GUIDELINES ON WRITING A GOOD PAPER FOR THE *PROCEEDINGS OF THE WINTER SIMULATION CONFERENCE*

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The *Proceedings of the Winter Simulation Conference* is the permanent record of the papers presented at the conference. As an aid to authors who seek to improve the readability of their *Proceedings* papers, this note summarizes some useful guidelines on technical writing, including key references on each topic that is discussed. For questions about these guidelines, please send e-mail to <jwilson@eos.ncsu.edu> or contact the *Proceedings* Editors.

I. Organizing the paper (what to do before beginning to write)

A. Analyze the situation—that is, the problem, the solution, and the target audience.

1. Formulate the objectives of the paper.

2. Specify the scope of the paper's coverage of the subject and the results to be discussed. Orient the paper toward the theme of your session as indicated either by the title of your session or by the instructions of your session chair. Also take into account the type of track—tutorial, methodology, or application.

3. Identify the target audience and determine the background knowledge that you can assume for this particular group of people. Introductory tutorials are generally attended by newcomers who are interested in the basics of simulation. Advanced tutorials are designed to provide more experienced professionals with a thorough discussion of special topics of much current interest; and some special-focus sessions in this track are designed to provide experts with an overview of recent fundamental advances in simulation theory. Methodology sessions are attended by professionals who have at least an undergraduate-level background in computer simulation techniques. In the application tracks, session attendees are generally familiar with the application area covered by their session.

4. Formulate the most logical sequence for presenting the information specified in item 2 to the readers identified in item 3. For a discussion of effective aids in organizing your paper (specifically, pattern notes, concept maps, clustering, and issue trees), see pages 16–20 of Matthews, Bowen, and Matthews (1996). In structuring your presentation, keep the following points in mind.

a. Introductory and advanced tutorials should have an educational perspective. Within the advanced tutorials track, special-focus sessions should synthesize the latest research results in a unified treatment of a given topic.

b. Methodology contributions should provide up-to-date information on proven techniques for building and analyzing simulation models.

c. Application papers should relate directly to the practice of simulation, and they should emphasize lessons of transferable value.

B. Make a detailed outline and use it as the basis for both the oral and written presentations of your work. See chapter 1 of Menzel, Jones, and Boyd (1961) and pages 12–16 of Matthews, Bowen, and Matthews (1996) for an excellent discussion of the construction and use of a detailed outline.

1. The introductory paragraph(s)

a. State the precise subject of the paper immediately.

b. State the problem to be solved.

c. Summarize briefly the main results and conclusions.

d. Tell the reader how the paper is organized.

2. The main body of the paper

a. Include enough detail in the main body of the paper so that the reader can understand what you did and how you did it; however, you should avoid lengthy discussions of technical details that are not of general interest to your audience.

b. Include a brief section covering notation, background information, and key assumptions if it is awkward to incorporate these items into the introductory paragraph(s).

c. Include sections on theoretical and experimental methods as required. For an application paper, you should discuss the development of the simulation model—including input data acquisition as well as design, verification, validation, and actual use of the final simulation model. For a methodological or theoretical paper that requires substantial mathematical development, see Higham (1998), Swanson (1999), Krantz (1998), section 2 of *A Manual for Authors of Mathematical Papers* (American Mathematical Society 1984), or pages 19–48 of Steenrod et al. (1973).

d. Plan the results section to achieve the most effective mix of text, figures, and tables in the presentation of the findings. The definitive reference on the design of tables and figures is Tufte (1983).

3. The concluding paragraph(s)

a. Explain how the theoretical and experimental results relate to the original problem. State why these results are important.

b. State the final conclusions explicitly in plain language.

II. Writing the paper

A. Prepare an abstract that is concise, complete in itself, and intelligible to a general reader in the field of simulation. The abstract should not exceed 150 words, and it should not contain any references or mathematical symbols.

1. Summarize the objectives of the paper.

2. Summarize the results and conclusions.

3. State the basic principles underlying any new theoretical or experimental methods that are developed in the paper.

4. For complete instructions on the preparation of scientific abstracts, see *Guidelines for Abstracts* (National Information Standards Organization 1997), pages 91–93 of Carter (1987), page 5 of the *AIP Style Manual* (American Institute of Physics 1990), or chapter 6 of Day (1994).

B. Write the rest of the paper as though you were talking to a group of interested colleagues about your work.

1. Strive for accuracy and clarity above all else.

2. Like the abstract, the introduction should be accessible to general readers in the field of simulation. For methodology papers and advanced tutorials, substantially more advanced background may be assumed in the sections following the introduction.

3. In constructing each sentence, place old and new information in the respective positions where readers generally expect to find these types of information. For an excellent discussion of the principles of scientific writing based on reader expectations, see Gopen and Swan (1990), Williams (1990), and Williams (1994).

a. Place in the topic position (that is, at the beginning of the sentence) the old information linking backward to the previous discussion.

b. Place in the stress position (that is, at the end of the sentence) the new information you want to emphasize.

c. Place the subject of the sentence in the topic position, and follow the subject with the verb as soon as possible.

d. Express the action of each sentence in its verb.

4. Make the paragraph the unit of composition.

   a. Begin each paragraph with a sentence that summarizes the topic to be discussed or with a sentence that helps the transition from the previous paragraph.

   b. Provide a context for the discussion before asking the reader to consider new information.

   c. Avoid paragraphs of extreme length—that is, one-sentence paragraphs and those exceeding 200 words.

   d. Place the important conclusions in the stress position at the end of the paragraph.

5. Allocate space to a topic in proportion to its relative importance.

6. For methodology papers, emphasize the concepts of general applicability that underlie the solution procedure rather than the technical details that are specific to the problem. Supply only the technical details and data that are essential to the development.

7. For application papers, emphasize the new insights into the problem that you gained from building and using the simulation model.

8. Use standard technical terms correctly.

   a. For standard usage of mathematical terms, see James and James (1992). For example, a nonsquare matrix cannot be called "orthogonal" even if any two distinct columns of that matrix are orthogonal vectors.

   b. For standard usage of statistical terms, see Marriott (1990). For example, the probability density function of a continuous random variable may be called a "density" but not a "probability distribution function" or a "probability function."

   c. For standard usage of computer terms, see *Microsoft Computer Dictionary* (1999) and *Microsoft Manual of Style for Technical Publications* (1998).

   d. For standard usage of industrial engineering terms, see *Industrial Engineering Terminology* (Engineering and Management Press 2000). For example, the time that a workpiece spends in a manufacturing cell may be called "cycle time" or "flow time" but not "throughput time."

9. Avoid illogical or potentially offensive sexist language. See Miller and Swift (1988) for a commonsense approach to this issue.

10. Avoid strictly the following—

    a. religious, ethnic, or political references;

    b. personal attacks;

    c. excessive claims about the value or general applicability of your work; and

    d. pointed criticism of the work of other people.

Such language has no place in scientific discourse under any circumstances, and it will not be tolerated by the *Proceedings* Editors. With respect to software tutorials, items c and d immediately above require authors to avoid invidious comparisons of their products with competing products.

C. For each table, compose a caption that briefly summarizes the content of the table. Comment explicitly in the text on the significance of the numbers in the table; do not force the reader to guess at your conclusions. See chapter 12 of *The Chicago Manual of Style* (University of Chicago Press 1993) or chapter 13 of Day (1994) for a comprehensive discussion of how to handle tables.

D. For each figure, compose a caption (or legend) that explains every detail in the figure—every curve, point, and symbol. See the *AIP Style Manual* (American Institute of Physics 1990) or chapter 14 of Day (1994) for excellent examples.

E. Revise and rewrite until the truth and clarity of every sentence are unquestionable.

   1. For questions about the rules of English grammar and usage, see Bernstein (1965), Fowler (1996), Fowler and Aaron (1998), Strunk and White (2000), and *Webster's Third New International Dictionary of the English Language, Unabridged* (1976).

   2. For those who use English as a second language, particularly helpful references are Booth (1993), Fowler and Aaron (1998), and Huckin and Olsen (1991).

   3. For guidelines on how to edit your own writing effectively, see Cook (1985).

F. Prepare a complete and accurate set of references that gives adequate credit to the prior work upon which your paper is based.

   1. The author-date system of documentation is required for all papers appearing in the *Proceedings of the Winter Simulation Conference*. The definitive reference on this citation system is chapter 16 of *The Chicago Manual of Style* (University of Chicago Press 1993).

   2. Comprehensive bibliographic formats for citing various types of electronic information can be found in the document titled "Excerpts from International Standard ISO 690-2: Information and Documentation—Bibliographic References—Part 2: Electronic Documents or Parts Thereof" (International Organization for Standardization 2001), which is available on the web via

      <www.nlc-bnc.ca/iso/tc46sc9/standard/690-2e.htm>.

      Another key reference on citing electronic documents is *The Columbia Guide to Online Style* (Walker and Taylor 1998), which is regularly updated at <http://www.columbia.edu/cu/cup/cgos> on the web. See also pages 208–214 of Dodd (1997).

   3. In preparing your list of references, you should strive for completeness, accuracy, and consistency. Using the information provided in your list of references, the interested reader should be able to locate each document that you cite in your paper.

III. Achieving a natural and effective style

A. Strunk and White (2000) succinctly express the gist of the matter of writing style:

> Style takes its final shape more from attitudes of mind than from principles of composition, for, as an elderly practitioner once remarked, "Writing is an act of faith, not a trick of grammar." … Style *is* the writer.

Zinsser (1998) is another definitive reference on good writing.

B. Contrast the following descriptions of an experiment in optics:

   1. I procured a triangular glass prism, to try therewith the celebrated phenomena of colors. And for that purpose, having darkened my laboratory, and made a small hole in my window shade, to let in a

convenient quantity of the sun's light, I placed my prism at the entrance, that the light might be thereby refracted to the opposite wall. It was at first a very pleasing diversion to view the vivid and intense colors produced thereby.

2. For the purpose of investigating the celebrated phenomena of chromatic refrangibility, a triangular glass prism was procured. After darkening the laboratory and making a small aperture in an otherwise opaque window covering in order to ensure that the optimum quantity of visible electromagnetic radiation (VER) would be admitted from solar sources, the prism was placed in front of the aperture for the purpose of reflecting the VER to the wall on the opposite side of the room. It was found initially that due to the vivid and intense colors which were produced by this experimental apparatus, the overall effect was aesthetically satisfactory when viewed by the eye.

The most striking difference between these two accounts of the experiment is the impersonal tone of the second version. According to version 2, literally nobody performed the experiment. Attempting to avoid the first person, the author of version 2 adopted the third person; this in turn forced the author to use passive verbs. As Menzel, Jones, and Boyd (1961) point out, "Passive verbs increase the probability of mistakes in grammar; they start long trains of prepositional phrases; they foster circumlocution; and they encourage vagueness." Notice the dangling constructions in the second sentence of version 2. Isaac Newton (1672) wrote version 1. Even though it was written over 325 years ago, Newton's prose is remarkable for its clarity and readability.

C. To achieve a natural and effective writing style, you should adhere to the following principles that are elaborated in chapter 5 of Menzel, Jones, and Boyd (1961):

1. Write simply.
2. Use the active voice.
3. Use plain English words rather than nonstandard technical jargon or foreign phrases.
4. Use standard technical terms correctly.
5. Avoid long sentences and extremely long (or short) paragraphs.
6. Avoid slavish adherence to any set of rules for technical writing, including the rules enumerated here.
7. Remember that the main objective is to communicate your ideas clearly to your audience.

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