Janet Emig's 1971 study, *The Composing Process of Twelfth Graders*, spurred an interest in the writing process: how writers compose rather than simply what they compose. However, a survey of current literature indicates that little has been published on the composing processes of technical writers. Perhaps we have assumed that technical writers compose as other writers do. In order to test this assumption, we conducted the research on which we base this study.

ASSESSING THE LITERATURE

Our first step was to review the literature on the composing process. This literature examines writers from a diversity of disciplines and does not focus on students or professionals in the pure or applied sciences. From this review, we delineated three areas of general agreement:

1. The composing process is made up of several stages.
   For the purposes of discussion, the composing process may be segmented, although researchers differ on the number and names of these stages. Emig delineated seven: pre-writing (from the awareness of stimuli in the environment to the first words put on paper); planning (a setting of parameters); starting; composing; reformulation (correcting, revising, or rewriting); stopping; contemplating the produce. However, a simpler model de-
signed by Gordon Rohman is more commonly used: pre-writing, writing, and re-writing.²

2. The composing process is reflexive.

Though the writing process may be segmented for discussion purposes, it is in fact reflexive or non-linear. That is, the stages overlap, and may occur and recur at any point. Both Sondra Perl³ and Sharon Pianko⁴ have documented these facts in their studies of writers at the college level. Perl⁵ has termed this reflexivity "shuttling," where the writer works backward as well as forward, returning to "substrands" of the writing process in order to compose additional material. Nancy Sommers⁶ has also stressed the non-linearity of the composing process in her studies of revision: rewriting can and does occur at any point in the writing process.

3. The composing process may be mastered by means of strategies.

Experienced writers have a range of techniques, or strategies, to assist them in planning, writing and revising their rough drafts. Therefore, their composing processes are well-developed and effective. Sharon Crowley⁷ has stressed this latter fact in her comparison of inexperienced and experienced writers. Inexperienced writers do not pre-plan or reflect on their writing. They compose their products straight through and revise little beyond changes in mechanics. Experienced writers, on the other hand, have well-defined composing processes. In particular, they reflect on their work, as Sharon Pianko⁸ has found.

In their studies of problem-solving, Linda Flower and John Hayes⁹ have concentrated specifically on writers' strategies that provide alternative discovery procedures to the trial-and-error methods inexperienced writers frequently use. Flower and Hayes have discovered that good writers constantly redefine their audiences and assignments while composing. They also consider their goals, how they wish to affect the audience. Flower¹⁰ has then delineated techniques which these successful writers use to "solve" the problem of composing.
COLLECTING THE DATA

Our second step was to collect data on the way technical writers compose and relate our findings to these three areas of agreement. We used questionnaires and interviews (see Appendix) to gather information from a broad sample, surveying 70 writers in all: 30 technical writing students, 8 students working part-time in industry, 2 university professors, and 30 engineers and researchers working full-time in industry. The disciplines represented by these 70 writers included civil, chemical, agricultural, geological, mechanical, electrical and petroleum engineering, chemistry, hydrology, geology and biology. The writers working full or part-time in industry were employed by firms performing research. No technical editors or professional writers were surveyed, only technicians, engineers, and researchers whose jobs involved composing reports.

INTERPRETING THE RESULTS

Our third step was to interpret the results of our survey in terms of the areas of agreement delineated above.

1. The composing process is made up of several stages.

Our study shows that the technical writer does have a composing process of several stages, similar to that of other writers. We have used Rohman's model to discuss these stages: pre-writing, writing, re-writing.

Of the technical writers surveyed, all 70 indicated that they engaged in some form of distinctly pre-writing and re-writing activity, in addition to their writing stages. The amount of time spent in all three stages and their distinct separation varied greatly, however, and depended on two factors: the projected length of the document being written and the form of that document.

If the writer knew that the final product would be long, 10 pages or more, he or she spent more time on pre-writing and re-writing activities and separated the stages of the composing process more distinctly. On the other hand, if the writer knew that the final product would be short, he or she spent less time on the stages and also distinguished among them less sharply.
For example, one experienced writer said that, when composing a short letter, he often thought for a minute or two, mentally noting the main points to be covered, and perhaps "came up" with a full sentence to be used in the draft. His pre-writing stage, then, was very brief and tended to merge with the writing itself. After composing the letter, his re-writing activity consisted only of reading through the secretary's typed draft. When preparing a lengthy proposal, however, this same writer had pre-writing and re-writing stages which were divided into several sub-stages and were clearly separated from composing the first draft of the document.

The second factor, form, particularly affected the length of the pre-writing and re-writing stages. If the form were flexible (e.g., the journal article or the proposal), more activity took place in these stages. If the form were highly structured (e.g., the progress report), less activity took place.

2. The composing process is reflexive.

The composing process of technical writers is reflexive or nonlinear, as is that of other writers. We found several indications of this reflexivity.

First, pre-writing acts recur in the writing stage. For example, as Emig has discussed for other writers, the writing stage is a time of generation for technical writers. Virtually all writers (67 of 70) surveyed indicated that they frequently discovered and added information while composing, content which they had not intended to use and perhaps had not fully articulated. In fact, one chemical engineering professor said he always wrote the conclusion section of a paper or journal article last because he was never sure until he had composed other sections precisely what he wished to conclude, despite finishing his technical work and making extensive pre-writing plans. This generative aspect of the writing stage involved selecting content and setting parameters for the product—traditionally two pre-writing activities—and illustrates the reflexive nature of the composing process.

Second, pre-writing plans reappear as criteria guiding the re-writing stage. The 70 writers surveyed all performed traditional revision activities of adding, rearrang-
ing, substituting and deleting material, both during and after composing. Their criteria in terms of content were completeness and proper emphasis of the data. To apply these criteria, 38 of 70 said they often used a testing process, comparing the information included in the draft with the needs of the audience and the purpose of the document. Audience and purpose, as we will discuss, are two primary considerations in the pre-writing stage, which reappear as aids in re-writing.

In addition, all 70 writers said they examined their drafts for logical progression. When checking for logical progression, only eight writers said they referred directly to written ordering techniques, another primary component of the pre-writing stage. However, this examining activity itself indicates the internationalization of these ordering techniques and another recurrence of pre-writing aids as criteria for re-writing. Thus these writers engage in the process Perl has called "shuttling," again an indication of reflexivity in composing.

Third, writing and re-writing merge with editing: correcting mechanics and usage problems. For 48 of 70 writers surveyed, the re-writing of long documents in particular had several sub-stages: the document was examined as a whole and revised; it was examined section by section or paragraph by paragraph and revised; it was examined sentence by sentence and edited. These actions, however, could occur at any point in the composing process. For example, one writer said he frequently reread a previous paragraph or even the entire piece he had composed to date before continuing to write. He then added, reordered, substituted and deleted material and performed editorial operations while composing; his first draft was frequently his last. This merging of writing, re-writing and editing again reveals the reflexive nature of the composing process.

3. The composing process may be mastered by means of strategies.

Our survey indicates that the most experienced technical writers have a range of strategies from which to select at each stage of the composing process. These strategies help them master writing.
Pre-Writing

We have classified strategies used in the pre-writing stage into two groups: first-order and second-order. First-order strategies apply to composing in general, regardless of the specific communication situation giving rise to the document. These first-order strategies include analyzing the audience, analyzing the purpose of the document, and consulting the accepted forms of technical writing. Second-order strategies apply to the accepted form once it has been chosen, and include the use of an ordering device to structure the material.

First-Order Strategies. Only eight writers—all inexperienced—did not reflect on who would read the document and what its purpose would be before beginning to compose. The most experienced writers considered these questions, as well as the form they would select. This first-order strategy of form, however, was frequently implied rather than consciously articulated. For example, writers would discuss the major and minor emphases of a document or refer to the "parts" they intended to include in a specific report, indicating in this way their consideration of form.

Second-Order Strategies. All but one writer used some type of written technique to order the material gathered for the communication task. For all, this written technique was an outline, though the degree of formality and complexity of the outline varied. For example, several of the more experienced writers began by listing ideas for inclusion in the draft, after which they sought logical relationships among items in the lists and shaped them into more formal outlines. In fact, one interviewee's outline was often so complete he would simply write it out in full sentences as his rough draft. However, this same writer would compose lists resembling notes when time pressures or familiarity with the material precluded extensive ordering. All but three of the writers said they used these outlines as guides in the writing stage.

Writers did not, however, limit themselves to one organizational pattern in this pre-writing stage. Instead they often considered several patterns before deciding on a final arrangement. Two such writers mentioned making three or four different out-
lines in a given reporting situation, then choosing the most effective among them.

Although the list expanded to an outline was the most common ordering device used, writers also mentioned utilizing diagrams when describing systems, or a combination of diagrams and flow charts when describing processes, indicating the form-specific nature of this second-order strategy.

The pre-writing stage we have delineated resembles that described in the literature. However, the technical writer's pre-writing stage does differ in quality from this stage with other writers: it is more deliberate or logical. One indication of deliberateness or logic is found in the nature of technical "invention."

Researchers on the composing process frequently emphasize searching for new knowledge, "inventing" content, or choosing a topic as the writer's first pre-writing step. Thus strategies for invention, the generation of material, are important pre-writing aids.

None of our interviewees considered searching for or inventing knowledge or choosing a topic, in pre-writing or anywhere else in the composing process. Instead, most viewed pre-writing as a time to select and organize material collected prior to the communication task in their technical inquiries. This difference is probably due to what James Souther has called the "situational" nature of most technical writing: the writer is assigned a topic or one is dictated by an organizational problem he or she has explored, an exploration which also provides the content for composing.

Because the technical writers interviewed did not face the problems of generating content or delineating a specific topic and intent from a broader subject area, they could proceed to set parameters for a specific communication task: select and order content rather than generate it. These activities gave the stage its deliberate or logical cast.

Deliberation was also evident in the specific strategies used to order: the list and the outline. Technical writers find these
strategies useful because of the nature of technical forms. These tend to be more prescriptive than forms used on other writing situations and structured on logical rather than associative or emotional principles. Therefore, the logical ordering by list or outline is appropriate to technical communication.

Re-Writing

Strategies used in the re-writing stage are all first-order because they apply regardless of the specific communication situation. This re-writing can and does occur throughout the composing process and proceeds on three levels: content, structure and style.

Of the writers surveyed, 38 of the 70 indicated that they returned to their audience and purpose analyses as checks when revising for inclusiveness and proper emphasis of content.

In terms of method, 48 of the 70 writers surveyed usually revised from larger units to smaller, solving major content and/or structural problems before proceeding to the paragraph or sentence level. Logical progression of the draft was the major criterion guiding this revision, which proceeded by checking the actual pre-writing outline or more frequently an internalization of that outline.

The writers surveyed made stylistic changes during composing, often after considering audience needs, but they also edited when the draft was complete: 45 of 48 writers indicated that they corrected mechanics and usage during a last sentence-by-sentence reading.

The re-writing stage we have delineated also tends to be more deliberate than that of writers described in the literature. The technical writer's audience, purpose and type of report are set by his or her technical task. The parameters guiding the technical writer's revision are thus more clearly defined than may be the case with other writers and the technical writer's major criteria for revision—inclusiveness and proper emphasis of the contents of the draft, and logical progression—can be met because the revisionary task itself is clearer.
DEFINING THE IMPLICATIONS

The 70 technical writers we surveyed all engage in a composing process similar to that of other writers, with strategies to master it at each point. The difference we found does not concern the process itself, but the deliberate or logical cast of the stages and the strategies used.

We feel this information has several important pedagogical implications:

1. Composing as process ought to be taught.
   In addition to the data we have presented, we have found that most experienced technical writers understand the nature of composing: the process involved and the steps used. Our students must also understand composing as process if they are to write well.

2. Strategies to master writing ought to be delineated.
   The experienced technical writers we surveyed have a range of writing strategies at their disposal. Our students must also be given these tools, in order to master composing.

3. The distinctive nature of the technical writer’s composing process and writing strategies ought to be presented.
   Technical composition does differ from composing in other fields, as our study indicates. The composing process and the strategies used are both more deliberate because the situational nature of writing influences composing; audience, purpose and form guide planning, writing and revising. These distinctions help define the nature of technical writing, and thus they too ought to be taught.

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NOTES


11 Janet Emig, “Writing as a Mode of Learning,” *College Composition*
and Communications, 28 (1977), 122-128.


13 Many researchers stress invention. In particular, Rohman feels the pre-writing stage is a time for discovery, and Stallard and deBeaugrande discuss invention as well. Heuristic systems such as Young, Becker and Pike’s tagmemics, Burke’s pentad or the classical topoi are strategies for mastering invention.


APPENDIX

QUESTIONNAIRE USED

Name:

Degree(s):

Brief description of your job:

What percentage of working time do you spend on writing (including preparing to write, revising, etc.)?

What types of writing are you responsible for (letters, proposals, technical reports, progress reports, etc.)?

What educational experience and background do your audiences have? (technical experts holding the same degree you have? people relatively unfamiliar with your field?)

How often is one document that you write read by both experts in your field and those who have little technical knowledge?

What questions do you ask yourself before beginning to write?

What is the first thing that you write when composing a report?

Does how you write (not what) vary with the type of the report you are writing? How?

Does the audience you are writing for affect what you write? How?

What is the most difficult part of writing for you?

Do you revise while you write or after you have completed a rough draft? Why?
What types of changes do you make while revising?

How do you decide what changes to make? Do you ask yourself specific questions? What questions?

Do you have a system for revising? What is it? State your criteria for revision.