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## The Unwritten Laws of Engineering

Part 1 of 3:

### WHAT THE BEGINNER NEEDS TO LEARN AT ONCE

By W. J. King and James G. Skakoon

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#### TIMELESS ADVICE FOR ENGINEERS

*The Unwritten Laws of Engineering* by W. J. King was first published in 1944 as three articles in Mechanical Engineering magazine. It has been in print as a book ever since, becoming a classic of engineering literature. Recent editions, including a trade version, *The Unwritten Laws of Business*, have revisions and additions by James G. Skakoon. *Mechanical Engineering* magazine is excerpting laws from the book, presented in three articles just as in 1944, with comments from contemporary authorities.

For the first in the series, we start with "What the Beginner Needs to Learn at Once." Future installments will be "Relating Chiefly to Engineering Managers" and "Professional and Personal Considerations."

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The originating author of *The Unwritten Laws of Engineering*, W. J. King, observed that the chief obstacles to the success of engineers are of a personal and administrative rather than a technical nature. King, a wartime engineer with General Electric and later a UCLA engineering professor, conceded that he and his associates were getting into much more trouble by violating the undocumented laws of professional conduct than by violating the well-documented laws of science. So he laid down some "unwritten" laws into house rules for professional conduct.

None of these laws is theoretical or imaginary, and however obvious they appear, their repeated violation is responsible for much of the frustration and embarrassment of engineers everywhere. Many laws were derived by King while directly observing four engineering departments. These have been supplemented, confirmed, and updated by King and others from numerous discussions, observations, and literature; they do not reflect the unique experience or characteristics of any one organization.

Many of these laws are generalizations to which exceptions will occur in special circumstances. There is no substitute for judgment and, in an emergency, vigorous initiative is needed to cut through formalities. But notwithstanding the infrequent striking exception, these laws cannot be violated too often with impunity.

#### { IN RELATION TO THE WORK }

*However menial and trivial your early assignments may appear, give them your best efforts.*

Many young engineers feel that the minor chores of a technical project are beneath their dignity and unworthy of their college training. They expect to prove their worth in some major, vital enterprise. Actually, the spirit and effectiveness with which you tackle your first humble tasks will likely be carefully watched and may affect your entire career.

You may worry about where your job is going to get you—whether it is sufficiently strategic or significant—and you will do well to take stock of this from time to time. But by and large, if you perform your present job well, the future will take care of itself. It is also true that if you do not make a good showing on your present job, you are not likely to be given a chance to try something else more to your liking.

Karen Kelley counsels beginning engineers even before they finish college in the cooperative education program within Northeastern University's Mechanical and Industrial Engineering Department. "I can tell you, this is certainly a hot topic for both my employers and our co-op coordinators who are helping to shape young engineers' careers," Kelley said.

According to Kelley, who is a faculty co-op coordinator for one of the nation's largest engineering co-op programs, employers pay close attention to the enthusiasm, as well as the skill, that beginners bring to an assignment, even if it may seem menial. Furthermore, menial tasks could very well be unnecessary, so why not "challenge the system," Kelley said. "Develop new methods that might streamline the process and present them to others. Managers love when employees 'think out of the box'."

and save time and money.”

Summing up the value of this unwritten law, Kelley said, “One employer told me this should be a ‘law for life,’ not just for early in your career.”

*Demonstrate the ability to get things done.*

This quality is achieved by various means under different circumstances, but it can probably be reduced to a combination of three basic characteristics:

*Initiative*, which is expressed in energy to start something and aggressiveness to keep it moving.

*Resourcefulness and ingenuity*, or the faculty for finding ways to accomplish the desired result.

*Persistence or tenacity*, which is the disposition to persevere in spite of difficulties, discouragement, or indifference.

Persistence is sometimes lacking in engineers to the extent that their effectiveness is greatly reduced. Such dilettantes are known as good starters but poor finishers. Of these it is said, “You can’t take their type too seriously; they will be all steamed up over an idea today, but by tomorrow will have dropped it for some other wild notion.” Finishing a job may be worthwhile, if it has at least some merit, just for the sake of finishing it.

It is ironic, or perhaps telling, that despite normally sufficient effort, we were unsuccessful in finding a prolific entrepreneur or inventor who would respond with comments on this law. Everyone is busy these days and returning a call or an e-mail outside of normal responsibilities taxes one’s time. But busy people get things done not only by being busy but also by carefully selecting what they do, and commenting for print wasn’t selected. Likewise for you when demonstrating the ability to get things done, do not overlook the profit in selecting the right things.

*Develop a “Let’s go see!” attitude.*

Throughout your career people will approach you to solve real-life problems they will have observed on devices or equipment for which you are responsible. A wonderfully effective response is to invite them to have a look with you. That is: “Let’s go see!”

This phrase comes from a singularly insightful 1992 book about visual imagery, *Engineering and the Mind’s Eye*. The author, Eugene Ferguson, was an engineer, university professor, and historian who wrote extensively about the history of technology. In the book, he states: “The engineer and the worker must go together to the site of the difficulty if they expect to see the problem in the same light.” He further explains that remaining at one’s desk to speculate about causes and solutions, or to retreat to drawings, specifications, and reports won’t provide the insight needed to solve a problem. That insight can only be developed by observing first-hand what might at once be too subtle and complex to imagine.

Ferguson went to see, even when many of us would shy away. According to author and historian David Hounshell, professor of technology and social change at Carnegie Mellon University, early employment for Ferguson included investigating dynamite accidents for DuPont. “One of his jobs after an explosion was to plot where the body parts landed, and to figure out what caused the explosion.” Hounshell was a student and colleague of Ferguson’s, and is a past president of the Society for the History of Technology, for which Ferguson was a founding member. Of him, Hounshell said, “He was always interested in things and how they operated. Whether they were attractive and worked well, or didn’t work so well, he wanted to see what made them go.”

*Don’t be timid—speak up—express yourself and promote your ideas.*

Too many new employees seem to think their job is to do what they are told. Of course there are times when it is wise and prudent to keep silent, but as a rule, it pays to express your point of view whenever you can contribute something. The quiet, timorous individual who says nothing is usually credited with having nothing to say.

It frequently happens in any sort of undertaking that nobody is sure of just how a matter ought to be handled; it is a question of selecting some kind of program with a reasonable chance of success. The “best” scheme usually cannot be recognized as such in advance, so anyone who talks knowingly and confidently about the project will often be assigned to carry it out. If you do not want the job, say nothing and you’ll be overlooked, but you’ll also be overlooked when it comes time to assign larger responsibilities.

Kelley confirms this law to the Northeastern University co-op undergraduates she counsels: “I tell students this is the time to take a chance.” Kelley said that speaking up speaks volumes about a beginner’s interest in the topic or assignment. “Saying

nothing makes the manager believe [an intern] is not invested or interested in the work," she said.

Kelley also noted that the opposite is true: "Sometimes my students will tell me their suggestion was pretty small so they almost didn't say anything." But she noted that these small ideas can sometimes make a very big impact on a project.

*Strive for conciseness and clarity in oral or written reports; be extremely careful of the accuracy of your statements.*

If there is one most irksome encumbrance to promoting urgency in the workplace, it is the person who takes a half hour of rambling discourse to say what could be said in one sentence of twenty words. Engineers often surround the answer to a simple question with so many preliminaries and commentaries that the answer itself can hardly be discerned; they explain the answer before answering the question.

To be sure, very few questions endure simple answers without qualifications, but the important thing is first to state the essence of the matter as succinctly as possible. There are times when it is important to add the pertinent background to illuminate a simple statement, but try to convey the maximum information in the minimum time.

Many engineers lose the confidence of their superiors and associates by guessing when they do not know the answer to a direct question. A wrong answer is worse than no answer. If you do not know, say so, but also say, "I'll find out right away." If you are still not certain, indicate the degree of certainty upon which your answer is based. A reputation for conciseness, clarity, and reliability can be one of your most valuable assets.

Good engineering requires good communication, according to Trevor Young, author of *Technical Writing A-Z: A Commonsense Guide to Engineering Reports and Theses*. "I see myself as an engineer, not a technical writer, and part of being a good engineer is being able to communicate in a way that is accurate, complete, and efficient."

Some recommendations for technical writers from Young's book, condensed here, include:

- Use serious, but normal, conversational language: avoid long convoluted sentences.
- Be precise: avoid fuzzy, ambiguous, or inexact statements.
- Be concise: get to the point promptly.
- Be explicit: avoid figures of speech and euphemisms.
- Use formal language: avoid colloquialisms, slang, inappropriate abbreviations, contractions, jargon, and exclamations.
- Get the emphasis right: structure ideas in sentences, lists, and paragraphs to convey not just the information, but also the relative importance of the ideas.
- Report results honestly and objectively.

Young, a senior lecturer in aeronautical engineering at the University of Limerick in Ireland, weighing in on the need for accurate reporting, said: "I see this as the essence of good engineering: to be appropriately accurate in the technical work and in the reporting of that work."

### { IN RELATION TO YOUR SUPERVISOR }

*One of the first things you owe your supervisor is to keep him or her informed of all significant developments.*

How much must a manager know? How many of the details? This is always a difficult matter for the new employee to get straight. Many novices hesitate to bother their superiors with everyday minutiae and this can be overdone. But more often than not, the manager's problem is to extract enough information to keep adequately posted.

It is much safer to risk having your supervisor say, "Don't bother me with so many details," than to allow your supervisor to ask, "Why doesn't someone tell me these things?" Your manager must account for, defend, and explain your activities to others, as well as coordinate these activities into a larger plan. Compel yourself to provide all the information that is needed for these purposes.

No matter how hard you try nor how good an engineer you become, unexpected evils will occur that you will dread having to inform your supervisor about. Although no manager delights in being surprised by unanticipated problems—even though you are

obligated to report them without hesitation—you will improve your predicament immeasurably if you can also recommend solid solutions while presenting the problem. The best you can hope for in this dreaded situation is a solution that can be implemented with the greatest urgency.

*Do not overlook the steadfast truth that your direct supervisor is your “boss.”*

This sounds simple enough, but some engineers never get it. By all means, you are working for society, the company, the department, your project team, your project leader, your family, and yourself—but primarily you should be working for and through your supervisor, the manager to whom you directly report.

You will no doubt encounter conflicts—you are assigned to a project team with a demanding leader, a corporate executive orders a task be done, and so forth. Whenever this happens, discuss it with your supervisor, whose job includes resolving conflicts.

You can serve all ends to best advantage by assuming that your supervisor is approximately the right person for that job. It is not uncommon for young engineers, in their impatient zeal or imprudent disrespect, to ignore or to go over or around their superiors. Generally speaking, you cannot get by whoever evaluates your performance, for he or she rates you in part on your ability to cooperate. Besides, most of us get more satisfaction out of our jobs when we're able to display at least some personal loyalty to our superiors, with the feeling that we're helping them to get the main job done.

*Be as particular as you can in the selection of your supervisor.*

For most neophyte engineers, the influence of the senior engineers with whom they work and, even more so, of the engineer to whom they report is a major factor in molding their professional characters. Long before the days of universities and textbooks, master craftsmen absorbed their skills by having been apprenticed to master craftsmen. Likewise, you will do well to use those with more experience, especially a well-selected supervisor, as your master, your mentor. A properly selected mentor will likely have been through gauntlets as severe as your present one, and will guide you better than you can guide yourself.

But, of course, you don't always get your preferred choice in a boss. What if yours turns out to be less than you hoped for? There are only two proper alternatives: (1) accept your boss as the representative of a higher authority and execute his or her policies and directives as effectively as possible, or (2) move to some other department, division, or company at the first opportunity. Consider the mischief created when you, disliking your leader, ignore or modify orders to suit your individual notions, or, worse, purposefully undermine your superior's authority.

While the above two alternatives still apply to today's workplace, mentoring outside of the traditional chain of command is now endorsed as another way to gain from the experience and knowledge of others.

Long-time management consultant, Theodore Ryan, now an adjunct professor in the Fuqua School of Business at Duke University, views today's best mentor/mentee relationships as bi-directional exchanges of knowledge, unlike those of the traditional master and apprentice. When choosing a mentor, Ryan said to choose “someone who has some complementary talents and experience that you don't have and is willing to share them, but also is willing to learn from you and to engage in an actual dialogue with you.” Ryan explained how, nowadays, novices are often just as likely to impart new knowledge to a mentor as the other way around. “Sometimes it's obvious. The mentor knows things the mentee doesn't know, and that's great,” Ryan said. But he also noted this: “There is much more of a collegial dialogue framework for great mentoring these days than there was earlier. It's really another source for continuous learning.” So Ryan recommends choosing a mentor who wants that.

Ryan, whose experience includes leadership development and organizational consulting for a wide range of U.S. corporations and government agencies, also advises to screen potential mentors for shared human values and ethical principles. Asking questions about these topics might be uncomfortable, but Ryan said, “It's a nice way to see how open they'll be. That's pretty personal. It's a little bit sensitive. If the mentor welcomes those questions, then that's quite a sign that this will be an open dialogue.”

But Ryan warned not to expect everything from just one mentor. “Don't ask for something that someone can't give you,” he said. “There is specialization in everything. One of my premises is that you may have two or three different mentors for different reasons.”

*Whenever you are asked by your manager to do something, you are expected to do exactly that.*

If your supervisor sends you off to perform a specific task, you have two possible responses: (1) you do it exactly as requested, or (2) you come back and talk it over some more. (Take special note of this law, for it applies to anyone with whom you have agreed on a task to be done or a course of action to be taken.) It is simply unacceptable either not to do it, or to do something different instead. If you become concerned in view of new data or events that the planned action isn't worth doing as originally

assigned, you are obligated to discuss the entire matter again. State your intentions and reasons so that your manager can properly reconsider it.

Despite the responsibility to do exactly as instructed or agreed, you will sometimes want to prove your initiative by doing not only that, but also something in addition thereto; perhaps the next logical action has become clear; perhaps a promising alternative has come to light. Doing these within reason will make your drive and inventiveness immediately apparent.

The other side of this law is that you needn't be too eager to embrace agreed-upon instructions. In general, a program laid down by your manager, a department, a project leader, or a design team is a proposal rather than an edict. It is usually intended to serve only as a guideline, one that will have been formulated without benefit of the new information that will be discovered during its execution. The rule therefore is to keep others informed of what you have done, at reasonable intervals, and ask for approval of any well considered and properly planned deviations.

### { REGARDING RELATIONS WITH COLLEAGUES AND OUTSIDERS }

*Cultivate the habit of seeking other peoples' opinions and recommendations.*

Particularly as a beginning engineer, you cannot hope to know all you must about your field and your employer's business. Therefore, you must ask for help from others. This is particularly useful advice during a confrontation of any sort; a good first question to ask is "What do you recommend?" Your confronter will usually have thought about it more than you have, and this will allow you to proceed to a productive discussion and avoid a fight.

A warning about soliciting others' opinions deserves mention. Condescending attitudes toward others and their opinions are gratuitous and unwelcome. If you have no intention of listening to, properly considering, and perhaps using someone's information or opinion, don't ask for it. Your colleagues will not take long to recognize such patronizing and to disdain you for it.

*Promises, schedules, and estimates are necessary and important instruments in a well ordered business.*

Many engineers try to dodge making commitments. You must make promises based upon your best estimates for your part of the job, together with estimates obtained from contributing departments for theirs. No one should be allowed to avoid the issue by saying, "I can't give a promise because it depends upon so many uncertain factors." Of course it does. You must account for them, estimating best and worse cases, and then provide neither laughably padded nor unrealistically optimistic schedules. Both extremes are bad; good engineers will set schedules that they can meet by energetic effort at a pace commensurate with the significance of the job.

A corollary to this law is that you have a right to insist upon reasonable estimates from other departments. But in accepting promises from other departments, make sure that you are dealing with a properly qualified representative. Bear in mind that if you ignore or discount other engineers' promises you dismiss their responsibility and incur the extra liability yourself. Ideally, other engineers' promises should be negotiable instruments in compiling estimates.

Dorothy Kangas, a business process improvement specialist for The Nielsen Co., said that despite the many tools and techniques available for managing a project, sound estimating of resources and schedules is fundamentally important: "Getting reliable estimates is key to creating and maintaining a project schedule."

Kangas, who contributed to the Project Management Institute's *A Guide to the Project Management Body of Knowledge*, has seen both extremes: "Engineers or project team members sometimes provide estimates based on the assumption that every task will be executed on time; that nobody goes on vacation, nobody is sick, and absolutely no other factors interfere with the scheduled activities. I've seen others try to pad every one of their tasks. Suddenly what seemed to be a realistic product development project will take twice as long as expected." But Kangas noted this as well: "A good project manager probably knows which engineers are pessimistic and which are optimistic and tries to work the middle!"

One area that is often overlooked in planning projects, according to Kangas, is risk. "If there are uncertain factors, or risks, those should be compiled and managed according to their impact and likelihood of actually occurring," she said.

Furthermore, according to Kangas, project risks and project issues are two different things; risks can be predicted and managed, whereas issues arise unpredictably throughout a project. So risk management activities should be scheduled into a project right from the start, but issues must be squeezed onto the schedule as they appear.

*In dealing with customers and outsiders, remember that you represent the company, ostensibly with full responsibility and authority.*

You may be only a few months out of college, but most outsiders will regard you as a legal, financial, and technical agent of your company in all transactions, so be careful of your commitments.

{ TO BE CONTINUED }