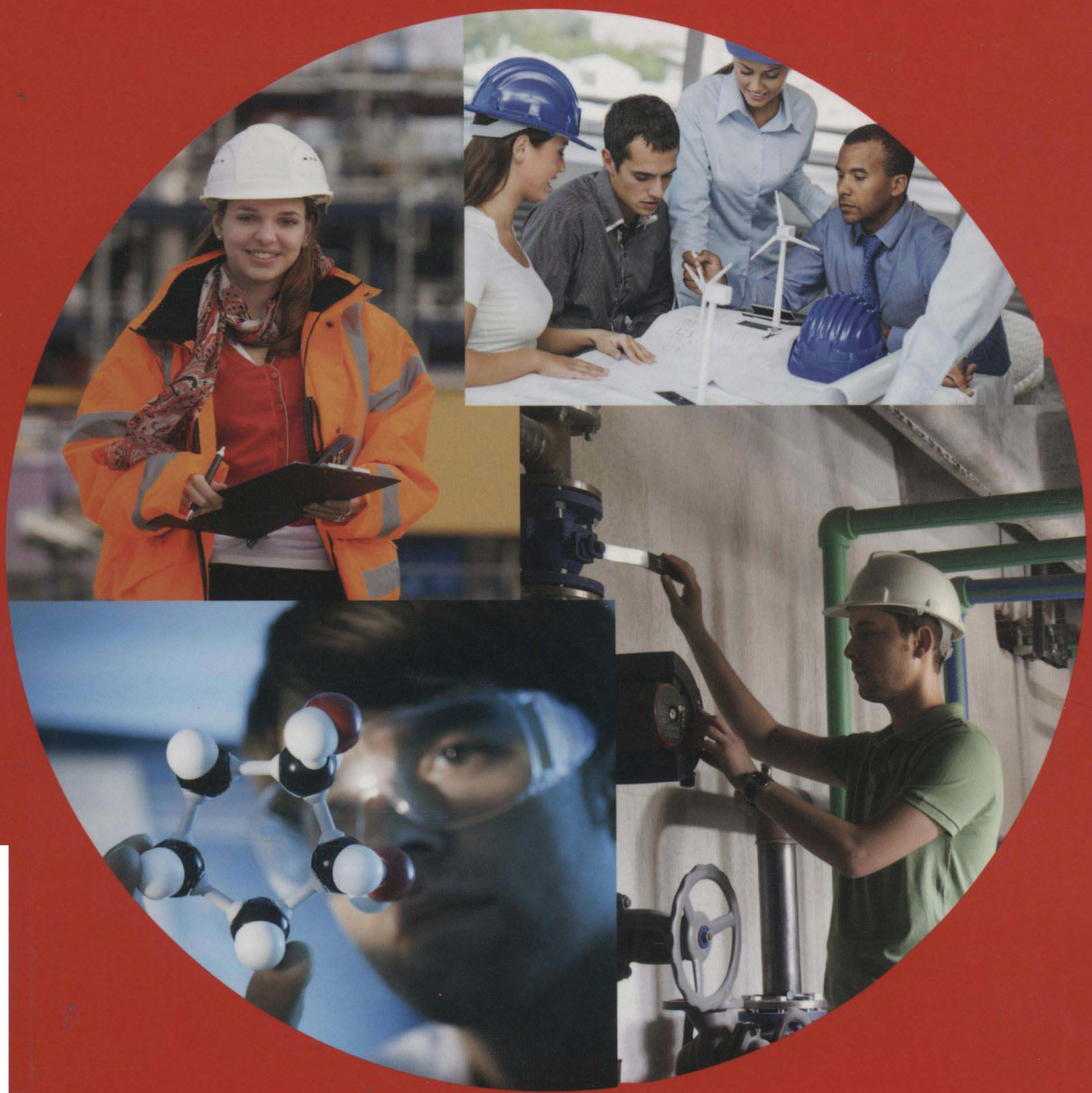
So You Want To Be An Engineer?

What to Learn • What to Expect



Ray Floyd • Richard Spencer

So You Want To Be An Engineer?

What to Learn • What to Expect

by
Ray Floyd
Richard Spencer

Industrial Press Inc.

A full catalog record for this book is available
from the Library of Congress.

ISBN 978-0-8311-3523-2

Industrial Press, Inc.
32 Haviland Street
South Norwalk, Connecticut 06854

Sponsoring Editor: Jim Dodd
Developmental Editor: Robert Weinstein
Interior Text and Cover Design: Janet Romano-Murray

Preface

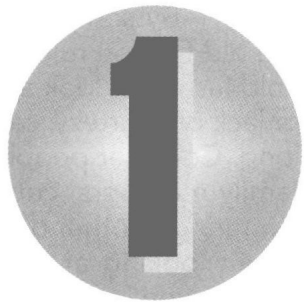
In this book you will find few equations, algorithms, data tables, or graphs of the type that are typically found in most engineering theory textbooks. Rather, you will find aspects of engineering that are not taught as a part of theory courses or elsewhere in the engineering course curriculum. We write from our personal experience as engineers in laboratory, field, and manufacturing environments, progressing through an extended sequence of positions, i.e., lab engineers, and then first-, second-, and third-level managers. This book draws on those personal qualifications and not on any references to other work, although we include some suggested readings that expand on a particular topic. The information presented herein was learned during our 100 years of combined experience — things we learned, practiced as engineers, and applied as managers of engineers, programmers, and technicians.

The idea for this book grew out of a number of conference papers, industrial publication articles, and several articles published or under review by the IEEE in their Potentials magazine. The positive feedback we received to our self-published edition led us to undertake a more comprehensive book with Industrial Press, to which we have added many new topics besides expanding the prior discussions on careers, career paths, and the types of activities prospective engineers may become involved with. We have also included work problems that will allow you to pursue your own line of inquiry on a particular topic.

Raymond Floyd
Richard Spencer
January 2015

Table of Contents

Engineering 101



Over our long careers, we have been asked many times by students, employees, and peers at management meetings, what approaches to our work as engineers or as managers served us best. The answer was almost always the same, whether one follows a technical career, a career in management, or a mix of both: keep things simple (more about that later).

- Be considerate of others' feelings and abilities.
- Be consistent when dealing with people, not favoring one over another.
- Maintain sensitivity to others; there may be pressures they are under that you are not aware of.
- Do the very best job you can, regardless of the assigment.

The impact of each part of this answer is important to understand because it can affectnot only your career, but the career of others.

Basics

In moving from course work into the world of industry, many adaptations have to be made. In school failing a test can be a transient action, perhaps lowering a grade point average, possibly requiring a course to be repeated, or simply an action lost in the semester's average and of little consequence. In industry, failing a test can mean a very large loss of time and equipment — all of which can adversely affect the bottom line. In most instances, young engineers will be given some guidance and thus protection against the possibility of catastrophic failure early in their career. Academics provide the fundamentals and introductory tools for the engineer, but it is the application of that knowledge and those tools within the industrial environment that will define the success or failure of an engineering career.

By some interpretations, the four approaches above are simply the old fashion rules of courtesy or manners. Before exception is taken to "old fashion," look around and see how many examples of poor manners, or lack of courtesy, can be observed in a day. The list, unfortunately, is very long. Consider people failing to hold doors for others, even for their own family members, cutting into lines, yelling at clerks in a store, yelling or gesturing at other drivers, or simple acts of rudeness, and the list goes on. When looking at the work environment, how many times do you hear "Thank you" when you hand in a report you were asked to complete, or do you say it to someone who, for example, gives you your tickets for a trip? Even considering that the work done may be within the expected assignment, what is the impact of such simple words? In those two words, you are demonstrating consideration for the other person's time on your behalf. On the other side, how about the remark, "That's the dumbest idea I have ever heard," given by a peer or even a manager in a discussion. It may be the dumbest idea ever, but the remark itself is probably right next to the dumb idea as being out of line. Being embarrassed in front of one's peers is among the worst things that can happen to an individual in the work place.

Sensitivity training is one of the more important goals covered in modern manager training classes. It is seldom discussed during academic courses, unless working as a team is involved. Even then, because most such team efforts are short term, the expedient solution to a problem may be simply to reassign the offending team member to a new team. There's little discussion about the role of being sensitive to the needs of others. In particular are the current topical lessons covering sexual harassment, where ignoring such rules can result in a career-ending termination. The need for sensitivity goes far beyond just sexual harassment. It applies to anyone's feelings, beliefs, or personal traits that could cause anguish, pain, or embarrassment for that person if discussed in public. Understanding events, pressures, and other circumstances involving co-workers or others with whom you have to interface exposes you to areas where you must be attuned to other people's feelings. It may not always be comfortable, but the more sensitive you are in dealing with other people's needs, the more successful you will be in your own career.

The use of sarcasm offers one of the greatest opportunities for exposure to insensitivity. Quick, cutting remarks may seem funny at the time, but in retrospect may cross the line, damaging peer-to-peer working relations. The use of sarcasm by a manager to a subordinate could even be worse. A sarcastic remark flung in your direction can make you feel diminished and less willing to work with the individual verbally abusing you.

Being consistent in how you approach work, deal with people, handle various situations, and even how you handle your boss can go a long way in ensuring a successful career. Being consistent says that assignments are completed on time and satisfactorily, providing indications that

you can be depended on. Although this trait is important to the average engineer, it is especially critical as a manager.

For example, if a manager is inconsistent in handling job evaluations, the word will get around that, "The boss sure takes care of his (or her) favorites." Just the hint of being inconsistent can destroy the credibility of managers in the eyes of their staff. This does not mean that the *expectations* of a group of personnel are all the same. There are different skill sets, levels of experience, and a number of other items that may change the level of *expectation* between individuals. Such *expectations,* when applied consistently across the staff, will be recognized and appreciated by those being managed. Consistency and expectations can become even more critical when peers, having worked together for a number of years, suddenly experience that great schism — one of them is promoted to the position of manager of the group and is now the boss. Now the new manager must address personnel issues, performance problems, salary adjustments, and a host of other issues affecting individuals who formerly were their colleagues.

In addressing competence, one would hope that you will rise within an organization based on your demonstrated ability. That said, perhaps the best known comment is from Dr. L. J. Peter's best-selling book, *The Peter Principle,* "In a hierarchy every employee tends to rise to his or her level of incompetence." If you are comfortable in rising to your level of incompetence, so be it. But be sure to get out of the way. Others with no more competence than you will be willing to research, learn, and adapt their knowledge to new situations and opportunities. They may not be the greatest researcher, board designer, chip designer, and so forth, but they work to gain sufficient knowledge to understand the concepts being employed. Their *adaptation* is the very strength that will allow them to continue to rise within the hierarchy — in spite of their initial level of incompetence at each rung of the ladder. They follow another old saying in the business world, "Lead, follow, or get out of the way!"

What Degree to Pursue?

Actually the question is not as simple as it implies. The decision as to any degree beyond high school depends on what individuals want to do, their personal interests, as well as the requirements for entry-level positions and for future growth opportunities. It should be noted that the following comments are applicable to the educational system in the United States, but may vary considerably in their application to non-U.S. educational systems. Given that, what then might drive an individual to pursue a Bachelor, Masters, or Doctoral program?

Bachelor Program

Part of the selection process is in first determining the answer to the often-asked question, "What is it you wish to be when you grow up?" Although the question is simple, the answer may be complicated by many factors: interests, background, financial concerns, educational accomplishments, and so on. As a matter of fact, many students begin with one goal in mind and find that the goal changes as they learn more about their choice of study or develop other interests.

One of the fundamental choices the student must make is whether to pursue a career in the Arts or Sciences. In the first case, the studies will center on education, art, speech, business, philosophy, and similar fields. In the latter case, the studies will center on engineering, computer science, mathematics, physics, or other such fields.

Once the student determines what field to pursue, another decision will be what school to attend. In many cases, the student will go to a nearby school or one that will provide the degree they wish to obtain at a reasonable cost. Almost all such schools will provide a reasonable program, preparing students for their planned careers. For students who have a strong interest in research, however, the list of schools recognized nationally for their strong research programs is limited. Based on our recruiting experience, some schools that come to mind are Carnegie-Mellon University, Rensselaer Polytechnic Institute, Georgia Institute of Technology, Massachusetts Institute of Technology, California Institute of Technology, Stanford, and Purdue, just to cite some examples.

Given that most schools will provide the student with the fundamentals for their program of interest, students must determine what program contains the information most directly applicable to their interests. In some cases, for example, a school may offer a degree in electrical engineering, with all the requisite courses expected for that program. A closer look, however, may reveal that the upper-level classes may stress motor design or similar specialty, whereas the student is interested in control systems — not necessarily a good fit. Look closely at the school offerings; in many cases, the offerings will reflect the employers in a region, with specialties closely aligned with the employer needs. Also, school offerings may reflect societal interests, i.e. agriculture, animal husbandry, and similar offerings in a heavy farming oriented area.

In many cases, a Bachelor degree will be sufficient for a successful career. In some rare cases, the employer will place requirements on the new engineer to obtain a Masters or Doctoral degree as part of their ongoing employment, but such requirements are unusual — a little more about that later. In many cases, the employer will provide a reimbursement program to encourage their employees to continue their education, thus enabling them to obtain advanced degrees.

Masters Program

The emphasis found in most Masters programs is to provide a specialized program for the student. The curriculum can be manipulated to provide the student with courses concentrating in the areas of career interest. From a general degree at the Bachelor level, where the intent is grounding the student in fundamental educational needs, the student can concentrate on areas of interest that couldn't be followed at the undergraduate level. As previously noted, many employers will provide some form of tuition refund, ranging from a percentage of the tuition, to full reimbursement plus books and time off to attend classes. Both authors experienced the latter policy with IBM.

The Masters program is not limited to the sciences by any means. Of particular interest, especially in the United States, is the MBA (Masters in Business Administration). In the MBA, the orientation is to prepare the graduate to develop the necessary skills and expertise to run a successful business.

Some students who wish to teach or work in research-oriented careers may bypass the Masters program and move directly from their undergraduate degree program to a Doctoral program. Those pursuing a Masters degree often have the choice of writing a thesis or taking additional class hours. We strongly recommend that students take the thesis route for a number of reasons. First, the thesis provides the student with the opportunity to develop a highly-structured report, with emphasis on style, content, and findings. Second, it requires students to present their findings to a review board (professors), just as they may do during their career to management. Finally, most programs expect some level of original research to be included within the thesis; thus, it is not the simple search for existing material. It is a more difficult route, but well worth the effort in furthering one's career.

Ph.D. Program

A Doctorate degree represents the pinnacle of success in our educational system. It addresses an extended term of educational accomplishment, as well as some level of original research: the dissertation. There are a number of careers that demand that individuals obtain a doctorate in order to advance, or even participate. A good example is the field of education at the college level. Although some colleges allow Master degrees for Adjunct and Associate Professors, the role of the Assistant or Full Professor typically requires a Ph.D. A Ph.D. is also frequently required for school teachers who wish to move into administration, eventually becoming principals and similar posts.

For companies heavily involved in basic research, such as IBM, General Electric, Texas Instruments, Intel, Motorola, and others, obtaining a Ph.D. is required simply to be considered for employment. That is not to say that these companies employ only Ph.D.s; there are many career paths with each that do not involve basic research. As both authors can attest, career opportunities can abound for those with just a Bachelor degree or Masters.

It should also be noted that Ph.D. recipients may also find opportunities outside of basic research. Spencer, as a Test Department manager, had a Ph.D. engineer assigned to his department. At first, the new engineer had a bit of trouble with the hands-on aspect of his job as a test engineer. However, as he gained experience, he became an excellent addition to the staff; he could explain not just what was happening, but also the theoretical aspects in much greater depth. Some years later, that Ph.D. engineer's son was studying for his Doctorate in electrical engineering, and his father kept after him to understand not only the what's and why's of what he was learning, but also the practical applications as well. It is that very depth of knowledge found in the studies for a Ph.D. that accentuates the value of this degree.

Bachelors, Masters, or Doctorate? Again, a simple question with the complex answers. What is it you wish to accomplish over your career? This "bucket list" may be the deciding factor on what educational degrees you must reach for. In some cases, it may simply be a feeling of self-accomplishment, adding nothing to one's career, but the personal satisfaction that it could be done. Perhaps it may the good feeling of being able to participate in the many activities to benefit mankind. It may be simply the desire to teach, helping others reach their full potential through your efforts. Regardless of the reason, reach out and find the niche that best fits your goals.

Suggested Problems

1. Write a 250–300 word paper explaining your desire to be come an engineer.

2. Analyze your plan for a degree program. What is your long-term educational goal and why?

Other Readings

Christopher Columbus: Explorer. http://www.enchantedlearning.com

John F. Kennedy and the Space Program. http://www.uah.edu

King, Rev. Martin Luther. (1963). *I Have A Dream.* http://www.usconstitution.net

The Impossible Dream. From Man of La Mancha, music by Mitch Leigh and lyrics by Joe Dorian. http://www.reelclassics.com

The Wright Brothers & The Invention of the Aviation Age. http://www.nasm.st.edu

Floyd, R. (1993). *The Four "Ins" of Management — Avoid Them!* Industrial Management, May/June 1993.

Floyd, R. (2008). *Rules of Thumb.* IEEE Potentials, November/December 2008.

Floyd, R. (2011). *On Planning Your Career.* IEEE Potentials, May/June 2011.

Floyd, R. (2011). *Chef, Cook, or Bottle Washer?* IEEE Potentials, May/June 2011.

Spencer, R. (1983). *Planning, Implementing, and Control in Product Test and Assurance.* Prentice-Hall, Inc. Upper Saddle River, NJ.