comments moving the report to an industrial format is worthwhile.

As we saw earlier the industrial calculation method is not the same as those used in school involving as they do the use of catalogs, specialized software and plant calculation methods. Frequently interns arrive thinking they will be designing pump internals (for example) only to be surprised that that effort is usually restricted to the manufacturer and the engineer's task is one of selecting the appropriate pump or other equipment from a catalog. The intern's education on centrifugal pumps for instance is generally all theory including how the impeller, etc. work.

Another item of interest which is rarely covered by the schools is the number and details involved with the various codes and the inspectors who enforce them. Exposing the intern to an inspection by any inspector presents a learning experience of value.Some exposure to the major codes (NEC, ASME, etc.) is warranted if it can be coupled with some task.

Depending on the age of your facility the intern may be exposed to out dated (in academia's view) technology. One of my electrical engineering interns was completely at a loss to move forward on an assignment where the old control panel used relays instead of solid state devices. He had never seen a relay and nothing in his education had prepared him for this antique control mechanism.

I've seen engineering interns react with disbelief when they first learned about pipe "out of roundness" and similar codes. At no time in their academic exposure had anyone ever mentioned that such a thing existed. In academia everything is assumed to be round or square or perfectly uniform. Most of these assumptions are necessary for the class room calculations however they do on occasion need to be taken into account. These simplifying assumptions are common in the classroom but not always acceptable to the industrial engineer.

THE FINAL REPORT

Most colleges or other sponsoring group will ask for a report on the intern's efforts over the summer, at the least the plant's Human Resources Department may want a report for its files. As with any personnel review the report needs to be concise and factual with a minimal amount of details generated by the mentor's feelings about the intern.

A listing of experiences and accomplishments is generally beneficial as that kind of information helps with the next intern. An honest evaluation of the intern should be presented if requested; a sense of what information is truly wanted can generally be gathered from the content of the form.

For upper class interns an offering to provide a reference to others is in order.

CONCLUSION

Having an intern in the facility frequently adds interest to the engineer's workday and can be a satisfying experience for the mentor. Helping someone with their choice of an engineering career is usually a pleasant experience.