Organization in Technical Writing

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Abstract: Proficiency in technical writing is required of the student or professional engineer throughout his or her career. Technical writing that communicates well depends upon good organization at every level, from the details of grammar to the broad outline of structural headings and a title. Some aspects of organization in technical writing are readily prescribed by rules. Others, involving organization at a higher level, are not. This Technical Note first considers some hindrances to clearly written communication that are often overlooked in the literature. Concerned with the logical flow of ideas and with presentational form, the problems are illustrated by two examples of poor practice and suggestions for remedial action. The subject of the structural outline is then discussed and illustrated by the same examples. The emphasis of the note is that organization in technical writing is vital if the writer is to communicate his or her intended meaning and achieve the required outcome.

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Introduction

It is a paradox that the authors of fiction, which is designed to entertain, frequently express themselves more clearly than the writers of technical documents, which are intended to accurately inform. Evelyn Waugh, the 20th century novelist, said that he engaged his reader by simply presenting the facts. Such should be the task of the technical writer, but often he or she fails in that respect.

The title of this note reflects the writer's belief that, in technical writing, poor organization is a root cause of the problem. To convey the logical flow of ideas, organization is essential in both the detail and the broader arrangement of a document. A report written with faultless grammar, but poorly organized at a higher level, may well fail to communicate the intended meaning and so confuse the reader. Indeed, because of the richness and variety of the English language, writers from Shakespeare to the present day have deliberately exploited its subtle shades of meaning for comic effect. In the line, "He opened the door in his dressing gown—funny place for a door!", ambiguity serves the intended purpose. However, that is not so with the following bullet point taken from a technical conference paper, "Rapid progress in fuel-cell technology is not well represented by lack of public awareness."

There are many books on how to write technical reports and reports in general, most of which include the topic of organization and structure. However, the purpose of this note is to focus on some structural problems, concerned with the logical flow of ideas and presentational form, that are often overlooked in the literature and are not easily treated by simple rules. The problems are illustrated by two brief examples (Fig. 1 and 2) of poorly organized technical writing, with suggestions for remedial action. In the writer's opinion, such problems create more serious barriers to communication and understanding than grammatical errors, which are often more readily compensated for by the reader. Regrettably, such problems occur in the professional literature and in commercial reports, as well as in student theses.

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Logic and Coherence

In the left-hand column of Fig. 1 is the original text of a poster, advertising a talk to be presented at a meeting for professional engineers. In the right-hand column is the writer's revised version, based on his interpretation of the original. The message seems to be that classical physics and mathematics have dominated the education of engineers for centuries and that has now changed. There are a number of reasons why the intended meaning is not clear:

1. The notional reference to Rip Van Winkle is imaginative but complex.
2. In the opening paragraph of the original, "He would see" is an imprecise response to the question in the previous sentence.
3. In the second paragraph, "the principle" is undefined and its different relevance to Isaac Newton unexplained.
4. In the third paragraph, the use of the first person in "our understanding" is confusing and the significance of Henry Ford is not clear. To whom does "he" in "he lived" refer? Isaac Newton or Rip Van Winkle?
5. The fourth paragraph completes the opening "scenario," but what does "proto-engineer son" mean?
6. The fifth paragraph refers to a "different scenario," but it is identical to that described in the first paragraph.

Original

Educating Wide Awake Engineers

If Rip Van Winkle were to wake up now after one hundred years of sleep, and if Rip Van Winkle were an engineer, what would his presuppositions be? He would see the training and education of engineers, in a way that was not radically different from the great figures of the seventeenth, eighteenth and nineteenth centuries.

He would want to work on the principle which he shared with Watt the inventor of the steam engine, with George Stephenson of locomotive engine fame, Thomas Stevenson (father of Robert Louis) who built lighthouses, as well as with Brunel, and in a different way Isaac Newton.

Classical physics and the mathematics which went with it dominated both our understanding of and the manipulation of the empirical world in which he lived–and this was no different from the world of Henry Ford.

By implication, the education or training which he sought for his proto-engineer son would be driven by such an understanding of the world.

What however, if we imagine a different scenario. The new picture is of a Rip Van Winkle who fell asleep in 1901 and who after the statutory century wakes up next year. What kind of engineering education should he expect to find today?

For a start, I hope that he is as likely to be enquiring about this as much on behalf of his daughter as his son. But what else would be different?

Revised

Educating Wide Awake Engineers

If Rip Van Winkle were to wake up now after one hundred years of sleep, and if Rip Van Winkle were an engineer, what would his presuppositions be? They would be those of the world of Henry Ford, which shaped the education and training of engineers of his day. Indeed they would not be radically different from those embraced by the great figures of the seventeenth, eighteenth and nineteenth centuries.

Classical physics and the mathematics which went with it had dominated the engineer's understanding and his manipulation of the empirical world in which he lived. Those principles, pioneered by Isaac Newton, had been followed by Watt the inventor of the steam engine, George Stephenson of locomotive engine fame, Thomas Stevenson (father of Robert Louis), who built lighthouses, and Brunel.

By implication, the education or training which Rip Van Winkle might seek for his apprentice-engineer son would be driven by such an understanding of the world.

On the other hand, if Rip Van Winkle awoke at the beginning of the twenty-first century, but instead inquired about a modern engineering education for his son (or indeed his daughter), what might he be offered today and what would he find different from his previous assumptions?

Fig. 1. Illustration of logic and coherence

7. The sixth paragraph refers to the entry of women into the profession, but is awkwardly phrased.

Frequently there are discontinuities between successive sentences because they do not correspond with or refer to each other precisely. For instance, as already mentioned, "…what would his presuppositions be?" and "He would see the training…" do not flow logically, one from the other. Carefully matching expressions from one sentence to another would have prevented such confusion.

Continuity is not served by the paragraph structure, in which the opening theme is arbitrarily broken up into four paragraphs. A thematic paragraph structure would have improved clarity.

Although there are no serious grammatical problems, because the message is unclear, the reader may not be attracted to the meeting. The advertisement will then have failed to achieve its intended outcome. In the revised version, the original problems have been addressed as follows:

1. Henry Ford is now associated with the engineering presuppositions acquired 100 years ago, by moving the two references together in paragraph 1.
2. The reference to classical physics is associated with the list of famous engineers, by combining them in paragraph 2 and providing continuity between the sentences.
3. Classical physics and mathematics are now clearly identified with the principle(s) originally undefined.
4. The final paragraph now reflects Rip Van Winkle's different aim.

In this example, given the complexity of the argument, clarity could have been improved by preparing an outline structure (Fig. 3, discussed later) or by writing the first draft in very short, uncomplicated sentences. Such a simply expressed succession of ideas might have exposed the out-of-place reference to Henry Ford, for example, and suggested its relocation to a more logical position.

The logical sequence having been established, the second draft could then have been devoted to improving the literary quality, albeit at the cost of greater complexity. In complex sentences it is worth experimenting with word order to see whether the intended meaning can be achieved more precisely. For example, moving a subordinate clause to an earlier or later position can shift the emphasis. Changing from the active to the passive voice, or vice versa, can also affect the sense.

Aspects of organization to do with continuity, logic, and coherence, are not easily addressed by simple rules. If time permits, it is beneficial for the author to leave the first draft for a few days, then read it afresh to check that it clearly says what was intended. However, the author's familiarity with the text and its intended meaning makes an objective assessment difficult. Asking a colleague who is noted for clarity with the written word to read and comment may be revealing and salutary. Peer review is an effective learning method and quality control tool, which is routinely employed by some companies. Alley (1996) helpfully addresses the subject of clarity, and his book is recommended for further reading.

Presentational Form

In the left-hand column of Fig. 2 is the original set of instructions issued by an awarding body to applicants for a travel grant. The writer's revised version is in the right-hand column. The original instructions are not easy to follow and it is difficult to check that no requirement has been missed. For example, when

Original

INSTRUCTIONS FOR APPLICANTS

Before completing the application form please read through the leaflet explaining the scheme to ensure you are eligible. The application form should be completed in **black ink using block capitals**.

You are required to arrange for the references prepared by your two nominated referees to be sent to the *Grant Awarding Body*. One referee must be a superior in your current working situation, and the other from a different organisation who knows your work well. Both must be engineers. Each referee should be given a copy of the enclosed "Guidelines for Referees" with a copy of your application form.

Please ensure that your referees are able to respond promptly, as your application will not be processed without their recommendations.

If you are presenting a paper at a conference, give the titles of both when stating the Activity on the form. An abstract of the paper must be included with the application form together with a list of previous publications.

Applicants are required to submit a photocopy of the personal details page from their passport or documentation pertaining to permanent resident status and a paragraph of no more than 200 words, on a separate sheet of A4, justifying the relevance of the visit to their current work, as part of the application.

"Subject Keywords" are required for categorisation and cross-referencing. Engineering fields relevant to your work should be given. **Two copies** of the application form and supporting papers should be returned to

Address

Decisions on funding will normally be given six weeks from receipt of the application forms.

It is quite acceptable for applicants to forward reports from referees at the same time they submit their applications, but referees have the option of forwarding their reports separately if they wish.

Revised

INSTRUCTIONS FOR APPLICANTS

Before completing the application form please read through the leaflet explaining the scheme, to ensure you are eligible.

Application Form

Please complete the application form in **black ink using block capitals**. Provide "Subject Keywords" (page 2 of form) for categorisation and cross-referencing, giving engineering fields relevant to your work. If you are presenting a paper at a conference, give the titles of the paper and the conference when stating the Activity on the form.

References

Please arrange for references, from two referees nominated by yourself, to be sent to the *Grant Awarding Body*. One referee must be a superior in your current workplace, and the other from a different organisation who knows your work well. Both must be engineers.

Give each referee

1. A copy of the enclosed "Guidelines for Referees"
2. A copy of your application form.

Ensure that your referees are able to respond promptly, as your application will not be processed without their recommendations. You may forward the referees' reports when you submit your application, but referees do have the option of forwarding their reports separately if they wish.

Two copies of each of the following items should be submitted in your application

1. A completed application form
2. A photocopy of the personal details page from your passport or documentation pertaining to permanent resident status
3. A paragraph of no more than 200 words, on a separate sheet of A4, justifying the relevance of the visit to your current work
4. An abstract of the paper
   A list of previous publications
   (If you are presenting a paper at a conference).

Send your application to

Address

Decisions on funding will normally be given six weeks from the receipt of the application.

Fig. 2. Illustration of presentational form

using the instructions, the present writer read the request for two copies of supporting papers too late to avoid a second trip to the photocopier!

At the broad scale, the original structure is fragmented, with information on the same theme dispersed among items of different subject matter. In the revised version, the second, third, and last paragraphs on References have been collected into one section. The revised version also brings together material on how to complete the Application Form and on the documentation to be submitted (two copies). In the original, the final instruction regarding supporting papers was confusingly in the same paragraph as the requirement for "Subject Keywords" on the application form. That and other incongruities are removed by this reorganization.

The difficulty of following the original instructions is aggravated by the grammatical and presentational forms:

1. There is a switch from the personal "you" and imperative "give" of paragraph 4 to the impersonal/passive "Applicants are required" in paragraph 5.
2. Paragraph 5 is one long sentence with a conjunction connecting disparate instructions.
3. Also, in paragraph 5, "Applicants" are the subject and the instructions are predicated, whereas in paragraph 4 the instruction, "An abstract of the paper…etc.," is the subject.

Such grammatical forms and their presentation as continuous prose are ill suited to enunciating a set of instructions. The text calls for bullet points or enumeration. In the revised version, enumeration is reinforced by parallel structure (Woolston et al. 1988) in which each item is given a similar grammatical form.

Representative Structure

For the reader, structure in the form of outline headings, Title, Chapter, Section and so on, provides a route map through the

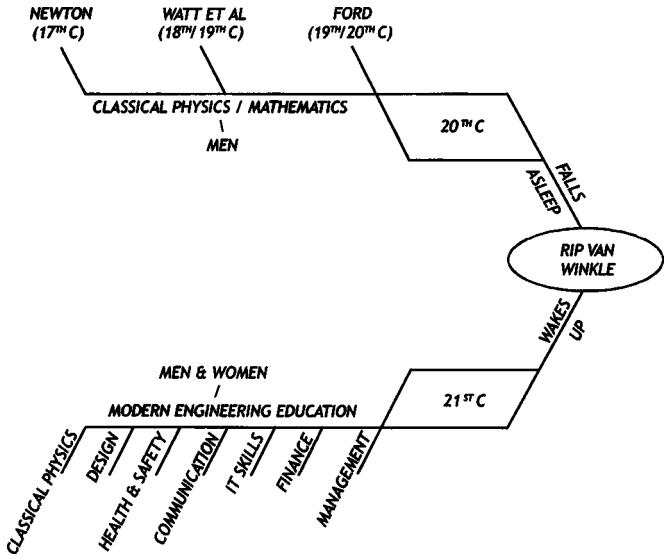

Fig. 3. Mind map (structure for text in Fig. 1)

written document. For the writer, this high level structure is both a planning tool for the development of ideas and a framework for the organization of the text as it is drafted. Structure enables the writer to achieve a representative and a comprehensive treatment of the subject.

In the sense that it is representative, structure can be thought of as a distillation of the text in which the essence is preserved. It should fit naturally; it should not be a strait jacket. The structural headings thus developed will therefore be thematic, as, for example, in the present Technical Note.

However, that is not to preclude the standard forms or templates sometimes used, for example, in reporting experiments: Introduction, Theory, Experimental Procedure, Results, Discussion, Conclusion. Where a template faithfully represents the intended message, it is a great help in speeding up the writing process, and many organizations adopt this prescriptive approach for efficiency and consistency in style (Graves and Hoffman 1965). But for the report that is different, using the in-house template may produce a contrived effect and impair communication.

The mechanics of developing an outline structure are various and need not be limited to traditional linear methods of thought. Work has been done by Tony Buzan and others on the subject of brain patterns for recall and creative thinking, and the "mind map" is a well-established alternative route to structural design that some find helpful (Buzan and Buzan 1993). Fig. 3 shows the latter method applied to an outline structure for the poster in Fig. 1. Such preparatory work, before writing the full text of the poster, would have clarified the author's thinking and helped to produce a logical flow of ideas in the final product. (Fig. 3 actually expands on the material covered by the poster by listing some aspects of a modern engineering education that depart from tradition. This structure therefore covers the poster advertisement and could provide an outline for the talk itself.) On the other hand, the instructions for applicants given in Fig. 2 might more easily be organized by means of a linear outline, e.g.,

Application Form
- Black ink, block capitals
- Keywords
- Conference papers

References
- Two referees
- Prompt response
- Submission by applicants or referees

Documents/Two Copies
- Application form
- Passport details
- 200 word justification
- Conference paper/publication list

Final Details
- Address
- Decision

Conclusion

Organization in technical writing is vital if the writer is to communicate his or her intended meaning and achieve the required outcome. Such organization permeates a hierarchy of scales, from the details of grammar to the broad outline of structural headings and a title. Some aspects, such as grammar, are amenable to prescribed rules, and mistakes are accordingly easier to prevent or correct. Those most resistant to remedy call for logical, precise thinking, and comprehension, qualities which, if not endowed by natural ability or previous education, can often be won by hard work and self-discipline.

Unlike creative writing in literature, technical writing reports on work previously done; it is a presentational skill. It will not compensate for an ill-conceived tender, a badly conducted piece of research, or a poor feasibility study. However, if well done, it will engage the reader and inform and persuade, and for those reasons it is worth every effort. Long after most professional engineers have ceased to integrate a differential equation, they are still required to write technical reports.

Acknowledgments

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References

Alley, M. (1996). *The craft of scientific writing*, 3rd Ed., Springer, New York.

Buzan, T., and Buzan, B. (1993). *The mind map book*, BBC Books, London.

Graves, H. F., and Hoffman, L. S. S. (1965). *Report writing*, 4th Ed., Prentice Hall, Englewood Cliffs, N.J.

Woolston, D. C., Robinson, P. A., and Kutzbach, G. (1988). *Effective writing strategies for engineers and scientists*, Lewis, Chelsea, Mich., 37–38.