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Survey of Reader Preferences Concerning the Format of NASA Technical Reports

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INTRODUCTION

The National Aeronautics and Space Administration (NASA) and many research and development organizations use the technical report as a primary medium for the communication and dissemination of research results. NASA published 3,399 technical reports in 1980, for example. Six hundred twelve of these reports were published by the Langley Research Center (LaRC).

A survey of engineers and scientists at LaRC and in the academic/industrial communities was conducted to determine the opinions of readers concerning the format (organization) of NASA technical reports and usage of report components. The questionnaire used for the study also elicited information concerning usage of scientific and technical information (STI), perceived image of NASA- and Langley-authored STI, and demographic data about the respondents. This report presents the results of the internal and external surveys in regard to the organization (format) of NASA technical reports.

STATEMENT OF THE PROBLEM

NASA technical reports serve as a primary means of communicating the results of NASA's research. Consequently, NASA technical reports must be organized and written to accomplish effective communication. NASA employs uniform publications standards which are designed to ensure the clarity, quality, and the utility of its technical reports. These standards include a basic report format which defines the report's components and establishes their sequence. The standards address, in a limited sense, language (verbal and visual) and presentation (typography, graphic design, and physical media) components. These standards had not been examined to determine the extent to which they contribute to the effectiveness of the NASA technical report as a product for information dissemination. However, there were no generally accepted standards against which NASA publications standards for technical reports could be compared.

As part of the review and evaluation of the Langley Research Center's scientific and technical information (STI) program, the technical report was examined to determine the organization of the report (sequential components), the language used to convey the information (language components), and the methods used to present the information (presentation components). The examination included a survey of the literature pertinent to the subject and an analysis of current usage and practices of publishers of technical reports. The results of the examination were presented in NASA Technical Memorandum 83269.

No generally accepted structure for the organization (sequential components) of the report was found in the survey and analysis of the technical report (McCullough, Pinelli, et al., 1982). The survey reports, style manuals and publications guides, and textbooks were not unified in the number or names of components and the placement of components recommended for inclusion in technical reports. The results did not provide sufficient data against which the NASA format for technical report components could be compared. Consequently, it was recommended that a "reader preference" survey be conducted among producers and users of NASA technical reports. The results would be used with the data produced from the survey and analysis to form a standard (bench mark) against which the NASA format for technical reports could be compared.

Purpose of the Study

The study utilized survey research. The purpose of the study was threefold: (1) to determine through a survey of the internal population (Langley engineers and scientists) and the external population (engineers and scientists in the academic and industrial communities) which report components are read and in what sequence; (2) to determine the use of non-NASA, NASA-authored, and Langley-authored (published) STI; and (3) to gather data as to the technical quality, the adequacy of data, the organization (format), and the quality of visual presentation to determine the perceived image of NASA- and Langley-authored (published) STI.

Objectives of the Study

Twelve objectives were established for the study. These objectives were to:

1. Determine how the technical report is read; specifically, which components are read and in what sequence;
2. Ascertain the effect of deleting or including certain report components;
3. Gather data as to the preferred arrangement of report components;
4. Ascertain the need for a summary and abstract--their length, location, and content;
5. Determine whether the integration of illustrative material within the text is preferred and, if so, whether the illustrative material is read before, with, or after the text;
6. Determine when illustrative material is not integrated whether it is read before, with, or after the text;
7. Ascertain which form of reference citation is preferred;
8. Gather data as to the usefulness of the appendixes; what they should include; and whether they are read before, with, or after the text;
9. Ascertain the helpfulness of glossaries and symbol lists and where they should appear in the report;
10. Gather data as to the technical quality, the adequacy of data, the organization (format), and the quality of visual presentation to determine the perceived image of Langley-authored technical reports;
11. Determine the use of non-NASA, NASA-authored, and Langley-authored (published) STI; and
12. Ascertain specific demographic information about the survey respondents including field of research, present professional duties, and type of organization.

Importance of the Study

A survey of the literature disclosed that little empirical research has been devoted to determining how technical reports are read by engineers and scientists and, consequently, the inclusion and sequence of technical report components. The NASA technical report format, including the components and their sequence, had not been empirically tested. Therefore, an investigation of report components and their sequence, which includes input from engineers and scientists who produce and use NASA technical reports, was deemed essential.

Assumptions

Underlying the conduct of the study are certain assumptions which were tested during the course of the study. These assumptions are given below.

1. The summary, introduction, conclusions, and illustrative material are read most frequently.

2. One or more of the aforementioned components may be the only one(s) read; therefore, each of these components should be independent of the remaining components.

3. The abstract, along with the conclusions, is sufficient to summarize the report thereby negating the need for a summary.

4. The reading of the entire report may well depend upon the ability of the introduction and conclusions to hold the reader's interest.

5. The technical report is read by audiences having diverse technical backgrounds and should be understandable to those who are not expert in its subject.

Limitations of the Study

The study was specifically concerned with the preferences of readers relative to the format of NASA technical reports. Preferences were limited to engineers and scientists assigned to the Aeronautics, Electronics, Structures, and Space directorates at the NASA Langley Research Center and non-NASA engineers and scientists chosen at random from three professional/technical societies who agreed to participate in the study. In terms of data reduction, no attempts were made to distinguish between the responses of the researchers (approximately 70 percent of the respondents) and the technical managers (approximately 30 percent of the respondents).

The study was limited to (1) searches of 10 manual and machine-readable data bases; (2) style manuals, publications guides, and textbooks; (3) books, periodicals, reports, conference proceedings; and (4) research specifically concerned with the technical report and such factors as reading habits, use patterns, order of use, and components usage. The study spanned the period from September 1981 to April 1982.

DEFINITION OF TERMS

Abstract. The abstract was defined as a technical report component consisting of a concise (approximately 200 words) but informative statement of a paper's purpose, research methods, and conclusions. The abstract is designed to stand independent of the paper itself (thus excluding undefined symbols and references) and to encourage the interest of a potential reader.

Back matter. Back matter of a technical report was defined as the section immediately following the body or text. Supplemental materials such as appendixes, index, references, and bibliography appear in this section.

Body or text. The body or text of a technical report was defined as the section immediately following the front matter. The development of the central theme of the report, including the introduction; the investigative, analytical, or theoretical material; the description of the research; the results and discussion; and the conclusions appear in this section.

Conclusion. The conclusion was defined as a technical report component consisting of a summation of findings, conclusions, and recommendations independent of the text. The conclusion also usually includes a brief introduction to the subject and purpose of the paper.

External population. The external population in this study was defined as those non-NASA engineers and scientists holding membership in one of three professional/technical organizations.

Front matter. Front matter of a technical report was defined as the section immediately preceding the body or text. Included in this section are the foreword, preface, and contents. This section is related only to the writing of the technical report itself and is not essential to the subject matter.

Illustrative material. Illustrative material was interpreted in this report to be all visual representations. As used herein, illustrative material includes tables, drawings, graphs, and photographs.

Internal population. The internal population in this study was defined as those engineers and scientists assigned to the Aeronautics, Electronics, Space, and Structures Directorates at Langley Research Center.

NASA technical paper. The technical paper (TP) was defined as a record, subject to professional review, of the significant findings of work conducted by NASA scientific and technical personnel. The technical paper is considered to be NASA's counterpart to the peer-reviewed journal article.

NASA technical report format. The format for NASA formal reports was interpreted to consist of (in the order of appearance) the title page, summary, introduction, symbols list, description of procedure and apparatus, results and discussion, conclusion, appendixes, references, tables, figures, and the standard COSATI page (containing the abstract).

Summary. The summary was defined as a technical report component which provides an overview of the principal ideas of the entire paper including such items as the introduction, investigative procedure, and findings.

Symbol list or glossary. The symbol list or glossary was defined as a technical report component which alphabetically lists all symbols, abbreviations, acronyms, and/or technical terms included in the report and provides a definition of each.

Technical report. The technical report was defined as an information product designed to convey the comprehensive results of basic and applied research to an external audience. Included in the technical report was the ancillary information necessary for the interpretation, replication, and application of the results or techniques.

GLOSSARY

COSATI	Committee on Scientific and Technical Information
DoD	Department of Defense
DoE	Department of Energy
LaRC	Langley Research Center
n	Sample Size
NACA	National Advisory Committee for Aeronautics
NASA	National Aeronautics and Space Administration
NMI	NASA Management Instruction
P	Population Proportion
p	Sample Proportion
R&D	Research and Development
SATCOM	Committee on Scientific and Technical Communication
SPSS	Statistical Package for the Social Sciences
STI	Scientific and Technical Information

RELATED RESEARCH AND LITERATURE

The historical developments of technical report literature have been presented by Tallman (1962), Boyland (1970), and Auger (1975). The complexity of technical report literature has been described by several authors (Wright, 1963 and Hartas, 1966). Studies by Earle and Vickery (1969) and Coile (1969) determined the use of technical reports as citations in scientific and technical publications such as books, periodicals, and monographs. Wilson (1958), Fuccillo (1967), and Randall (1959) conducted separate studies to determine the half-life of technical reports. The SATCOM Committee (National Academy of Sciences, National Academy of Engineering, 1969) and the report of the Weinberg Panel (Executive Office of the President, 1963) were concerned with the structure, organization, and transfer of scientific and technical information and the role of the technical report within an STI system.

Perhaps the largest and most comprehensive studies devoted to the technical report were conducted by the American Psychological Association (Garvey and Griffith, 1965) and a COSATI Task Group (1968) under the direction of Sidney Passman.

Various dimensions of the technical report have been studied. Many, if not most, of these studies were limited in scope and were devoted to the use of the technical report within the broader context of scientific and technical communication.

History and Growth of Technical Report Literature

According to Brearley (1973), scientists were exchanging reports with one another long before scientific communication was institutionalized. He further suggested that technical reports may predate scientific journals. Auger (1975) stated that the history of technical report literature coincides entirely with the development of aeronautics and the aircraft industry. He further stated that in the United States the aircraft industry has been represented continuously by the National Advisory Committee for Aeronautics (NACA), now known as the National Aeronautics and Space Administration (NASA), which issued its first technical report on The Behaviour of Aeroplanes in Gusts in 1915. However, as Auger points out, some authorities consider that these dates are anticipated by publications which were reports in all but name, notably the Professional Papers of the United States Geological Survey which appeared in 1902 and the Technologic Papers of the National Bureau of Standards which were first published in 1910. The development of the technical report as a major means of communication, according to several authorities such as Auger (1975), dates back to about 1941, with the establishment on June 28 of the United States Office of Scientific Research and Development.

Grogan (1976) agreed with Brearley that scientists have been writing reports since the earliest days; what has changed over the years has been their method of communicating these reports. In describing the development of scientific communication, Grogan (1976) stated that dissemination of research was made first through personal correspondence and then through papers given at society meetings. As science grew and became more specialized, the journal became the accepted method of reporting new work. However, as the growth of science and technology began to rapidly escalate, the scientific journal was no longer capable of meeting the total information needs of the researcher. The technical report, according to Grogan (1976), emerged as an alternative method of disseminating the results of research.

The volume of technical report literature has increased proportionally to the increase in government spending for research and development (R&D) (Subramanyam, 1981). For many R&D agencies of the federal government, including the National Aeronautics and Space Administration, the technical report constitutes an information product, a primary means of communicating the results of research to the user (Stohrer and Pinelli, 1981).

During the past 40 years, the technical report has developed into an important medium of communication in science and technology to the extent that it has sometimes been viewed as a threat to the scientific journal. Prior to World War II, the technical report was used primarily by industry and by agencies of the federal government. Due primarily to the federal government's support of R&D activities and the associated need to record the progress and document the results of government-performed and -sponsored research, the volume of technical report literature has grown steadily. In 1973, approximately 80-85 percent of the world's technical report literature was of U.S. origin (Chillag, 1973).

Numerous technical reports are issued annually; the exact numbers are unknown because production figures are usually obtained from a variety of sources. Production figures usually do not include those reports which are classified or limited in distribution. In fiscal year 1963, of the 38,880 technical reports produced by or for the U.S. Department of Defense (DoD), 62 percent were subject to limited or restricted distribution (Hall, 1967). A similar case can be made for technical reports which document the results of industrial research. Quite often this research is considered proprietary and is subject to restricted distribution.

By 1950, the annual output of technical reports in the U.S. was placed at between 75,000 and 100,000 (Tallman, 1961). According to the 1963 Weinberg report, some 100,000 technical reports were being issued each year in the U.S. alone (Grogan, 1970). By 1965, the number of technical reports had decreased to 15,000. A decade later, in 1975, the yearly total of technical reports being produced in the U.S. exceeded 60,000. The projected production for 1980 was estimated at 80,000 technical reports (King, 1977). The number of U.S. produced technical reports as compared with other STI media is shown in Figure 1.

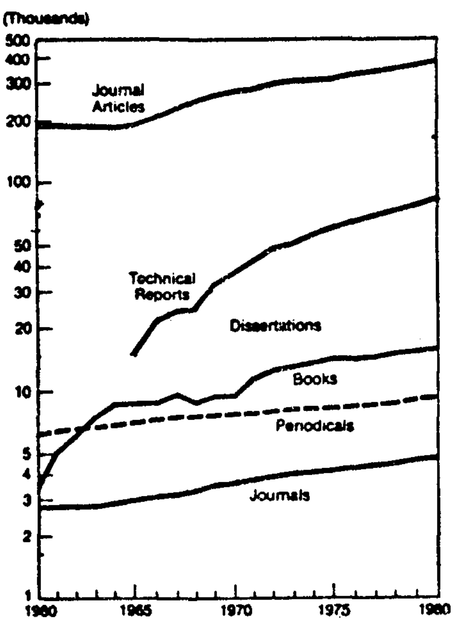

Figure 1. Number of U.S. STI literature items by medium (1960-1980)

Technical Report Production by NASA

All significant scientific and technical findings derived from NASA activities, including those generated by NASA-sponsored R&D and related efforts, are disseminated either in NASA technical publications and/or in suitable non-NASA scientific and technical media such as journals, conference proceedings, symposia, and workshops. Accordingly, NASA operates a scientific and technical information program to acquire, process, announce, publish, and disseminate STI required for or resulting from its research activities (NMI 2220.5A). Central to the operation of the NASA STI program is the NASA STI Facility, which acts as the clearinghouse for NASA STI; the NASA STI Branch at NASA Headquarters, which has functional management responsibility for the program; and the NASA STI operations at each of the NASA field centers, which are responsible for managing their center's STI output. The total research output for the Agency from 1971-1981 appears in Figure 2.

NASA technical reports constitute a primary means of communicating the results of research to the user. NASA's history of technical report production dates back to and is built upon the heritage established by its predecessor, the National Advisory Committee for Aeronautics (NACA). The NASA technical publications series included several categories of technical reports, each designed to accomplish a specific purpose or function. Uniform publications standards designed to ensure the clarity, quality, and the utility of its technical reports are employed by NASA (NASA, 1974).

	Accession Year											
STI Media	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	Totals
Formal Reports	1131	898	704	736	590	530	506	440	420	420	301	6676
Contractor Reports	3732	3440	3891	3023	2735	2570	2627	2078	2121	1572	2355	30,144
Informal Reports	2088	2189	1811	2525	1926	1613	1511	1430	1318	1407	2386	20,204
Other Published Literature	5125	4502	4775	4687	4587	4527	4614	4547	5038	4563	4527	51,492
Totals	12,076	11,029	11,181	10,971	9,838	9,240	9,258	8,458	8,895	7,962	9,569	108,516

Figure 2. Total agency STI output for 1971-1981 by medium

Use and Assessment of NASA Technical Reports

In 1978, the NASA Ames Research Center contracted with Communimetrics, Inc., to undertake an evaluation of NASA STI from the viewpoint of non-NASA users in the aeronautical industry. Monge (1979) based The Assessment of NASA Technical Information on data obtained from 450 employees in 40 of the 49 major aeronautical companies. Three methods of obtaining information were used: a questionnaire containing open- and closed-ended questions, structured interviews, and a multidimensional scaling technique.

Overall, the respondents registered a highly positive perception of NASA STI and, in particular, NASA technical publications. In terms of which publications were most helpful in their work, both executives (30 percent) and researchers (28 percent) reported that journal publications were the most frequent source of technical information. NASA technical publications were the next most frequently listed source of technical information by both groups (25 percent and 22 percent). According to Monge, these data indicate that, in terms of the technical information available to industrial personnel, NASA technical information is considered highly important, second only to journals in the field, many of which are authored and co-authored by NASA personnel.

The specific content of NASA technical publications was cited by executives (57 percent) and researchers (69 percent) as the major benefit of receiving NASA technical reports, although executives more than researchers also cited assistance with planning and problem-solving and assistance in working with NASA as relatively important benefits (Monge, 1979). According to Monge, content generally was not seen as a major inadequacy of NASA technical reports. For both executives and researchers, the data presented in NASA technical reports was adequate. Generally, writing style was not a major problem, although the executives preferred a less formal, tutorial style.

The respondents to the Monge study expressed several concerns relative to the content and presentation of NASA technical reports. These concerns were expressed in terms of recommendations for change.

The respondents expressed the desire for NASA to produce more state-of-the-art publications. It was reported that one of the major inadequacies of NASA technical reports was the failure to effectively relate the findings of a new research project to existing knowledge and similar research being conducted. It was recommended that each NASA technical report should have a section which synthesizes other relevant research from within and outside of NASA.

The Monge study further concluded that existing standards and actual practice for technical reports resulting from contractual arrangements should be reviewed to assure greater consistency of these reports with those produced within NASA. Summaries and abstracts should be clear and concise. It was recommended that abstracts should provide an overall description of the research while the summary should contain the essence of the findings or results and that the practice of not developing conclusions in NASA technical reports should be examined.

It was recommended by Monge that the style and quality of graphics used in NASA technical reports should be reviewed for consistency and appearance. In particular, graphs, charts, and illustrative material should be examined for compliance to standards. Where standards for graphics, for example, do not exist, they should be created. Particular emphasis should be placed on grids and type size.

The Monge study further concluded that the typography used in NASA technical reports should be examined for uniformity. The type size in some cases was too small, the type style too light, and the line length inappropriate. The type of binding used for NASA technical reports should also be examined, particularly for those technical reports which are considered to be informal. A type of binding which would permit the report to lie flat and remain open was recommended. Finally, it was recommended that NASA technical reports should contain information which would permit the reader to contact the author. This could include both a mailing address and business phone number.

In 1980, the NASA Langley Research Center undertook a comprehensive review and evaluation of its STI program. A series of studies were conducted to determine the extent to which the program was meeting the information needs of Langley research personnel and non-NASA users (academic and industrial researchers), the areas of the program which needed improvement, and the ways in which the program could be modified to improve its overall efficiency and effectiveness.

Phase I (Pinelli, 1980) of the review and evaluation study involved a survey of Langley engineers and scientists in the four research directorates. The questionnaire contained 50 closed-ended and 3 open-ended questions. From the internal user population of 1,036 engineers and scientists, 710 valid surveys were returned. From the valid surveys, a random sample of 300 was selected and subjected to analysis. The survey collected information on six topics including the perceived image of NASA and Langley STI.

Phase IV (Pinelli, 1981) of the review and evaluation study involved a survey of academic and industrial research personnel. The questionnaire contained 35 closed-ended and 3 open-ended questions. From a contact list of nearly 1,200 active academic and industrial researchers, approximately 600 addresses were verified. The 497 persons who agreed to participate were mailed questionnaires from which 381 completed questionnaires were received by the cutoff date. The survey collected information on seven topics including the perceived image of NASA- and Langley-authored STI.

The questionnaires administered to both populations covered such dimensions as the prestige of Langley-authored journal articles and technical reports (as compared to other technical literature within the respondent's discipline) and the adequacy of data and the effectiveness of report organization (format) of Langley-authored technical reports. The results of this portion of the questionnaires were compared to determine if similar perceptions and use were shared by the internal and external populations (Pinelli, Cross, et al., 1981).

Two questions were included in the surveys of the internal and external populations to establish the prestige (image) of Langley-authored STI. Concerning Langley-authored journal articles, 56 percent of the internal population indicated that the prestige was high as compared to 35 percent of the external population (see Table A). Concerning Langley-authored technical reports, 48 percent of the internal population indicated that the prestige was high as compared to 41 percent of the external population (see Table A).

TABLE A

Summary: A Comparison of Perceived Prestige for Langley-Authored (Published) STI

PERCENTAGES

	Internal				External			
	High	Neither	Low	No opinion	High	Neither	Low	Unfamiliar with
When compared to other journal articles in my discipline, the prestige of Langley-authored journal articles is	56	16	8	19	35	42	5	18
When compared to other literature in my discipline, the prestige of Langley-authored formal series publications is	48	15	23	24	41	36	5	18
	n = 300				n = 381			

An analysis of the findings revealed that, overall, the prestige of Langley-authored (published) STI was perceived as being higher by the internal population than by the external population. However, a perception of lower prestige for the Langley-authored technical reports was indicated more frequently by the internal population than by the external population. Furthermore, the internal population attributed higher prestige to Langley-authored journal articles than did the external population. Analysis of the internal population's responses concerning Langley-authored journal articles and technical reports revealed significant differences in the perception of prestige within certain disciplines. Since the overwhelming majority of the internal population rated the quality of Langley STI high, the inference can be drawn that respondents in certain disciplines perceived that their research was viewed with less prestige by engineers and scientists outside the Langley Research Center. However, an analysis of the external population responses to the perception of prestige did not reveal significant differences within disciplines.

Two questions were included in the internal and external surveys to establish two dimensions of technical quality: the effectiveness of report organization (format) and the adequacy of data for Langley-authored technical reports. Seventy-one percent of the internal population indicated that the organization (format) of Langley-authored formal series technical reports made readability easy as compared to 47 percent of the external population (see Table B). Seventy-two percent of the internal population indicated that the data contained in Langley-authored formal series technical reports were sufficient as compared to the responses of 48 percent of the external population (see Table B).

TABLE B

Summary: A Comparison of Organization and Adequacy of Data for Langley-Authored Technical Reports

PERCENTAGES

	Internal				External			
	High	Neither	Low	No opinion	High	Neither	Low	Unfamiliar with
The organization (format) of Langley formal series publications makes readability easy	71	15	5	9	47	32	3	18
When compared to other technical report literature, the adequacy of data in Langley-authored technical reports is sufficient	72	12	3	13	48	32	2	18
	n = 300				n = 381			

An analysis of the findings revealed that, overall, the effectiveness of the report organization (format) and the adequacy of data were perceived as being higher by the internal population than by the external population. Neither the internal nor the external populations indicated that the organization (format) of Langley-authored technical reports made them less readable. Likewise, neither population indicated that the adequacy of data in Langley-authored technical reports was low. However, the external population expressed the following concerns about NASA technical reports: (1) the separation of text from the visual material, (2) the absence of grids from graphs, (3) insufficient tabular data, and (4) the exclusion of negative results.

Audience Analysis as a Function of Report Organization

The organization (sequential components) of the technical report was examined as part of the survey and analysis of the technical report conducted by McCullough, Pinelli, et al., (1982). In that study, technical reports obtained from report producers were analyzed. The structural components and their arrangement were compared with the current practice and usage as recommended by six style manuals and publications guides and six writing and editing textbooks.

The survey reports showed wide variation in the number, kind, and placement of sequential components. The 99 reports surveyed used 96 different components with only five components common to half or more of the reports. The six style manuals and publications guides were not unified in the number and names of the components recommended for inclusion in technical reports. Sixteen of twenty-four components were recommended by half or more of these sources; however, unanimous agreement for inclusion existed for only three components. Textbooks showed the greatest agreement on which components should be considered for inclusion in technical reports.

McCullough, Pinelli, et al., (1982) postulated that variation in component inclusion and sequence may be attributed to the content, purpose, and audience being addressed. The nature of the report--whether it is informative, analytical, or assertive--may also contribute to the variation. The assumption is that the structural components to be included in a technical report and their arrangement are a function of the reader's information needs and habits.

Authors of technical writing and editing textbooks pointed out the need for a flexible organizational structure and the need of the technical report writer to know precisely who will read the report. Houp and Pearsall (1980) stated that a technical report must suit the needs, abilities, and interests of its principal users and referred to the many kinds of people the report must satisfy. Mathis and Stevenson (1976) referred to the operational, objective, and personal characteristics of the individual report readers and recommended audience analysis as a major step in the preparation and writing of the technical report. In their book, Writing That Works, Oliu, et al., (1980) stated that the writer, in determining the needs of the reader, must identify who the reader is and that different readers have different needs depending upon their jobs. Mills and Walter (1978) discussed the importance of adapting the style of the report to, first, the state of the reader's knowledge of the subject and, second, the total situation in which the reader examines and uses the report.

Souther and White (1977) stated that while engineers and scientists write for a variety of audiences, two groups of readers are particularly important--technical managers and professional colleagues. They further stated that too little is known about either the informational needs or the reading habits of these readers and that effective communication actually requires either a good knowledge of both groups or some very accurate assumptions concerning them. Based on the results of an extensive review of the published literature contained in 10 manual and machine-readable data bases, there is little empirical evidence to conclude that the reading habits of engineers and scientists are known in terms of how they read technical reports, specifically which components are read and in what sequence.

How the Technical Report Is Read

Numerous studies have been devoted to the percentage of time devoted by engineers and scientists to reading the professional literature as a function of their professional duties. Several studies on the information gathering habits of engineers and scientists have determined the various literature sources used by researchers. In his survey of technical managers and researchers in the aeronautical industry, Monge (1979) found that journals, followed by technical reports, were used to obtain information necessary to their research. Pinelli (1981) found little difference in the use of journal articles, technical reports, and conference/meeting papers by non-NASA engineers and scientists. In a survey conducted by King Research (King, Griffiths, et al., 1982) for the U.S. Department of Energy (DoE), engineers and scientists funded by DoE were found to be reading 9.8 journal articles and 9.2 technical reports per month. The methods of identifying technical reports read by DoE engineers and scientists appear below.

Method of identification	Technical reports, %*
While browsing/distribution copy	52
From another person (i.e., a colleague)	24
Cited in another article/report	8
Cited in a printed index	16
In the output of a computerized literature search	12

*King Research, Inc., surveys of DoE-funded scientists and engineers

The reading habits of engineers and scientists may be viewed two ways. First, the engineer or scientist must decide to read/obtain or not read/obtain a report. Pullen and Hoffman (1970), in their article, "Is the Report Worth Reading?" stated that this decision must be made by every engineer and scientist in his/her search for vital information or data needed for his/her research. The title and abstract were cited as key factors used by engineers and scientists in the decision process. Thompson (1970), as part of a field experiment conducted in three military laboratories, asked 85 engineers and scientists to provide data concerning their use of journals and technical reports which, in the normal course of events, arrived at their desk. In terms of "what to do with the material," participants were asked how they arrived at their decision. Better than half (57 percent) of the decisions were based on the title, followed by the abstract, the table of contents, the introduction, and skimming the text. Of the material that arrived at their desk, 53 percent was read immediately and 24 percent was held for later reading. In another study, Thompson (1973) conducted a field experiment to determine the extent to which abstracts may be used by engineers and scientists in determining whether to read/not read an article or report. Thompson concluded that the addition of a separate, identifiable abstract at the beginning of a report or journal article does not increase the ability of the readers to decide what disposition to make of the article or report. He did conclude that the title and associated information resulted in quicker disposition decisions, and that disposition decisions are apparently based on a variety of cues. In terms of time taken and quality of relevant judgment, these other cues are at least as effective as the abstract.

Secondly, once a decision is made to read the report, how is the report read and specifically, which components are read and in what sequence. Research regarding how engineers and scientists read technical reports is limited. What little published literature does exist pertains more to the reading habits of technical managers than to researchers or "bench scientists." Souther and White (1977) implied that the reading habits as well as the informational needs of the two groups differ. This difference in terms of information needs is supported in part by the findings of the Monge study and the specific benefits derived from NASA technical reports by technical managers and researchers.

Turner (1974) stated that technical managers have numerous demands placed on their time. Insofar as technical reports are concerned, Turner pointed out that the majority of managers only have time to read the summary. In a survey of technical managers in several large engineering enterprises, Turner found that, as shown below, 87 percent of the technical managers who received technical reports read the summaries while only 12 percent referred to the main body or text.

Parts of Technical Reports
That Managers Read

Part of report	Percentage of managers reading part*
Summary	87
Introduction	43
Main body	12
Conclusions	55
Appendices	5

*Sample size, 287

Perhaps the most comprehensive study of the information needs and reading habits of technical managers was conducted by Souther for the Westinghouse Corporation. The purpose of Souther's study (1962) was to identify the information needs of management and to determine how managers use reports and their reading habits. The study identified five broad technological areas of primary interest to technical management. These areas are shown below.

- Technical problems
- New projects and products
- Experiments and tests
- Materials and processes
- Field troubles

In addition to the five technological areas, Souther stated that the manager must also consider organizational problems and market factors. Although such problems and factors may not be a primary concern to engineers and scientists, they should include the information in reports going to their management. According to Souther, these five areas of interest are important for two reasons. They pinpoint more accurately the actual information needs of the management reader. These areas point directly to the necessity of relating the technical report to industrial decision-making. According to Souther, this is an important concept often overlooked in advice on technical writing.

In terms of their report reading habits, members of the technical staff ranked their information needs in order of importance as follows.

*Items Most Often Looked For	Weighted scale
Conclusions and recommendations	79
Statement of the problem	76
Approach used	62
General concepts	58
Special problems	50
Results	45
(and at the bottom of the list)	
Detailed data	16

*Source: Souther and White, 1977, p. 20

Souther concluded from this portion of his study that how a researcher writes a report is altogether different from what a researcher looks for when reading a report. According to Souther, this, too, is an important concept often overlooked in advice on technical writing.

Summary

The technical report has grown in number and in use to become a primary information product for the dissemination of scientific and technical information. The number of technical reports produced each year is directly proportional to government support of research and development.

The evaluation of NASA technical reports has been confined to feedback obtained from users. This feedback indicated that NASA technical reports were being used, that their perceived prestige was high, that the organization (format) made readability easy, and that the adequacy of data was sufficient.

In terms of deciding to read/obtain a technical report, the title followed by the abstract, the table of contents, and the introduction were the components most frequently used in the decision-making process. The reading habits and information needs of the technical manager and the research were perceived to differ. From the standpoint of empirical research, more is known about the reading habits/information needs of the technical manager than the researcher.

RESEARCH METHODOLOGY AND PROCEDURE

The study used survey research methods to obtain feedback from Langley engineers and scientists assigned to the Aeronautics, Electronics, Structures, and Space Directorates and from engineers and scientists in the academic and industrial communities. The study was conducted in conjunction with Continental Research. Professional research assistance was used to establish and ensure objectivity and confidentiality, to maintain the integrity of the study, and to obtain research skills not otherwise readily available to the project.

Research Methodology

The methodology for the survey portion of the study was based on the work of Fishbein and Ajzen (1975). This methodology combined the semantic differential technique, taken from communication research, with the concepts of classical and operant conditioning, taken from learning theory. (For a discussion of these concepts, see Hilgard and Brower, 1966.) This methodology has been used to assess attitudes toward such diverse topics as using birth control pills (Jaccard and Davidson, 1972), voting for a political candidate (Fishbein and Coombs, 1974), and buying consumer products (Sheth and Talarzyk, 1972). This methodology was also used in Phase I (Pinelli, et al., 1980) and Phase IV (Pinelli, et al., 1981) of the Langley STI review and evaluation study. While others have employed similar approaches (Tolman, 1932; Edwards, 1954; and Rosenberg, 1956), Fishbein's approach is currently the most widely used.

Random probability sampling was used to survey the external population. To determine how NASA technical reports were read and to help decrease the likelihood of reconstructed logic, respondents were given a NASA technical paper (TP) related to their discipline or area of research interest.

Research Procedure--Questionnaire Design

The survey questionnaire, which was jointly prepared by Continental Research and the project director, contained 33 closed-ended questions and three open-ended questions. The open-ended questions were listed on a separate sheet and were included as a supplement to the questionnaire. The closed-ended questions employed the attitude scaling technique developed by Fishbein and Ajzen (1975).

The survey questionnaire was designed to obtain the preferences of readers relative to the format of NASA technical reports. Specifically, the questions were designed to determine which report components were read and in what sequence; to determine the use of non-NASA, NASA-authored, and Langley-authored STI; and to gather data about the technical quality, adequacy of data, format, and the quality of visual presentations. In addition, certain demographic characteristics of the sample populations were obtained.

Each question was pre-tested for relevance and clarity on a randomly selected sample of Langley engineers and scientists. The same twenty-six questions were used to survey both the internal and external populations. Certain of the seven demographic questions were applicable only to one population. The final version of the questionnaire is presented in Appendix A.

Research Procedure--Internal Population

The survey questionnaire was sent to 513 (50 percent) of the 1,026 engineers and scientists assigned to four research directorates (Aeronautics, Electronics, Structures, and Space) at the Langley Research Center. Every second name on a personnel list was selected to receive a questionnaire. The questionnaire was accompanied by a letter of transmittal signed by the Director of the Langley Research Center. A copy of this letter is provided in Appendix B. Approximately 21 days after the initial mailing, approximately 200 follow-up calls were made. This call served as a thank you call to those who had returned their surveys and as a reminder to those who had forgotten. Thirty-nine respondents indicated that they had misplaced the survey or had not received it. Each of the 39 was then mailed a new questionnaire packet. People who were not reached by phone were sent reminder/appreciation letters (Appendix C).

Three hundred seventy-eight questionnaires were returned, comprising a response rate of 74 percent. The questionnaires were edited, coded, and categorized. The data were keypunched, entered into a computer, and statistically treated using established analytical techniques. The Statistical Package for the Social Sciences (SPSS)* was used for data reduction and aggregation.

When a sample is randomly selected from a population, the characteristics of the population may reasonably be inferred from the attributes of the sample. Such inference is then subject to various conventions regarding statistical significance. The appropriate application of such conventions to the primary survey effort is called "estimation of parameters." The population parameters, in this case a population proportion (P), is estimated from a sample proportion (p). Such estimates are dependent in part upon sample size. The sample sizes vary from question to question because all respondents did not answer each question. However, given the general range of sample sizes and the nature of the sampling distribution of proportions, it can be stated conservatively that at the 95 percent confidence level, the true population proportion (P) of the internal survey group is within ±5 percent of the sample proportion (p), that is, $P = p \pm 5\%$.

Research Procedure--External Population

Stage 1 of the two-stage procedure involved the development of a sample frame of academic and industrial engineers and scientists from the membership lists of three selected professional/technical societies who agreed to participate in this study. The first society has a membership of approximately 200,000 electrical and electronic engineers. A listing of members in the specialized categories of aerospace and electric systems and instrumentation and measurement was purchased.

The second society has approximately 25,000 members from the fields of aeronautics and/or astronautics. Only the names of those members listed in one of the following categories of primary interest were purchased: structures, materials, astrodynamics, aircraft design, fluid dynamics, or aeroacoustics.

The third society participating in this project has a membership of approximately 9,000 persons specializing in the area of geophysics. Only names of members who specified a primary interest in oceans and atmospheres were purchased.

*SPSS is a tradename of National Opinion Research Center, University of Chicago.

A random probability sample was drawn from each list, selecting every "nth" name such that each of the three societies reflected the percentage of LaRC-published material in each interest area. After selecting the potential respondents (approximately 1,400 names), telephone numbers were obtained from directory assistance and transcribed onto index cards. Members for whom a telephone number could not be obtained were deleted from the sample. The cards were next alphabetized and compared to eliminate duplication and to remove any names of Langley employees. The sample frame which remained (1,000 potential respondents) was grouped according to time zones to ensure that all respondents were called at a reasonable hour. Addresses were reviewed, and any incomplete cards were deleted, resulting in a final sample frame of 896 respondents.

Stage 2 involved the actual conduct of the survey. A four-step method combining the personal touch of telephone interviews with the depth of information possible in a mail survey (Dillman, 1978) was used.

Step 1 - Each person from the final sample frame of 896 usable names was telephoned during the week beginning January 16, 1982. Each individual was asked if he/she was a user of NASA technical reports. Those qualifying as report users were asked to participate in the evaluation project by completing a mail questionnaire. The results of these calls were as follows:

67.0% - willing to participate

2.1% - out of town

7.1% - did not qualify as a NASA report user

22.7% - never reached (after four tries)

1.1% - unwilling to participate

Step 2 - Each of the 600 persons who agreed to participate was mailed a questionnaire within 24 hours. With the questionnaire was sent a sample NASA technical publication that reflected the participant's field of interest, a brief cover letter signed by the President of Continental Research thanking the individual for his/her participation (Appendix D), and a postage paid reply envelope for use in returning the questionnaire.

Step 3 - Of the 600 potential respondents who were mailed a questionnaire, 374 received a follow-up phone call approximately one week after his/her initial expression of willingness to participate in the study. This call served as a reminder to those who had not responded and as a thank you call to those who had returned their completed questionnaire. Those persons not reached by phone were sent letters of reminder/appreciation (Appendix E).

Step 4 - Five hundred eleven (over 85 percent) of the questionnaires were returned to Continental Research by the cut-off date of March 15, 1982. Seven responses were marked "NOT APPLICABLE" and were not completed. The remaining 504 questionnaires were edited, coded, and categorized. Their data were keypunched, entered into a computer, and statistically treated using established analytical techniques. Data reduction and aggregation were accomplished by use of the Statistical Package for the Social Sciences (SPSS)®.

Weighted Average Rankings of Sequential Use

Weighted average rankings were used to determine the order of use of the 15 report components (survey topic 1). The weighted average rankings were obtained by assigning weights based on specific order of use. A weight of 15 was assigned for components read first, 14 for components read second, decreasing sequentially to 1 for components read fifteenth. The weighted ranking was calculated by the formula $\frac{\sum n_i w_i}{n_t}$ where n_i was the number of users reading a component in the "ith" position, w_i was the weight assigned for the "ith" position, and n_t was the total number of users who read that component in any position.

Weighted average rankings of order of use were also calculated for survey topic 2, which addressed the question of components reviewed to decide whether to read a report. The same calculation procedure was employed except that the assigned weights ranged from 5 (for read first) decreasing sequentially to 1 (for read fifth).

PRESENTATION OF THE DATA

The responses to the 14 questions concerned with the NASA technical report format were presented as 12 survey topics. Questions 8, 9, and 10 all related to placement and use of illustrative material and, for this reason, they were grouped into a single survey topic for presentation of the data. The responses of both the internal population of Langley scientists and engineers and the external population of academic and industrial engineers and scientists were given for each question. Appendixes F and G present summaries of the internal and external survey results, respectively, to the 14 questions.

In 1982, McCullough, Pinelli, et al., published the results of their survey and analysis of the technical report. The results are contained in NASA TM-83269. The survey and analysis were concerned with the organization of the technical report (sequential components), the language used to convey the information (language components), and the methods used to present the information (presentation components). Where relevant, the findings from the survey and analysis are included after the data on each survey topic.

Demographic Information About Survey Respondents

Background data collected as part of the survey revealed that 42 percent of the internal respondents and 49 percent of the external respondents specified aeronautics as their major field of interest. The major fields of interest of the remaining respondents were divided among various scientific/technical disciplines.

Sixty-nine percent of the internal respondents held positions as individual contributors within the organization. Thirty-one percent held positions as unit, group, section, branch, or division heads (management).

Seventy-four percent of the internal respondents and seventy-one percent of the external respondents had at least 16 years of professional experience. Forty-one percent internally and fifty-five percent externally had been employed for 21 years or more. Fewer than 1 percent of both survey groups had less than 1 year of professional experience.

A majority (59 percent) of the external respondents were associated with industrial organizations, while 17 percent were employed by educational institutions. When asked about the nature of their professional duties, 37 percent of the external group indicated applied research, 20 percent stated technical administration, and 14 percent specified teaching/academic duties.

An overwhelming majority (96.5 percent) of the internal respondents used technical reports in their research. Slightly less (94.9 percent) of the internal respondents used NASA-authored technical reports and Langley-authored technical reports in their research.

An overwhelming majority (96.2 percent) of the external respondents used technical reports in their research. Slightly less (89.5 percent) of the external respondents used NASA-authored technical reports while 70 percent used Langley-authored technical reports in their research.

Survey Topic 1: Order in Which Users Read or Review Report Components

To determine how NASA reports are read, survey respondents were asked to use the NASA technical report provided and to number a list of report components to indicate the chronological sequence in which these components are generally read. The question as it appeared on the questionnaire is shown in Table C. Tables D and E summarize the responses of the internal and external populations, respectively, to this question.

TABLE C

Text of Question 1

The format for a typical NASA technical report appears below. Please number IN ORDER the components you generally read/review. (For example, if you read the "ABSTRACT" first, number it with a "1.") Do not number those components you skip.

a. ____ Title Page
b. ____ Foreword
c. ____ Preface
d. ____ Table of Contents
e. ____ Summary
f. ____ Introduction
g. ____ Symbol List and Glossary
h. ____ Description of Research Procedure
i. ____ Results and Discussions
j. ____ Conclusion
k. ____ Appendixes
l. ____ References
m. ____ Tables
n. ____ Figures
o. ____ Abstract

TABLE D

Summary: Order in Which Report Components Are Read by Internal Respondents (n = 378)

Component \ Response	Percentage of participants indicating response															
	Don't read	Read 1st	Read 2nd	Read 3rd	Read 4th	Read 5th	Read 6th	Read 7th	Read 8th	Read 9th	Read 10th	Read 11th	Read 12th	Read 13th	Read 14th	Read 15th
Title page	22.2	75.1	1.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.3
Foreword	84.7	0.0	4.0	2.6	1.9	1.3	0.5	0.5	0.3	0.3	0.3	0.3	0.3	1.1	1.3	0.8
Preface	83.3	0.0	1.1	4.0	2.9	1.3	1.1	0.8	0.5	0.3	0.3	0.5	0.8	0.8	1.6	0.8
Table of contents	59.0	0.3	5.0	9.3	10.6	4.8	3.2	1.3	1.1	0.8	0.3	0.8	1.1	1.3	0.3	1.1
Summary	18.8	6.1	30.4	26.5	7.1	3.7	2.9	1.1	0.8	0.5	0.5	0.5	0.8	0.0	0.0	0.3
Introduction	11.1	0.3	6.9	24.3	23.5	14.8	10.1	5.3	1.6	1.1	0.5	0.0	0.3	0.0	0.3	0.0
Symbol list and glossary	52.1	0.0	0.3	1.9	1.6	6.6	7.1	4.8	5.3	5.8	2.9	5.3	2.6	1.1	1.1	1.6
Description of research procedure	14.6	0.0	0.3	2.4	13.5	13.8	17.2	14.6	12.2	4.0	4.2	1.9	0.8	0.5	0.0	0.3
Results and discussions	6.1	0.0	1.1	2.4	8.5	22.5	18.5	18.0	9.0	7.1	5.0	0.5	0.3	0.5	0.5	0.0
Conclusion	1.9	1.6	4.8	15.6	19.3	14.0	11.6	8.5	8.5	4.8	6.1	2.1	0.3	0.5	0.5	0.0
Appendixes	37.8	0.0	0.0	0.0	0.0	0.5	0.8	6.3	8.2	10.3	9.3	12.2	7.4	4.2	1.1	1.9
References	37.3	0.0	0.0	0.8	0.5	1.1	2.1	4.5	6.9	9.8	11.4	9.5	9.0	3.4	1.6	2.1
Tables	30.2	0.0	0.0	0.3	1.6	2.9	2.6	11.1	13.8	14.8	8.5	7.7	2.6	3.2	0.8	0.0
Figures	15.6	0.8	0.5	4.5	5.8	7.7	13.5	9.8	11.1	9.8	8.7	4.2	4.2	1.3	1.9	0.5
Abstract	28.8	15.3	43.7	4.8	0.8	0.3	0.0	0.0	0.3	0.0	1.1	1.6	1.3	1.3	0.5	0.3

TABLE E

Summary: Order in Which Report Components Are Read by External Respondents (n = 504)

Component \ Response	Percentage of participants indicating response															
	Don't read	Read 1st	Read 2nd	Read 3rd	Read 4th	Read 5th	Read 6th	Read 7th	Read 8th	Read 9th	Read 10th	Read 11th	Read 12th	Read 13th	Read 14th	Read 15th
Title page	14.1	81.9	3.0	0.0	0.2	0.0	0.0	0.4	0.0	0.0	0.0	0.2	0.0	0.0	0.2	0.0
Foreword	78.6	0.2	6.7	2.6	0.8	1.0	1.4	1.6	0.8	0.2	0.8	0.8	1.4	0.8	1.8	0.6
Preface	80.0	0.0	0.6	4.0	3.2	0.8	1.0	1.8	1.0	1.2	0.4	1.2	0.8	1.6	1.8	0.8
Table of contents	51.0	1.0	10.3	10.5	8.9	4.8	3.0	1.2	2.2	2.0	0.4	1.0	1.6	1.0	0.4	0.8
Summary	9.3	5.4	35.1	28.0	10.1	6.5	1.8	1.2	0.8	0.4	0.6	0.4	0.0	0.4	0.0	0.0
Introduction	18.5	0.6	4.8	21.0	21.0	12.1	9.7	5.6	3.6	2.2	0.4	0.2	0.2	0.2	0.0	0.0
Symbol list and glossary	55.8	0.2	0.0	0.2	2.2	4.6	4.4	5.2	4.2	5.4	4.6	4.0	2.8	3.8	1.2	1.8
Description of research procedure	25.6	0.0	0.4	2.6	9.1	11.3	14.1	12.5	8.1	5.4	5.6	3.2	1.0	0.8	0.4	0.0
Results and discussions	10.3	0.0	0.4	4.8	10.5	19.0	17.1	14.3	10.9	6.2	3.8	1.6	0.6	0.4	0.2	0.0
Conclusion	3.8	0.2	2.6	10.9	19.4	19.2	14.9	7.9	7.3	6.5	4.4	2.2	0.4	0.2	0.0	0.0
Appendixes	45.0	0.0	0.0	0.2	0.2	0.6	1.6	3.8	3.0	6.5	10.7	11.3	9.3	3.8	1.8	2.2
References	41.5	0.0	0.4	1.0	1.8	3.0	3.6	5.6	5.8	5.0	7.9	7.5	8.1	5.0	2.8	1.2
Tables	35.7	0.0	0.2	0.2	1.0	4.2	6.3	8.5	10.5	12.3	7.3	6.0	3.2	2.2	1.4	1.0
Figures	24.2	0.2	1.4	4.6	5.8	7.9	9.1	9.1	11.1	8.9	6.7	4.2	2.8	1.2	1.8	1.0
Abstract	34.7	9.7	33.5	8.3	3.4	0.8	1.2	0.8	1.0	1.0	0.8	0.6	1.4	0.2	0.4	2.2

The data in Tables D and E were used to construct Table F which shows, for each component, the percentages of survey respondents who indicated they read that component at some stage in the use sequence. The report components are listed in Table F in descending frequency of use.

For both internal and external populations, the component read by the highest percentage of readers was the conclusion. Ninety-eight percent of Langley respondents and ninety-six percent of academic/industrial respondents indicated they read the conclusion. Other components read by more than 80 percent of both groups were the results and discussion, the summary, and the introduction.

On the other hand, certain components were read by very few respondents in either survey group. The foreword and preface had very low usage rates. Only 15 to 21 percent of the respondents indicated that they read these components. (With the exception of NASA Conference Publications, Reference Publications, and Special Publications, NASA Technical Papers and Technical Memorandums generally do not include a foreword or preface.) Other components read by less than half of the respondents were the table of contents and the symbol list/glossary.

TABLE F

Summary: Percentage of Survey Respondents Who Read Various Report Components

Internal survey (n=378)		External survey (n=504)		Combined surveys (n=882)	
Component	Percentage who read	Component	Percentage who read	Component	Percentage who read
Conclusion	98	Conclusion	96	Conclusion	97
Results and discussion	94	Summary	91	Results and discussion	91
Introduction	89	Results and discussion	90	Summary	87
Description of research procedure	85	Title page	86	Introduction	85
Figures	84	Introduction	82	Title page	82
Summary	81	Figures	76	Figures	79
Title page	78	Description of research procedure	74	Description of research procedure	79
Abstract	71	Abstract	65	Abstract	68
Tables	70	Tables	64	Tables	67
References	63	References	59	References	60
Appendixes	62	Appendixes	55	Appendixes	58
Symbol list and glossary	48	Table of contents	49	Symbol list and glossary	46
Table of contents	41	Symbol list and glossary	44	Table of contents	46
Preface	17	Foreword	21	Foreword	19
Foreword	15	Preface	20	Preface	19

To clarify sequence of use of report components, a weighted average ranking was calculated and is presented in Table G. When both surveys were combined, the resulting mean sequence for the first six components read was title page, summary, abstract, introduction, table of contents, and conclusion. When examined separately, the internal and external survey groups showed very similar overall use patterns with a few narrow variations in sequential positions. For example, while both surveys groups read the title page first, internal respondents indicated they read the abstract second and the summary third; whereas, external respondents read the summary second and the abstract third. Both groups named the references and appendixes as last in their reading sequences.

Although the abstract appears on the last page of NASA reports, this component was read by a clear majority of users (71 percent internally and 65 percent externally). Moreover, the abstract was most commonly the second or third report component read by users.

The McCullough and Pinelli study (1982), while not addressing the sequence of use by readers, was concerned with which components were actually present in a survey of 99 reports and with which components were recommended for inclusion in technical reports by selected textbooks and style manuals/publications guides.

The survey reports showed wide variation in the number, kind, and placement of sequential components. The 99 reports surveyed used 96 different components. Only five components (cover, title page, table of contents, introduction, and appendixes) were common to half or more of the reports; however, strong agreement (82 percent or more) existed in regard to placement of these five components as front, body, or back matter.

The six style manuals and publications guides were not unified in the number and names of components recommended for inclusion in technical reports. Sixteen of twenty-four components were recommended by a majority of these sources; however, unanimous agreement for inclusion existed for only two components, the introduction and appendixes. The style manuals and publications guides were even more divided in the recommended sequence of the report components.

Textbooks showed the greatest agreement on which components should be considered for inclusion in technical reports. All six texts consulted recommended the following seven components: memo/letter of transmittal, title page, abstract, contents, list of illustrations/figures, introduction, and appendix. Further, a consensus for inclusion existed for 16 of 20 components mentioned by one or more texts.

The three sources used in the McCullough and Pinelli study (survey reports, style manuals/publications guides, and textbooks) were compared to produce a list of components recommended for inclusion by 50 percent or more of any of the three sources. This comparison, shown in Table H, was presented to indicate whether each source, as a consensus, advocated that a particular component should be included as a structural component of a technical report. Components recommended by NASA were included for comparison. The survey reports represented the limiting factor in that, as mentioned previously, only five components were common to more than half of the reports. Considering only the textbooks and style manuals, agreement existed on 12 components: the cover, title page, abstract, contents, list of figures/illustrations, list of symbols, introduction, body (text), bibliography, references, appendix, and glossary. The NASA Publications Manual discussed 10 of these 12, omitting only the list of figures/illustrations and the glossary.

TABLE G

Weighted Average Ranking: Order in Which Report Components Are Read

Internal survey			External survey			Combined surveys		
Component	n	Weighted avg. rank*	Component	n	Weighted avg. rank*	Component	n	Weighted avg. rank*
Title page	294	14.9	Title page	433	14.9	Title page	727	14.9
Abstract	269	13.2	Summary	457	12.9	Summary	764	12.9
Summary	307	12.9	Abstract	329	12.6	Abstract	598	12.9
Introduction	336	11.6	Introduction	411	11.4	Introduction	747	11.5
Table of contents	155	10.9	Table of contents	247	11.1	Table of contents	402	11.0
Conclusion	371	10.4	Conclusion	485	10.3	Conclusion	856	10.4
Foreword	58	9.9	Foreword	108	9.7	Foreword	166	9.8
Results and discussion	355	9.6	Results and discussion	452	9.7	Results and discussion	807	9.6
Description of research procedure	323	9.5	Description of research procedure	375	9.2	Description of research procedure	698	9.4
Preface	63	9.2	Figures	382	8.5	Preface	164	8.8
Figures	319	8.4	Preface	101	8.5	Figures	701	8.5
Symbol list & glossary	181	7.9	Tables	324	7.3	Symbol list & glossary	404	7.5
Tables	264	7.2	Symbol list & glossary	223	7.2	Tables	588	7.3
References	237	6.1	References	295	6.5	References	532	6.3
Appendixes	235	6.0	Appendixes	277	5.6	Appendixes	512	5.8

*Highest number indicates component was read first; lowest number indicates component was read last

TABLE H

Components Included by Half or More of Each Source (McCullough and Pinelli, 1982)

Component	Source			
	Included by a majority of survey reports	Included by half or more of style manuals and guides	Included by half or more of textbooks	Listed by NASA Publications Manual
Cover	Yes	Yes	Yes	Yes
Memo/Letter of transmittal	No	No	Yes	No
Title page	Yes	Yes	Yes	Yes
Abstract	No	Yes	Yes	Yes
Contents	Yes	Yes	Yes	Yes
List of figures/ illustrations	No	Yes	Yes	No
List of symbols	No	Yes	Yes	Yes
Introduction	Yes	Yes	Yes	Yes
Summary	No	No	Yes	Yes
Conclusions	No	No	Yes	Yes
Recommendations	No	No	Yes	No
Body (Text)	No	Yes	Yes	Yes
Discussion	No	No	Yes	Yes
Bibliography	No	Yes	Yes	Yes
References	No	Yes	Yes	Yes
Appendix	Yes	Yes	Yes	Yes
Foreword	No	Yes	No	No
Preface	No	Yes	No	Yes
List of tables	No	Yes	No	No
Glossary	No	Yes	Yes	No
Index	No	Yes	No	No

Survey Topic 2: Components Reviewed or Read to Determine Whether to Read the Full Report

The respondents were asked to indicate which components (up to five) listed in question 1 (see Table C) were used to decide whether to read the report. Respondents were asked to indicate the order in which these components were read. Table I shows the question contained in the questionnaire. Summaries of the results from the internal and external respondents are given in Tables J and K, respectively.

TABLE I

Text of Question 2

Referring to the list above, which NASA report components do you review or read to determine if you will actually READ THE REPORT? (Please select letter from list above in the order you review them.)

____ review first	____ review second	____ review third	____ review fourth	____ review fifth

TABLE J

Summary: Components Used by Internal Respondents to Decide Whether to Read a Report (n = 378)

Response / Component	Percentage of participants indicating responses					
	Review 1st	Review 2nd	Review 3rd	Review 4th	Review 5th	Summation review 1st - 5th
Title page	47.6	0.0	0.3	0.0	0.0	47.9
Foreword	0.0	2.6	0.8	0.3	1.1	4.8
Preface	0.0	0.3	0.5	0.8	0.8	2.4
Table of contents	0.3	3.2	6.6	3.4	1.3	14.8
Summary	17.2	28.3	19.0	3.2	1.1	68.8
Introduction	0.8	11.1	14.3	11.9	8.5	46.6
Symbol list and glossary	0.0	0.3	0.5	0.0	0.5	1.3
Description of research procedure	0.0	0.8	3.4	4.0	4.2	12.4
Results and discussions	0.3	1.1	5.3	9.0	8.7	24.4
Conclusion	2.6	16.1	23.3	16.7	8.5	67.2
Appendixes	0.0	0.0	0.0	0.8	0.8	1.6
References	0.0	0.3	0.8	1.6	1.3	4.0
Tables	0.0	0.0	0.5	1.1	1.9	3.5
Figures	0.8	1.9	7.7	7.9	5.3	23.6
Abstract	29.1	31.2	2.1	0.8	0.0	63.2
None of the above components	1.3	2.9	14.8	38.6	56.1	----

TABLE K

Summary: Components Used by External Respondents to Decide Whether to Read a Report (n = 504)

Component \ Response	Percentage of participants indicating responses					
	Review 1st	Review 2nd	Review 3rd	Review 4th	Review 5th	Summation review 1st - 5th
Title page	55.6	0.8	0.2	0.2	0.2	57.0
Foreword	0.2	3.2	0.8	0.8	0.6	5.6
Preface	0.0	0.6	0.6	1.6	0.0	2.8
Table of contents	0.6	6.7	6.7	4.6	2.4	21.0
Summary	16.9	31.5	19.6	5.2	3.8	77.0
Introduction	1.2	7.7	15.1	8.9	4.2	37.1
Symbol list and glossary	0.0	0.2	0.0	0.4	0.2	0.8
Description of research procedure	0.0	0.6	2.0	3.4	5.4	11.4
Results and discussions	0.4	3.4	6.7	8.1	6.3	24.9
Conclusion	1.0	9.7	19.6	17.3	10.5	58.1
Appendixes	0.0	0.0	0.0	0.8	0.4	1.2
References	0.6	0.6	0.4	1.0	2.5	5.1
Tables	0.0	0.0	1.8	1.2	3.0	6.0
Figures	0.6	3.2	5.0	6.5	4.6	19.9
Abstract	21.0	27.4	6.0	2.0	0.2	56.6
None of the above components	2.0	4.4	15.5	38.1	55.8	----

Table L lists the five components most frequently used by survey respondents in reviewing reports for possible reading and the percentage use by each group. Respondents from both groups indicated the summary, conclusion, abstract, title page, and introduction (listed in decreasing frequency of use) as the components most often reviewed to determine if a report would actually be read. The summary was the component utilized by the highest percentage of survey respondents as a screening tool. Sixty-nine percent of the internal and seventy-seven percent of the external respondents indicated that the summary was used as one of the screening components.

TABLE L

Components Most Commonly Used to Review/Read Reports

Component	Percentage of respondents indicating use of a report component	
	Internal survey n = 378	External survey n = 504
Summary	69	77
Conclusion	67	58
Abstract	63	57
Title page	48	57
Introduction	47	37

Table M gives a weighted average ranking for order of use of the five components most frequently reviewed in deciding whether to read a report. This table shows that the most common sequence used by the combined surveys was: title page, abstract, summary, introduction, and conclusion. The use pattern for both internal and external groups was the same as that for the combined surveys except that the internal users read the conclusion (fourth position) before the introduction (fifth position).

TABLE M

Weighted Average Ranking: Order in Which Components are Reviewed in Deciding Whether to Read a Report

Internal survey			External survey			Combined surveys		
Component	n	Weighted avg. rank*	Component	n	Weighted avg. rank*	Component	n	Weighted avg. rank*
Title page	181	4.99	Title page	287	4.95	Title page	468	4.97
Abstract	239	4.40	Abstract	288	4.17	Abstract	527	4.28
Summary	260	3.83	Summary	388	3.68	Summary	648	3.74
Conclusion	254	2.82	Introduction	187	2.81	Introduction	363	2.73
Introduction	176	2.65	Conclusion	293	2.54	Conclusion	547	2.67

*Highest number indicates component was read first; lowest number indicates component was read last

Survey Topic 3: Report Components Which Could Be Deleted

The respondents were asked to list any NASA report components (up to five) which could be deleted. Table N shows question 3 as it appeared on the questionnaire, and Table O contains a summary of the results tabulated for this question.

TABLE N

Text of Question 3

In your opinion, which of the above listed (in q. 1) report components could be deleted?

_____ _____ _____ _____ _____

TABLE O

Summary: Opinions of Respondents Concerning Which Report Components Could Be Deleted

Component	Percentage of respondents suggesting deletion	
	Internal respondents n = 378	External respondents n = 504
Title page	2.6	1.8
Foreword	69.0	53.0
Preface	67.5	54.2
Table of contents	24.1	10.3
Summary	13.0	7.3
Introduction	1.9	1.6
Symbol list and glossary	5.6	6.2
Research procedure	0.5	1.0
Results and discussions	0.0	0.2
Conclusion	0.5	0.8
Appendixes	1.6	2.8
References	0.0	1.0
Tables	0.0	0.2
Figures	0.3	0.0
Abstract	11.4	12.5
None	22.0	34.3

The most dispensable components were thought to be the foreword and the preface by both survey groups. Sixty-nine percent of the internal respondents and fifty-three percent of the external respondents suggested deleting the foreword. Sixty-eight percent of Langley respondents and fifty-four percent of the academic/industrial respondents named the preface as a component which could be deleted.

Twenty-four percent of the internal respondents suggested deleting the table of contents. Only 10 percent of the external respondents concurred with that opinion. Twenty-two percent of the internal and thirty-four percent of the external respondents indicated that no components should be deleted.

Survey Topic 4: Desirability of a Table of Contents

The respondents were asked a question concerning the need for and/or desirability of a table of contents in NASA technical reports, regardless of the report's length. Table P shows the question and possible responses as contained in the questionnaire. Summaries of the results from the internal and external respondents are given in Table Q.

TABLE P

Text of Question 4

Should ALL technical reports have a Table of Contents (regardless of length of report)?

___ Yes, all should. ___ No, only long reports need it.

TABLE Q

Summary: Opinions of Respondents Concerning the Desirability of a Table of Contents

Response	Percentage	
	Internal respondents n = 376	External respondents n = 503
Yes, all should	22.1	43.5
No, only long reports need it	77.9	56.5

Only 22 percent of the Langley respondents indicated that all NASA reports (regardless of length) should contain a table of contents; however, of the external respondents, 44 percent expressed the need for a table of contents in all NASA reports. Thus, while the majority opinion of both internal and external respondents was that only long reports need a table of contents, non-NASA respondents expressed the desire for this component in all NASA reports twice as often as the NASA Langley respondents.

McCullough and Pinelli (1982) found that 70 of the 99 reports they analyzed contained a table of contents. In every case, the table of contents was located as front matter. All six of the technical writing and editing textbooks and five of the six publications guides and style manuals consulted in the study recommended that technical reports contain a table of contents.

Survey Topic 5: Desirability of a Summary in Addition to an Abstract

The respondents were asked a question concerning the need for a summary (appearing in the front) in addition to the abstract, which appears as back matter on the COSATI page of NASA reports. Table R contains the question and possible responses as contained in the questionnaire. Summaries of the results obtained from the internal and external respondents are given in Table S.

TABLE R

Text of Question 5

Given that NASA reports contain brief abstracts (about 200 words) in the back, do you also need the more detailed summary section (which appears in the front)?

___Yes, include a summary, too. ___No, don't bother with it.

TABLE S

Summary: Opinions of Respondents Concerning the Desirability of a Summary in Addition to an Abstract

Response	Percentage	
	Internal respondents n = 374	External respondents n = 496
Yes, include a summary, too	51.1	68.7
No, don't bother with it	48.9	31.3

The internal respondents were fairly evenly divided about whether the more detailed summary should be included in NASA technical reports in addition to the abstract. (A slight majority (51 percent) favored inclusion of both components.) Among external respondents, however, 69 percent indicated that NASA reports should have a summary in addition to an abstract.

In the McCullough and Pinelli study (1982), 39 of the 99 technical reports analyzed contained an abstract, and 30 of the 99 contained a summary. Data were not collected on how many of these reports contained both components and how many contained only one of the two. In those reports containing an abstract, it was located as front matter in the majority of cases (85 percent). When present, the summary tended to be located as body matter most commonly (53 percent of the reports), followed by front matter (37 percent), and back matter (10 percent). All six textbooks recommended inclusion of an abstract; three of the six also recommended that a summary be used. The style manuals and publications guides were less uniform concerning both components. Three of the six sources recommended an abstract, but only one recommended a summary. All style manuals/publications guides placed the abstract and summary components in the front matter of the report. No data were obtained from the textbooks on the order of these two components.

Survey Topic 6: Location of the Definition of Symbols and Glossary of Terms

Survey respondents were asked to indicate where in a NASA report the definition of symbols and glossary of terms components should appear. Table T contains the question and possible responses as worded in the questionnaire. Summaries of the results from the internal and external respondents are given in Table U.

TABLE T

Text of Question 6

Where in a NASA technical report should a Definition of Symbols and Glossary of Terms appear? (check only one)

___Near front of report
___Near back of report
___Near front of report AND where symbol or term appears
___Near back of report AND where symbol or term appears
___NO Symbol List or Glossary of Terms needed; just define symbol or term where it appears in report

TABLE U

Summary: Opinions of Respondents Concerning the Location of the Definition of Symbols and Glossary of Terms

Response	Percentage	
	Internal respondents n = 375	External respondents n = 501
Near front of report	48.8	47.1
Near back of report	12.3	15.0
Near front of report AND where symbol or term appears	20.5	16.2
Near back of report AND where symbol or term appears	8.3	9.2
NO symbol list or glossary of terms needed; just define symbol or term where it appears in report	10.1	12.6

The response pattern from the internal and external respondents was similar. In both cases, the largest percentage (49 percent internally; 47 percent externally) chose the response, "near front of report." The second highest percentage of both groups (21 percent internally; 16 percent externally) chose "near front of report AND where symbol or term appears." Thus, when results from these two responses were combined, a preference (69 percent among internal respondents; 63 percent among external respondents) was evident for the definition of symbols and glossary of terms to be located near the front of reports as opposed to being located as back matter.

In the McCullough and Pinelli study (1982), the list of symbols and glossary were considered separately. Eighteen percent of the technical reports analyzed contained a list of symbols. Placement statistics were: front matter, 61 percent; body matter, 6 percent; and back matter, 33 percent. Twenty-three of the ninety-nine reports had a glossary. There was a strong consensus of practice to locate the glossary as back matter (87 percent). Glossaries appeared as front matter in only 9 percent and as body matter in only 4 percent of their occurrences.

Four of the six style manuals/publications guides consulted by McCullough and Pinelli recommended that a glossary be included in technical reports. Three style manuals/publications guides, all of which had recommended a glossary, also recommended a list of symbols and/or abbreviations. The list of symbols was treated as front matter by all three style manuals/publications guides. The glossary was treated as back matter by all four manuals. Of the six textbooks used in this study, three suggested inclusion of a list of symbols, and three suggested inclusion of a glossary. Two of the three books recommending a glossary had also recommended a list of symbols. No data were obtained from the textbooks regarding placement of these two components.

The NASA Publications Manual placed the symbols list as body matter following the introduction rather than as front or back matter. This location was viewed by several sources to interrupt the continuity from the introduction to the rest of the text and to be less accessible as a reference tool to the reader.

Survey Topic 7: When Appendix Material Is Read

Survey respondents were asked a question concerning when they read appendix material--before, with, or after the text. Table V contains the question and possible responses as they were worded in the questionnaire. Summaries of the results from the internal and external respondents are given in Table W.

TABLE V

Text of Question 7

When Appendixes appear in a NASA technical report, when do you usually read them? (check only one)

____Before the text
____With the text
____After the text

TABLE W

Summary: When Respondents Read Appendix Material

Response	Percentage	
	Internal respondents n = 373	External respondents n = 498
Before the text	1.6	2.0
With the text	22.0	20.5
After the text	76.4	77.5

The internal and external responses were very similar. A strong majority (77 percent internally; 78 percent externally) indicated that the appendixes were read after the text. Twenty-two percent of internal respondents and twenty-one percent of external respondents stated that the appendixes were read with the text. Only 2 percent of each population indicated that the appendix material was read prior to reading the text.

Survey Topic 8: Location and Use of Illustrative Material

Internal and external respondents were asked three questions concerning the location and use of illustrative material (such as tables, graphs, and photographs) in NASA technical reports. Table X contains the first of these questions and the possible responses. A summary of the results from the internal and external respondents is presented in Table Y.

TABLE X

Text of Question 8

Where in a NASA technical report should the illustrative material (tables, graphs, photographs, etc.) appear?

____Integrated with text
____Separate from text; at end of report

TABLE Y

Summary: Opinions of Respondents Concerning Integration of Illustrative Material as Opposed to Grouping It At the End of the Report

Response	Percentage	
	Internal respondents n = 375	External respondents n = 500
Integrated with text	80.3	80.2
Separate from text; at end of report	19.7	19.8

The survey results showed that 80 percent of both Langley and academic/industrial engineers and scientists preferred that illustrative material be integrated with the text as opposed to being grouped in the back matter.

The majority of the prescriptive sources and experimental/theoretical literature reviewed by McCullough and Pinelli (1982) recommended that figures and tables be integrated with the text. Eighty-two percent of the technical reports analyzed in that study had figures integrated into the text. Seventy-eight percent had tables integrated in the text. Figure 3 summarizes the findings of that study in regard to this topic. Average values were relatively similar among the various document categories except that figures were integrated in less than 60 percent of government reports.

The NASA Publications Manual stated that tables and figures can be either integrated with the text as body matter or grouped together in the back matter after the appendixes and references. Examination of several NASA reports indicated that the latter treatment was often employed. Prescriptive sources and the survey reports were in strong agreement that figures and tables should be included in the text as soon as possible after first mentioned.

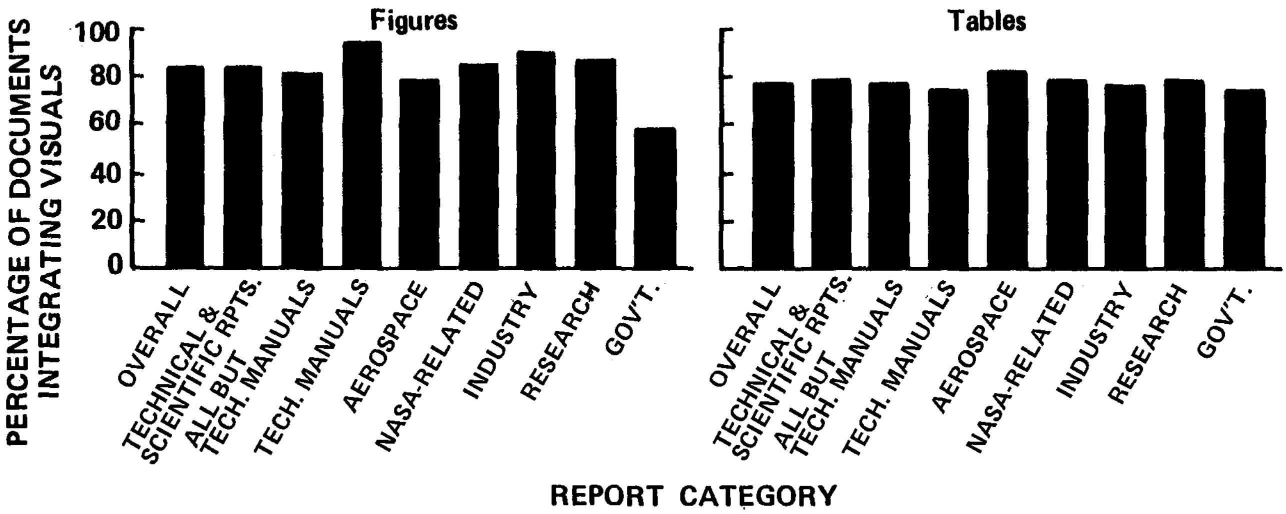

Figure 3. Percentage of documents analyzed by McCullough and Pinelli (1982) with visuals integrated in text

Table Z contains the second of the three questions related to user preferences concerning the placement of illustrative material. This question was addressed only to those participants who said in response to the previous question that illustrative material should be integrated with the text. The question was concerned with determining if a limit exists on the amount of visual matter than can be integrated without interrupting the reader. Summaries of the internal and external responses are presented in Table AA.

TABLE Z

Text of Question 9

If illustrative material should be integrated, is there a point at which the illustrative material interrupts your reading? (check only one)

___Yes, when there are two pages of illustrative material for every page of text

___Yes, when there are three pages of illustrative material for every page of text

___Yes, when there are four or more pages of illustrative material for every page of text

___No, I always prefer to have illustrative material integrated in text

TABLE AA

Summary: Opinions of Respondents Concerning the Amount of Illustrative Material That Can Be Integrated With the Text Without Interrupting the Reader

Response	Percentage	
	Internal respondents n = 298	External respondents n = 399
Yes, when there are two pages of illustrative material for every page of text	25.5	19.3
Yes, when there are three pages of illustrative material for every page of text	17.1	20.1
Yes, when there are four or more pages of illustrative material for every page of text	8.1	7.7
No, I always prefer to have illustrative material integrated in text	49.3	52.9

Of the Langley engineers and scientists, 49 percent indicated that integration of tables and figures did not interrupt their reading no matter how much illustrative material the report contained. The corresponding figure for academic and industrial engineers and scientists was 53 percent. The illustrative-page/text-page ratio which interrupted reading was placed at two by 26 percent of internal respondents and 19 percent of external respondents; at three by 17 percent of internal respondents and 20 percent of external respondents; and at four or more by 8 percent of both groups.

The McCullough and Pinelli study (1982) did not compile information from prescriptive sources on the amount of visual materials that can be integrated into the text without interrupting reading. The study did, however, present data on average table-to-page and figure-to-page ratios for 50 technical reports. The mean table-to-page ratio was 0.16, with a range of 0 to 0.66. The average figure-to-page ratio was 0.66, with a range of 0 to 2.03. Summing the means of the two ratios yields a visual-page/text-page ratio of 0.82. Only at the very upper range of the ratios did the amount of visual material in proportion to text material approach the point where some respondents indicated interruption of reading.

The third question concerning illustrative material dealt with when this material was read. Table BB contains the question and possible responses as worded on the questionnaire. Summaries of the internal and external responses are presented in Table CC.

TABLE BB

Text of Question 10

When do you usually read illustrative material?
(check only one)

____Before the text
____With the text
____After the text

TABLE CC

Summary: When Respondents Read Illustrative Material

Response	Percentage	
	Internal respondents n = 377	External respondents n = 500
Before the text	14.7	19.0
With the text	82.6	77.2
After the text	2.7	3.8

Most respondents (83 percent internally; 77 percent externally) indicated that the illustrative material was read with the text. Some respondents (15 percent internally; 19 percent externally) indicated that the illustrative material was read before the text. Only a few respondents (3 percent internally; 4 percent externally) indicated that the illustrative material was read after the text.

Survey Topic 9: Format of Reference Citations

The respondents were asked to specify their preference between two formats for reference citations in NASA technical reports. Table DD lists the survey question and the response options. Summaries of the internal and external respondents' responses are presented in Table EE.

TABLE DD

Text of Question 11

Which of the following two forms of reference citation do you prefer for technical reports? (check one)

____Cited in text by author/year (e.g., Jones 1978) with an alphabetical list in back of report
____Cited in text by number (e.g., reference 16) with a numbered list in back of report

TABLE EE

Summary: Preferences of Respondents Concerning the Format of Reference Citations

Response	Percentage	
	Internal respondents n = 371	External respondents n = 494
Cited in text by author/year (e.g., Jones 1978) with an alphabetical list in back of report	35.8	36.0
Cited in text by number (e.g., reference 16) with a numbered list in back of report	64.2	64.0

Sixty-four percent of the scientists and engineers preferred references in the text to be cited by number rather than by author and date. The percentage was essentially the same for both internal and external populations.

Survey Topic 10: Specification of Units for Dimensional Values

Question 12 asked the respondents to specify their preferences concerning the use of the International System (S.I.) units and/or U.S. Customary units for dimensional values in reports. Table FF contains the survey question and the response options. Table GG contains the results of the survey responses concerning this question.

TABLE FF

Text of Question 12

How do you prefer to have dimensional values specified in reports? (check only one)

____The International System (S.I.) units (e.g., meter, kilogram)
____U.S. Customary units (e.g., foot, pound)
____S.I. units with U.S. Customary units in parentheses
____U.S. Customary units with S.I. units in parentheses

TABLE GG

Summary: Preferences of Respondents Concerning Units for Dimensional Values

Response	Percentage	
	Internal respondents n = 374	External respondents n = 498
The International System (S.I.) units (e.g., meter, kilogram)	22.5	25.3
U.S. Customary units (e.g., foot, pound)	29.7	17.9
S.I. units with U.S. Customary units in parentheses	25.7	24.1
U.S. Customary units with S.I. units in parentheses	22.2	32.7

There was no overall agreement among either survey group as to how dimensional values should be specified in NASA technical reports. The responses were approximately equally divided among the four possible options except that, of the academic and industrial engineers and scientists, 33 percent preferred U.S. Customary units with S.I. units in parentheses, while only 18 percent preferred U.S. Customary units alone.

<u>Survey Topic 11: Column Layout and Right Margin Treatment</u>

The respondents were asked to state their preferences concerning one or two column layouts and ragged or justified right margins. Table HH contains the question as it appeared in the questionnaire. Table II summarizes the results of the internal and external surveys.

TABLE HH

Text of Question 13

Which of the following forms of layout do you prefer for technical reports? (check only one)

____One column; ragged right margin
____One column; justified right margin
____Two columns; ragged right margin
____Two columns; justified right margin

TABLE II

Summary: Preferences of Respondents Concerning Column Layout and Right Margin Treatment

Response	Percentage	
	Internal respondents n = 365	External respondents n = 483
One column; ragged right margin	53.4	55.3
One column; justified right margin	24.9	24.4
Two columns; ragged right margin	8.8	5.6
Two columns; justified right margin	12.9	14.7

Over half of both internal (54 percent) and external (55 percent) respondents preferred the one column, ragged right margin format. The one column, justified right margin was preferred by the second largest portion of both groups (25 percent internally; 24 percent externally). Thus, the one column format was preferred by 78 percent of the Langley scientists and engineers and by 80 percent of the academic/industrial scientists and engineers. Ragged right margins were preferred over justified right margins by 62 percent of the internal respondents and 61 percent of the external respondents.

Column layout and right margin treatment were aspects of technical report survey and analysis conducted by McCullough and Pinelli (1982). Their results, summarized in Figure 4, indicated that 75 percent of the reports analyzed used a one column layout, 22 percent used a two column format, and 3 percent had three columns. For technical and scientific reports, 90 percent used one column layouts. Technical manuals employed double column layouts more frequently (42 percent) than any other category.

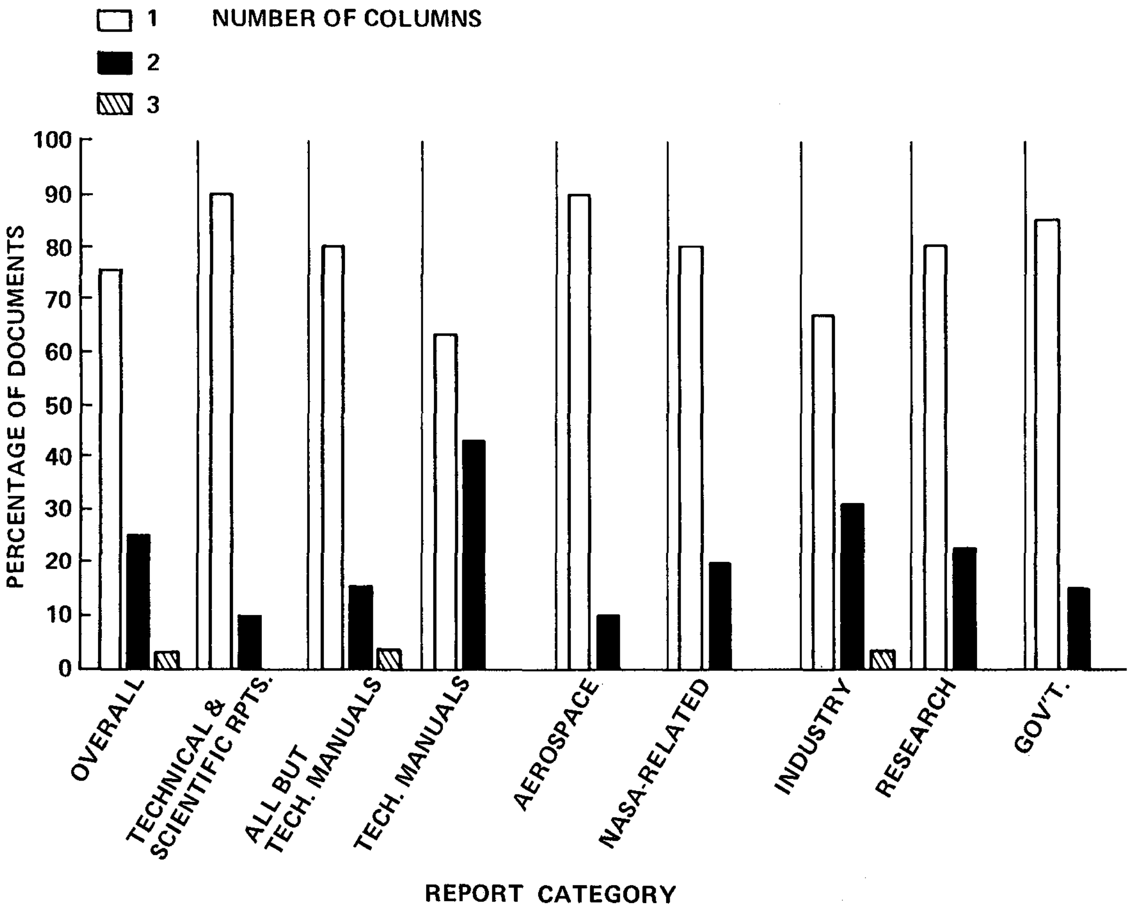

Figure 4. Number of columns in layouts of technical publications (McCullough and Pinelli, 1982)

McCullough and Pinelli's review of the literature relative to single and multiple column layouts revealed that the sources were mixed in their recommendations and opinions. Tinker (1963, p. 116) listed five advantages of double column over single column layouts: (1) higher character/page density, (2) fewer pages, (3) more logical and economical placement of figures and tables, (4) fewer sideways visuals, and (5) elimination of foldouts and tip-ins. Results of experimental studies by Tinker (1963, p. 118), Foster (Rehe, 1974, p. 50), Poulton (1970, p. 208), and Williamson (1966, p. 117) led many sources to recommend use of double column layouts in scientific and technical publications for reasons of increased legibility and readers' preference. Soar (1951, p. 65) and Tinker (1963, p. 116) reported a steady increase in the use of double column formats in scientific journals over a 60-year period.

Other researchers questioned whether multicolumn layouts possess any advantages. Burt (1959, p. 17) felt that double column measures were too narrow for any publication with extensive mathematical material. Kat and Knight (1980, p. 296), Hartley (1974, p. 16), and Burnhill (1976, p. 13, 17-18) demonstrated that the narrow measures encountered in multicolumn layouts retarded the reading rate of scanners and speed readers significantly by as much as 200 words per minute. Hartley (op. cit.) and Burnhill (op. cit.) both recommended as a result of their experiments that if a figure is wider than a column, it should be placed at the top or bottom of the page. Burnhill went on to recommend that if more than 50 percent of the figures span more than one column in a multicolumn layout, a single column layout should be used instead.

In regard to margins, the McCullough and Pinelli (1982) study showed that 60 percent of the survey reports used ragged right-hand margins. Only in the categories of technical manuals and reports published by research organizations did a majority of the documents use justified right-hand margins. Figure 5 illustrates the proportions of the overall survey and various document categories which employed each margin treatment.

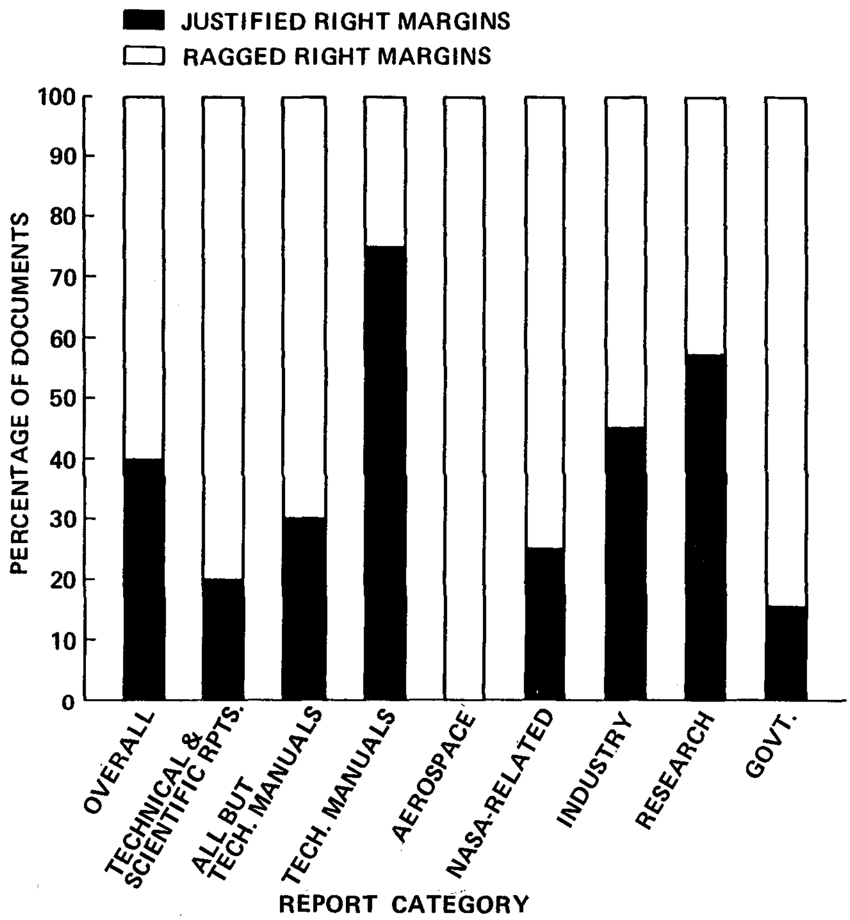

Figure 5. Use of justified and ragged right-hand margins in technical documents (McCullough and Pinelli, 1982)

Williamson (1966) stated that unjustified (ragged) right margins do not adversely affect legibility. Experiments conducted by Fabrizio, Kaplan, and Teal at the U.S. Office of Naval Research (Spencer, 1969, p. 37); Gregory and Poulton (Poulton, 1970, p. 208); Hartley and Burnhill, and Wiggins (Rehe, 1974, p. 32); and Zachrisson (1965, p. 155) all supported this conclusion. Mills and Walter (1978), A Manual of Style (University of Chicago, 1969), and the COSATI guidelines (U.S. Federal Council for Science and Technology, 1968) all stated that unjustified right margins were acceptable.

Survey Topic 12: Person and Voice

Survey respondents were asked to specify their preference in regard to person and voice in NASA technical reports. Table JJ contains the question as it appeared in the questionnaire. Table KK summarizes the results of the internal and external respondents.

TABLE JJ

Text of Question 14

Which of the following writing styles do you prefer for technical reports? (check only one)

____Passive voice, third person (e.g., Some success has been achieved using empirical methods.)
____Active voice, third person (e.g., Using empirical methods, investigators have achieved some success.)
____Active voice, first person (e.g., Using empirical methods, we have achieved some success.)

TABLE KK

Summary: Preferences of Respondents Concerning Person and Voice

Response	Percentage	
	Internal respondents n = 368	External respondents n = 487
Passive voice, third person	53.0	45.0
Active voice, third person	20.4	19.1
Active voice, first person	26.6	35.9

Among both groups, the passive voice, third person option was chosen most often as the preferred writing style for technical reports. Among LaRC personnel, this preference represented a slight majority (53 percent). Among external respondents, the selection rate was 45 percent. The active voice, first person was the choice of the second largest block of respondents--27 percent of LaRC respondents and 35 percent of external respondents. Twenty percent of the LaRC sample group and nineteen percent of the external sample group preferred the active voice, third person.

Considering voice alone, Langley engineers and scientists preferred passive over active by a 53/47 ratio. External engineers and scientists, on the other hand, showed a preference for active over passive by a 55/45 ratio.

The majority of both the internal (73 percent) and external (64 percent) respondents preferred that third person be used rather than first person in NASA technical reports. It should be noted, however, that a higher percentage of external group (36 percent) preferred first person than did the internal group (27 percent).

The data extracted by McCullough and Pinelli (1982) concerning use of person and voice in technical publications are given in Table LL. There was a strong tendency toward use of the third person in the text material (88 percent of reports) and in the summary material (95 percent of reports). The passive voice was used more often than the active voice in both text and summary sections. In the text, 56 percent of the reports used the passive voice exclusively, 38 percent used the active voice exclusively, and 6 percent used both voices.

TABLE LL

Use of Person and Voice in Technical Reports (McCullough and Pinelli, 1982)

Report section	Person (No. reports using)				Voice (No. reports using)		
	1st	2nd	3rd	Varied	Active	Passive	Both
Text (n = 50)	2	2	44	2	19	28	3
Summary (n = 42)	1	0	40	1	18	23	1

The literature review conducted as part of the McCullough and Pinelli study (1982) indicated that the strong tradition which existed in the past for use of the passive voice in scientific and technical literature was no longer dominant. This was evident from a review of technical writing/editing textbooks, style manuals, publications manuals, and other literature sources (e.g., Strunk and White, 1978; Stanley, 1975; and Holloway, 1974). A very strong consensus of current thinking indicated that active voice should be used whenever possible because it is usually more direct, natural, and concise. The active voice was favored over the passive voice whenever verbs concerned the interaction of inanimate objects and/or the writer wanted to emphasize who or what performed the action. The passive voice was recommended when the writer wanted to emphasize the receiver of the action rather than the doer.

Textbooks, style manuals, and publications guides were more divided on the question of person. Most did not treat the subject of person. The Publication Manual of the American Psychological Association (1974) indicated that experienced writers can use first person without sacrificing objectivity or dominating the communication. (These are the usual arguments against use of the personal pronouns "I" and "we.") On the other hand, Pauley (1979) stated that the use of first and second persons should be avoided, and Mills and Walter (1978) advocated avoiding first person or using it only sparingly.

FINDINGS

The findings were summarized and are presented for each survey topic. The following descriptors were used to present the findings.

Plurality	- the largest group, but less than half of the respondents
Substantial Minority	- an opposing response of 25 percent or more
Majority	- 50 to 59 percent of the respondents
Clear Majority	- 60 to 69 percent of the respondents
Strong Majority	- 70 to 79 percent of the respondents
Overwhelming Majority	- 80 percent or more of the respondents

Survey Topic 1: Order in Which Users Read or Review Report Components

The conclusion was the component read by the highest percentage of both survey groups. An overwhelming majority (98 percent internally and 96 percent externally) indicated they read the conclusion at some point in their reading sequence. Other components read by an overwhelming majority (80 percent or more) of both groups were the results and discussion, the summary, and the introduction.

The preface and foreword were read by only 19 percent of the users in the combined groups. An overwhelming majority of both survey groups stated they did not read the preface. An overwhelming majority of internal respondents and a strong majority of external respondents also indicated they did not read the foreword.

In the combined surveys, the most common reading sequence for the first six components (as determined by a weighted average method) was the title page, summary, abstract, introduction, table of contents, and conclusion. Although the abstract appears on the last page of NASA reports as part of the COSATI page, this component was read by a clear majority of both survey groups, and it was most commonly the second or third component read.

Survey Topic 2: Components Reviewed or Read to Determine Whether to Read the Full Report

Respondents from both survey groups indicated the summary, conclusion, abstract, title page, and introduction (listed in decreasing frequency of use) as the components usually reviewed to determine if a report would actually be read. A strong majority of external respondents and a clear majority of internal respondents stated the summary was used as one of the screening components. A clear majority of both groups named the summary as one of the first three components reviewed in deciding if a report would be read.

A clear majority of LaRC engineers and scientists used the conclusion and the abstract almost as often as the summary in determining whether to read the full report. For a strong majority (77 percent) of academic and industrial engineers and scientists, the summary was a clearer choice as a screening component over the conclusion, title page, and abstract, which were named by only a simple majority of the respondents.

As determined by the weighted average method, the most common sequence used by the combined surveys in reviewing reports for possible reading was the title page, abstract, summary, introduction, and conclusion.

Survey Topic 3: Report Components Which Could Be Deleted

A clear majority of internal respondents suggested deleting the foreword and the preface. A majority of external respondents also named these two components as those which could be deleted. A substantial minority of external respondents indicated they did not want any components deleted.

Survey Topic 4: Desirability of a Table of Contents

A strong majority of internal respondents indicated that only long reports need a table of contents. A majority of external respondents agreed with that opinion; however, a substantial minority in the external respondents indicated that all reports should have a table of contents. External respondents expressed the desire for a table of contents twice as frequently as internal respondents.

Survey Topic 5: Desirability of a Summary in Addition to an Abstract

The internal respondents were fairly evenly divided about whether the more detailed summary should be included in technical reports in addition to the abstract. A slight majority favored inclusion of both components. Among external respondents, however, a clear majority indicated that NASA technical reports should have a summary in addition to an abstract.

Survey Topic 6: Location of the Definition of Symbols and Glossary of Terms

In regard to the location of the definition of symbols and glossary of terms in technical reports, a plurality of both internal and external respondents indicated their preference for "near front of report." The response chosen by the second largest percentage of both sample groups was "near front of report AND where symbol or term appears." When these two responses were combined, a clear majority of both survey groups preferred the definition of symbols and glossary of terms to be located near the front of the report as opposed to being placed in the back matter or omitted.

Survey Topic 7: When Appendix Material Is Read

A strong majority of respondents in the internal and external survey groups indicated that they read the appendixes after the text rather than before or with the text.

Survey Topic 8: Location and Use of Illustrative Material

An overwhelming majority of both Langley and academic/industrial engineers and scientists preferred that illustrative material be integrated with the text rather than grouped separate from the text at the end of the report. When those respondents who favored integration of visuals into the text were questioned further, a plurality of LaRC engineers and scientists and a majority of academic/industrial engineers and scientists indicated a preference for integration regardless of the amount of illustrative material in the report. The remaining respondents (consisting of a majority in the internal survey group and a plurality in the external survey group) indicated that at varying points, large amounts of illustrative material interrupted reading. A substantial minority of LaRC scientists and engineers stated that when there were two pages of illustrative material for every page of text, reading was interrupted by the amount of the visual material. By summation of the survey groups indicating interruption at illustrative-page/text-page ratios of two, three, and four, it can be stated that a majority of Langley and a plurality of external respondents who favored integration indicated that reading would be interrupted if there were four or more pages of illustrative material per text page.

An overwhelming majority of Langley scientists and engineers and a strong majority of academic and industrial engineers and scientists indicated that illustrative material was read with the text rather than before or after the text of a report.

Survey Topic 9: Format of Reference Citations

A clear majority of internal and external respondents preferred that references in NASA technical reports be cited in the text by number with a numbered list in the back of the report rather than by author/year.

Survey Topic 10: Specification of Units for Dimensional Values

There was no overall agreement among either survey group as to how dimensional values should be specified in NASA technical reports. Preferences were about equally divided between S.I. units and U.S. Customary units. Among the external respondents who indicated a preference for U.S. Customary units, a clear majority indicated they favored inclusion of S.I. units in parentheses following the U.S. Customary units rather than use of U.S. Customary units alone.

Survey Topic 11: Column Layout and Right Margin Treatment

A majority of both internal and external respondents preferred a one column, ragged right margin format. A substantial minority of LaRC respondents preferred a one column, justified right margin format. One column layouts were preferred over two column layouts by a strong majority of the internal and an overwhelming majority of the external respondents. Ragged right margins were favored over justified right margins by a clear majority of both survey groups.

Survey Topic 12: Person and Voice

A majority of internal respondents and a plurality of external respondents selected passive voice, third person as the writing style preferred for technical reports. A substantial minority of both groups preferred active voice, first person.

Considering voice alone, a majority of LaRC engineers and scientists preferred passive; whereas, a majority of the academic/industrial engineers and scientists chose one of the active voice options. Considering person alone, a strong majority of internal respondents and a clear majority of external respondents chose one of the third person options rather than first person as the preferred writing style for technical reports.

VALIDITY OF THE ASSUMPTIONS

Conclusions were formed and are presented concerning the validity of the five assumptions made prior to the start of the study.

Assumption 1: The summary, introduction, conclusions, and illustrative material are read most frequently.

Table MM shows for each component, the percentages of survey respondents who indicated a particular component was read at some stage in the use sequence. The report components are listed in Table MM in descending percentage of use. The components mentioned in the first assumption are marked with an asterisk.

By referring to Table MM, it can be seen that the use of the components varied between the two survey groups. Assumption 1 was clearly true in regard to the conclusion for both survey groups, in regard to the introduction for the internal survey group, and in regard to the summary for the external survey group. Illustrative material (figures and tables in Table MM) was not among the four most frequently read components in either survey group. Figures were read by a higher percentage of both survey groups than tables.

If the criterion of overwhelming majority use (80 percent or more) by both survey groups were used to select components read most frequently, those components would be the conclusion, results and discussions, summary, and introduction. Three of these components (conclusion, introduction, and summary) were cited in assumption 1; however, results and discussions would appear in place of illustrative material.

Assumption 2: One or more of the aforementioned components (summary, introduction, conclusions, and illustrative material) may be the only one(s) read; therefore, each of these components should be independent of the remaining components.

The components used most frequently to review reports are listed in Table NN in descending percentage of use by the respondents. The components mentioned in assumption 2 are included for comparison and are marked by an asterisk. The summary, conclusion, and abstract were the components used most often for reviewing reports to determine whether to read the full report. By referring to Table NN, it can be seen that assumption 2 was clearly true in regard to the summary and conclusion, somewhat less so for the introduction, and not really so for the illustrative material, especially tables. Thus, particular attention should be directed toward independence of the summary, conclusion, and abstract in technical reports because one or more of these components may be the only one(s) read by a substantial number of readers. (It is less important for the introduction to be capable of being understood alone.)

TABLE MM

Examination of Assumption 1 Against Empirical Data

Internal survey (n=378)		External survey (n=504)	
Component	Percentage who read	Component	Percentage who read
*Conclusion	98	*Conclusion	96
Results and discussions	94	*Summary	91
*Introduction	89	Results and discussions	90
Description of research procedure	85	Title page	86
*Figures	84	*Introduction	82
*Summary	81	*Figures	76
Title page	78	Description of research procedure	74
Abstract	71	Abstract	65
*Tables	70	*Tables	64
References	63	References	59
Appendixes	62	Appendixes	55
Symbol list and glossary	48	Table of contents	49
Table of contents	41	Symbol list and glossary	44
Preface	17	Foreword	21
Foreword	15	Preface	20

*Assumed to be read most frequently in assumption 1

TABLE NN

Examination of Assumption 2 Against Empirical Data

Component	Percentage of respondents indicating use in reviewing reports	
	Internal survey n = 378	External survey n = 504
*Summary	69	77
*Conclusion	67	58
Abstract	63	57
Title page	48	57
*Introduction	47	37
Results and discussions	24	25
*Figures	24	20
*Tables	4	6

*Assumed to be a component which may be the only one(s) read in assumption 2

Assumption 3: The abstract, along with the conclusions, is sufficient to summarize the report, thereby negating the need for a summary.

A slight majority of LaRC respondents and a clear majority of academic/industrial respondents indicated a need for a summary in addition to the abstract in NASA reports. However, the results to survey question 1 indicated that 81 percent of the internal respondents and 91 percent of external respondents read the summary in technical reports. More people in both survey groups read the summary than the abstract. In addition, tabulation of responses to survey question 2 indicated that the summary was the component used by the highest percentage of both internal and external sample groups in reviewing reports to determine whether to read the complete report. Finally, in response to question 3, only 13 percent of Langley scientists and engineers and only 7 percent of their external counterpart suggested deleting the summary from NASA reports. Based on all of these findings, it is concluded that assumption 3 is false and that the summary is necessary in addition to the abstract in NASA reports.

Assumption 4: The reading of the entire report may well depend upon the ability of the introduction and conclusions to hold the reader's interest.

Data presented in Table NN indicated that the summary, conclusion, and abstract were the components used by the highest percentage of survey respondents in deciding whether to read a report. Assumption 4 is thus considered valid in regard to the conclusion, but appears less so for the introduction. The assumption that the reading of the entire report is dependent upon the ability of certain components to hold the reader's interest is valid; however, those components are more correctly identified as the summary, conclusion, and abstract rather than the introduction and conclusion.

Assumption 5: The technical report is read by audiences having diverse technical backgrounds and therefore should be understandable to those who are not expert in its subject.

Several sources cited in the Related Research and Literature section noted the diversity of content, subject matter, and intended audiences in discussing the technical report literature. Considering these references; the interdisciplinary nature of many research projects; and the use of reports by managers, engineers, scientists, and technologists in government, academic, and industrial work environments, it is safe to conclude that assumption 5 is correct.

CONCLUSIONS

Based on an analysis of the data, conclusions were drawn and are presented for each survey topic.

Survey Topic 1: Order in Which Users Read or Review Report Components

The conclusion was the component read by the highest percentage of both survey groups (98 percent internally and 96 percent externally). Thus, it is very important that a conclusion section appear in every report and that it be independent of the rest of the report since many report users who read the conclusion will not read other sections.

The preface and foreword were read by very few respondents. These components are seldom used in NASA technical papers and NASA technical memorandums. These two report categories constitute the bulk of the Agency's report literature.

In the combined survey groups, the most common reading sequence for the first six components was the title page, summary, abstract, introduction, table of contents, and conclusion. Although the abstract appears on the last page of NASA reports as part of the COSATI page, a plurality of Langley respondents and a substantial minority of external respondents read the abstract second, after the title page. Thus, the abstract was shown to be important to the respondents, as evidenced by the high percentages of both survey groups which read this component at some point in the use sequence (71 percent internally; 65 percent externally) and by the prominence of the abstract's position in the sequence of use (usually the second or third component read). The higher use by LaRC respondents could be the result of more internal personnel being familiar with the NASA report format. Some external respondents may not be aware that NASA reports contain an abstract and where it is located in the report. It may be desirable to make the abstract more accessible to report readers. This could be accomplished by a change in NASA policy to allow the abstract to be placed near the front of the report rather than on the last page. If this is not possible or desirable, then users could be advised of the presence and location of an abstract by a notice, perhaps on or following the conventional title page in the front matter.

Survey Topic 2: Components Reviewed or Read to Determine Whether to Read the Full Report

Respondents in the combined survey groups indicated the title page, abstract, summary, introduction, and conclusion as the most common sequence of reviewing components to determine if a report would actually be read. The summary, conclusion, and abstract were used most frequently as screening tools. One or more of these components may be the only ones read; therefore, it is important that each of these sections be written so that it can be read and understood independent of the rest of the report. Further, the reading of the entire report may depend on the ability of one or more of these components to hold the reader's interest. Particular attention should be directed toward the summary because it was the component utilized as a screening tool by the highest percentage of respondents in both survey groups.

Survey Topic 3: Report Components Which Could Be Deleted

A clear majority of internal respondents and a majority of external respondents named the foreword and preface as report components which could be deleted. Based on these results and the responses to question 1, which indicated that only 15 to

21 percent of report users read the preface and/or foreword, it may be desirable for the Agency to omit these components from the NASA report format.

Survey Topic 4: Desirability of a Table of Contents

While a strong majority of LaRC respondents and a majority of external respondents indicated that only long reports need a table of contents, the number of external respondents (43.5 percent) who thought all reports should have a table of contents was substantial. The table of contents may be more useful to non-NASA readers than to NASA personnel because of less familiarity with the customary format. Also relevant to this question were the responses to survey topic 3, to which 24 percent of the internal respondents, but only 10 percent of external respondents, named the table of contents as a component which could be deleted. Based on all these findings and the strong consensus in the literature and the 99 reports examined by McCullough and Pinelli (1982), it would probably be advantageous for NASA to routinely include a table of contents in all reports regardless of length. The table of contents provides an outline of the report's contents in addition to serving a locator function.

Survey Topic 5: Desirability of a Summary in Addition to an Abstract

A slight majority of internal respondents and a clear majority of academic/industrial respondents indicated the need for a summary in addition to the abstract in NASA reports. The results to survey question 1 showed that 81 percent of internal respondents and 91 percent of external respondents read the summary in technical reports. More people in both survey groups read the summary than the abstract. In addition, a tabulation of responses to survey question 2 showed that the summary was the component used by the highest percentage of both internal and external sample groups in reviewing reports to determine whether to read the complete document. Finally, in response to question 3, only 13 percent of Langley scientists and engineers and only 7 percent of their external counterpart suggested deleting the summary from NASA reports. Based on all of these findings, it is concluded that the summary should be retained in NASA reports.

Survey Topic 6: Location of the Definition of Symbols and Glossary of Terms

A clear majority of both sample groups stated a preference for the definition of symbols and glossary of terms to be located near the front of the report rather than near the back or omitted. The majority of readers did not indicate the need for symbols or terms to be defined where they appear in reports if definition of symbols and glossary of terms components were present in the report. By inference, it can be concluded that an overwhelming majority of respondents favored inclusion of a symbols list and glossary of terms because they selected a placement option for these components rather than the option which stated they were not necessary.

Results presented for question 1 showed that 52 percent of the internal respondents and 56 percent of the external respondents did not read the symbol list and glossary. Considering this result alone, the need for these components might be questioned. However, the responses to survey question 3 revealed that only 6 percent of LaRC and only 6 percent of external respondents suggested deleting the symbol list and glossary.

Thus, it can be concluded that while the majority of respondents do not actually read the definition of symbols and glossary of terms, they indicated that these components should be present for reference purposes. The most preferable placement from the respondents' viewpoint is near the front of the report. NASA's present practice of locating the symbols list as body matter following the introduction may need to be changed because the present location was found in the McCullough and Pinelli study (1982) to interrupt the continuity from the introduction to the rest of the text and to be less accessible to the reader as a reference tool.

Survey Topic 7: When Appendix Material Is Read

Based on the results showing that a strong majority of report users read appendix material after the text rather than before or with the text, the present placement of appendix material by NASA is satisfactory.

Survey Topic 8: Location and Use of Illustrative Material

Illustrative material in NASA technical reports should be integrated with the text rather than grouped together at the end of the report. This conclusion is based on the findings that an overwhelming majority of Langley and academic/industrial engineers and scientists read illustrative material with rather than before or after the text and prefer illustrative material to be integrated with the text rather than grouped together at the end of the report. In addition, McCullough and Pinelli (1982) found that an overwhelming majority of technical reports had figures and tables integrated with the text. Also, the majority of literature sources consulted during that study recommended the integration of visuals.

The results of more detailed questioning of respondents who favored the integration of visuals confirmed the need for the incorporation of tables and figures in the text material. A plurality of LaRC respondents and a majority of external respondents indicated a preference for integration regardless of the amount of illustrative material in a report. It does appear, however, that at a point when there were four or more pages of illustrative material per page of text, a majority of LaRC and a plurality of external respondents indicated that reading would be interrupted by the volume of the visual material. Thus, the mandate to integrate illustrative material was somewhat tempered by a consideration of amount; however, results of the McCullough and Pinelli (1982) project showed that only in rare instances would that amount of illustrative material appear in any technical report.

Survey Topic 9: Format of Reference Citations

A clear majority of both internal and external respondents expressed a prefer ence for references to be cited in the text by number (with a numbered list in the back of the report) rather than by author/year. Based on this finding, it can be concluded that from the respondents' perspective, citation by number is the preferred format for references in NASA technical reports.

Survey Topic 10: Specification of Units for Dimensional Values

It can be concluded that there is no general agreement either among internal or external respondents as to whether dimensional values in technical reports should be given in International System (S.I.) units and/or U.S. Customary units. Since responses were about equally divided among the four options, NASA's present practice of using S.I. units as the primary system with U.S. Customary units permitted in parentheses or as a secondary system appears satisfactory.

Survey Topic 11: Column Layout and Right Margin Treatment

A majority of internal and external survey respondents preferred NASA's present format--one column, ragged right margin--over two columns and/or justified right margins. No changes are indicated in NASA reports in regard to this survey topic. It is concluded that NASA's current format is quite satisfactory.

Survey Topic 12: Person and Voice

From the findings of the survey and the McCullough and Pinelli study (1982), it can be concluded that third person rather than first person is the clear majority choice for technical report writing. In regard to voice, any conclusions are less well defined. The passive voice was preferred by more LaRC respondents, but the active voice was preferred by more of their academic/industrial counterparts. In reports analyzed by McCullough and Pinelli, more documents were written in passive voice than in active voice, but the statistics were closer than those on person. Further, the McCullough and Pinelli literature review revealed a strong consensus of thinking in current sources that use of the active voice should be encouraged in technical reports whenever possible as the active voice was deemed more natural, concise, and direct. The Agency's current guidelines do not discuss person or voice.

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APPENDIX A

SURVEY QUESTIONNAIRE

For Office Use Only

NASA Technical Report Format

These questions are designed to determine how NASA technical reports are read and the preferred format of our readers.

1. The format for a typical NASA technical report appears below. Please number IN ORDER the components you generally read/review. (For example, if you read the "ABSTRACT" first, number it with a "1.") Do not number those components you skip.

1-30 (number 1, 2, 3, etc.) (ignore items you do not read)

a. ____ Title Page
b. ____ Foreword
c. ____ Preface
d. ____ Table of Contents
e. ____ Summary
f. ____ Introduction
g. ____ Symbol List and Glossary
h. ____ Description of Research Procedure
i. ____ Results and Discussions
j. ____ Conclusion
k. ____ Appendixes
l. ____ References
m. ____ Tables
n. ____ Figures
o. ____ Abstract

2. Referring to the list above, which NASA report components do you <u>review</u> or <u>read</u> to determine if you will actually READ THE REPORT? (please list letter from list above in the order you review them)

31-40

____ review first ____ review second ____ review third ____ review fourth ____ review fifth

3. In your opinion, which of the above listed (in q. 1) report components could be deleted?

41-50

____ ____ ____ ____ ____

4. Should ALL technical reports have a Table of Contents (regardless of length of report)?

51____ ____Yes, all should. ____ No, only long reports need it.

5. Given that NASA reports contain brief abstracts (about 200 words) in the back, do you <u>also</u> need the more detailed summary section (which appears in the front)?

52____ ____Yes, include a summary, too. ____No, don't bother with it.

6. Where in a NASA technical report should a Definition of Symbols and Glossary of Terms appear? (check only one)

53____

____Near front of report
____Near back of report
____Near front of report AND where symbol or term appears
____Near back of report AND where symbol or term appears
____NO Symbol List or Glossary of Terms needed; just define symbol or term where it appears in report

7. When Appendixes appear in a technical report, when do you usually read them? (check only one)

54____

____Before the text
____With the text
____After the text

8. Where in a NASA technical report should the illustrative material (tables, graphs, photographs, etc.) appear?
   ___ Integrated with text
55___ ___ Separate from text; at end of report

9. If illustrative material should be integrated, is there a point at which the illustrative material interrupts your reading? (check only one)
   ___ Yes, when there are two pages of illustrative material for every page of text
   ___ Yes, when there are three pages of illustrative material for every page of text
56___ ___ Yes, when there are four or more pages of illustrative material for every page of text
   ___ No, I always prefer to have illustrative material integrated in text

10. When do you usually read illustrative material? (check only one)
   ___ Before the text
57___ ___ With the text
   ___ After the text

11. Which of the following two forms of reference citation do you prefer for technical reports? (check one)
   ___ Cited in text by author/year (e.g., Jones 1978) with an alphabetical list in back of report
58___ ___ Cited in text by number (e.g., reference 16) with a numbered list in back of report

12. How do you prefer to have dimensional values specified in reports? (check only one)
   ___ The International System (S.I.) units (e.g., meter, kilogram)
   ___ U.S. Customary units (e.g., foot, pound)
59___ ___ S.I. units with U.S. Customary units in parentheses
   ___ U.S. Customary units with S.I. units in parentheses

13. Which of the following forms of layout do you prefer for technical reports? (check only one)
   ___ One column; ragged right margin
   ___ One column; justified right margin
60___ ___ Two columns; ragged right margin
   ___ Two columns; justified right margin

14. Which of the following writing styles do you prefer for technical reports? (check only one)
   ___ Passive voice, third person (e.g., Some success has been achieved using empirical methods.)
   ___ Active voice, third person (e.g., Using empirical methods, investigators have achieved some success.)
61___ ___ Active voice, first person (e.g., Using empirical methods, we have achieved some success.)

USE OF SCIENTIFIC AND TECHNICAL INFORMATION

These questions are designed to determine your use of published scientific and technical information.

15. Do you use non-NASA authored literature in your research?

62 a. technical report literature ___ yes ___ no ___ not sure
63 b. journal articles ___ yes ___ no ___ not sure
64 c. conference/meeting papers ___ yes ___ no ___ not sure

16. Do you use NASA-authored literature in your research?

65 a. technical report literature ___ yes ___ no ___ not sure
66 b. journal articles ___ yes ___ no ___ not sure
67 c. conference/meeting papers ___ yes ___ no ___ not sure

17. Do you use literature authored by Langley Research Center personnel?

68 a. technical report literature ___ yes ___ no ___ not sure
69 b. journal articles ___ yes ___ no ___ not sure
70 c. conference/meeting papers ___ (1) yes ___ (2) no ___ (3) not sure

YOUR IMAGE OF NASA AND LANGLEY-AUTHORED PUBLISHED INFORMATION

Please rate the following items, using the scale below:

Scientific research is Important ☒ ☐ ☐ ☐ ☐ Unimportant

Check 1 for "very important"
Check 2 for "somewhat important"
Check 3 for "neither important nor unimportant"
Check 4 for "somewhat unimportant"
Check 5 for "very unimportant"

SAMPLE

18. When compared to other journal articles in my field the PRESTIGE of NASA-authored journal articles is

71 Higher ☐ ☐ ☐ ☐ ☐ Lower ____ not familiar with those from NASA

When compared to other journal articles in my field, the PRESTIGE of Langley-authored journal articles is

72 Higher ☐ ☐ ☐ ☐ ☐ Lower ____ not familiar with those from Langley

19. When compared to other technical report literature in my discipline, the PRESTIGE of NASA-authored technical reports is

73 Higher ☐ ☐ ☐ ☐ ☐ Lower ____ not familiar with those from NASA

When compared to other technical report literature in my discipline, the PRESTIGE of Langley-authored technical reports is

74 Higher ☐ (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) Lower ____ (6) not familiar with those from Langley

75-77____

78-80____

20. When compared to other technical report literature in my discipline, the ADEQUACY OF DATA in NASA-authored technical reports is

1 Higher ☐ ☐ ☐ ☐ ☐ Lower ____ not familiar with those from NASA

When compared to other technical report literature in my discipline, the ADEQUACY OF DATA in Langley-authored technical reports is

2 Higher ☐ ☐ ☐ ☐ ☐ Lower ____ not familiar with those from Langley

21. When compared to other technical report literature, the QUALITY OF VISUAL PRESENTATIONS in NASA-authored technical reports (e.g., graphics, photography, type style) is

3 Higher ☐ ☐ ☐ ☐ ☐ Lower ____ not familiar with those from NASA

When compared to other technical report literature, the QUALITY OF VISUAL PRESENTATIONS in Langley-authored technical reports (e.g., graphics, photography, type style) is

4 Higher ☐ (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) Lower ____ (6) not familiar with those from Langley

NASA SCIENTIFIC AND TECHNICAL INFORMATION

22. In terms of "ADVANCING THE STATE OF THE ART," NASA-authored scientific and technical information is

5____ Higher ☐ ☐ ☐ ☐ ☐ Lower ____ not familiar with those from NASA

In terms of "ADVANCING THE STATE OF THE ART," Langley-authored scientific and technical information is

6____ Higher ☐ ☐ ☐ ☐ ☐ Lower ____ not familiar with those from Langley

23. For my research, NASA scientific and technical information is

7____ Important ☐ ☐ ☐ ☐ ☐ Unimportant

24. In terms of my professional advancement/development, publishing is

8____ Important ☐ ☐ ☐ ☐ ☐ Unimportant

25. In my organization, publication is

9____ Encouraged ☐ ☐ ☐ ☐ ☐ Discouraged

Continued On Next Page

26. For my research, I use: (check appropriate boxes)

		Always	Usually	Sometimes	Unfamiliar with
10___	a. STAR (Scientific and Technical Aerospace Reports), the NASA announcement journal for report literature	☐	☐	☐	☐
11___	b. IAA (International Aerospace Abstract), the NASA announcement journal for periodicals, meeting papers, and conference proceedings	☐	☐	☐	☐
12___	c. SCAN (Selected Current Aerospace Notices), a NASA current awareness publication	☐	☐	☐	☐
13___	d. NASA literature searches obtained through NASA Scientific and Technical Information Facility, NASA libraries, Defense Technical Information Center, or Dept. of Energy	☐	☐	☐	☐

BACKGROUND

The purpose of these questions is to determine whether people with different backgrounds all have different opinions. The answers will NOT be used to identify anyone.

14___ 27. Total years of professional work experience:
- ___ less than 1 year
- ___ 1-5 years
- ___ 6-10 years
- ___ 11-15 years
- ___ 16-20 years
- ___ 21+ years

28. MAJOR field of interest (check only ONE, please)

15-16___
- ___ aeronautics
- ___ chemistry and materials
- ___ astronautics
- ___ math and computer science
- ___ physics
- ___ geosciences
- ___ life sciences
- ___ space sciences
- ___ structural analysis
- ___ electronics/electrical

TO BE ANSWERED BY NON-LANGLEY PERSONNEL ONLY

29. Type of organization you work at:

17___
- ___ industrial organization
- ___ not-for-profit organization
- ___ educational institution
- ___ NASA
- ___ other government agency
- ___ other (please specify) ______________________

30. Present professional duties (check the ONE that most applies):

18___
- ___ basic research
- ___ applied research
- ___ teaching/academic (may include research)
- ___ private consultant
- ___ technical administration
- ___ other (please specify) ______________________

TO BE ANSWERED BY LANGLEY PERSONNEL ONLY

31. Your position within the organization (check one):

19___
- ___ individual contributor
- ___ unit, group, or section head
- ___ branch/assistant branch head
- ___ division/assistant division chief

32. How many years have you been with Langley?

20___
- ___ less than 1 year
- ___ 1-5 years
- ___ 6-10 years
- ___ 11-15 years
- ___ 16-20 years
- ___ 21+ years

21-22___ 33. Research organization assigned to (e.g., ACD, FED, MATD.): ______________________
(Please specify)

23-25___

26-28___

APPENDIX A

PROGRAM IMPROVEMENT (Please fill this out last.)

1. Are there comments you would like to add about topics covered in this questionnaire?

2. Are there comments you would like to add about anything not previously mentioned?

3. What can be done to make NASA-generated research more accessible to you?

APPENDIX B

National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia
23665

REQUEST FOR PARTICIPATION:
CENTER DIRECTOR'S TRANSMITTAL LETTER

NASA

Reply to Attn of

Approximately 18 months ago, a review and evaluation of the Center's scientific and technical information (STI) program was undertaken. The purpose of the study was to determine the areas or portions of the Center's STI program which could be improved. Many of the study's recommendations have already been implemented.

The final phase of the study involves a review of the NASA technical report format as an effective medium for transmitting information. The review will focus on the organization of the report, the component parts, and their relationship within the total report context. The goal of the study is to determine if the NASA report format can be improved.

Mail-in questionnaires will be used to obtain the desired data. A representative sample of participants will be selected from three professional/technical societies (e.g., AIAA, IEEE, and AGU) and from the Langley Research Center. The confidential responses will be tabulated and analyzed by an independent research firm to provide valuable insights into the NASA technical report and NASA/Langley STI.

Your name has been selected at random to participate in the study. Please complete and return the enclosed survey questionnaire by January 19, 1982, to Continental Research, Box 6112, Norfolk, Virginia 23508, using the prepared enclosed envelope.

I endorse this effort and request your participation and cooperation. The intended outcome of this study is to improve the overall organization and format of the NASA technical report and to improve its effectiveness as a medium for information dissemination.

Sincerely,

Donald P. Hearth
Director

Enclosure

APPENDIX C

REMINDER/APPRECIATION LETTER: INTERNAL SURVEY

Continental Research

4500 Colley Avenue
Norfolk, Va. 23508
(804) 489-4887

February 3, 1982

Someone from my office tried to call you last week to be certain that the NASA technical report survey had arrived. Since you were unavailable, I just wanted to be sure you know how much your effort was appreciated. The survey was mailed from NASA on January 4, 1982. If you have not received it, please call me at 1-489-4887.

Thanks so much!

Sincerely,

Nanci A. Glassman
President

NG/ray

Marketing, Advertising, Political, and Social Problems Research

APPENDIX D

COVER LETTER:
EXTERNAL SURVEY

Continental Research

4500 Colley Avenue
Norfolk, Va. 23508
(804) 489-4887

January 1982

Thank you for your willingness to participate in the pre-test phase of this study being done for the National Aeronautics and Space Administration. This is one phase of a project to review and evaluate NASA's scientific and technical information program. A sample of a typical NASA technical report has been enclosed for your reference.

Your opinions are vital. Please complete the enclosed anonymous survey today and return it to me at Continental Research, P. O. Box 6112, Norfolk, Virginia 23508, using the pre-paid envelope provided.

Your cooperation is appreciated.

Sincerely,

Nanci A. Glassman
President

NG/js

Enclosures: 1 pre-test survey
1 pre-paid envelope
1 postcard
1 sample report

APPENDIX E

Continental Research REMINDER/APPRECIATION LETTER: EXTERNAL SURVEY

4500 Colley Avenue
Norfolk, Va. 23508
(804) 489-4887

February 3, 1982

Just a note to thank you for your willingness to participate in our pre-test survey for the National Aeronautics and Space Administration.

Someone from my office tried to call you last week to be certain that the survey had arrived and to thank you for your help. Since you were unavailable, I just wanted to be sure you know how much your effort was appreciated.

Thanks so much!

Sincerely,

Nanci A. Glassman
President

NG/js

APPENDIX F

QUESTIONNAIRE WITH AGGREGRATE TALLIES: INTERNAL SURVEY

For Office Use Only

NASA Technical Report Format

These questions are designed to determine how NASA technical reports are read and the preferred format of our readers.

1. The format for a typical NASA technical report appears below. Please number IN ORDER the components you generally read/review. (For example, if you read the "ABSTRACT" first, number it with a "1.") Do not number those components you skip.

See Table D(p.21) for aggregrate tallies for question 1.

1-30 (number 1, 2, 3, etc.) (ignore items you do not read)

a. ____ Title Page
b. ____ Foreword
c. ____ Preface
d. ____ Table of Contents
e. ____ Summary
f. ____ Introduction
g. ____ Symbol List and Glossary
h. ____ Description of Research Procedure
i. ____ Results and Discussions
j. ____ Conclusion
k. ____ Appendixes
l. ____ References
m. ____ Tables
n. ____ Figures
o. ____ Abstract

2. Referring to the list above, which NASA report components do you review or read to determine if you will actually READ THE REPORT? (please list letter from list above in the order you review them)

31-40

____ review first ____ review second ____ review third ____ review fourth ____ review fifth

See Table J(p.27) for aggregrate tallies for question 2.

3. In your opinion, which of the above listed (in q. 1) report components could be deleted?

41-50 ____ ____ ____ ____ ____

See Table O (p.31) for aggregrate tallies for question 3.

4. Should ALL technical reports have a Table of Contents (regardless of length of report)?

51____ 22.1% Yes, all should. 77.9% No, only long reports need it. n=376

5. Given that NASA reports contain brief abstracts (about 200 words) in the back, do you also need the more detailed summary section (which appears in the front)?

52____ 51.1% Yes, include a summary, too. 48.9% No, don't bother with it. n=374

6. Where in a NASA technical report should a Definition of Symbols and Glossary of Terms appear? (check only one)

53____ n=375

48.8% Near front of report
12.3% Near back of report
20.5% Near front of report AND where symbol or term appears
8.3% Near back of report AND where symbol or term appears
10.1% NO Symbol List or Glossary of Terms needed; just define symbol or term where it appears in report

7. When Appendixes appear in a technical report, when do you usually read them? (check only one)

54____ n=373

1.6% Before the text
22.0% With the text
76.4% After the text

8. Where in a NASA technical report should the illustrative material (tables, graphs, photographs, etc.) appear?
80.3% Integrated with text n=375
55 19.7% Separate from text; at end of report

9. If illustrative material should be integrated, is there a point at which the illustrative material interrupts your reading? (check only one)
25.5% Yes, when there are two pages of illustrative material for every page of text n=298
17.1% Yes, when there are three pages of illustrative material for every page of text
56 8.1% Yes, when there are four or more pages of illustrative material for every page of text
49.3% No, I always prefer to have illustrative material integrated in text

10. When do you usually read illustrative material? (check only one)
14.7% Before the text
57 82.6% With the text n=377
2.7% After the text

11. Which of the following two forms of reference citation do you prefer for technical reports? (check one)
35.8% Cited in text by author/year (e.g., Jones 1978) with an alphabetical list in back of report
58 64.2% Cited in text by number (e.g., reference 16) with a numbered list in back of report n=371

12. How do you prefer to have dimensional values specified in reports? (check only one)
22.5% The International System (S.I.) units (e.g., meter, kilogram)
29.7% U.S. Customary units (e.g., foot, pound) n=374
59 25.7% S.I. units with U.S. Customary units in parentheses
22.2% U.S. Customary units with S.I. units in parentheses

13. Which of the following forms of layout do you prefer for technical reports? (check only one)
53.4% One column; ragged right margin
24.9% One column; justified right margin n=365
60 8.8% Two columns; ragged right margin
12.9% Two columns; justified right margin

14. Which of the following writing styles do you prefer for technical reports? (check only one) n=368
53.0% Passive voice, third person (e.g., Some success has been achieved using empirical methods.)
20.4% Active voice, third person (e.g., Using empirical methods, investigators have achieved some success.)
61 26.6% Active voice, first person (e.g., Using empirical methods, we have achieved some success.)

OMB 2700-0030

APPENDIX G

QUESTIONNAIRE WITH AGGREGRATE TALLIES:

NASA Technical Report Format EXTERNAL SURVEY

For Office Use Only

These questions are designed to determine how NASA technical reports are read and the preferred format of our readers.

1. The format for a typical NASA technical report appears below. Please number IN ORDER the components you generally read/review. (For example, if you read the "ABSTRACT" first, number it with a "1.") Do not number those components you skip.

1-30 (number 1, 2, 3, etc.) (ignore items you do not read)

a. ____ Title Page
b. ____ Foreword
c. ____ Preface
d. ____ Table of Contents
e. ____ Summary
f. ____ Introduction
g. ____ Symbol List and Glossary
h. ____ Description of Research Procedure
i. ____ Results and Discussions
j. ____ Conclusion
k. ____ Appendixes
l. ____ References
m. ____ Tables
n. ____ Figures
o. ____ Abstract

See Table E(p.22) for aggregrate tallies for question 1.

2. Referring to the list above, which NASA report components do you review or read to determine if you will actually READ THE REPORT? (please list letter from list above in the order you review them)

31-40

____ review first ____ review second ____ review third ____ review fourth ____ review fifth

See Table K(p.) for aggregrate tallies for question 2.

3. In your opinion, which of the above listed (in q. 1) report components could be deleted?

41-50

____ ____ ____ ____ ____

See Table O (p.31) for aggregrate tallies for question 3.

4. Should ALL technical reports have a Table of Contents (regardless of length of report)?

51 ___ 43.5% Yes, all should. 56.5% No, only long reports need it. n=503

5. Given that NASA reports contain brief abstracts (about 200 words) in the back, do you also need the more detailed summary section (which appears in the front)?

52 ___ 68.8% Yes, include a summary, too. 31.3% No, don't bother with it. n=496

6. Where in a NASA technical report should a Definition of Symbols and Glossary of Terms appear? (check only one)

53 ___

47.1% Near front of report
15.0% Near back of report
16.2% Near front of report AND where symbol or term appears
9.2% Near back of report AND where symbol or term appears
12.6% NO Symbol List or Glossary of Terms needed; just define symbol or term where it appears in report

n=501

7. When Appendixes appear in a technical report, when do you usually read them? (check only one)

54 ___

2.0% Before the text
20.5% With the text
77.5% After the text

n=498

OMB 2700-0030

APPENDIX G

8. Where in a NASA technical report should the illustrative material (tables, graphs, photographs, etc.) appear?
80.2% Integrated with text
55 19.8% Separate from text; at end of report n=500

9. If illustrative material should be integrated, is there a point at which the illustrative material interrupts your reading? (check only one)
19.3% Yes, when there are two pages of illustrative material for every page of text
56 20.1% Yes, when there are three pages of illustrative material for every page of text n=399
7.7% Yes, when there are four or more pages of illustrative material for every page of text
52.9% No, I always prefer to have illustrative material integrated in text

10. When do you usually read illustrative material? (check only one)
19.0% Before the text
57 77.2% With the text n=500
3.8% After the text

11. Which of the following two forms of reference citation do you prefer for technical reports? (check one) n=494
36.0% Cited in text by author/year (e.g., Jones 1978) with an alphabetical list in back of report
58 64.0% Cited in text by number (e.g., reference 16) with a numbered list in back of report

12. How do you prefer to have dimensional values specified in reports? (check only one)
25.3% The International System (S.I.) units (e.g., meter, kilogram)
17.9% U.S. Customary units (e.g., foot, pound)
59 24.1% S.I. units with U.S. Customary units in parentheses n=498
32.7% U.S. Customary units with S.I. units in parentheses

13. Which of the following forms of layout do you prefer for technical reports? (check only one)
55.3% One column; ragged right margin
24.4% One column; justified right margin n=483
60 5.6% Two columns; ragged right margin
14.7% Two columns; justified right margin

14. Which of the following writing styles do you prefer for technical reports? (check only one) n=487
45.0% Passive voice, third person (e.g., Some success has been achieved using empirical methods.)
19.1% Active voice, third person (e.g., Using empirical methods, investigators have achieved some success.)
61 35.9% Active voice, first person (e.g., Using empirical methods, we have achieved some success.)

1. Report No. NASA TM-84502	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle SURVEY OF READER PREFERENCES CONCERNING THE FORMAT OF NASA TECHNICAL REPORTS		5. Report Date AUGUST 1982 6. Performing Organization Code
7. Author(s) Thomas E. Pinelli,* Myron Glassman,† and Virginia M. Cordle‡		8. Performing Organization Report No.
9. Performing Organization Name and Address NASA Langley Research Center Hampton, Virginia 23665		10. Work Unit No. 11. Contract or Grant No.
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, D.C. 20546		13. Type of Report and Period Covered Technical Memorandum 14. Sponsoring Agency Code

15. Supplementary Notes

*Assistant Chief, Research Information and Applications Division, M/S 180A
NASA Langley Research Center, Hampton, VA 23665, (804) 827-2691, FTS 928-2691
†Old Dominion University, Norfolk, VA ‡College of William & Mary, Williamsburg, VA

16. Abstract

A survey of engineers and scientists at NASA's Langley Research Center (LaRC) and in the academic/industrial communities was conducted to determine the opinions of readers concerning the format (organization) of NASA technical reports and usage of technical report components. A survey questionnaire was sent to 513 LaRC engineers and scientists and 600 engineers and scientists from three (3) professional/technical societies. The response rates were 74 and 85 percent, respectively.

The questionnaire contained 14 questions covering 12 survey topics which included the order in which users read report components, the components reviewed or read to determine whether to read a report, report components which could be deleted, the desirability of a table of contents, the desirability of both a summary and abstract, the location of the symbols list and glossary, the integration of illustrative material, the preferred format for reference citations, column layout and right margin treatment, and person/voice.

The validity of five assumptions was tested. Conclusions were drawn from the 14 questions which were grouped into 12 survey topics. The results of the reader preference survey indicated that the conclusion was the component most often read by survey respondents. The summary, conclusion, abstract, title page, and introduction were the components used most frequently to determine if a report would actually be read. Respondents indicated that a summary as well as an abstract should be included, that the definition of symbols and glossary of terms should be located in the front of the report, and that illustrative material should be integrated with the text rather than grouped at the end of the report. Citation by number was the preferred format for references. A one-column, ragged right margin was preferred. Third person, passive voice was the style of writing preferred by the respondents.

17. Key Words (Suggested by Author(s)) Component Usage Technical Report Format Survey Research Reader Preferences Reading Habits		18. Distribution Statement Unclassified – Unlimited Subject Category – 82	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 84	22. Price*

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20546

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NASA

POSTMASTER: If Undeliverable (Section 158 Postal Manual) Do Not Return