The Composing Processes of an Engineer

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Since Janet Emig over a decade ago investigated *The Composing Processes of Twelfth-Graders*, many researchers have studied various aspects of writers' composing habits. However, because it has mostly considered only unskilled beginning writers, student writers working in academic contexts, or professional writers like novelists or journalists, that research has had relatively little impact on the teaching of technical writing. Little work has been done on the composing strategies of people who call themselves engineers or scientists, not writers or students; little study has been devoted to people who compose within the limitations of the workplace. Although as a profession we know what scientists and engineers write at work, we know far less about how they plan, arrange, write, and rewrite on the job. As a result, teachers of technical writing have been unable to teach students reliable ways to succeed under the special and dynamic circumstances presented by on-the-job writing.

Procedures

To begin to overcome these difficulties, I decided to investigate in detail the composing processes of a single engineer. My subject was Kenneth E. Nelson, an experienced engineer in Chicago who spends roughly half of his time on the job writing various proposals, reports, and correspondence. Educated at the University of Illinois at Chicago Circle and at Northwestern, Nelson specializes in transportation. Presently he manages the Chicago office of Henningson, Durham, and Richardson (HDR), one of the nation's largest "design, systems, and sciences" firms, and directs the highway, airport, and environmental studies undertaken there.

To find out how Nelson writes at work, I adopted and adapted methods suggested by Emig and by Cooper and Odell's *Research on Composing*. Most
basically, I collected and examined all the interim written materials that contributed to several of his finished products—jottings, notes, outlines, plans, drafts, revisions. I did not ask Nelson to compose aloud for me, even though protocol analysis is commonly used to investigate writing processes, for composing aloud can be extremely unnatural, artificial, and obtrusive, especially in Nelson's work environment. Instead, I asked Nelson to respond in detail, on a tape recorder, before and after he finished each writing session, to a long series of written questions that I had devised concerning the conduct and length of each session. In addition, I visited Nelson at work to observe him writing and to determine what I could about the effects of Nelson's physical environment. After those visits, I interviewed Nelson at considerable length about things I had observed, about comments he had made on the tapes, and about the principles and attitudes that shape his habits; and I suggested a series of changes (major and minor, substantial and stylistic) in his work in order to prompt him to explain and defend his choices. I even looked at his revisions of his coworkers' work to get a sense of his stylistic habits. Finally, I followed Nelson's writing as it proceeded through the documents comprising an entire engineering project, from the original "Qualifications Statement" (a sort of preliminary proposal used in transportation engineering to select those eligible for a formal project proposal), to the proposal and presentation required to win a contract for the project, to the project's progress reports, technical memos, and final report. Thus, I was able to observe how Nelson composes in different situations and how he re-uses some documents to shape others in the course of a project.

Results

While Nelson's composing habits are in some ways fairly conventional—he performs distinct planning, arranging, writing, and revising activities—I found that he places special emphasis on planning and arranging at the expense of revision. In addition, I learned-unexpectedly—that his writing process is in many ways more linear than recursive.

Planning and Inventing

While he is planning his writing, Nelson behaves like most other writers: he determines his purpose, and then invents and selects content to carry out that purpose.

Although Nelson never makes the formal, written "statements of purpose" recommended by some textbooks, he still determines his purpose rather efficiently. Since he nearly always writes in response to a specific request (e.g., a client's request for a proposal; requirements for progress reports and final reports) and since he writes certain kinds of documents again and again, his
consideration of purpose has become ingrained, almost second nature. Thus, according to his tape-recorded comments, Nelson has a clearly persuasive aim when he writes proposals and recommendations, and an informative goal for technical memos and progress reports. He also knows from experience that in some cases he might have to juggle several purposes—a persuasive recommendation report might have particular parts that must inform; a proposal must “look good” aesthetically if it is to accomplish its larger persuasive end.

But if arriving at a purpose is a relatively routine part of Nelson’s writing process, his invention procedures are anything but routine. For except when he writes unimportant or very routine items, especially correspondence, Nelson takes as much time to invent content as a professional writer. For the reports and proposals that occupy most of his writing time, Nelson spends up to 80% of his time inventing and arranging! Not only that, over the years Nelson has devised an impressive repertoire of techniques that enable him to invent the material he needs for each document.

For example, Nelson analyzes his audience’s needs carefully not when he is making stylistic choices later in his writing process but when he wants to generate content. Because Nelson knows that his audiences will approve or reject his proposals or judge reports useful or deficient, he thinks about their needs at the very beginning of the writing process. He considers past associations with clients or telephone conversations with them to stimulate his thinking. While inventing content for a proposal related to an airport-development project in Waukegan, for instance, Nelson mulled over a four-page RFQ (Request for Qualifications) for over two hours, thinking about his audience’s criteria and considering how he could adapt his company’s resources for such a client. Similarly, when he wrote the final report for the project, his preliminary notes show that he considered his audience’s technical background and the ways his report would be used, while he was considering what to include. By the end of a project, Nelson often knows readers so personally that meeting their needs is not difficult. Nelson is so aware of how he might adapt content for his primary audience that he only rarely and in minor ways considers secondary audiences (such as persons in his office) or possible future uses of his reports.

In addition to audience analysis, Nelson uses other tactics to stimulate invention. Sometimes, if the project is important enough and if it involves his specialty, he visits the Northwestern University library to review the literature on a given topic. Far more often, though, he consults with colleagues. Either he speaks with advisors on the telephone (a third of the Waukegan Airport proposal, for example, was developed from two phone calls to the Omaha office) or he engages his coworkers in formal and informal conversations. The sessions amount to a sort of communal brainstorming procedure. Moreover, Nelson exploits more individual brainstorming activities. It is not clear if Nelson uses some kind of private heuristic to develop ideas or if he might have developed a mental checklist of some sort from his past experi-
ence with certain documents that unconsciously guides his brainstorming. What is clear is that he notes ideas on paper until his memory is exhausted.

Further, Nelson jogs his memory by reviewing previously completed documents. Past letters, old proposals, and completed reports, especially on related projects or for the same client, suggest what might be included in present documents. In fact, Nelson often borrows sentences, paragraphs, sections—even graphics—from past documents and incorporates them into new proposals, reports, and correspondence. Nearly half of one proposal that I saw came directly from past documents: from a company brochure came part of the introduction; from several past proposals he lifted sections of justification; from files he got standard certification data, supporting documents, résumés, and several graphics. In addition, he re-uses consecutively any documents related to the same project. For instance, once HDR redesigned some roads and a railroad underpass in Franklin Park, near Chicago. The project itself required nineteen tasks (surveys, technical descriptions, and summaries of technical work), seven technical memos (each when a significant step was completed), and a series of progress reports. When it came to writing the final report, Nelson essentially incorporated all those interim documents, adapted the project proposal into an introduction, added conclusions and recommendations, and tidied up, and his final report was finished.

In short, Nelson relies on an impressive array of invention procedures—analyzing audiences, reading, consulting colleagues, brainstorming, and reviewing previously written documents. Nelson uses such techniques in no particular order. Nor does he use each one every time he writes. Nevertheless, these techniques mutually reinforce each other and serve Nelson well as he searches for the content he needs in a given situation. Then, at last, after his invention stage is well advanced, Nelson begins to review his material to see how much is necessary to satisfy his needs—and to see if he can keep the length of his document down. Of course, the process of selection has gone on unconsciously throughout the invention process. But now, especially because Nelson believes that most reports and proposals contain far too much material, he consciously tries to let rhetorical considerations determine what he will include. Consequently, he reviews his purpose and audience again, eliminates extraneous material, and commits himself to the details most appropriate to his aim.

One last point. Once Nelson has invented and selected his ideas, he rarely adds more to them later. After he has invented and selected the materials relevant to a writing task, he arranges them—and doesn’t look back.

Arrangement

Several students of the writing process have argued that arrangement is less important to writers than some teachers believe. Except when he composes the most routine correspondence, however, Nelson follows a particular pro-
procedure for arranging ideas; as he told me in one interview, he does not "see how anyone could write anything of any length or any importance without an outline."

The intricacy, tidiness, and formality of Nelson's outlines are interesting features of his writing process. Nelson divides the material he has generated and selected into groups and subgroups. While he uses no numbers, letters, Roman numerals, or the like, he does use dots, indentations, and headings to indicate coordinate and subordinate relationships. For anything likely to require more than four or five pages of written text, he uses separate sheets of paper for each major heading. If the outline is for a proposal, letter, or progress report, he completes the outline before he begins; if the outline is for a final report, he begins it early in the engineering operation and then revises it as necessary throughout the project. But while such revisions in the outline are possible before he begins a draft, almost never will Nelson modify his plan after he has begun to write. For to Nelson writing presupposes an outline; it is not much of an exaggeration to say that he cannot write without one.

Nelson follows well-established principles in arranging entire documents, individual segments, and particular subsections and paragraphs. As you might expect by now, his arrangements are most of all determined by audience. When he organized the Waukegan Airport Qualifications Statement, for instance, his seven sections conformed exactly with the seven criteria suggested in the RFQ; even within several of those sections, he ordered references, accounts of past projects, and personnel according to their relative importance to his audience. Nelson is also aware of the emphasis inherent in first and final positions in a document and of the relationship between general and specific information. If Nelson cannot determine his audience's preference for the arrangement of a proposal or report, he will adopt his firm's conventional format. Finally, "writer preferences" on some occasions account for some of Nelson's orderings; at times he orders material so that he can keep better control of it as a writer.

When I commented on the detail of his outlines, Nelson showed me some of his engineering plans: a Critical Path Diagram showed how the redesign of a city street would proceed from initial study to final design; and a Project Task Flow detailed how a transit plan would move from preliminary studies, literature reviews, and transit rider surveys to preliminary plans, public hearings, and revisions to final recommendations and implementation. Perhaps detailed plans for writing complex documents come naturally to professionals who must plan and coordinate complicated engineering tasks.

Drafting

Given such attention to planning and arrangement, and given his re-use of previously written documents, it should not be surprising that Nelson's actual
writing of a draft proceeds smoothly and efficiently, nor that he spends relatively little time drafting—less than 20% of the total time he spends in composing, on the average. Nelson typically sits at a desk in a quiet office, takes up a pen and a pad of white, lined paper (he does not type or use word-processing equipment), and produces a rough draft.

Because he has detailed plans and outlines and is ready to incorporate previously written documents, Nelson composes each unit very efficiently, pausing and rescanning much less frequently than the writers observed by Perl, Pianko, and Stallard. My observations and Nelson's remarkably clean drafts showed that once Nelson writes a sentence he seldom reconsiders it. Instead, he pushes forward with confidence so that whole drafts of proposals and whole chapters of reports can be completed at one sitting. For one short proposal I observed, Nelson composed over 1200 words of his own and incorporated two other documents into his draft in less than two hours. Only one paragraph, three sentences, and three other single words in that draft were at all reconsidered, scratched out, and redrafted before the next sentence was composed. While not every one of his drafts goes so smoothly, and while it is possible that he "rehearses" at least some sentences before writing them, the evidence I saw suggests strongly that Nelson is a confident, efficient—and linear—composer.

The principles that guide Nelson's drafts are extremely conventional and conservative. He composes each section or chapter around discrete beginnings, middles, and ends, and announces the purpose of paragraphs in a topic sentence or in a paragraph's first few words. Because he believes that long paragraphs are hard to read, Nelson writes short ones that "give the reader a chance to breathe." (The representative samples that I analyzed from proposals, technical memos, and reports had a mean length of just 77 words, with a high of 138 and a low of 52.) The same motive explains his sentences: in the documents I examined, they averaged between eighteen and twenty-one words in length—and between 71% and 90% were grammatically simple! Nelson builds length by means of prepositions and participles rather than by adding clauses. He uses colons only to introduce lists and never uses semicolons or dashes because he is afraid of misusing them. He consciously avoids contractions and personal pronouns (except in correspondence) because he believes that his writing demands a formal rhetorical stance. Only occasionally does Nelson strive to achieve stylistic effects, to "sound good" (especially through the skillful use of a parallel series), for he has little time to concentrate on the non-utilitarian. He strives for diction that is simple, denotative, and non-technical, since most of his writing goes to readers outside his organization.

Revision

After Nelson completes a rough draft, his secretary types it for him with
spacing generous enough to permit revisions. But although Nelson revises all but the least important communications, he subordinates revision to—and separates it from—other activities in his writing process. While professional writers like those studied by Donald Murray, Nancy Sommers, and others revise extensively as they plan, invent, draft, and redraft, revision takes up less than 5% of Nelson's time and consists of little more than superficial editing. As Nelson has become a more confident and competent writer, and as he comes to spend more time planning, his drafts have needed less revision. Moreover, the time he can spend on revision is limited by competing demands on his time and that of his secretary. Thus, in the Qualifications Statement for the Waukegan Airport, for example, Nelson made only minor revisions and only in nine of the 107 sentences. He removed contractions; simplified diction; deleted unnecessary words in two sentences; and edited the manuscript carefully, correcting spelling and commas. I never saw Nelson add material or reorganize it when he was revising. If for academic and professional writers revision is a messy, recursive matter of discovering and shaping what one wants to say, for Nelson revising is a rather clean matter of polishing a rough draft that already approximates his intentions.

Conclusions and Discussion

It is impossible to come to reliable conclusions about the writing process of engineers on the basis of a single case study. Nevertheless, some observations based on Nelson's composing habits are worth making, if only to direct further research and to suggest some new directions in pedagogy, especially if we keep in mind Cooper and Odell's point that all research in composing by its very nature "is tentative, subject to continual revision." The most striking thing about Nelson's composing habits is how closely they approximate the habits of the professional writers and skilled academic writers whose composing processes have been studied by other researchers. Nelson writes alone, not as part of a team. Except for the most common memos and correspondence, he spends as much time planning as many professional writers, despite the pressures and time limitations imposed on him at work. He invents content in detail and through various schemata of invention. He arranges material carefully. He consciously shapes his style. His composing process always includes a distinct, if brief, revision stage. Thus, if Nelson's habits are like those of other engineers, it may in technical writing courses be worth attending to the writing process in much the same way that it is attended to in other courses. That means that instead of ignoring invention and planning, as nearly all technical writing texts now do, teachers might direct students to various ways of developing, selecting, and arranging content. It means that technical writing teachers might begin to modify students' writing processes (not just correct their products) by examining their stu-
The Composing Processes of an Engineer

185

dents' plans, outlines, rough drafts, and revisions. Since engineering and science are themselves processes, engineers and scientists are as likely as any students to respond to courses that also approach writing as a process.

However, some important differences between Nelson's composing habits at work and the habits of other writers need consideration, too. Several researchers have inveighed against what Sondra Perl has called "the fallacy of reducing the composing process to a simple linear scheme" of prewriting, writing, and revising; they have argued that composing is more accurately described as a recursive set of optional actions than as a sequence of linear stages. Yet the linear model of composing does seem to describe accurately the writing habits of Kenneth Nelson. For him, writing activities fall into mutually exclusive and consecutive stages: rarely does he begin to arrange or draft before his inventing and global planning are completed; rarely does he invent or revise while he writes his first draft; rarely does revision include anything but final editing. Whether his linearity is a personal quirk or a characteristic of on-the-job writers in general or engineers in particular must be determined by further research. In the meantime, it may be appropriate to describe the writing process of engineers as more linear than recursive. It may also be appropriate in teaching prospective engineers to emphasize principles and techniques of arrangement and, by contrast, to regard revision as the least important activity in the engineer's writing process.

In addition, if we can judge from Nelson, an engineer's techniques for invention differ in important ways from the techniques for invention employed by other writers. Since engineers may do less private brainstorming than group brainstorming, teachers might explore ways to incorporate group invention into their technical writing courses. Since engineers seem to consider the needs of their audience as they invent, analysis of audience might be incorporated into an expanded invention segment of a course in technical writing, instead of being considered a separate step, as it now is in textbooks. Finally, since invention in technical writing makes heavy use of previously written documents and graphics, especially ones composed by the writer or his co-workers in earlier stages of a particular project, technical writing courses might teach students to adapt and re-use previously written material—for example, by requiring students to simulate all the stages of an entire project cycle, from proposals and progress reports to technical memos, descriptions, and final reports.

Such suggestions about the conduct of technical writing courses must remain suggestions and not firm recommendations, however, until we know more about the composing processes of engineers. Additional research on composing might reveal how Nelson, his firm, and his subdiscipline are and are not typical. It might show how his composing habits are more efficient or less efficient than those of his colleagues. It might suggest that some tasks call for very different composing habits and skills than others, or it might imply that technical writers should develop several composing styles that they
can call upon in different composing situations. One thing seems certain, however: only when more research is completed will teachers know better how to prepare students for the kind of writing they will do at work.

Notes


2. A few more details about Nelson may be relevant. Thirty-four years old, Nelson has lived most of his life near Chicago, where he attended public schools through twelfth grade; took college preparatory classes, but "wrote very little" (he reports) before college. He attended Iowa State University in 1966-67, where he took Freshman English, his only writing course in college but one which had an enormous impact on his writing. He also credits his M.A. thesis director at Northwestern with inspiring him to take special pride in his writing. Like many engineers, Nelson recognizes the importance of good writing to his work. He sometimes even volunteers to do the writing associated with a project instead of some of the technical work, and he enjoys publishing professional articles on engineering, even though such articles do little to advance his career. Except for those articles, Nelson says, the writing he does at work is typical of the writing done by most engineers at a similar career stage within his particular engineering sub-discipline.


5. C. H. Knoblauch, in "Intentionality and the Writing Process: A Case Study," College Composition and Communication, 31 (May, 1980), 153-59, has also discussed how writers at work juggle multiple aims.

6. Janet Emig, for example, has shown that arrangement occupies little of the time of student writers and that even professional writers often do little detailed arranging, especially if their material is narrative, descriptive, or lyric. See Composing Processes, pp. 20-24.

7. The pressure to conform to "company practice" is greater at some engineering firms than at others. Nelson's present employer decides only very minor details about his writing—e.g., abbreviations, résumé formats, report covers. On the other hand, Nelson has also worked for companies that allowed him much less autonomy, companies that "second guessed" (Nelson's term) nearly every writing decision he made, even minor stylistic decisions.

8. The Critical Path Diagram and the Project Task Flow are remarkably analogous to models of the writing process. In fact, when I talk to my students about the writing process, I compare it to the processes engineers go through in the course of an engineering project—gathering data, planning, designing, implementing, evaluating.

10. Cooper and Odell, p. xiv.


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