Transitioning from Industry to Education: The First Year

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Abstract

After years as an engineering professional in industry, a career transition into a related field was on the horizon. The events at the beginning of the 21st century lead to the downsizing of numerous companies and the eventual elimination of countless jobs. As the economy weakened, it became increasingly difficult to find engineering positions, particularly for seasoned managers. Never the less, many former colleagues continued to search within these careers, while a few branched out and explored alternate professions.

But one important question had to be answered. Were the skills learned and practiced as an engineering manager transferable? Engineering managers were usually proficient in planning, scheduling, organizing, exploring, controlling, mentoring, communicating, leading, budgeting, administrating and allocating scarce resources. After independent investigation it was determined that these skills were not only transferable but necessary in a wide variety of other fields. Opportunities existed in industry, education, government, project management and technical sales to list just a few. The best fit, however, appeared to be engineering education.

After the new career was selected, it led to numerous other questions. How difficult would the transition be? How long would it take? Could engineering and management skills be applied directly into the classroom environment or would they have to be adapted? Would the engineering experience be beneficial? What new skills had to be acquired? What teaching methods should be used? How and where to start? These and many additional questions were answered during the first year as a full time engineering educator.

This paper describes the trials, tribulations, successes and lessons learned during the writers first year as a full-time engineering educator. The results may be of great benefit to those in industry considering a similar career change.

Introduction

A stimulating career in industry followed an extensive engineering education with the opportunity to solve many technical problems and create numerous useful products. Many

positions were held including: Electrical Engineer, Project Engineer, Lead Engineer, Section Manager, and finally Engineering Manager. As engineering careers progress so do the responsibilities and to better understand the management side of industry, a Masters in Business Administration Degree was added. This sequence of events is far from unique; numerous engineers have experienced a very similar career path.

During every career there are surprises and unexpected events. The past few years were no exception. Many engineering and engineering management positions were eliminated as the economy reacted to the events at the beginning of the century. Most of the affected individuals proceeded to seek a position similar to the one that vanished, but others searched for alternate ways to utilize their skills in related fields.

The career shift to engineering education appeared to be a natural progression. After all, who would be better suited to teach engineering principles than someone who had been directly applying them to real world problems. Describing how design issues were resolved on actual projects by engineers in industry would add a new dimension to the coursework. This sharing of engineering knowledge would greatly enhance the student's classroom experience.

However, the transition from industry to engineering education was far from a painless and seamless process. Many of the skills developed as an engineer and engineering manager were directly transferable to engineering education but others had to be modified or acquired. A skills assessment led to an entirely new learning curve that had to be dealt with.

Transferable Skills

As with all career changes, some degree of cultural shock was experienced during the transition from industry to education. This ranged from excitement to anxiety including a wide array of emotions in between. Actually this was nothing new. Everyone has experienced it before and survived. Just recall the feelings from that first day on the job after graduating from college. Typically it begins at a high point with some trepidation, followed by a low point when reality hits and then settles into a steady state as a semblance of a normal routine appears.

How can this transition be made as smooth as possible? Tackling the problem as an engineer, research would be the first step. Many excellent books and papers have been written on effective teaching techniques and practices including those by Gupta [1], Wankat [2], Laurillard [3], Ramsden [4], Knight [5], and Yelon [6].

While conducting this study it became clear that many of the skills utilized both as an engineer and engineering manager were directly transferable to engineering education. In practice, teachers were actually managers in many ways. This affirmed the conclusion that practicing engineers could successfully utilize their background effectively in the university environment. The major transferable skills included: planning, scheduling, organizing, exploring, controlling, mentoring, communicating and leading. Other skills were also transferable but usually pertained to the management side of the university that incorporated budgeting, administrating and allocating scarce resources.

Everything begins with a plan. Teaching a course can be thought of as a project with a definite start and end date. As such, the plan for a course or project can be visualized in terms of time, scope and cost. Time is the one constraint that determines the deadline when the objective must be met and the project completed. Scope describes the intended quality, features, and functions of the product or project. Costs are more than just money, they include all the resources required to carry out the project including people, materials and equipment. Thus planning can be applied just as easily to educational projects, like teaching a course, as it can to an engineering project.

Scheduling is the process of creating a timeline or timetable for performing work or achieving an objective. It specifies the order and allotted time for each part and is usually presented as a list of items in tabular form. In engineering it is used to set the pace or monitor the progress of a project. In education it is widely used to set the tempo and outline the work required for a course and is typically called a syllabus. When the readings, assignments, exams and other items are listed on the syllabus in detail with deadlines, then it becomes a schedule.

Managing requires the organization of skills, resources, devices and systems. Teaching requires the organization of learning. Thus it follows that a teacher is essentially an organizer as well. The task of any organizer is to enable a group and the individuals in it to function effectively together for the achievement of a common purpose. As the class or engineering team learns how to work together and as individuals in it learn to set their own direction, the function of the organizer merges more and more into guidance. This is precisely the role of both a teacher and a manager.

The process of learning can be broken down into the components of exploring, experimenting and discovering. Both the practice of engineering and the method of learning depend on these components. Students learn by doing, making, writing, designing, creating and solving. The same is true for engineers as they create, analyze and develop new products. Engineers are always in the learning mode as they search for new innovative ways to utilize emerging technologies. Continual life-long learning is actually required for engineers and engineering managers to stay current in their field. Engineers are essentially students for their entire career.

Managers strive to influence results and often accomplish tasks by exercising power and control. Control can be broadly defined as the process of measuring, evaluating and adjusting performance to meet goals. Within this definition there are five phases of control: sensing, comparing, analyzing, decision making and corrective action. Along with this authority also come responsibility and accountability. All of these skills can be used equally as well by teachers in the classroom. However, being a teacher can be as much a position of dependence on student activity as of authority. The relationship between personal efforts and control over results is far more indirect in the classroom. It becomes more an issue of motivation to accomplish objectives.

It is extremely important for both managers and educators to establish mentor-like relationships with their workers and students. Mentors encourage, motivate, offer advice and give direction. The best mentors typically display three characteristics: they set high standards, they make themselves available and they orchestrate development experiences. As a result workers and students equally trust their mentors for both professional and personal support. These individuals characteristically become their advisors, counselors and confidants. The willingness to work as a mentor or coach with the students creates and maintains the best atmosphere for learning.

Developing good interpersonal communication skills are equally important for both the manager and educator. In addition to verbal or speaking skills, listening skills are perhaps even more significant. This involves learning to listen carefully without interrupting and making sure the other persons' statements are understood, before starting to react to them. Good listening skills lead to being responsive to the student's questions and inquiries expanding the learning process. The effective exchange of ideas opens minds allowing for alternate points of view, encouraging discussions and fostering feedback. These are all vital to the learning process.

Perhaps leadership is one of the most studied and least understood traits of management and has become almost a catch-all phrase. However, leaders manage not just by directive, but by example, persuasion, motivation and empowerment. They identify and gain commitment to an exciting or challenging vision. In addition, leaders manage not only individual performance, but group performance as well. All of the transferable skills are united into leadership to successfully manage a team or facilitate a class. Leadership in the classroom encourages, motivates and promotes individual efforts that collectively enhance the learning experience. Effective teachers always involve the students and make them active participants in the learning process.

This assessment reinforced the belief that engineering and engineering management skills were directly transferable to engineering education. However, it was also clear that not all of the required skills for education were present. Many were missing and would only be discovered during the transition phase from industry to education.

The Transition

During the initial weeks at the university change was constant. Some of the new things were easy to adjust to while others were quite difficult. However, with patience and the willingness to seek advice from seasoned faulty members the transition became systematic and tolerable. In addition, excellent articles by Kaw [7], Dean [8] and Miller [9] shed valuable insight and direction aiding the new educator through the transition process. As the days passed, more and more of the skills from industry were directly applied in the classroom.

Some of the transferable skills were utilized right from the start. A project plan was created for each course outlining the material to be covered in lecture, assignments and exams. This information was then easily transformed into a comprehensive syllabus. As it turned out, managing a class was extremely similar to managing an engineering project.

Other transitions were not quite as easy. The initial adjustment to a professor's salary was perhaps the hardest. With a nine month contract paid over ten months and a reduced salary from industry levels, some modifications in lifestyle had to be made. Downsizing and adjusting to a new way of life was never an easy process but with careful planning it yielded great rewards.

While adapting to an academic career another reality soon appeared. The responsibilities as an engineering manager in charge of four large engineering teams designing innovative products had changed dramatically and were replaced with new duties and tasks. The support staff and technical teams that actually completed the projects were gone. Now the role returned to being

an individual contributor solely responsible for completing all of the work. Success or failure was judged by students as customers and their expectations had to be met in the classroom.

People outside of education widely believe that teaching is the main duty of educators, but in reality this may not be the case. A great variety of other demands for time and effort were also requested sometimes requiring more resources than what was available. How to deal with these additional commitments became a new dilemma to reconcile. There were numerous department and university committee meetings to attend. In addition, time had to be allocated for student academic advising and recruitment. All of these meetings required outside work, preparation time and of course time for the meetings themselves. It was amazing just how many meetings were held and how much time they consumed. This became a difficult issue to resolve since the new educator had little control over them and their participation usually was mandatory.

Academic meetings were drastically different than meetings in industry. The vast majority of meetings at the university were working sessions where long discussions and debates occurred before any decisions were made. Contrast this to industry where all of the work was usually completed outside of the meeting and then during the get-together the facts were stated and decisions made. Industrial meetings were short and to the point while academic meetings tended to be long with occasionally nothing being accomplished.

During the first class sessions a presentation gathered from industrial experience was given to gain the students interest. It clearly described the history and background of the course material and its importance. It went on to show where the concepts were applied and why they were used. Actual engineering projects were followed and discussed from start to finish. The presentation ended by noting that after completing the course the students would understand how all of this was accomplished and be able to create simple designs. This encouraged numerous questions and instigated a very interesting discussion that continued throughout the course.

While preparing lectures a problem was noticed almost immediately. It was taking way too much time to prepare lecture notes, often well over forty hours a week. The notes were too detailed and often contained paragraphs quoted directly from the textbooks. Quickly this method was changed to an outline approach that sped up the process but resulted in equally well prepared lectures. Now by simply glancing at the notes without reading them directly the lectures became more spontaneous and informative. It worked especially well for the math intensive engineering courses with all of the equations, charts and diagrams.

It was also difficult to determine just how much material to cover during a class period. As with almost every class, the student's ability resembles a bell curve. With a few catching on immediately, a few lost, and the majority somewhere in between. In order to resolve this dilemma, a type of consultative engineering was used. The coursework was targeted at the middle majority of the class to challenge them with extra help offered during office hours to the student's who wanted it. Amazingly, many came and were able to understand the material with the extra assistance. This open door policy was similar to the successful strategy used previously in industry. When in the office and not busy, help was always available. Otherwise appointments were encouraged and many students actually reserved time for tutoring sessions.

Testing became another challenge. How many exams, tests or quizzes should be given? How many problems should they contain? What type of questions should be used? Was it acceptable to use multiple choice questions for engineering problems or large classes? Writing tests quickly became a very strenuous, demanding and grueling task. Sometimes what seemed to be a good representative test was either too difficult or too simple. It became a challenge to determine exactly what the students knew. As the first year progressed the tests improved, but satisfaction with them has not yet occurred. The tests were always graded as fairly as possible and returned at the beginning of the next class session for review and discussion.

The transition process wasn't abrupt and it didn't happen all at once, it actually occurred gradually during the entire academic year. Just as the transition from engineer to manager required experience and the development of new skills, so it was with the transition to education. Every career change requires the acquisition of new tools to ensure success in the new role. A great deal of patience was essential, because this process doesn't happen overnight.

Lessons Learned

As is the case with almost everything new and different there are numerous lessons to be learned from the experience. The knowledge gained through the many trials, tribulations, successes and disappointments was invaluable. These experiences and the information derived from them were part of the transition process and immediately utilized to improve many teaching skills. The most beneficial lessons concerned attitude, time, experience and seeking advice.

Always exhibit a positive, exciting and enthusiastic attitude. The passion for the subject displayed by the teacher is contagious and the students will be interested, stimulated and motivated by it. Granted for some subjects that may be difficult but even the dullest material can gain life when presented in an entertaining manner. It is more likely that the students will get enthused about a subject if they sense that the instructor is. Utilize the classroom as a stage with an audience full of eager students needing a gentle nudge to peak their interest.

Make the most of the expertise and experience of other faculty members', remember they have gone through this before. Don't be afraid to ask them for advice because they possess a wealth of knowledge and were eager to share it. Recall that at one point in their career they were a first year educator as well. In every case they were extremely helpful and wanted to see the new faculty members succeed. Look for a mentor among the seasoned faculty to assist with the transition to education; it will make the experience less painful and more enjoyable.

Paraphrasing Murphy's Law, "Everything takes longer than it should." This is particularly true for the first year educator. Starting with nothing, lesson plans have to be written, lectures prepared, projects developed, tests written and finally everything must be graded. To make matters even worse, this process will be repeated for each new course taught during the first academic year. Teaching three or four courses during a term requires a great deal of effort that may have to be repeated frequently during the next few terms or academic years.

Class preparation takes considerable time, but with practice this can be shortened. Utilize industrial experience to enhance the course while rephrasing the material in new and interesting

ways; don't just read from the textbook. The use of an outline format proved successful along with encouraging students to solve and explain problems on the board in front of class.

The "perfect" exam doesn't exist, but don't give up trying to create it. Don't be afraid to experiment with test procedures and processes. The worst result was discovering that certain methods work better than others. The best exam questions challenged the students, made them think and really apply the material learned. This process, as it turned out, became the true measure of learning. Anyone can memorize concepts and formulas for an exam but applying them to actual problems was the real gauge of success.

Grading projects and exams became another very time consuming process. No shortcut method or procedure was ever discovered to speed up this task. The fair and accurate evaluation of lab reports, essays, exams, projects and other assignments was a very tedious responsibility. It often required reading the documents multiple times to obtain an accurate assessment of the work. Reports and essays demanded the most effort while engineering problems were a little more clear-cut. However, the determination of partial credit for solutions that were close or followed the correct procedures only to contain a computational error needed close scrutiny as well. Extra time should always be allowed to complete this labor intensive endeavor.

Students like to hear real world stories about industrial experiences. New dimensions were added to the coursework by discussing applications of the material to actual engineering problems. Draw from past experiences citing both successful as well as unsuccessful projects to extend their studies past traditional textbook exercises into genuine engineering work. This resulted in a better understanding of how actual engineering problems were solved and new products designed. Students received, as a side benefit, a true glimpse of their future as engineers.

Get to know the students; they were the key to a new teacher's success. They became the best source of feedback and other valuable information that complimented the learning experience. Encourage them to communicate openly and frequently. This was accomplished in many ways, but a couple methods worked particularly well. First, keep an open door office policy and encourage students to stop by if they have questions or need help. Second, acknowledge and talk to the students whenever possible, in the halls, on campus or at anytime outside of class. Third, students don't like being treated as numbers, get to know their names.

Don't be afraid to try new and innovative things, they just might work. Be creative in the classroom and once again utilize industrial experience to augment the material. Real world design problems can stimulate the students to new levels of creativity. Challenge them with actual constraints for the design including cost, benefit, speed, size, packaging, user interface and a host of others. Don't be satisfied with a project that just works, because their future employers will expect a great deal more. In addition, invite guest lecturers with experience in the field to discuss their work. Even exams have a more "real" feel when solving actual problems.

Finally, teaching has always been a learning experience for all of the participants, including the teacher. Perhaps during the first year as a full time educator, the instructor actually learns more than the students. Learn from the students, other faculty members and the lessons learned to build and enhance new skills that can be applied in future classrooms.

Conclusions, Reflections and the Future

The transition from industry to education was both exciting and terrifying at the same time. After all, the aim of teaching was simple: to enhance the process and improve student learning. It was exhilarating being a contributor to the process where students learn and grow. Teaching was truly an important and noble profession requiring a deep commitment to the students.

Reflecting on the first year as a full-time engineering professor it went rather smoothly. The opportunity to work with wonderful students yearning to learn was a wonderful experience. They were learning to be engineers at the same time that a former engineering manager was learning to become an effective teacher. Both learned a great deal from each other and together. After the first year many lessons were learned and once again experience proved to be an excellent teacher.

The second year as a full-time engineering educator may not be any easier than the first. New opportunities and challenges lay ahead, but experience has yielded tools to deal with them. After learning from experience the writer has become better prepared to face the new challenges.

Since numerous engineering and management skills were directly transferable to education, others in industry should be encouraged to consider the transition to engineering education. It has truly been an enlightening and rewarding experience.

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