

# Writing For Success — An Engineer's Guide

Volume 1

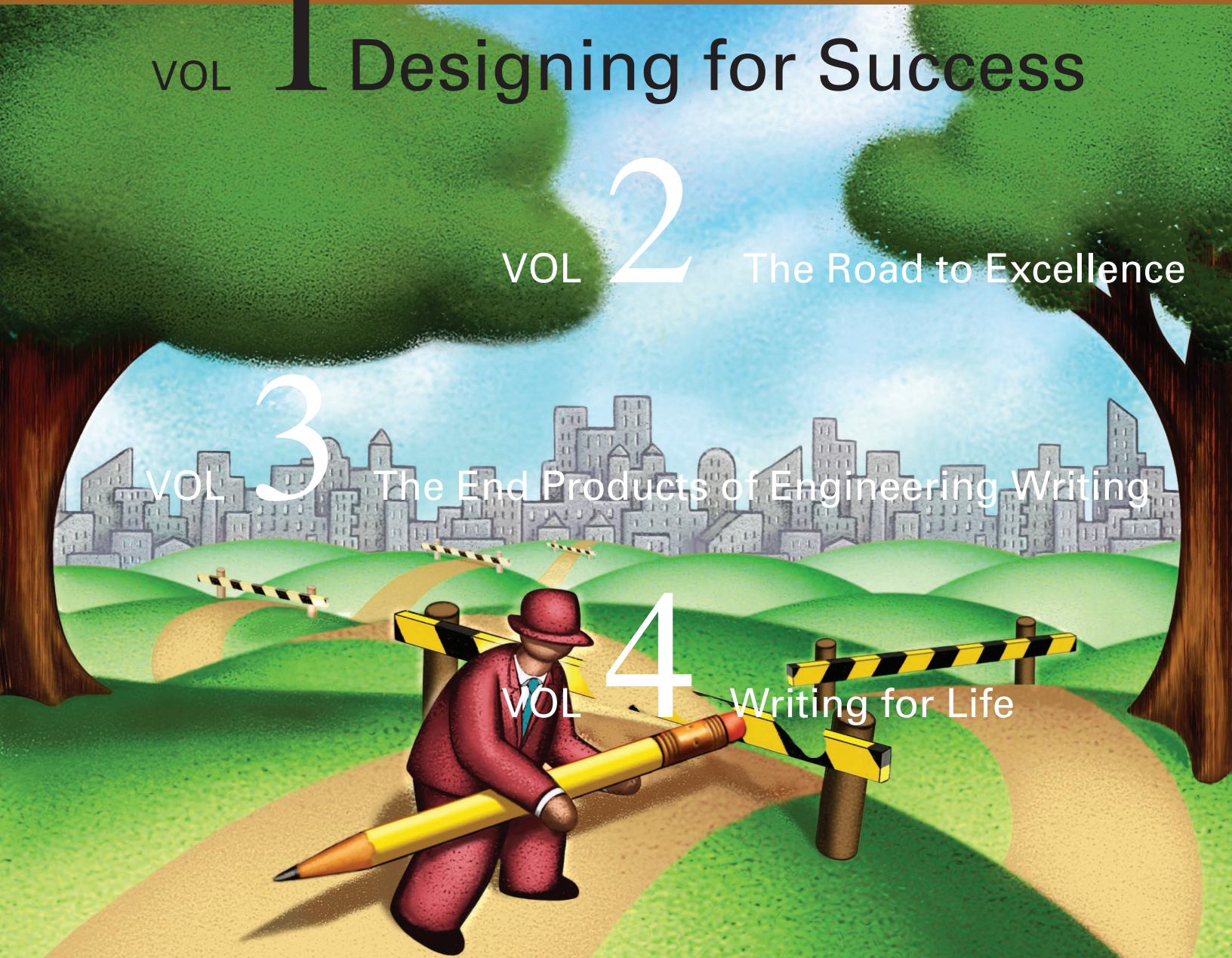
VOL **1** Designing for Success

VOL **2** The Road to Excellence

VOL **3** The End Products of Engineering Writing

VOL **4** Writing for Life

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## Introduction

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When I attended engineering school, more than a half century ago, a freshman's first stop was at the campus bookstore — where in addition to engineering, physics and calculus texts, we all bought drafting boards, tee-squares, and a drafting kit, as well as a good reliable Post or K&E slide rule, in its leather sheath. When classes started, we patched together op amps in analog computing labs, used the slide rules for our calculations, and typewriters for the assigned reports. In my first job as an engineer at Cal Tech's Jet Propulsion Laboratory, I would hike across the facility's campus-like setting almost daily, carrying boxes filled with computer cards that I had keypunched to represent aerodynamic data and equations for processing on our mainframes. Twenty-four hours later, if I hadn't made any mistakes, I could expect the results.

We do things quite differently today. The technology and tools that we use and work with have changed dramatically since the start of my engineering career, and they continue to do so with seemingly ever increasing speed. But the basics of physics and chemistry and engineering science remain relatively untouched. And, although my old slide rules and typewriters are collectors' items now, the need for clear, effective communication in engineering practice remains as important today as it was when, as a freshly minted engineer, I found myself writing system specifications, equipment requests, program summaries, progress reports and technical articles to support the design and development of an arc jet test facility.

Writing well was important then, and it remains so for today's engineer. Proposals, reports, technical articles, instructional guides, specifications, RFP's, test plans, SOP's, marketing data sheets, white papers, patent applications, and numerous other specialized documents are part of engineers' responsibilities in every discipline. Engineers who are able to write well are able to create these documents effectively, so that they achieve their objectives. Well-written proposals will gain acceptance. Clear instructions will lead their readers to success. Finely crafted reports will give readers needed knowledge, so they can make smart and well-founded decisions.

Early in my career, I discovered that writing was not an alien task, something separate and apart from the analytic and technical aspects of an engineer's work. Instead, it was apparent that writing was integral to the responsibilities of most engineers, an important aspect of how we communicate our discoveries, progress, needs, and designs. Our writing represents us, acts as a record of our concerns and achievements, a means of sharing our thoughts and ideas on matters of importance. And, of course, others will judge our thinking, our concerns, our designs, our competence — all these things — on the basis of our writing.

The good news is that the processes and approaches that many engineers use in their technical work are remarkably similar to those that lead to successful writing. Common engineering concepts like problem definition, analysis, design, prototype development, design reviews and

acceptance testing have analogs in the writing process. In the following pages I will present writing from an engineer's perspective, looking at comparisons between the steps that lead to good engineering practice and those that result in writing excellence.

This book is not a technical writing text. At least not the type of text used in most university classrooms. Instead, my hope is that it will serve as an inspiration and guide to help engineers approach their writing tasks with the same confidence and skill that they take to the technical problems that confront them. When that happens, they will find that the e-mails, reports, test-plans, and other documents they write are as useful and successful and valued as their engineering efforts.



## Guess What – Our Writing Is Useful!

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As engineers we strive to create useful things. Whether it is the design for a bridge that will span an eight-lane highway, a timing circuit to automatically control the phases of a heat-treating cycle, or a system of pipes and fluid control devices to irrigate a vineyard, engineers' efforts are aimed at developing devices, products, methods and systems that will be of use, that will be improvements over what is currently available, and that others will benefit from in some tangible way. The quest for usefulness is the very hallmark of engineering practice.

Too often, I have heard engineers refer to writing they must do as busy work, unnecessary, a wasted effort that will never be read. Unfortunately, there may be instances when that is true — and our own, off-the-mark writing might cause some of them — but most writing in the engineering workplace is useful, and much of it is critically important to the success and progress of our engineering efforts.

Readers rely on instructions to guide them through a new task safely and efficiently, confident that our writing will lead them to success. Managers and clients turn the pages of our progress reports, eager to determine if they can remain confident of on-time, on-budget completion, or if they must employ additional resources, or take corrective actions. Potential suppliers will read a specification we have carefully crafted and strive to figure out what their companies must do to deliver the expected performance and attributes. A manager pores over our proposal to reorganize and update the department's test laboratory, trying to understand whether the return in productivity will be worth the disruption in work flow, and the cost required to make the change.

Every piece of writing we do as engineers has an objective; we want our readers to gain the information they need, and use it to make decisions and choices. If we design the messages and documents we prepare with skill and care, those decisions and choices will be smart ones, and in many cases favorable to our own goals and interests. New equipment will be approved. Steps will be followed. Proposals will be accepted. Process changes will be investigated. Projects will be assigned more resources. Accomplishments will be recognized.

To get those reactions from our writing, especially the favorable ones, we must first understand who our readers are, and what it is that they will do with what we write. Having a clear picture of these two things, our audiences, and the way in which they will use our writing, is critical to our writing success. If we misjudge either, the chances that our writing will be fruitful lessen, and the possibility that we will be misunderstood, misjudged, and even ignored, blossoms.

Think of the analysis of these two factors, audience and purpose, as the problem definition phase of our writing. In our engineering efforts, only after we have clearly and accurately defined the problems facing us, can we begin the process of designing solutions. Similarly, in writing, we must have an accurate and well-defined understanding of expectations and targets for our writing. Only then can we be sure our solutions, our written solutions, will be effective and useful.

## Detective Work: Knowing Our Audience

Football coaches watch hundreds of hours of videotape in preparation for the next game, trying to learn as much as possible about the team they will be playing. Professional boxers readying themselves for a championship bout train with sparring partners who have similar styles and attributes to those of the expected opponent. The boxers and the football coaches know that the more they know about their opponents, the better their chances of success against those opponents.

In writing, it is the same. Our readers aren't opponents in the sense used in football and boxing, at least not usually, but they do present a challenge to us as writers. What do we need to do to satisfy them? To help them? To get them to understand? And, just like the coaches and boxers, the more we know about our readers, the more likely we'll be to meet and overcome that challenge.

Most of our workplace communication is with people we know. Our e-mails and memos will go to members of our group or team, managers or supervisors in our department, and managers in other areas within the organization that employs us. Other letters and e-mails may be directed to customers, clients, or regulators with whom we have worked for years.

In each case, our shared experiences over time, and the organizational culture we work within, has given us a sense of how best to communicate with these individuals. I think back to my first few weeks on some of my past jobs, times when I had no idea who many of my co-workers and managers were, or how best to approach them in writing. I did my best and got feedback, sometimes unpleasant feedback, and gradually learned which readers demanded detailed explanations and in-depth discussions of subjects I took for granted, and which ones

wanted to see only the key points, preferring lists and outlines to narrative. I learned the formats that quality assurance, or our government customers, required for displaying test results and directing corrective actions to be taken. I came to know which technicians required detailed, crystal clear, step-by-step directions, and which ones could be relied on when given only broad directives. With time, I learned what worked.

But later, even with years of experience, I found that my writing still had to address new readers, men and women I didn't know very well, and in many cases, people whom I had never met or seen, and probably never would. To better define my problem, how to write to these unknown people, I tried to learn as much as possible about them and their needs. I asked my colleagues and co-workers what they knew about them. Had they ever written to these same readers before? Could they offer any insights? I searched for clues from the job titles, ranks and areas of responsibility held by these new readers. Did they tell me anything about my readers — what they needed to know, and what they would do with the information? I tried to find other documents written for the same audience that might give some hint of the tone or vocabulary needed. I knew the better the picture I could develop of my audience and their needs, the greater the chances my writing would be read and used effectively.

Sometimes I think that process, a search for clues and some educated guesswork, was more the work of a crime novel detective than of an engineer. But if we want to maximize the chances that our writing will hit the mark with our readers, we must do some sleuthing to help us understand them better. In my experience, it generally doesn't take a big effort, but the payoff can be great. Here are some thoughts to keep in mind about your readers as you embark on your next case — I mean — writing task.

### **They only know so much**

Our readers can't read our minds. We must tell them what we know and, in particular, what they need to know. To accomplish this task, we must have a good idea of how much they understand about the topic at hand. Do they have a solid background in the technical details? The specifics? Do they know the context or history that prompts our writing?

We can't assume that they know things, or understand relationships, just because we do. We can become so familiar with the practices and techniques used in our work that we take them for granted. But we must be sure that our readers share that familiarity and understanding. If they don't, we must provide them with the information they need to understand our message and all its implications. A mistake will leave our readers scratching their heads, unsure of our messages, wondering what they missed. Our grasp of what they don't know will prevent such ambiguity.



## **They do know some things**

If we are writing to a manager or client who has been keeping tabs on our project for months, there is no need to include background information that they know, or context that they already possess. If we are writing instructions to skilled machinists, we don't have to tell them how to measure a surface finish, or find the true center of a piece of round stock. They do that all the time.

If our writing is loaded with information that our readers already know, we risk bogging them down, boring them, and, possibly, insulting them. Readers who are bogged down and bored will begin to skim over material, skipping sentences, paragraphs, and even pages. If that happens, they may miss critical facts, data, and arguments that we tucked away within writing they perceived to be only a rehash of what they already knew. Writing that they ignored. The missed information will influence how they react to our writing, generally for the worse.

Our grasp of what our readers do know will help prevent them from missing the information they need to know.

## **They have power**

Our writing will spur our readers to action. To know what action they will take, we must know what powers they have. What is their authority? What can they do? What are they able to approve? What are they able to start? When must they turn to others before taking action? Knowing the answers to these questions will help us refine our messages, so the actions they trigger fall within our readers' range of authority.

If we are not sure, we might look to an organization chart, or the reader's job title for a clue. Sometimes we will have to make assumptions, but the more we understand about what our readers can, and cannot, do, the more effective our writing to and for them will be.

## **They like what they like**

Some readers don't like to read. They value direct, concise communication. Some react far better to schematic diagrams, charts, maps, line drawings, and other visual material than they do to text. Others prefer clearly written narratives that carefully lead them through difficult concepts. Some like recommendations or calls to action. Others don't. It is not easy, especially with new readers, especially those outside our organizations, but we must try to find out as much as we can about our readers' likes and dislikes. The more we know about their preferences, the more accurately we can target those readers.

## **They're not neutral**

Our readers may approach what we write with prejudices and preconceptions. Managers facing budgetary problems will not be receptive to requests for unexpected new expenditures. Organizations that experienced delays or problems with our company's performance on previous contracts will approach our new proposals with caution – at best. An over-worked and over-booked usability specialist will not welcome our request to push the schedule for alpha testing of a new software release forward.

Organizational politics, budgetary considerations, and past experiences can all influence a message. If we expect a welcoming and sympathetic reception, we can write with confidence and efficiency, not needing to oversell our ideas, requests or recommendations. If we expect negativity, possibly even hostility, we must assuage it with arguments, data and plans that counter those prejudices. Knowing our readers' predispositions and attitudes helps us craft our messages strategically.

## **There may be a lot of them**

Writing for a single reader, trying to understand exactly how much technical detail is needed, how strong the recommendation should be, and how carefully the message must be worded to create a tone and flow that will be received positively, is difficult enough. Very often our writing will be directed at multiple readers, and our task becomes even more challenging.

An e-mail to our supervisor may be forwarded to her manager, and even the supervisor of another group. They may read our writing with a different perspective, need different information, and have different expectations. Our response to a Request for Proposals (RFP) may be reviewed by a panel of technical, managerial, and financial experts. What will they be looking for? How will we satisfy all of them? Will our report on a failure be forwarded to other engineers? Will it contain enough data to meet all their needs?

Understanding that several sets of eyes will read and evaluate our writing allows us to broaden our message, add detail that will satisfy the different interests, and eventually have success.

## Analysis: What Is Our Writing's Purpose?

When I was still in school, the purpose of my writing was clear. My essays and reports were all designed to show my instructors how smart I was, and how diligently I had worked. My goal, not always achieved, was to get an A. With the possible exception of my graduate research advisor, my professors rarely used the writing I produced for anything other than evaluating my performance and assigning a letter grade.

Workplace writing, I discovered, was altogether different. Of course, I was still evaluated by my writing. If I wrote poorly or deftly, my skills would be obvious to my readers. In the workplace, I realized, my writing had some function, and in most cases an important one. To be successful, I had to understand how my writing was to be used by those who would read and review it. And, even more critical, I had to have a clear picture of how I wanted those same readers to react after having read my requests, reports, and other written documents.

Eventually I understood, my writing was almost always going to lead its readers to make decisions. And, usually, there was a direction I really wanted to see those decisions go. If I made recommendations to managers or clients, I wanted them to see the merits of my choices and, hopefully, follow them. If I was reporting on tests that were completed or observations that had been made, I wanted the readers to see the quality of those efforts, and take the next logical action, perhaps approve follow-on tests, or authorize a purchase or procedure change. I wanted my readers to make the right decision.

Readers will always be making decisions on our writing. They will make a decision to read it now, or perhaps sometime in the future when they see the subject line or title page. After the first few sentences or paragraphs or pages, they will decide whether to read on or not, based on what they have found to that point. And, when they finish, they will make decisions to gather more data, schedule meetings, approve changes, or cancel projects. Even if it is just to note and file what they have learned, our readers make decisions every time they read our writing. Figure 1 lists a number of common writing products and some examples of the decisions they can trigger.

Written Document	Decision
Proposal	Does the reader accept or decline the offer? Is the firm added to a short list? Does the reader decline the offer?
Progress Report	Does the reader find the progress acceptable? Are any changes required (more or less resources, more or less oversight)?
Technical Article/White Paper	Does the reader see value in what was reported? Can the reader use the information?
Instructions/Procedures	Does the reader view the steps as safe and effective? Will the reader follow them?
Recommendation Report	Does the reader see the recommendation as valid? Will the reader accept it? Will the reader ask for clarification or additional information?
Test Report	Does the reader accept the methods and results as valid? Will the results trigger an action (request additional testing, authorize a purchase, initiate corrective action, ok product release, etc.)?
Incident Report	Was the situation avoidable? Are changes necessary?

**Figure 1:** *Common decisions readers make after reading various types of workplace writing.*

## Questions We Need to Ask

Here are some questions to help us think about the purpose of our writing. Knowing the answers will help us understand our objectives and point our writing towards success.

### What happens when our readers finish?

What decision do we expect our readers to make when they finish the last line of what we have written? Will they take an action? Will they need more information? Will they need to contact us, or someone else? The better we are able to anticipate the actions and reactions our writing will generate, the easier it will be for us to design messages that lead to ones that are optimal.

We may want our proposal approved; additional personnel assigned to the project our report covers, so that schedule variances will be averted; and 100 percent compliance with our new safety policy. Knowing our readers are faced with choices and decisions, we can structure our writing so that they clearly understand their options, and, most important, recognize and concur with the one we observe as the wisest choice or path.

### Will our readers rate our performance?

Our workplace writing will not be graded like our college assignments, but we will still be judged through it. What we write represents our thinking. It also reflects directly on other aspects of our performance. Do our reports clearly show why our projects are running over budget? Do they give understandable reasons why our design failed qualification testing? Is the rationale for the scope changes requested by our vendor credible?

Knowing that our readers will evaluate our performance helps us make sure that our writing presents a clear and accurate picture of what happened so that praise and blame, should there be any, are assigned fairly and appropriately.

### Are we writing for the future?

The main purpose for some of our writing will be to form a historical record. We might undervalue these assignments, realizing that our writing will not be acted upon immediately, and that it may lie buried in a file deep into the future. We may put in less effort, worry less about making sure it is good writing. After all, we are not certain it will ever be read.

But historical writing is critical. It might provide a record of design reviews done on a large-scale project that clients or governmental agencies may audit a few years in the future. It might depict progress on a development that scholars may study decades from now. It could be documentation of a development process that may lead to patents, competitive advantages, and possibly play a role in future legal action. What we write for the “file”



today, can take on tremendous importance in a future that may not be that far away.

Our writing lasts, and continues to reflect on us well into the future. We must ensure its completeness, accuracy and clarity. Like actuator circuitry on a planetary rover carried deep into space, our writing is counted on to do its job when called upon — months, years, and even centuries after we produce it. Realizing its importance, instead of devaluing writing that will only go into the “file”, we can use our skill to make sure it will help its readers when they need it, no matter how distant into the future that time might be.

We must remember that our writing is important, and readers need it and will use it. Our goal is to help those readers make the decisions they have to, and make them well. Knowing that, we will be on the road toward writing success. To get on that road, however, we must define our problem, understand who our readers will be, and what they need (and don't need) to know. We must not start our writing until we are confident that we have a firm grasp of what is needed — that we are clear about the problem facing us. With that confidence, we can move on and begin designing a solution. It is the way that engineers do things.

**D**esign is an essential element of engineering. We design everything from time delay circuits, software routines, impact-resistant packaging, and high-temperature fluid valves to storm drain systems, prosthetic devices, and bioburden test equipment. In our search for solutions to problems, we must design those solutions. Design is an integral part of an engineer's education, and many engineers find that it plays a huge role in the projects they undertake.

As strange as it might seem, design plays a major role in our writing. Underlying every piece of successful writing is a good design. In writing, design controls the information flow, and organizes it in such a way that readers clearly and efficiently gain understanding. Good designs will lead readers through highly complex material — establishing context, building confidence, and imparting facts and new understandings in a studied and logical way. Poor designs will leave readers shaking their heads, rereading in frustration, and questioning even simple concepts. As with engineering success, writing success always stems from a top notch design.

## **Rounding Up the Raw Materials**

Before I start crafting a design for my writing, I always try to gather up the raw materials that I will have available. These are the facts and understandings and other data elements that I can call upon as I write. Things that my readers may need to know. They will be the meat of my writing.

I have already defined the problem that faces me, learned about the readers I will be writing to, and the reasons I am writing. Now, I must simply gather up all the resources I have amassed to undertake that task. They might be the results of research I had done, or that my team had undertaken: experiences we have had; analyses we have done; and recommendations I may want to make.

For lower stakes communication projects, simple e-mails and correspondence, I do this informally, sometimes just sorting out the possibilities in my head. But I usually find it best to scratch out a list of considerations on a piece of paper or a blank screen. The list helps me visualize the elements that will make up my writing, and the act of compiling it often causes new possibilities to leap to mind as the list forms.

For larger writing projects, such as reports, proposals, and technical articles, this stage is an important one that I approach much more formally. It usually involves brainstorming, and making a list of all the possibilities that might be included when I finally start the actual writing.

Making the list can be a task in itself, often involving team members who work together to identify sources and gather relevant data. Yellow sticky notes posted on a wall or board work well. A shared online file is also an effective way of rounding up the potential elements from a working group. However it is done, the key is to think of all the possibilities, every bit of data, every topic and sub-topic, that might contribute to helping your writing meet its objective.

## Culling the Crop

Once I have compiled a list of all my raw materials, the different elements that might form part of the writing I am about to undertake, I stop and take a critical look at each item. Is it something that my reader really needs to know?

The lists that come from our brainstorming frequently include things we spent a lot of time on, or that took great effort on our part. The list will also include what we learned, and what is important to us. It will represent experiences and concepts we value. However, despite the time and effort and the personal worth we have attached to our lists, many of them will not have any value to our readers. So, we must eliminate them. It is never easy, but it is time to cross off every item on the list that will not be important to our readers and the goals of our message.

We must cull the crop carefully. In good design, we eliminate any parts that don't contribute to the overall success of the product. We do the same during the design phase of our writing.

## Chunking to Establish Relationships

After I have whittled down my brainstorming list, eliminating any non-important entries, I try to see what relationships exist between the many items that remain. How many of these relate to the mechanical performance of the system I am writing about? The electrical demands? The logistics needed for the mission? The tests that will need to be run? I try to sort the items into groupings based on their relationships, a process that, in most instances, will reveal the main sections or points that I want my readers to understand.

This process is sometimes called "chunking," because it organizes disparate ideas into chunks of closely related information that can serve as sections and subsections of our writing. Our raw materials are transformed into building blocks. Chunking must be done with care, making sure that items truly do function together in a way that furthers the goal of our writing. If we do a solid job of chunking, we will greatly simplify the final step in designing our writing — creating the outline or flow chart — and the writing itself.

## Designing for Our Readers

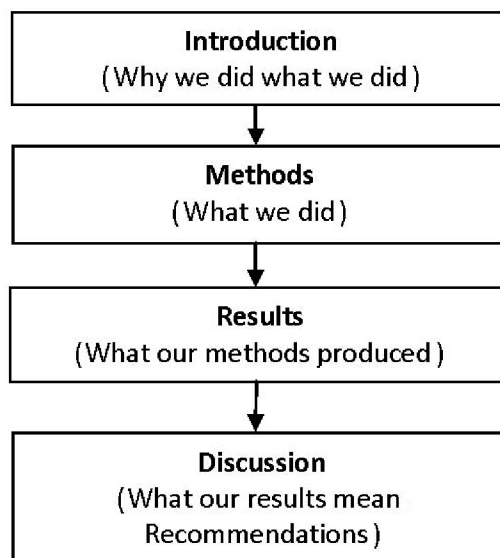
The most obvious part of our design is the way we organize the information we have for our reader. A poor organization, like the misplaced punch line to a joke, spoils the message and undermines its effectiveness. Good writing is well organized. It has a framework or skeleton that we can follow as we start to actually write, a logical order that helps us, and will also help our readers. Creating an order that will guide our readers through a complex array of new data and concepts, leading them to needed understandings, is the essence of good writing design.

## Charting the Flow

Now, with the raw materials chunked into major categories, I begin to organize them and develop a framework for my writing. Good writers will understand the variety of organizational schemes available for their messages, and successful writers will choose the one that works the best.

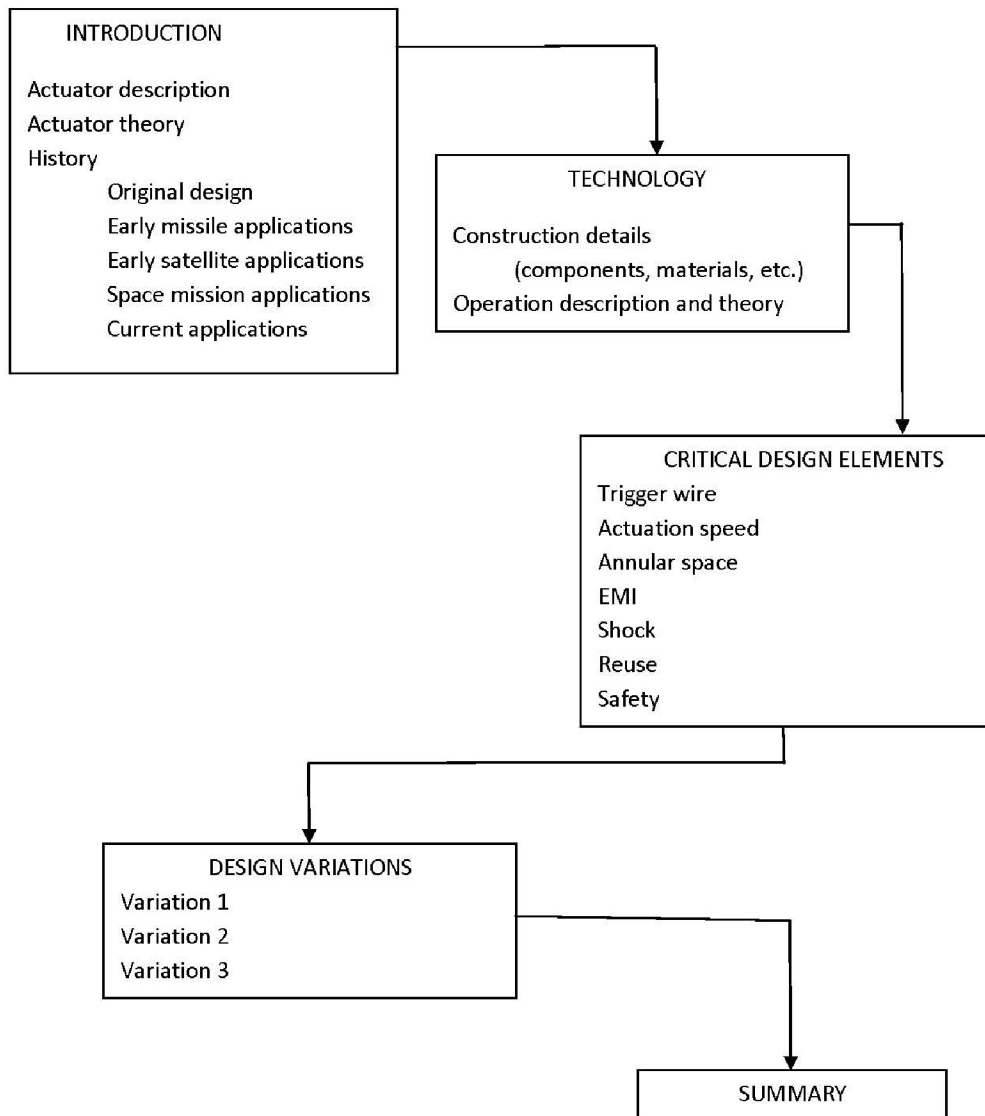
For relatively simple writing tasks, I can sometimes come up with a structure for organizing my thoughts in my head. But for most of my writing assignments, I find it invaluable to prepare a flow chart or outline to help visualize the framework of my design.

As an engineer, I prefer flow charts, as I am used to using them to understand systems and processes. A flow chart for a generic test report is shown in Figure 2. I find that making outlines, especially those constructed according to the rigid hierarchies and formats demanded in college freshmen writing seminars, is usually a more complex and trying task than is needed for most workplace writing tasks. In some cases, however, especially where a specification or RFP requirement drives the organizational scheme, outlines will be the best bet.



**Figure 2** Flow chart depicting a generic test report/article.

Figure 3 depicts the flow chart for an article I wrote describing an electro-mechanical actuator designed for space applications. The flow chart I actually used was much rougher than the one shown. It was done in pencil on paper and served merely as a guide. You will note that this one actually combines a flow chart, used for the systems view, and outlines, used to show the subsystems or components.



**Figure 3** Flow Chart Example (Depicts design for article on electro-mechanical actuator. Sub-sections are displayed in outline form.)



Either approach, flow chart or outline, allows us to create a visual representation of the order that the writing will follow. As we prepare it, we will recognize weaknesses. Places where the flow has gaps or seems rough and bumpy. Key points that need to be given more emphasis. It is far easier to correct these problems now, on a flow chart or outline, than later after hundreds, possibly thousands of words, have been written. So, we need to test the flow we have depicted, trying different arrangements and orders until we're confident that we have blazed a trail that will lead us and our readers to success.

## Setting the Stage

We need to prepare our readers, set the stage so they quickly know why the document in front of them is important, and have a context for the information that follows. I do this with some form of introduction. A good introduction makes our readers comfortable, even eager, as they begin to read what we have written. So, the first element in our flow charts, or the top entry on our outline, should be an introduction of some sort. For many documents, the introduction may only require a sentence or two. For long proposals and reports, it might have several detailed, possibly lengthy, sub-sections itself, as we give our readers important background information, history, assumptions and constraints.

## Choosing a Design that Is Sure to Work

After the introduction, we will have many choices as we craft a design for the delivery of our information. A report on an incident at a power plant may be best presented in a chronological order. A warning light appeared on an operator's console; the operator contacted his supervision; the supervisor authorized an emergency shutdown of the failed system; the shutdown was implemented; etc. Time becomes the organizing strategy for the report, as the details of the incident are revealed.

That same incident could be reported using other organizational schemes, depending on the goal of the report and the needs of its readers. A report could start with the cause of the incident, and then present the fault isolation process used to identify that cause, and close with a recommended method for correcting the underlying problem. Or, much like a detective novel, the report might start with the troubleshooting process and lead to its conclusions.

A report summarizing the lessons learned from the power plant incident might simply list those lessons, presenting any changes in procedures, equipment modifications, and new understandings. In some cases, the list opens with the most important consideration. In others, it may be best to build, making each list element more important, until the final and most critical of the many lessons grows out of the incident and its investigation. Your strategy for delivering the information will shape your final design.

Some reports begin with a recommendation and then follow with a number of reasons in support of that recommendation. Others start with a description of the problem, then an analysis of the many factors involved in its solutions, then finish with a recommendation based on that analysis.

Different writing objectives will demand different organizational schemes. Instructions usually follow a chronological pattern. Step 3 follows Step 2. Step 4 will be next. Descriptions and specifications for processes often follow the same pattern. Proposals may start with the proposed solution to a problem, often the one described in a request for proposals. The proposed solution is followed by an orderly progression of details, in an effort to show how well the change or idea will fix the problem, and the proposal finishes with a recap and final pitch for the change.

A product description might start with a general description, then a more detailed description going from left to right, or top to bottom, and then information on operation and performance. Systems are often described by breaking them down into sub-systems, and then describing each in detail.

Just as there is no single design approach that solves all our engineering problems, no one organizational pattern will work for every writing effort. As writers, our task is to analyze the information on hand, the anticipated audience, and the job the writing must accomplish. Then, taking all that into account, devise a logical, effective strategy for delivering the information to that audience, so that the writing goals are attained. Most engineers will excel at this analytic task. And, at its very core, it is the creation of a design for something new, the essence of engineering practice.

### **Following the Guidelines: Templates and Specifications**

I got a traffic ticket last year. I was not pleased. The officer filled out a Notice to Appear and had me scrawl out my signature at the bottom, acknowledging that I had received it. The ticket noted my speed, the time of day, the location, the license, make and model of my car, and details of the intersection and weather. It was a report of what the officer had witnessed, a report that was written by simply filling in the blanks on a pre-printed form. A template.

Many organizations have templates and forms that are used for different types of communications. Test results may be entered into a preprinted form or online matrix. Progress reports may require graphics depicting schedule and budgetary performance, as well as sections on milestones completed and problems encountered. Technical articles developed for engineering journals will have very well defined organizational schemes, often using some variation of the IMRAD (Introduction, Methods, Results, and Discussion) approach. Requests for Proposals (RFPs) will usually provide guidelines for the organizational structure that is expected in responsive proposals.

If there is a template or specification for how a document should be organized, we can forget all the possibilities for good design discussed in the previous paragraphs. A design already exists. All we have to do is use it.

Those templates and specifications represent organizational schemes and formats that the intended readers are used to and expect to see. We want those readers to process the new information we are providing, to understand what it means, and easily grasp what they should do because of it. If we surprise them with an unexpected and unfamiliar design, those things won't happen. Instead of concentrating on the content of our message, they will be wondering why things aren't arranged in the prescribed order, or put into the format that is "always" used. Using templates, forms, and expected organizational schemes will help ensure that our readers get the information they need.

And, even more important, not using the right template or specified format may doom our writing's chances of being read and acted upon. Proposals and contractual deliverables usually demand adherence to document formats and specifications. Failure to do so will result in rejection. Rejection, of course, is not successful writing.

There may be a time when you can suggest changes or improvements in templates or specifications that don't seem to be the optimal designs for their missions. But, until those changes are made, it is always prudent to adhere to and use available templates and specifications, and deliver our writing in a way that meets our readers' expectations.

# Building with Words: The Task of Writing

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## Getting a Jump Start

As engineers, the projects we work on must move from their planning stages to points where we move forward, and begin to do the actual work. Prototypes and engineering models are machined and assembled. Alpha versions are coded. Components and black boxes are wired and patched together into kludges that will be tested and refined. Surveying and site preparation begins. We look forward to this phase as progress will suddenly become visible, hands-on activities begin, our design starts to take shape, and begins its transformation to reality.

Often, engineers find they have difficulty greeting the kickoff of their actual writing with that same enthusiasm. Instead, we are likely to hear ourselves mumbling, “I hate to write,” and looking for any excuse not to start our writing. Shouldn’t I check on those test samples? I better return Jorgenson’s telephone call right now. I wonder if Mehta e-mailed the results of the calculations he was working on. I should check. Anything to keep from having to write.

Professional writers sometimes suffer from what is called “writers’ block”. They will find themselves staring at a blank piece of paper, or an empty computer screen, and not be able to write. Something, possibly fear that they have lost their skill, or faded confidence in their creativity, paralyzes them and inhibits their ability to begin the writing process. Think Johnny Depp in the movie *Secret Window*, or Jack Nicholson in *The Shining*. The workplace writing of engineers, talented, skilled, creative engineers, can be similarly impeded.

There are ways to get past these feelings of reluctance and even dread. Let’s look at some ways to jump start the writing process.

## Relax — It’s Only a First Draft

In the game of golf, everything rides on every swing. A golfer steps up to the tee, takes a few practice cuts at thin air, and then swings at the ball. If the swing is perfect, the ball flies down the fairway toward the green. If not, it shanks or hooks, fails to get altitude, and bounces along the rough, rolling into a trap or water obstacle. Every swing at a ball is important, especially the first.

Some writers approach writing like golf, attacking each report, proposal and test plan as if their efforts, like a golfer’s swing at the ball, have to be perfect. For them, there is no first draft, second draft, or more. There is only what they write. What they put down on the page has to be good. It has to do the job. That first swing has to get to the green. To the cup.

But writing is not golf. It is an iterative process, a series of attempts and corrective actions leading to perfection, or as close to it as possible. Our first draft is merely a test. It doesn’t matter if it goes in the rough. It doesn’t matter if the sentences are incomplete, some spelling is wrong, or an apostrophe is missing. Equally, it doesn’t matter if some of it is vague or unclear, if points are missing, or if the data are only estimates. First drafts can be ugly, raw and crude.

Sure, the better the first draft is, the less work will be needed as we edit, revise and rewrite.

But we don't need to let our quest for perfection, and our fears of imperfection, slow us down and stop us. In the first draft, perfection doesn't matter. The point, the important point, is that we just need to get started.

For many engineers, this concept is hard to accept. But in many of our engineering efforts, we start with a basic design, test it, modify the design, test it again, do additional modifications, and continue, until we reach our technical goals. Writing is molded the same way — and our first draft, the basic design, can be very crude and rudimentary. It is merely a starting point.

Creating our first draft should be as stress free as possible. Sometimes I actually get a sense of exhilaration as my thoughts, the analyses I have made, and the arguments I have developed take shape in written form. Letting your ideas flow into words without great worries about organizational flaws or grammatical perfection creates a sense of great freedom. Rather than dreading the start of our first draft, we should savor the joy that comes with this stage of imperfect writing.

If we can, and I admit it is not always easy, during this first draft writing we should refrain from going back to correct an obviously misspelled word, or correct a phrase that has a troubling awkwardness. Time spent puzzling over spelling and grammar, or crafting an ideal word order, will be wasted if those sentences are cut or rewritten in subsequent drafts. It is best to just write on, realizing that our first draft is only an initial effort. We will have other opportunities to correct our misspelled words (as well as those mangled by Spell Check) and tongue twisting passages, when we return to appraise where we are, and we begin the process of making big and small adjustments that will sharpen our writing, until we are sure it will be effective and successful.

### **It's Simple, Start at the Beginning**

To start, I turn to my outline or flow chart, and I look for a place to begin writing my first draft. I want to find a place where I have confidence that I know what needs to be said. Ideally, the flow of words has already formed in my head, as I set out to craft this first prototype of our document. My goal is a starting spot where I know the writing will come easily.

Very often the beginning, the introduction that opens our outline or flow chart, provides the perfect starting point. It is here we need to set the stage for our readers, and our familiarity with our subject usually makes those sentences relatively easy to write. All we have to do is introduce our readers to our subject, and then give them enough information that they will have a context and understanding of the details that follow.

In concept, the introduction is quite simple. Here's our problem. It is what we recommend. We would like to introduce our newest product. Our latest addition. The department's most recent acquisition. This is what we will describe as you read on. These are the processes governed by the specifications that follow. This procedure will allow readers to calibrate this equipment. We only have to find the words to engage our readers, and let them know what to expect as they read on.

These are things that we have been thinking about as we brainstormed, analyzed our audience, determined our purpose, and set up a framework to organize our writing. Introductions are often simple, straight forward presentations, and in most cases, the perfect places for us to begin writing.



## Sometimes It's Not So Simple

Sometimes, I find that the introduction is not an ideal place to start writing my first draft. I may not be crystal clear as to how much background on the topic my readers will already have, making it difficult to set the context. Or I may be uncertain as to how forceful to be at the start of my recommendation or proposal, still unsure as to the best approach to take with my readers. For any number of reasons, I discover that starting at the beginning is more challenging than I would like.

When that happens, we need to find some other place to start. We must turn to our outlines and flowcharts, scan them considering what we know about each of the sections or topics we find. Every one of them represents a writing task in itself. Which ones do we feel the most confident about? Which ones could we explain easily, if we suddenly had to give a talk? Which ones do we know so well that we can almost picture how the writing should go?

Our goal is to find a section where the writing will come to us with ease. When we start to write, we want it to be a downhill ride, the words and sentences pouring out as we collect our thoughts and make our points. To find a section where we can expect that kind of flow, we scan our flow chart for topics or sections where we can visualize how the writing might go. Can we sense a good start for this topic? Do we see a way the facts might build up for our reader? Can we envision a logical way to deliver the information? When we have a sense of what might be a workable approach for writing that section, it is time to begin our draft.

Again, we must remember that it is a first draft, and our goal is just to start the framework. With that in mind, our work should go quickly, and soon we will have that section done. Then, using the same process, we go back to our outline or flow chart, and we find another section that seems a likely candidate to work on, where we have a sense of how the writing will go. Soon, bit by bit, topic by topic, we will have developed a complete first draft.

## Write, Even when there Is Nothing to Write About

There are times when I have sections, or parts of sections, that I just can't write. I may be awaiting data or input from colleagues, and the information and details are not available, or are uncertain. Or I am so unsure of how to approach and write about the facts and data that I do have, I know that writing — even first-draft writing — would be a waste of time, until my thoughts on the subject firm up. These are sections that I must just skip over as I do a first draft, and perhaps, even later drafts.

I just leave blank space, or mark the section TBD (To be Determined), or some other notation to remind me that more writing is needed there. I will return to it when the missing data arrives, or my thinking clears about how to approach the troubling section.

The danger in these situations is letting the missing section paralyze our writing altogether. We might focus on what we don't know or don't have, and let those gaps completely halt our writing. We can't let that happen. We need to find a place to start in on our draft and initiate

the process of actually writing. We may end up with a first draft that has more holes and gaps than a slice of Swiss cheese, but it's a beginning. And at this point, it's exactly what we need.

Be especially wary of impeded progress when writing on a deadline, as is frequently the case with proposals and reports. Letting a troublesome paragraph or chapter stop our progress on the entire document risks skyrocketing stress, as deadlines loom and demands for the information grow strident.

## Recognizing False Starts

At track and swim meets, when a competitor makes a mistake at the start, an official fires a gun, and everything comes to a halt. It is a false start. Sometimes, I experience the same thing writing. After getting the first few sentences or paragraphs of a first draft down, I begin to sense that something is not right. The writing may become more and more difficult, making me unsure that I am headed in the right right direction with it. Or I might sense that I am becoming bored with my own writing, a sure-fire sign that my readers will have the same difficulty. Or sometimes a light goes off in my head, and I sense I should take a different approach, or a different strategy, a different organizational scheme that would be a vast improvement over what I am doing.

At this point, as writers we have two choices. Either one of them will work, and our choice depends on variables, such as the deadlines we face, our personal preferences in rewriting and editing, and how different the new ideas or strategies are from what we had been doing.

First, we may just make notations about our thoughts on improvements, and continue with our writing, realizing that it is only a first draft, and we will have ample opportunity to make the needed improvements in the next iteration. This choice can be the smartest, if we are not having trouble with the writing, but do have a feeling that some major changes are required. For the sake of efficiency, we finish up the full first draft, and then prepare for some heavy re-writing in round two.

Or, just like runners and swimmers when the gun shot sounds, we may screech to a halt, and with the new approaches and ideas fresh in our minds, head back to make another start at the first draft. It will still be first draft writing — fast, flowing easily, not striving for perfection — but it takes a new path as our words flow on the page. This may be the smartest choice if our writing has slowed down, and we find ourselves plodding along, unhappy with the writing's direction, or the way our message is unraveling, taking another stab at the first draft makes good sense. Sometimes, it's just more efficient to make fresh start with the first draft, setting the entire communication on a surer and more comfortable path.

## Getting this Far

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We have seen that the writing process is a familiar one, a matter of identifying the problem, coming up with a preliminary design for the solution, and then making a rough model or prototype based on that design. It is, essentially, an engineering process.

But that doesn't necessarily make it an easy process to follow. Just as we grapple with engineering problems that challenge our knowledge, skills and creativity, writing can do the same. As in engineering, it is a process that will eventually lead to a solution. And each step in the process makes the one that follows easier. If we do a good job of understanding our audience and why we are writing to them, we will discover that rounding up and organizing the content we will write about comes readily. And the thought we put into that organization will spur our initial writing, helping us get that all-important first draft down.

The next phase of writing involves editing and rewriting, the iterative process that will move our writing from the rough draft to the final, near-perfect message. It, too, mirrors our engineering world, acting very similarly in function to design reviews and preliminary tests. The second e-book in this series, *Writing for Success: The Engineers Guide to Writing* will look at how we use those cycles of review and test to ensure our final written efforts — whether they be reports, proposals, instructions, specifications, or any of the many workplace documents we face — are effective and successful.

The arc jet project that was a major component of my first assignment at the Jet Propulsion Laboratory is described in a technical memorandum, “A Plasma Arc Jet Test Facility for Extra-Terrestrial Atmospheric Entry Studies”, JPL TM 33-42, 1971, and two brief reports, both titled “Planetary Entry Heat Shields” that appeared in JPL Space Programs Summary 37-55, Vol. 3, pp. 140-141, and 37-48, Vol. 3, pp. 78-81.

Several books and articles describe the variety of written documents that are a part of an engineer’s work and their importance. Hazel Sales’ *Professional Communication in Engineering* (Palgrave Macmillan 2006) provides a detailed look at many aspects of writing required by engineers, as well as an excellent analysis of the amount of an engineer’s time that is spent writing. In *A Guide to Writing as an Engineer* (John Wiley & Sons 2005), David F. Beer and David McMurrey provide a long list of studies, standard reports, manuals, special reports, and other documents that engineers may need to write during their careers. C. Marsh argues that, with corporate downsizing, even more writing responsibility has fallen to engineers in “The Engineer as Technical Writer and Document Designer: The New Paradigm”, *The Journal of Computer Documentation*, Volume 23, Number 2, May 1999.

I introduced the similarities between engineering practice and writing, focusing on creative writers who happened to be engineers, in *Engineers Can Write!*, an award-winning e-book published by IEEE-USA in 2010. Henry Petroski made that connection much earlier, in his first book, *To Engineer is Human: The Role of Failure in Successful Design* (St. Martin’s Press 1985). He made a similar comparison in *Beyond Engineering: Essays and Other Attempts to Figure Without Equations* (St. Martin’s Press, 1986).

I note that what I have written here is not meant as a technical writing textbook but for those interested, there are many fine books available to fill that need. I have used Mike Martel’s *Technical Communication* (Bedford/St. Martin’s Press 2009), John Lannon and Laura Gurak’s *A Concise Guide to Technical Communication* (Pearson 2004), and David Riordan and Steven E. Pauley’s *Technical Report Writing Today* (Wadsworth Publishing 2004) in classes, and found them to be effective and comprehensive. Colleagues very much value David Beer and David McMurrey’s text, mentioned above, in their classes. And I have always enjoyed texts by my friends Ron Blicq and Lisa Moretto, especially *Technically-Write!* (Prentice-Hall 2003).

Nancy Roundy Blyder does a nice job of summarizing recent thoughts on the theory of purpose in technical writing, as well as research, in “The Effect of Purpose on Professional Communication”, *Technical Communication*, Volume 41, Number 1, February 1994, pp. 71-80. Leo Lentz and Henk Maat cover audience and purpose in “Functional Analysis for Document Design”, *Technical Communication*, Volume 51, Number 3, August 2004, pp. 387-398.

Most writing textbooks have a section on outlining. The “Outlining” section in the *Handbook of Technical Writing* (Bedford/St. Martin’s 2000) by Gerald Alred, Charles Brusaw, and Walter Oliu, provides good coverage of basic outlining techniques. Barbara Leard and Richard Peres offer advice in “Outlining-Taming the Savage Beast”, *Intercom*, July-August, 1998, p. 20. Geoffrey Hart provides a three step methodology in “Effective Outlining”, *Intercom*, September/October 2006, pp. 18-19. Also, although I am not a fan of formal outlines, it should be noted that Microsoft Word includes features that make setting up several different types of outlines quite easy.

The outline depicted in Figure 3 is for a paper, “Electro-Mechanical Actuators for Remote Actuation Requirements”, AIAA 95-2985, that appeared in the *Proceedings of the 31st AIAA/ASME/SAE/ASEE Joint Propulsion Conference*, July 10-12, 1986. It was co-authored with Craig Courtney, Larry McCormick, and Roger Stephenson.

The two movies mentioned that feature characters with writers’ block were both written by the popular horror novelist, Stephen King. *Secret Window* (2004) was based on the novella *Secret Window, Secret Garden* that was included in King’s 1990 collection, *Four Past Midnight*. King’s novel *The Shining* was a best seller in 1977 and was made into the movie in 1980. It is doubtful the prolific King, himself, ever suffered from writer’s block.

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### Author Note:

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