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Use of Abstracts and Summaries as Communication Devices in Technical Articles

Circular 3

NOTE

Until October 2, 1970, the National Marine Fisheries Service, Department of Commerce, was the Bureau of Commercial Fisheries, Department of the Interior. Throughout the body of this report, which was prepared for printing before October 2, the older term is used.

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By

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ABSTRACT

Abstracts and summaries, if appropriately written, help the author communicate his ideas. This circular gives the rationale for using these communication devices and tells how to design them. With this knowledge, the author of a technical article can use them to best advantage in getting his ideas across to the reader.

Use of Abstracts and Summaries as Communication Devices in Technical Articles

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INTRODUCTION

Communicating complex factual information to a reader is hard to do. Because it is difficult, the technical author has to use a number of writing devices to get his ideas across. Among these devices are headings and introductions, tables and graphs, and drawings. Still others are abstracts and summaries. A brief abstract at the beginning of an article and a comprehensive summary at the end help the author transfer ideas from his mind to the reader's mind. These abstracts and summaries, which are included to help the author communicate, are integral parts of his article and are written as such.

To write these abstracts and summaries so that they will aid communication maximally, an author needs to recognize that abstracts and summaries are of at least two kinds. The first kind, which is the one I referred to in the preceding paragraph, may be called communication abstracts and summaries, inasmuch as their primary purpose is to help the author communicate directly with his reader. The second kind may be called retrieval abstracts and summaries, inasmuch as their primary purpose is to assist the reader to retrieve, from the general technical literature, those articles that supply information he needs. Abstracts and summaries of this kind are published separately from the original articles and are to be found in such journals as *Chemical Abstracts*, *Biological Abstracts*, and *Commercial Fisheries Abstracts*.

An author who fails to distinguish between the two kinds of abstracts and summaries will have trouble writing either kind. Consequently, unless he maker this distinction, neither his communication abstracts and summaries nor his retrieval abstracts and summaries will perform their own specialized functions well.

A discussion of how best to write retrieval abstracts and summaries is outside the scope of this circular. It therefore will be limited to a consideration of how communication abstracts and summaries can best be written to accomplish the individual purpose for which each is used.

Because an author presents the abstract at the beginning of his article and the summary at the end, we consider the abstract first and the summary second.

I. THE ASTRACT

What are the functions of the abstract, and how can we design it so that it will fulfill these functions optimally?

A. FUNCTIONS OF THE ABSTRACT

The abstract has three main functions: (1) supplementing the title of the article, (2) giving the reader a bird's-eye view, and (3) solving the problem of the surprise ending.

1. Supplementing the Title

The first function of the abstract is to supplement the title of the article and thereby help the potential reader decide whether or not the article is worth his while. Titles, for practical reasons, must be short. Being short, they ordinarily cannot convey sufficient information to enable the reader to judge accurately the value of the article to him. The abstract, not being as limited in wordage as the title is, can make up for such deficiencies of the title.

2. Giving a Bird's-Eye View

The second function of the abstract is to give the reader a bird's-eye view of the contents of the article. With the substance of the article in perspective, he can more quickly see how the details he is reading fit together to make up the whole. Thus, the abstract helps him to get a quick grasp of the total subject.

3. Solving the Problem of the Surprise Ending

The third function of the abstract is to solve the problem of the surprise ending — that is, technical articles should not be written as though they were detective stories. The reader, to decide on the value of the article to him, needs to know its main outcome.

To reveal this information at the beginning of the article, some technical authors adopt a newspaper type of organization. Unfortunately, this solution to the problem of the surprise ending gets an author into an even worse problem — that of illogical organization. In using the newspaper approach to organization, he cannot present his work in the same way that he thought about it and that he did it. He has to present his conclusions first, despite the fact that they came last when he did the work. If the author's ideas are complexly interrelated, the reader now is confronted with a puzzle in determining their interrelations and in keeping these ideas in mind while attempting to follow the author's inverted discussion.

By presenting an abstract, the author can reveal the main outcome of his article immediately and can thereby solve the problem of the surprise ending without involving himself and his reader in an organizational problem. In short, he can now use the same outline for his article that he used for his research or that he used when clarifying his subject in his own mind.

B. DESIGN OF THE ABSTRACT

Having considered the three main functions of the abstract — namely, clarifying ambiguities in the title, presenting a broad view of the subject, and removing the element of surprise, thereby permitting the article to be logically organized — we now consider how to write an abstract that will perform these functions. The answer to two questions in particular will affect the design of the abstract: How long should it be? What information should it contain?

1. Length

The abstract must be short, so that the potential reader can decide quickly whether to read the article or not. It therefore should be no longer than is required to give him a comprehensive idea of its substance. Ideally, as we shall find later, an abstract can accomplish this purpose in three sentences.

In general, however, even with a book-length article, the abstract should be no longer than one typewritten page, double spaced. A long abstract will defeat its reason for being, because it will unduly

encroach upon the time of the reader who has no particular need for the information we are presenting, and, equally important, it will blur the picture we are trying to bring into focus for the reader who does need the information.

2. Contents

The potential reader, in deciding whether to read an article, needs to know three basic kinds of information about it:

1. What is the significance of the subject it treats — in short, what is the problem.
2. How, in general, the subject is treated.
3. What the main outcome of the treatment is — that is, what findings, conclusions, and recommendations are of major importance.

Ordinarily, an author can supply this information to the reader in an abstract containing three sentences, as is shown by the following example.

FARM-POND SEINE

Present methods of harvesting fish from farm ponds are time consuming, laborious, and wasteful of water. This paper describes a mechanized system that incorporates a haul seine and associated equipment for taking fish from farm ponds and a conveyor and associated equipment for weighing the fish and loading them into trucks for shipment to market. The mechanized siene works well both in ponds of small or large size and in water as deep as 8 feet.

Such an abstract gives the reader sufficient insight to assess accurately the value of the article to him and thereby judge whether reading it is worth his time. Furthermore, if he does decide to read the article, an abstract of this kind aids him in making transitions from topic to topic in the article. Few authors, however skilled they may be, are ever able to express their ideas completely, so the reader has to fill the gaps that the author leaves. The comprehensive view gained from the abstract helps the reader infer unexpressed ideas or decipher poorly expressed ones and make the transitions that the author failed to bridge for the reader. In addition, such an abstract reveals the main outcome of the work. Giving this information eliminates, on the one hand, any need for the reader to turn to the summary and conclusions at the end of the article to see whether the findings will be of value to him and eliminates, on the other hand, any need for the author to write his article in reverse order.

The following abstracts furnish additional examples of the three-sentence technique suggested here and show that it can be used with a wide variety of subjects.

ORGANIZATION OF TECHNICAL BOOKS

With the vast increase in scientific and technological knowledge, we need to increase the communication efficiency of technical books because many of the books now require too much time to be read understandingly. This article presents quantitative data obtained in a study of how well technical books are organized. The data show that most books are not organized logically, so it is evident that giving greater attention to organization will vastly improve their readability.

PROPOSED PURSE SEINE DESIGN

In the Eastern Tropical Pacific Ocean, about 50 percent of the purse seine sets for tuna are unsuccessful, principally because the fish escape the net while it is being set and pursed. Described here is the design of a proposed purse seine that largely retains the desirable features of the seines used now in the tuna fishery, yet will sink faster and use webbing with greater economy than the present seine. In comparative tests with scale models (1:25), a model built according to the proposed design sank nearly three times as fast as did a model of the usual seine.

II. THE SUMMARY

Assuming that we now have an abstract at the beginning of our article, do we also need a summary at the end of it? The answer is yes — at least, if the article is lengthy. To see why we need both, let us consider the functions of the summary. Then, once we know what it is supposed to do, we not only can understand why we need it but can design it appropriately.

A. FUNCTIONS OF THE SUMMARY

The functions of the summary are entirely different from those of the abstract. The abstract, as we have seen, is written to acquaint the reader with the nature of the article, to give him the quick overall view he needs in order to understand its contents rapidly if he does decide to read it, and to reveal the ending immediately so as to permit the ideas that are presented in the body of the article to be presented in natural order — that is, in the same order that the author himself thinks of them and not, say, in reverse order. The summary, on the other hand, is written (1) to help the reader consolidate information he has already read — that is, to give him a good final grasp of it, and (2) to impress the information on his memory.

1. Consolidating Information

When we read an article in which the summary has been omitted, we often feel that the article is incomplete, particularly if it is lengthy or involved. This feeling of dissatisfaction is easily explained — without a summary or a section called "conclusions," "recommendations," or the like, the article will always end on a minor detail. For a general example, see figure 1, which gives in symbolic form the general topic outline for the article. As can be seen, the symbolic outline does end on a detail — namely, Topic ABBB. For a specific example, see the topic outline presented as a part of the table of contents of this circular. Note that the topic outline for the circular also ends on a detail — namely, "Topic IIB3. Position."

(A discussion of outlines is beyond the scope of this circular. Note, however, that a topic outline does not include such parts of an article as introductions, summaries, acknowledgments, and literature citations, although these parts are customarily and rightly included in a table of contents. To see quickly the difference between "topics" and the other parts of a table of contents, note that only the topics refer uniquely to the subject matter of the article and hence only the titles of the topics in the tables of contents have to be changed from one article to another. In contrast, the other titles in the table of contents, such as "literature cited," could be used with any other technical article and hence would not have to change from one article to another unless say the author had no literature citations.)

Thus, every topic outline ends on a detail, and the longer and more complex the outline, the more subordinate, or specific, the detail will be. When we complete our discussion of the final detail in the article, we accordingly need some way of bringing the reader's mind back to the overall subject that we were discussing. Otherwise, he will end the article without having a firm grasp on the overall subject we were trying to communicate to him. To bring the reader's mind back to the overall subject and unify for him our detailed discussion of it, we append a summary in which we review the entire contents of the article.

When earlier we were presenting information in the body of the article, we had shown the reader, in effect, a large picture detail by detail close up. Now, by means of the summary, we enable him to step back and view the picture as a whole. By thus revealing the picture in its entirety, we help him understand the contribution that each major idea makes to the total effect. The summary thereby strengthens the reader's grasp on our ideas and helps him consolidate them in his mind.

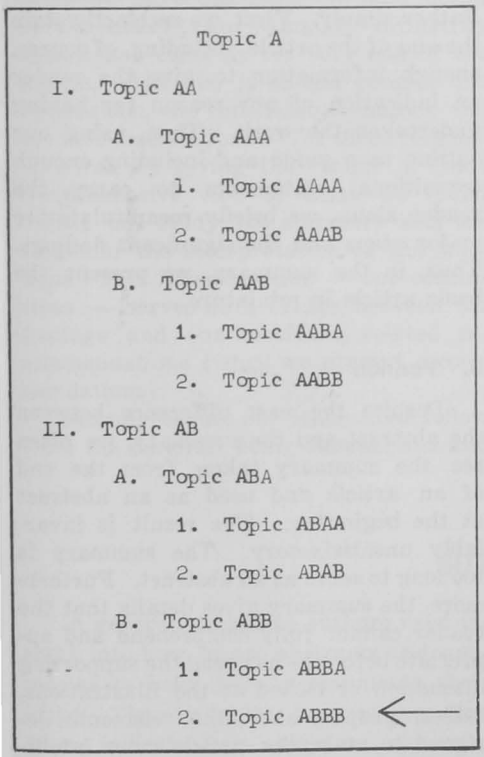

Figure 1.—Symbolic outline of an article.

2. Aiding the Reader's Memory

The psychology of learning, recalling, and forgetting is not completely understood. We do know, however, that every reader has a short-term memory and a long-term one (Peterson, 1966). He can remember much of what we tell him for a short time. But he tends to forget, depending on such various factors as the nature of the material, the amount of the material, the meaningfulness of the material, his ability to relate to it personally, the amount of activity intervening between his acquisition and recall, and the degree to which he is motivated to remember. Yet, if he forgets our important points, he has gained virtually nothing from our article. Our aim therefore is to get our basic information into his long-term memory.

To do so, we try to reinforce the stimuli that aid his ability to retain what he has read. One such reinforcement is repetition. For example, when we learned the multiplication table, we did so by repeating it over and over again. So, to help the reader remember, we repeat our ideas. We also use other types of reinforcement. For example, we delete from our summary the diverting details in our article and leave the essentials standing alone. We thereby emphasize the essentials and make them more easily retained. Also, because association is one of the most effective mnemonic devices, we additionally aid his memory by showing clearly, in the summary, the relation of one main idea to another.

Earlier, I indicated that the need for a summary depends on the length of the article. Having considered the problem of memory in the preceding two paragraphs, we now can understand this relation between the need for a summary and the length of the article, because this relation, in turn, depends on the reader's ability to remember what he has read. That is, the longer an article is, the

harder the various parts of it are for him to keep in mind. When our article gets beyond a certain length, he therefore finds that the ideas we have presented are difficult for him to recall sufficiently well to form them mentally into a unified whole. The need for a summary occurs at the point where the length of our article gives rise to this problem of recall.

Another factor related to the reader's need for a summary is the complexity of the subject being presented. The more complex the subject, the harder its various aspects are for him to remember and keep clear in his mind, and the greater then is his need for a summary to aid him in recalling the main points of what he has read and their interrelations.

Because both the length of the article and the complexity of the subject are involved in the need for a summary, no hard-and-fast rule can be given as to the relation between the length of the article and this need. In general, however, articles shorter than 5 typewritten pages usually require no summary, and those longer than 10 pages usually do. The ultimate test is in the reading. If after the article is read, the summary seems repetitious, then the various ideas presented in the article can be recalled sufficiently well without aid. On the other hand, if the summary does not seem repetitious, the reader's memory does require aid, and a summary then is needed.

In the remarks that follow, I assume that the article is sufficiently long or complex, or both, to require a summary.

B. DESIGN OF THE SUMMARY

In the design of the summary, we are concerned with its length, contents, and position.

1. Length

In general, the longer an article is, the longer its summary must be. This relation of the length of the summary to that of the article is in contrast to the relation of the length of the abstract to that of the article. The lengths of the abstract and article are largely independent, for we have seen that the abstract usually is made up of three sentences. So abstracts of long articles and of short ones usually contain about the same number of words.

Although we want to keep both the abstract and the summary short, we can make the summary longer than we can make the abstract, because (1) now we are not taking up the time of an uninterested reader — those who have little or no interest in our subject have already been eliminated by the abstract, and (2) the genuinely interested reader, who has already invested his time in the body of the article, wants the comprehensive review that the increased length of the summary permits.

2. Contents

When writing the summary, we must bear in mind that it is designed to give the reader a final, comprehensive, lasting impression of what we have told him. How do we write such a summary? Rather simply. First, we succinctly state the aim of the article, including, of course, enough information to give the reader an indication of our reason for having undertaken the work. Then, using our outline as a guide and including enough transitional statements to carry the reader along, we briefly recapitulate the major steps and the significant findings. Thus, in the summary, we present the basic article in miniature.

3. Position

Despite the vast difference between the abstract and the summary, we often see the summary taken from the end of an article and used as an abstract at the beginning. The result is invariably unsatisfactory. The summary is too long to serve as an abstract. Furthermore, the summary gives details that the reader cannot fully comprehend and appreciate before he has read the supporting discussion or looked at the illustrations, tables, graphs, and other elements designed to make the article more intelligible. Without this supporting background, the main points of the article,

as presented in the summary — though they usually seem to make sense — are not fully meaningful.

The fact that a summary cannot be substituted for the complete article proves the truth of the foregoing statements. That is, we cannot publish just the summary. We have to publish the entire article if the reader is to grasp our ideas completely and is to see their validity. The summary, which has the function of consolidating information already gleaned and of impressing it in the reader's permanent memory, should not therefore be substituted for the abstract, which has the function of quickly introducing the reader to information with which he is not yet acquainted.

The position of both the abstract and the summary is an integral factor in their design. Thus, their positions cannot be interchanged without reducing their effectiveness as instruments of communication.

Although we present the summary after we have discussed the final detail in the article, the summary ordinarily should not come at the very end of the article. That is, it should precede the conclusions, the concluding remarks, and the recommendations — for three reasons.

First, by giving the reader a quick comprehensive view of what we found during our study, the summary sets the stage for the interpretation of the findings. This interpretation — our conclusions — serves as a bridge between the findings and our resultant, related recommendations (when we present recommendations).

Second, because our conclusions follow from the material being summarized and has an individuality distinct from this material, the conclusions should not be included in a summary of the material. Theoretically, however, all the important subject matter presented in the article up to the point where the summary is presented should be included in the summary. So, if we present the conclusions and recommendations before we present the summary, we have to repeat them in the summary. But the summary then becomes intolerably repetitious. Fortunately, by presenting the conclusions and recommendations after we present the summary, we avoid the need to repeat them and thereby solve this problem of repetition.

Third, our conclusions from the facts we have presented and our recommendations about the course of action that the conclusions dictate are so important that, for emphasis and ease of reference, the conclusions and recommendations should be presented in well-defined, separate sections having their own individual headings. Here, again, we see another difference between the summary and the abstract. The abstract, though much shorter, is more comprehensive, because it covers the entire article, including our conclusions and recommendations.

The abstract and the summary in this circular furnish a specific example of the different way in which these two parts of the article are written. In addition, the table of contents and the summary furnish a specific example of the interrelation of these two parts. The appendix gives another specific example of the difference between the abstract and summary and of the relation between the outline and the summary.

SUMMARY

In general, technical authors need insight into how to use abstracts and summaries to help them communicate their ideas. The aim of this manual therefore is to indicate how abstracts and summaries can be used as communication devices in technical articles.

The Abstract

A major function of the abstract is to supplement the title of the article and thereby help the potential reader decide whether or not to read the article. A second function is to give the reader the broad insight he needs in order to grasp

the details of the article rapidly if he does decide to read it. A third function is to reveal the main outcome of the work at the beginning of the article and thereby permit the ideas that are presented in the body of the article to be presented in natural order — that is, in the same order that the author himself thinks of them.

In order that the potential reader can decide quickly whether to read our article, the abstract should be no longer than is required to give him a comprehensive grasp of what the article is about. The optimum length is three sentences, which (1) identify the problem dealt with in the article and thereby indicate the significance of the article, (2) describe the solution, and (3) reveal the main outcome or payoff.

The Summary

Because an article written according to an outline will always end on a detail, the reader needs a summary to bring the article's salient points and essential relations into perspective. Furthermore, because getting the reader to remember ideas for a length of time is difficult, the summary is needed to help make the main points memorable.

In writing the summary, we briefly point out the purpose of the article and the significance of the problem treated by it; then, using our outline as a guide, we recapitulate the article as briefly as an emphasis of main points will allow.

The summary, which has the function of consolidating and preserving information already gleaned, should not be taken from the end of the article and substituted for the abstract. It should, however, precede the conclusions and recommendations (when included), because it brings to a focus the data from which they are evolved.

CONCLUSION

By keeping the purposes of the abstract and summary in mind, we can write each in such a way that each will serve its purpose maximally. We thereby can use these two writing devices to help the reader grasp our ideas quickly, completely, and lastingly, though the ideas may be complex and difficult to understand.

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APPENDIX

Specific Example of the Relations of the Title of an Article to its Abstract, of its Abstract to its Summary, and of its Summary to its Outline.

Title of Article: PHYCOCOLLOIDS

Abstract: Although phycocolloids — gelatinous materials produced from seaweed — are strategically and economically important, they are not widely known materials. This paper discusses the three principal phycocolloids manufactured in this country — namely, agar-agar, algin, and carrageenin — and outlines the ways that they are produced and the ways that they are used. At the manufacturer's level, these three phycocolloids are worth about $15 million a year to the United States.

Outline and Summary:

Outline	Summary
Introduction	Phycocolloids are colloids extracted from seaweeds. This article discusses these marine products, which are of considerable importance strategically and economically. They are considered in two groups — those of minor economic importance and those of major economic importance.
I. Phycocolloids of minor economic importance	Phycocolloids of Minor Economic Importance The phycocolloids of minor economic importance consist mainly of laminarin, funorin, and fucoidin. A variety of these phycocolloids have been used in the manufacture of such products as surgical powders and textiles.

Outline	Summary
II. Phycocolloids of major economic importance	Phycocolloids of Major Economic Importance
A. Economic value of the major colloids	The phycocolloids of major economic importance are agar-agar, algin, and carrageenin. Collectively, these phycocolloids are worth about $15 million a year to the United States at the manufacturer's level.
B. Major phycocolloids considered individually	
1. Agar-agar a. Production (1) Harvesting (2) Manufacturing b. Use (1) Properties (2) Primary uses	Agar-agar.—The major problem in the production of agar-agar is the difficulty in getting the raw material. Agar is obtained primarily from *Gelidium cartilagineum*, a seaweed that is harvested by primitive methods, such as diving. The seaweed is extracted in an autoclave, and the agar is purified in steps, one of which is freezing. Agar is a colloidal salt of a poly-B-galactopyranose acid neutralized by calcium, sodium, magnesium, or other basic substances. Agar has hundreds of uses as a thickener, emulsifier, gelation agent, absorbent, lubricant, and inert carrier. Its most important use is in media for bacteriological cultures, for which it has ideal properties.
2. Algin a. Production (1) Harvesting (2) Manufacturing (a) Green's process (b) Le Gloahec-Herter process b. Use (1) Properties (2) Primary uses	Algin.—Algin is obtained from the giant kelp *Macrocystis pyrilera*, which grows in beds that are from 50 feet to 1 mile wide and that are several miles long. This seaweed, which grows in the waters off Southern California and to the south, is gathered by means of special harvesting vessels equipped with mechanical cutting and loading tools. On the east coast, *Laminaria* is the source. Green's cold process is used on the west coast for processing *Macrocystis*, and the Le Gloahec-Herter process is used on the Atlantic coast for processing *Laminaria*. Both processes are based on complex chemical methods.

Outline	Summary
(2) Primary uses—Con.	Algin is a hydrophilic derivative of alginic acid. This natural colloid is a polyuronic acid composed mainly of anhydrobeta-D-mannuronic acid residues linked together in the 1:4 position to form a long straight-chain molecule. One of the most important uses of algin is as a stabilizer to give smooth body and texture to ice cream. In addition, it has hundreds of other uses in the food, pharmaceutical, and other industrial fields.
3. Carrageenin a. Production (1) Harvesting (2) Manufacturing b. Use (1) Properties (2) Primary uses	Carrageenin.—The primary source of carrageenin is Irish moss, *Chondrus crispus*, which grows along the North Atlantic coast. The mosslike alga is generally harvested by men working from dories and using lead-weighted rakes 15 to 20 feet long. Carrageenin is extracted from Irish moss by hot water. The extractive is recovered from solution either by drying the solution on hot rolls or by precipitating it with isopropyl alcohol. The hydrocolloid carrageenin is a gelactosan sulfate having two fractions: kappa and lambda. Both kappa and lambda carrageenins consist of sulfated D-galactose units, which apparently must exist in definite structural relation with one another and cannot occur in large separate aggregates. Carrageenin is used primarily in nonsetting chocolate milk drinks and other foods as well as in various pharmaceuticals, such as hand lotions and toothpastes.

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