

## PROBLEM/SOLUTION CASES IN TECHNICAL WRITING

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Most of the “problem-solving” assignments that students undertake are designed mainly to test their mastery of the technical aspects of a subject. For example, an engineering student might be required to design a highway roadside mower that would meet various restrictions concerning size, weight, cost, and the like. In such an assignment, the student must solve the technical problem and describe his or her solution to the instructor, generally in some form of written report. Problem solving in this sense has been treated in Brian Lowe’s “A Method of Teaching Problem-Solving to Undergraduate Engineering Students”<sup>1</sup> and in *Engineering Fundamentals and Problem Solving*, by A. R. Eide *et al.*<sup>2</sup>

Such assignments have some value as training, because often an engineer’s or a technician’s responsibility is simply to convey technical details of all or part of a project to a person in charge of the project. By and large, however, assignments whose only purpose is to train students to report technical details have limitations. They ignore much of the real-world context of a problem—the context of economic and interpersonal problems of which the technical problem is only a small part, and also the context of a communication network in which many different kinds of readers with different kinds of uses for the report must be identified and addressed. Both contexts have been discussed in J.C. Mathes and Dwight W. Stevenson’s *Designing Technical Reports*<sup>3</sup> and in Linda Flower’s *Problem-solving Strategies for Writing*.<sup>4</sup> For example, under what circumstances might someone actually be asked to design a highway roadside mower? What is the “problem” in the most general sense? The answer might go something like this:

When weeds and other plants grow alongside a highway, they are unsightly and also hazardous to motorists, since they tend to reduce visibility. Thus, there is a problem for the general public.

Among the various government agencies that serve the general public, one is generally responsible for maintaining the public highways. If its present weed-control method is inadequate, the agency has a problem, and may therefore solicit bids for the design and manufacture of a new type of mower.

Since requests for bids are issued on a competitive basis, each company in the field of maintenance machinery has a problem. To maintain or increase its profits, it must convince the government agency that it has designed the cheapest, most efficient new mower and that it has the capability of manufacturing it.

Within each particular company, a group of engineers will be assigned the tasks of developing an efficient, cheap mower and of preparing a report of its recommended design.

As the report circulates within the company, other problems emerge. The new design might require the acquisition of new means of production, the hiring and training of new personnel, the firing or retraining and relocation of old personnel, the development of sales strategies to broaden the range of potential buyers for the new mower, and so on. Furthermore, all of these changes may generate emotional responses among personnel, since they might dislike their new assignments, or envy someone whose plan won out over theirs, or resent the fact that their own pet projects have been put on the back burner.

In the case approach, this wider, real-world context for the solution of a technical problem can be addressed. Students are given a body of information which describes a technical problem and a realistic environment of bosses, colleagues, clients, rivals, social and "political" relationships, information networks, company traditions and the like. To write a report based on such information, students must develop a sense of the overall writing context, the range of possible readers and functions of the report, and their own specific role as both technical and rhetorical problem-solver.

Besides offering a useful model of problem solving and report writing in realistic situations, the case approach also allows a class of students from various majors to address and even to collaborate on common topics, providing a solid foundation for later problem-solving assignments in their respective disciplines. Other features of the case approach (as used in composition classes) are described in

David Tedlock's "The Case Approach to Composition."<sup>5</sup>

Our version of the case approach emphasizes the difference between the solution of a technical problem and the design of a document which will address the needs and attitudes that different readers (and different kinds of readers) might have about the technical problem or its proposed solution. The approach involves a nine-question heuristic, a three-step motivated-sequence format, and a few generalizations about human nature.

The heuristic consists of nine traditional "Discovery Questions":

1. What is the background to the problem? That is, what information would someone need to understand the claim that a problem exists? (For example, a company's product might be manufactured in one area, assembled in another area that has limited space, and then sent to another area to be packaged and shipped.)

2. What is the problem itself? (A conveyor belt keeps breaking down in the final assembly area.)

3. What are the problem's effects? (The break-down causes delays in all areas of the plant, since the manufacturing area has no place to store parts, and the packaging/shipping department quickly runs out of products to process. Thus, valuable work time is lost, at considerable expense to the company. Furthermore, these delays in manufacturing cause shipping deadlines to be missed, which in turn causes added bookwork in the accounting department and credibility problems for the sales force.)

4. What are the problem's causes? (The conveyor belt was not designed to carry loads at the speed required by increased demand for the company's product. Specifically. . . .)

5. What, if anything is being done to solve the problem? Does this create further problems? (Two persons have been assigned to service the conveyor belt every day and to be on stand-by for emergency repairs. This has lessened the frequency of breakdowns but has not prevented them altogether.)

6. Generally speaking, what kind of thing is needed to solve the problem? (Costly delays need to be prevented.)

7. Specifically, what solutions are possible? (A storage area could be constructed for manufactured parts during breakdowns; the conveyor belt service crew could be improved; the conveyor belt could be modified; the conveyor belt could be replaced with a new, improved one; a method of assembly that doesn't require a conveyor belt could be devised.)

8. Which solution is best? (A storage area would solve only part of the problem, since the packing/shipping department would still have to be idle during conveyor-belt breakdowns; the conveyor belt service crew is the best available, and could not be further improved; modifications of the conveyor belt would be costly and would not guarantee further breakdowns; alternative methods of assembly would require more equipment and training of personnel than is currently feasible; thus, the conveyor belt should be replaced with a new, improved one.)

9. How should the solution be implemented? (An engineering firm should be retained to design a new conveyor belt, and appropriate measures should be taken for installing the new belt by a given date. Specifically, the company president should approve this course of action.)

This set of questions moves the problem-solver from the known to the unknown, and thus it can also be integrated with a motivated sequence for organizing a report of the information generated by the questions. Specifically, the nine heuristic questions can be recast into three psychologically conceived steps for persuading readers—i.e., into the “motivated sequence” of persuasion developed by Alan H. Monroe in *Principles and Types of Speech*.<sup>6</sup>

1. *Problem Step*. Readers must be made aware of a situation that has had consequences for them.

2. *Need Step*. Readers must be made conscious of the need for (and possibility of) remedial action.

3. *Solution Step*. Readers must visualize the specific actions needed to solve the problem, including their own specific roles in that solution. Finally, students need to recognize that, while almost any report or memo is best organized into a motivated sequence, any given report or memo might require that all nine questions be specifically addressed or that only one or a few questions be emphasized. For example, an in-house final report might focus on the technical problem and its solution (questions 6 and 7), so that the company or organization’s problem (questions 1-5) are treated briefly in the report’s introduction or in other prefatory material, and the recommendation and implementation (questions 8 and 9) might be referred to another company unit for treatment. Conversely, a proposal—which has a different purpose, and different readers, and a need for a stronger persuasive element—might focus on the company or organization’s problem (questions 1-5), and conclude with a call for a

follow-up report to deal with the needed technical solution, recommendation, and implementation (questions 6-8).

Once this principle of emphasis on the whole problem-solution process or on parts of the whole has been established, then students are better prepared to recognize the kinds of presentational adaptations that need to be made in their report’s organization and style, based on their recognition of the needs and attitudes of various readers (specific readers or kinds of readers) to various aspects of the overall process.

To show how the heuristic questions and the three-step motivated sequence can be applied to a variety of writing situations, we try to lead students through a sequence of case studies of increasing difficulty in regard to the technical problem and the rhetorical situation (the effect of topic and audience on organization and style). Since students in our classes are almost invariably seniors and graduate students from a variety of majors, we try to vary the subject matter by using different cases for each step in the sequence. But it can also be effective to use one case for two or more steps in the sequence; to save space here, we will focus on the latter technique, using one case with two sets of directions to show how technical problem solving leads to rhetorical problem solving.

In presenting the body of data that constitutes a case, we “de-write” all or part of an effectively written technical report, much as exercises are constructed in sentence-combining pedagogy. That is, information presented in a single sentence might be “atomized,” broken down into several short, simple sentences. Data from a table might be presented partly in tabular form and partly in prose, or a table might present information which justifies a key generalization that must be inferred from available data. Particularly in later, more difficult cases, some irrelevant information might be scattered throughout the material given to students; finally, in order to prevent students from merely copying down sentences from the case material and to encourage students’ perception of appropriate diction and usage, the data are presented in the form of rough notes, using sentence fragments, colloquial words and phrases, and even usage errors that students must change to meet the demands of different audiences.

Here is an example of the “data” section of a case:

*DATA SHEET FOR COMPCORP CASE*

During this quarter last year, the CompCorp company sold twelve million dollars worth of CompCorp 711s. \$9,000,000's worth was sold during the same quarter that just ended this year.

The "711" is the CompCorp 711. It's a small-sized computer.

There's been a turnover of 3 of six secretaries in the Sales Department of CompCorp during the last quarter.

Ted Rasmussen's the Sales Director.

Here's some data, numbers-wise, about sales of small-sized computers: During this quarter last year, total computer industry figures for sales of small-sized computers totaled \$200,000,000 versus \$180,000,000 this year. The Mediamaster 2100 is a small-sized computer made by CompCorp's big competitor, which sold \$30,000,000's worth of 2100s last year and \$29 million this year.

CompCorp's stressing the 711 as a device for the home in its advertising. This was the big idea of George Jacobson, who is the Manager of the Sales and Services Division of CompCorp Industries. You think it's a pretty stupid approach. Food prices are rising. Mortgages are out of sight. The economy's crummy. How could people who own homes put out cash on a computer these days?

Ted Rasmussen was in the hospital two weeks for an appendix operation during the last quarter.

The guys and gals in the sales force pick up a 10% commission on the sales of 711's and a fifteen percent commission on the 1211s. 1211s are big computers made by CompCorp. They're selling 3 percent above the average of the industry as a whole during the quarter that's coming to an end.

There was a turnover of 6 of 36 sellers in the Sales Dept. Two of the replacements are doing ok (5 percent under company average), three are doing good (at company's average), and one's hotshot (15 percent over company's average).

Mediamaster's advertising of its small computer (the 2100) is being aimed at the small business market.

It is interesting to note that exit interviews with secretaries who left the company this year show normal reasons for leaving. One complained about having to make coffee all the time.

Most folks in the sales dept. were found to be reasonably satisfied with their job situation, taken as a whole. The usual complaints were pretty much like anywhere: too much paperwork required by management, coffee machine's located to far away. Like that.

During the last quarter, the Sales Staff kept up on accounting procedures and generally got necessary office work done accurately and on time. Staff felt a little overworked.

One salesman told you that the Sales Department has low morale because "Jacobson's an s.o.b."

This case can first be accompanied by a set of directions which en-

courage students to focus on isolating the problems and to express their conclusions in a simple essay format:

*DIRECTIONS FOR COMPCORP CASE (1)*

After studying this material, write an essay-type report that would be clear to all the participants in this class or to anyone else who had not seen the data sheet. This report should explain the various aspects of the problem and describe an appropriate solution or solutions. Use the Discovery Questions to help you understand and identify the relevant issues and facts; analyze the data carefully, so that you can distinguish between real and merely apparent problems and factors, and devote at least one paragraph of explanation about your main conclusions about each of these various points.

Such a report can generally be written during a one-hour class meeting, and usually only a brief discussion of these essays is required to establish the three main problem areas: staff turnover and absences, compensation policy, and advertising strategy. In accordance with common essay practice, these three areas are generally best presented in order of importance—either greatest to least or vice versa. In other words, students write a standard "effect/causes" paragraph, first describing the company's problem and then describing the three main causes of that problem.

As a follow-up to this first case, we generally provide one or more additional cases, each with increasingly more complicated problems but with a relatively simple audience. Again, the intention is to focus first on the overall nine-step problem-solution sequence, with adaptations for various audiences to be treated in subsequent assignments.

Students are then ready for a second set of directions, which require attention to the report's function or use in a company, to the range of audiences (kinds of readers) who will use it (in various ways and to greater or lesser extents), and to the changes in format and style that will be required by such uses and audiences.

This second set of directions may merely outline a description of the company's organization, so that students can decide what kinds of information their report (usually a memo) should contain, who the official and unofficial readers would be, and what characteristics such readers might have. Or, as in the directions that follow, students can be presented a rhetorical situation which requires attention to attitudes and "company politics" as well as to readers' knowledge of facts and uses for the report.

## DIRECTIONS FOR COMPCORP CASE (2)

You work for CompCorp. You've got to write a memo to your boss, George Jacobson. The memo's supposed to be about the Sales Department. Jacobson says they're "a bunch of lazy bums." Yesterday, Jacobson said this to you: "Listen, I'm going to take your report and Mason's [Jacobson's other Assistant Manager, who's mainly responsible for Services] and put 'em together and present them when I make my report at Thursdays meeting—you know, the one where the company president, vice-president, and all the division managers will discuss trends for the quarter that just ended. They're gonna want to know why 711 sales are the pits this year. So remember, I want snappy job done on this, and I want answers that'll get us back on track." From previous experience, you know that Jacobson is literally going to staple your report and Mason's together and present them to the manager's "as is," so the report better be clear and easy to be read and referred to quickly during a meeting. Due to unavoidable problems, you've only got an hour or two left to write this report. As you begin, you recall that just six months ago you moved 600 miles to take this upwardly mobile job as Jacobson's assistant, right after the birth of your third child. You are also aware that the job market is currently very tight—so tight that it would be nearly impossible to get another job as good as the one you've got now.

For this second set of directions, the audience is considerably more complex, so students must change the presentation of the information in order to accommodate various readers' knowledge of and attitudes toward the various factors, and also the manner in which readers will *use* the report itself. As a guide for such changes, we urge students to apply two simple principles, both drawn from Young, Becker, and Pike's *Rhetoric: Discovery and Change*,<sup>7</sup> and both based on the idea that humans generally try to preserve homeostasis, and act in order to expend the least amount of effort. First, people tend to hold to whatever they currently understand, so that most efforts to *change* people's current beliefs must work from the familiar to the unknown—or from the "given" to the "new," as Herbert H. Clark and Susan E. Haveland conceive it in "Comprehension and the Given-New Contract."<sup>8</sup> Second, people perceive change as a threat, so that most efforts to persuade people must be presented in as non-threatening a manner as possible. To these principles we add a Machiavellian corollary: people usually act in their own interests, and resent any challenge to those interests, so that something apparently antagonistic should generally be presented as being a step toward a different, "higher" interest.

With these ideas as guides, students are encouraged to reach the following conclusions about the rhetorical situation created by the second set of directions.

First, there are "background" data to support the claim that an overall problem exists for the company (declining sales), and these data should come early in the report, so that all potential readers can visualize the problem, perceive the threat posed by the problem, and become conscious of the need for remedial action; also, there are three potential technical problems for which solutions must be found (staff turnover, advertising strategy, and compensation policy); and the solution must be appropriate to these circumstances.

Second, there are two main sets of readers: Jacobson, on the one hand, and the company officers on the other; and the goals of these two sets of readers may not be the same. Although both would be interested in maximizing profits in the company, Jacobson might be equally interested in preserving his own position (i.e., in protecting his own interests). And since the writer's own interests obviate against an attack on Jacobson's interests (except in the unlikely event that Jacobson's power can be circumvented), Jacobson's pet advertising strategy should be attacked only as a last resort, and then only in terms as little threatening as possible; and this should be reflected in the organization of the paper, with the discussion of deficiencies in the advertising strategy coming only after "staff turnover" has been eliminated as a major cause and "compensation policy" being recognized as a contributing cause. Or the role of the advertising strategy might be slightly emphasized by discussing it second, just after the section on staff turnover; with this arrangement, the student can begin by providing information that might tend to confirm Jacobson's prejudices, but can then turn to the more likely causes with a reasonable transition: "But despite these potentially disruptive circumstances. . . ." The unavoidable threat to Jacobson must be deflected, as for example by blaming "changing economic circumstances" for the decrease in sales rather than "Jacobson's stupid advertising strategy."

Third, despite this potential conflict of interests in the two sets of readers, both Jacobson and the company officials will *use* the information in the report similarly, to make a decision in a relatively short period of time (rather than, for instance, to provide a "deep background" for general study and understanding of the organization). Thus, the information in the report must be easily and quickly retrievable, suggesting that short paragraphs accompanied by head-

ings and white space would be appropriate.

By means of the Discovery Questions heuristic, the motivated-sequence strategy, and the three principles of human behavior, students can be led through a sequence of increasingly complex cases, with the complexity residing sometimes in the technical problem, sometimes in the rhetorical situation, and sometimes in both. For example, to return to the conveyor belt problem, we can imagine the rhetorical situation of having to write a report arguing for a new system to replace the belt—a report addressed to the supervisor, who started out in the company 20 years ago, who made his mark by designing the present conveyor system, and who believes the system can still do a good job. As a result of this approach, students learn to think of “problem solving” not only in its narrow, technical sense, but also in the broader sense that will be relevant to their professional performance and development.

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### Notes

<sup>1</sup>Brian Lowe, “A Method of Teaching Problem-solving to Undergraduate Engineering Students,” *British Journal of Educational Technology*, 13, 2 (May, 1982), 137-152.

<sup>2</sup>A.R. Eide, et al., *Engineering Fundamentals and Problem Solving* (McGraw-Hill, 1979).

<sup>3</sup>J. C. Mathes and Dwight W. Stevenson, *Designing Technical Reports* (Indianapolis: Bobbs-Merrill, 1976).

<sup>4</sup>Linda Flower, *Problem-Solving Strategies for Writing* (New York: Harcourt Brace Jovanovich, 1981).

<sup>5</sup>David Tedlock “The Case Approach to Composition,” *College Composition and Communication*, 32, 3 (October, 1981), 253-261.

<sup>6</sup>Alan H. Monroe, *Principles and Types of Speech*, 5th ed. (Chicago: Sott, Foresman and Company, 1962), pp. 280-329.

<sup>7</sup>Richard E. Young, Alton L. Becker, and Kenneth L. Pike, *Rhetoric: Discovery and Change* (New York: Harcourt, Brace & World, 1970).

<sup>8</sup>Herbert H. Clark and Susan E. Haveland, “Comprehension and the Given-New Contract,” in *Discourse Production and Comprehension*, ed. R. O. Freedle (Norwood, New Jersey: Ablex, 1977), pp. 3-37.