

Organizing the Research Report to Reveal the Units of Research

**UNITED STATES DEPARTMENT OF THE INTERIOR
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ABSTRACT

As a research project becomes increasingly complex, the traditional outline used to report the research becomes less satisfactory. The reason is that the traditional outline tends to dismember the basic units of the research and to regroup the parts in such a manner that the whole is obscured. Suggested here is a model that will help the researcher organize his report in such a way that the basic units are kept intact and their identity is revealed regardless of how complex the research may be.

INTRODUCTION

A scientific investigation is composed of units. If the reader is to understand the report of the research, he must know what the units are and how they fit together.

Unfortunately, except for articles reporting on only a single unit, the traditional pattern used in the organization of research reports (I. Materials and Methods; II. Results and Discussion) conceals both the identity of the units and their interrelations. As a result, the communication efficiency of the scientific literature is low.

Since the traditional model is inadequate, why do we persist in using it? There are three reasons. First, because the traditional model is logical for reporting a single unit of research, we assume that it is equally logical for reporting a larger number. Second, because the subject matter of a research report is complex, we ascribe much of the reader's difficulty in assimilating the report to the complexity of the subject. Third, be-

cause we recognize that part of any difficulty the reader may have in understanding our report may be due to our lack of ability to express ourselves well, we attribute any remaining unexplained obscurity to poorly written sentences. So, we overlook the basic fault--poor organization.

What we need then is an organizational model that will reveal the units of research and their interrelations regardless of the number of units being reported. The aim of this article is to suggest such a model.

The outline of a research report is determined by the design of the research--or, at least, it should be. The design of the research, in turn, is determined by the purpose of the research. Accordingly, to gain insight into our problem of organizing reports logically, let us first look at the relation of purpose to research design and then at the relation of research design to the outline of the research report.

I. RELATION OF RESEARCH PURPOSE TO RESEARCH DESIGN

When designing our research, we must consider the complexity of its purpose. If the purpose is complex, we divide it into a branch chain of subpurposes (as shown in fig. 3). We can thereby simplify the purpose and reduce the scope of our research to fit our resources. Let us suppose, for example, that the ultimate purpose of our research is to increase the demand for fish-reduction products. On thinking about our problem, we see that we can accomplish our purpose if we can increase the demand for fish-reduction lipids and fish-reduction proteins (fig. 1). Upon examining figure 1, we see that it is still too complex. We therefore continue subdividing, perhaps as shown in figure 2, until we come to purposes that are sufficiently specific and sufficiently restricted in scope that we can handle them with our particular research capabilities. Figure 3 illustrates this process of division symbolically.

Now that we have our hierarchy of purposes in mind, we can design our research to fit our time, our money, and our facilities.

If, for example, our research budget is small, we might confine our research to Purpose IA1. In that event the design of our research would take the form shown in figure 4. Note that the purpose determines the procedure and that the procedure determines the results. Note further that we draw a conclusion (or arrive at a recommendation) from the results and that this conclusion reflects back to the purpose.

If our research capabilities are larger, we might widen the scope of our research to include Purpose IA (fig. 5).

And if our research capabilities are larger still, we might widen the scope of our research to include Purpose I (fig. 6) and so on.

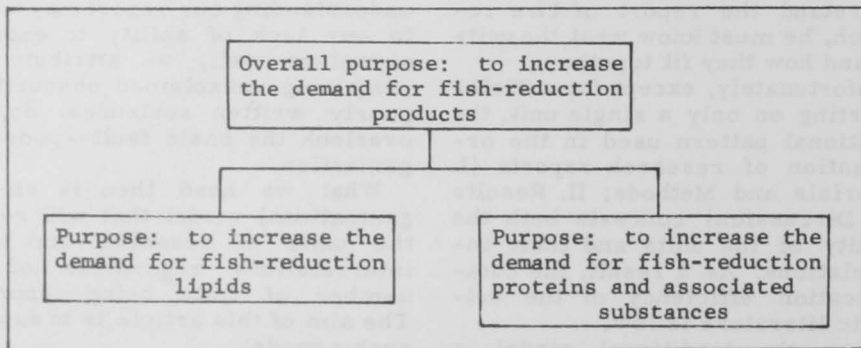


Figure 1.--Division of our overall purpose.

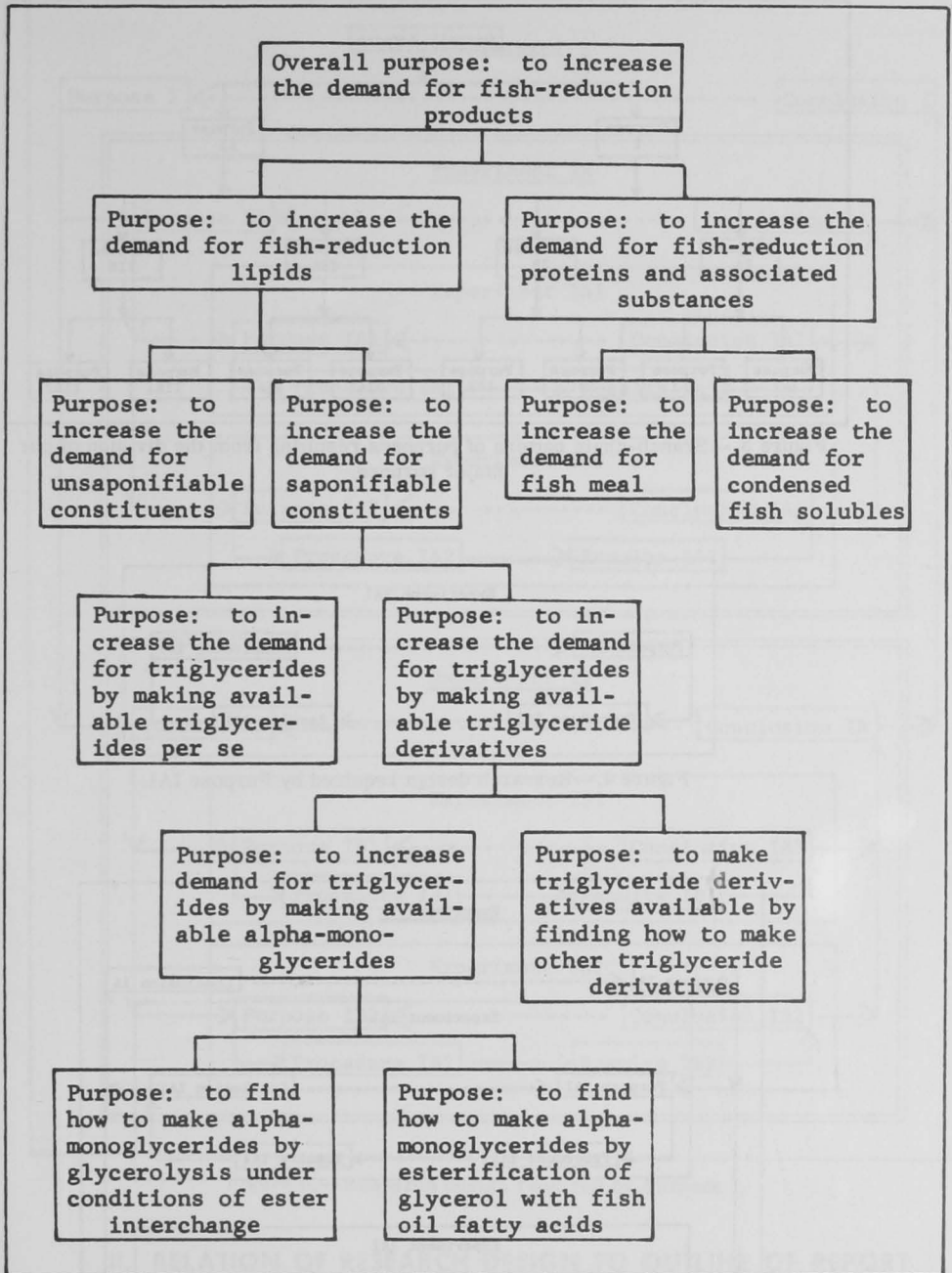


Figure 2.--Branch-chain pattern of purposes (greatly abridged).

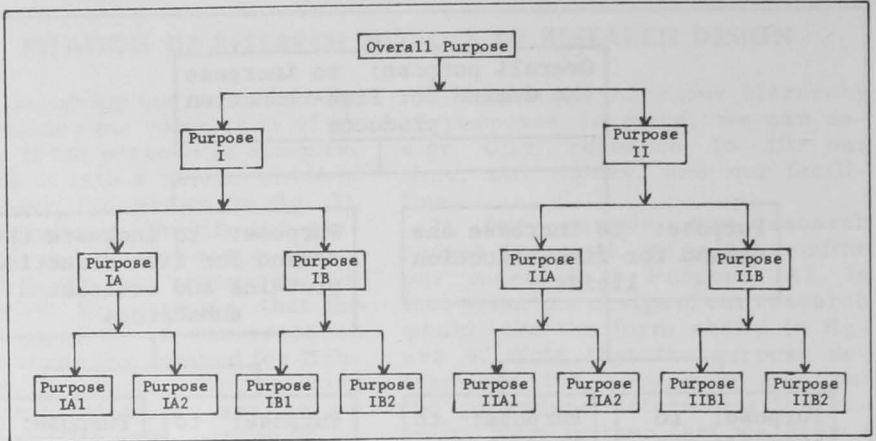


Figure 3.--Branch-chain pattern of purposes resulting from the division of our major purpose.

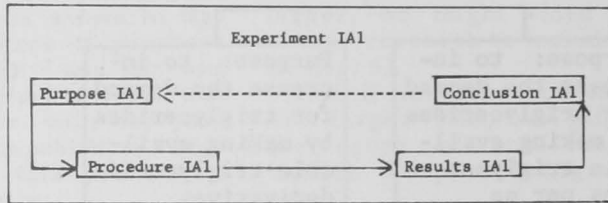


Figure 4.--Research design required by Purpose IA1.

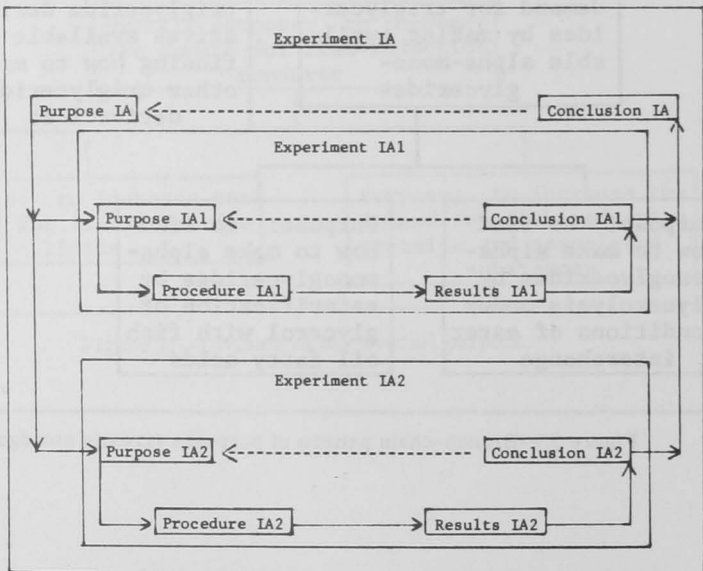


Figure 5.--Research design required by Purpose IA.

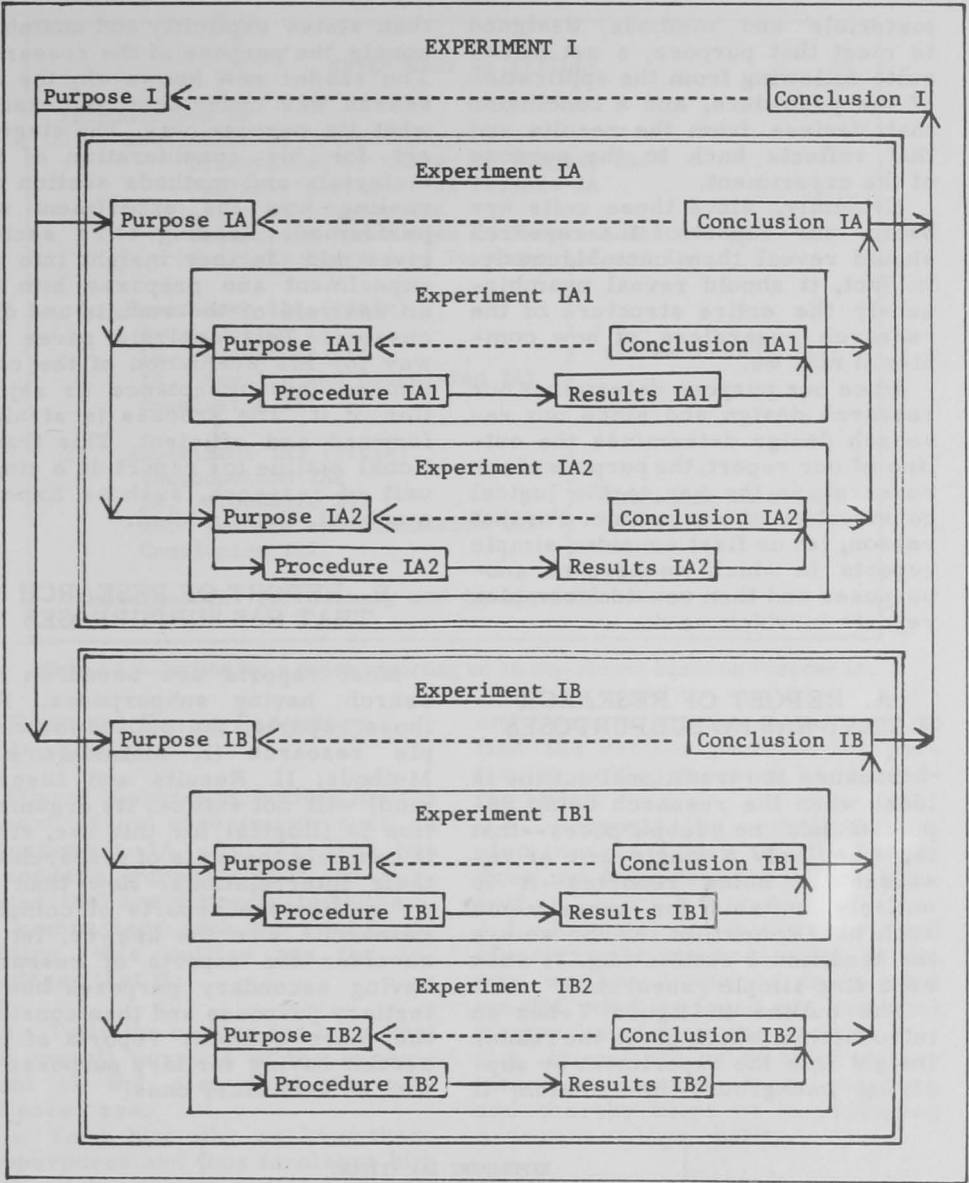


Figure 6.--Research design required by Purpose I.

II. RELATION OF RESEARCH DESIGN TO OUTLINE OF REPORT

From the foregoing discussion, we see the relation between the purpose of the research and the design of the research. Let us now look into the relation of the research design to the outline of the research report.

When we analyze the preceding figures 4, 5, and 6, we see that research is made up of a number of units, such as those formed by Experiments IA1, IA2, IB1, and so on. Each of these units consists of a purpose, a procedure (that is,

materials and methods) designed to meet that purpose, a set of results following from the application of the procedure, and a conclusion that derives from the results and that reflects back to the purpose of the experiment.

Evidently, since these units are basic, our report of the research should reveal them unambiguously. In fact, it should reveal unambiguously the entire structure of the research regardless of how complex it may be.

Since our purpose determines our research design and since our research design determines the outline of our report, the purpose of our research is the key to the logical construction of our outline. For that reason, let us first consider simple reports in which we have no subpurposes and then consider complex reports in which we do.

A. REPORT OF RESEARCH THAT HAS NO SUBPURPOSES

Because the traditional outline is ideal when the research being reported has no subpurposes--that is, when only a single unit of research is being reported--it is entirely suitable for experiments such as Experiment IA1. So we use the traditional outline (fig. 7) when reporting simple research.

The outline in figure 7 has an introduction, which gives the reader insight into the experiment by supplying background information; it

then states explicitly and unambiguously the purpose of the research. The reader now knows why the research was undertaken and exactly what its purpose was. The stage is set for his consideration of the materials-and-methods section revealing how the experiment was performed. Reading this section gives him further insight into the experiment and prepares him for an analysis of the results and discussion. This analysis paves the way for his evaluation of the conclusion--his acceptance or rejection of it. The process is straight forward and efficient. This traditional outline for reporting a single unit of research, such as Experiment IA1, thus is ideal.

B. REPORT OF RESEARCH THAT HAS SUBPURPOSES

Most reports are based on research having subpurposes. For those reports, the outline for simple research (I. Materials and Methods; II. Results and Discussion) will not suffice. Its organization is illogical for this use, since it conceals the units of research and their interrelations. How then do we outline the reports of complex research? For the answer, let us consider the reports of research having secondary purposes but no tertiary purposes and then consider the more complex reports of research having tertiary purposes as well as secondary ones.

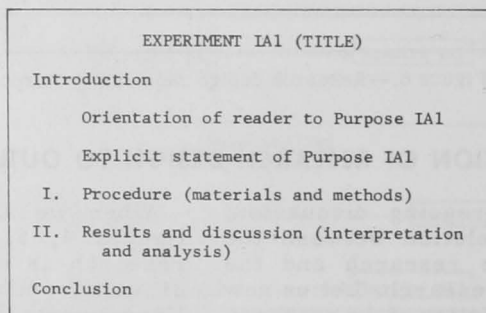


Figure 7.--Outline for a paper reporting on an experiment based on Purpose IA1.

EXPERIMENT IA (TITLE)

Introduction IA

Revelation of overall purpose

Orientation of reader to Purpose IA

Explicit statement of Purpose IA

Revelation of subpurposes

Orientation of reader to Purposes IA1 and IA2

Explicit listing of Purposes IA1 and IA2

- | | | |
|--------------------------------|---|---------------------|
| I. Experiment IA1 (Title) |) | |
| Introduction IA1 |) | |
| IA. Procedure IA1 |) | (Research Unit IA1) |
| IB. Results and Discussion IA1 |) | |
| Conclusion IA1 |) | |
| II. Experiment IA2 (Title) |) | |
| Introduction IA2 |) | |
| 2A. Procedure IA2 |) | (Research Unit IA2) |
| 2B. Results and Discussion IA2 |) | |
| Conclusion IA2 |) | |

Conclusion IA (or Summary and Conclusion)

Figure 8.--Outline for a paper reporting on an experiment based on Purpose IA.

1. Research Having Secondary Purposes

Figure 8 shows an outline for the report of an experiment, such as Experiment IA (fig. 5), that has secondary purposes but no purposes that are subordinate to them. In comparison with the traditional outline, this outline has the advantages that it:

a. Tells the reader not only what the overall purpose of the experiment is but also what the subpurposes are.

b. Tells him why we have those subpurposes and thus furnishes him with quick insight into them.

c. Permits the main headings of the paper to correspond to the main divisions of the research, further giving the reader quick insight.

d. Puts together all the information that belongs together. This outline thus properly unifies the reader's concept of the various experiments. His memory is not needlessly overburdened, nor is he sent on unnecessary trips backward

and forward in the manuscript to find the various parts of the particular unit of research he is reading about.

e. Presents the overall conclusion in such a way that the reader does not have to infer it for himself.

f. Reveals completely and clearly what we are trying to do, why we are trying to do it, what we did, what we found out, and what we concluded from the findings.

g. Stimulates us to think deeply into the meaning of our research and thereby helps us in producing research of high quality.

2. Research Having Tertiary Purposes

Figure 9 shows an outline for the report of an experiment, such as Experiment I (fig. 6), that has tertiary purposes.

Often Procedures IA1, IA2, IB1, and IB2 are closely similar. On looking at the outline in figure 9, we might therefore think that we

EXPERIMENT I (TITLE)

Introduction I

Revelation of Purpose I

Orientation of reader to Purpose I

Explicit statement of Purpose I

Revelation of Purposes IA and IB

Orientation of reader to Purposes IA and IB

Explicit listing of Purposes IA and IB or of the corresponding experiments

I. Experiment IA (Title)

Introduction IA (see Figure 8)

A. Experiment IA1 (Title)

Introduction IA1

1. Procedure IA1

2. Results and Discussion IA1

Conclusion IA1

(Research Unit IA1)

B. Experiment IA2 (Title)

Introduction IA2

1. Procedure IA2

2. Results and Discussion IA2

Conclusion IA2

(Research Unit IA2)

Conclusion IA (or Summary and Conclusion)

II. Experiment IB (Title)

Introduction 2A (see Figure 8)

A. Experiment IB1 (Title)

Introduction IB1

1. Procedure IB1

2. Results and Discussion IB1

Conclusion IB1

(Research Unit IB1)

B. Experiment IB2 (Title)

Introduction IB2

1. Procedure IB2

2. Results and Discussion IB2

Conclusion IB2

(Research Unit IB2)

Conclusion IB (or Summary and Conclusion)

Conclusion I (or Summary and Conclusion)

Figure 9.--Outline for a paper reporting on an experiment based on Purpose I. (Note: Introductions IA1, IA2, IB1, and IB2 can usually be omitted, since the superior introduction and the titles to the experiments usually supply all the needed information.)

would have to repeat the description of essentially the same procedure four times. But not so. All we need do is describe Procedure IA1 in detail and then, when describing each remaining procedure, tell only how it differed from the first.

As soon as we have completed each unit of research, we can write a paper on it, as indicated in figure

7. Then, as we accumulate these individual papers, we can combine them as indicated in figures 8 and 9. We thus can make as short or as long a paper as we wish, provided that we always have the appropriate unifying purposes. Accordingly, we have perfect freedom to modify our overall report to fit any changed concept we may have reached as

the result of new research findings. Furthermore, we can keep the reporting of our research strictly current. We need not delay the report

of one unit simply because some factor is delaying our completion of another unit.

SUMMARY

The outline of our research report is determined by the design of our research. This design, in turn, is determined by the purposes of our research. So, ultimately, the outline of our report is determined by the purposes of our work.

The purposes of research can be complex. Ordinarily, they form a hierarchy, ranging from an overall purpose, which covers a broad field of inquiry, to a number of subpurposes, each of which covers a relatively narrow field. Within this hierarchy, we choose a relatively general purpose or a relatively specific purpose, depending upon our time, money, and facilities.

When the purpose of our work is simple--that is, when it cannot be broken into subpurposes--the design of our research is simple. In this case, our research will consist of a single unit--a purpose, a procedure to effect that purpose, a set of results obtained when the procedure is carried out, and a conclusion that derives from the results and that reflects back to the purpose. When, on the other hand, the purpose of our research is complex--that is, when it can be broken into secondary, tertiary, and quaternary subpurposes and so on, corresponding to our hierarchy of purposes--the design of our research is complex. In that case, our research will consist of a number of units that are combined and united by a purpose of the appropriate complexity.

Research reports may be divided into two main classes--those rep-

resenting simple research and those representing complex research. When the research is simple, the outline of the report can be simple. That is, it can follow the traditional form--introduction, procedure (materials and methods), results and discussion, and conclusion. When, however, the research is complex, the traditional form is not adequate. In this case, the outline of the report must correspond to the outline of the research. The main divisions and subdivisions of the report then correspond to the main divisions and subdivisions of the research design. Only in those portions of the report where we present the individual units of the research do we again revert to the traditional form of introduction, procedure, results and discussion, and conclusion.

Making the outline of our report correspond to the outline of our research raises no problem except when the procedures used in our various units of research are closely similar. This problem, however, is easily solved. All we need do is to describe fully the procedure used in our first unit and then merely tell in the description of the remaining units how each of the subsequent procedures differed from the first.

By making the outline of our report correspond to the outline of our research, we give the reader immediate insight into our research and thereby enable him to read our report quickly yet understandingly.

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