28

TECHNICAL REPORT-WRITING :
METHODS AND PROCEDURES

A.L. Moorthy
C.R. Karisiddappa

Introduction

Communication is the process of transmission or exchanging or interchanging of ideas, thoughts, feelings, information etc. through a common system of symbols, signs, gestures or language. This progress may take place between individuals or groups. Various types of communication include oral, visual/audiovisual, written and electronic communication.

Technical communication had its origins during World War II when the Royal Air Force Officers felt the need for an operation manual explaining the procedures and techniques of maintenance of various systems and sub-systems of aircraft engaged in the War. Since a lot of technical details were included in them, these came to be known as technical manuals. Thus, a new career specialisation, 'Technical Communication', typical of technical jargon has emerged. This branch of knowledge received attention from R & D scientists, science administrators, top management in business and industry [1]

Necessity of Technical Communication to L IS Professionals

With increased R & D activities in each and every field of human knowledge, it has become necessary to have working knowledge about technical communication. Professionals in Library and Information Science (LIS) field may have to write project proposals, for example, starting a new professional service or purchasing an equipment or development of a machine readable database of library holdings; research and review papers for publication in scholarly periodicals or presenting in conferences; chapter in a book; project report, say, automation of library operations; periodical progress reports on activities, plans and ongoing projects; brochures or promotional material for marketing professional services like

consultancy, SDI and CAS; and state-of-the-art reports for management for helping in decision making. All these activities obviate good understanding of technical writing for effective handling of the tasks undertaken.

What is a Technical Report ?

A report is defined as a definitive document which provides information about a task or exercise. As R & D report states the results of or progress made with a research and development investigation [2]. A report is an organised, factual and objective information brought out by a person who has experienced or accumulated (information) and communicated to a person or persons who need it or want it or entitled to it.[3].

A technical report usually is more detailed than an article published in a journal or a paper presented at a conference. It contains sufficient data to enable a reader to evaluate the investigative process of original research or development. It is an end product of an investigation, survey, research project etc.

Technical report, the primary recording medium for R & D work, has become an important source of information in recent years. This is mainly because of the time consuming routines of publication procedures of journals and their preference to publish completed research as against research in progress. But many a time, the nature of communication does not require wide dissemination and so a technical report is brought out. Further, the government-funded research results in the areas of space, nuclear sciences, and defence is generally shrouded under secrecy and national security and so are circulated to a very limited people. All these factors have resulted in the emergence of the technical report, which is issued in different sizes and formats [4].

Technical reports are characterised by their objectivity and targeted audience. They define the problem, analyse and assess the current and future conditions, describe the method/experiment to solve a problem, discuss the results, draw conclusions and recommend future course of action.

A technical report is prepared for various purposes. Project proposals are submitted to get grants; periodical reports are made to

inform the status of and progress made in a project; state-of-the-art reports are prepared to make the top management abreast of the latest developments in a specific field; technical papers are published to inform the outside world and those working in the field about the new findings and so on. Whatever may be the form of the technical report, it is written with three main purposes: (a) to inform readers about the outcome of a study, (b) to record the research findings and test outcome for posterity, and (c) to recommend appropriate future course of action.

Although, of late, the get-up of the technical report has improved a lot mainly due to the computers and DTP techniques, it is quite common to duplicate/mimeograph the typed report. Generally, limited copies (not more than 50 in majority of cases) are made for circulation, though many reports are issued in large quantity. Though a small per cent of reports are prepared from published papers, a majority of the reports find their way to primary publications like scholarly journals, conference or symposium proceedings, books, etc.

It is difficult to answer a question if a report is published; a technical report is supposed to be 'published' (for limited circulation), however, it is 'unpublished' for practical purposes as it is not available easily!

Types of Technical Reports

Technical reports include technical papers, memoranda, proposals, progress and status reports, feasibility reports, technical manuals, investigation reports etc. A technical report may be a letter, an article, a research paper, an operational manual, a news bulletin, a company brochure, a book review ,etc. [5]. Passman [6] includes preprints, institutional reports, and committee reports also under technical reports literature. Depending on the purpose and information content, reports can be classified as informal and formal reports.

Informal reports usually present the results of investigations and convey information of products, methods and equipment. The informal nature makes these more accessible, and easy to be adapted to any situation. These are generally meant for immediate superiors and colleagues in an institution. These include memoranda, brief

analysis reports, trip reports, laboratory reports, field reports, inspection reports, etc.

Formal reports provide information which is needed by the management for decision making. Thus a formal report will have a larger target readership as compared to the informal report, and serve as a main source of information. Formal reports include project proposals, progress or status reports (half-yearly, annual etc), state-of-the-art reports and review reports, trend or critical evaluation reports, feasibility reports, etc. Types and characteristics of some of the above mentioned reports are briefly described in the following paragraphs.

Committee Reports

Many a time when a major decision is to be taken, the government or its department constitutes committees to go into various aspects of the issue (for example, the Abid Hussain Committee of CSIR, Committee on Bhopal Gas Tragedy etc). These issues include policy formulation, restructuring the organisation, prevention of losses due to hazards, etc. Usually, all the members in such committees will be experts in their fields and these reports provide very valuable information, including the pros and cons of an issue and a plan of action.

Feasibility Reports

These reports discuss the practicality, in physical and economic terms, of a new project (for example, feasibility reports on the establishment of DELNET, CALIBNET etc), new product development of a new program, purchase of a new equipment/plant or machinery, or reallocation of a factory site. A feasibility report generally includes explanation of the problem, present standards on criteria, subject-items to be analysed, examination of the scope of analysis, presentation and interpretation of the data, and conclusions and recommendations (ref. 5, p. 29). Feasibility reports may also include cost-effective analysis, alternative routes available to complete the project and a minimum time required to achieve a break-even point in cases where returns are expected.

Institutional Reports

These reports describe the activities and progress of projects

undertaken by an institution or establishment. These include techni-
cal information on programs, details of infrastructural and manpow-
er resources, and summaries of research undertaken during the
period of the report. As such these reports provide valuable informa-
tion not available elsewhere. The annual reports of the government
departments and agencies, private and public R&D laboratories, and
professional societies belong to this category of reports.

Preprints

These can be taken as the informal reports of individual
authors. These are circulated to the colleagues or professionals who
are working in the same field for their comments. The relevant
comments made by them, if any, are incorporated and then submitted
to a primary journal or presented in a conference/symposium. The
format of the preprint will be that of a research paper published in a
professional periodical.

Project Proposals

Project proposals are chiefly prepared for getting sanction of
projects or approval of a developmental works or getting grants and
contracts. These are not circulated before or after the purpose for
which they were prepared. Most of the times, the information
included is proprietary in nature. These are different from other types
of reports because they deal with future plan of action and method
of implementation of a project. The main characteristics of a
proposal are the statement of intention, willingness, and qualifica-
tions and expertise to accomplish a task as per a definite time
schedule. This may also include information about the capabilities of
existing facilities, financial, infrastructural and manpower consider-
ations. As these are to be professionally credible, subject knowledge
is necessary to prepare project proposals. Convincing the peers to
obtain financial support or sanction of project is a hidden function of
a proposal. Generally, proposals include a letter of transmittal, title,
executive summary, table of contents, introduction, overview and
analysis of the problem, statement of the problem, methodology,
infrastructural facilities needed to complete the project, financial and
manpower considerations, duration and summary

Project Reports

In any R&D organisation, project reports are the most frequently written documents. Once sanctioned, the project leader is bound by the schedule mentioned in the proposal. Often, one has to submit periodical progress reports-half-yearly or annual—to the institution or sponsoring or funding agency for evaluation purposes. By the time the project is completed, a few technical papers would also have been published. At the end, a detailed project report including the results and outcome of the project undertaken is to be submitted. This is a valuable source of primary information on the project. This may include a letter of transmittal, title, abstract or executive summary, contents, background material including introduction and objectives, methodology, results and discussion, conclusions, acknowledgements, references, appendices and list of abbreviations used in the report, if any.

State-of-the-Art Reports

These are prepared to keep the management or project leaders abreast of the latest developments in a subject field. These are similar to review articles and can be prepared by a person having general knowledge in the field. Here the relevant literature published in a specific subject during a particular period is collected and is grouped into the various sub-topics of the subject. This grouped material is presented after careful study of the different facets and arranging them in a logical sequence. Generalisation of the treatment of the contents and delimitation of the time are main characteristics of this report.

Status Reports

These are written to contain specified topics for a select and definite group of readers; hence it is very timely. A status report describes overall subject areas or problems for enquiry and breaks it down into component areas or problems. Conclusions are given leading to future course of action which also serve as a spring-board for the introduction of succeeding status reports. These are also known as preliminary reports, interim reports progress reports (daily, weekly, monthly, yearly) and so on (ref. 5, p. 29).

Trend Reports

These are value-added documents. The main characteristics of this kind of report is the evaluation (of published research) component, assessment of present status and prediction of the future trend the research may take. The positive aspects and shortfalls of the research already reported are also identified by the author. As such a trend report can be written by subject experts or peers only. A trend report includes title, abstract or executive summary, introduction, review of published literature, critical evaluation of the R&D, conclusions, and references and appendices.

Format of Reports

Like many publications, technical reports also have a typical format, although all the elements of the format may not necessarily be included in each and every report.

The informal reports have five basic elements, viz. preliminary material (background), introduction, discussion, conclusions and recommendations, and summary. The background material gives the reader an idea of the history of the project, and thus orients the reader towards the report. In the introduction part, objectives and the context are discussed; the reader is initiated to the problem, the necessity of writing the report, purpose of the report and general overview of the contents. Detailed and full information along with discussion of the method adopted, materials used, and the outcome, the conclusions drawn are presented in the body of the report.

While writing a formal report, the author employs a number of basic elements to orient the reader to the topic of the report and its organisation. Some of the formats used to arrange these elements include SIDCRA (summary, introduction, discussion, conclusions, references and appendices) or IMRAD (C/S) (introduction, materials and methods, results and discussion and conclusions/summary).

Format Analysis of Technical Reports

Whatever may be the arrangement of basic elements, a formal technical report should have the letter of transmittal, cover and title, summary and/or abstract, table of contents, list of illustrations, introductions, materials and methods, analysis and discussion of results, conclusions, recommendations, acknowledgements, refer-

ences and bibliography, appendices, abbreviations, and symbols used in the report. A few of these elements are discussed briefly in this section.

Letter of Transmittal

This is correspondence (usually a letter) which directs the report to some one. It may contain the information regarding the title of the report, a general statement of the scope and purpose of the report, explanation of problems faced, if any (for example, non-availability of facilities which might have delayed the project), and acknowledgements.

Preliminary Material

This includes title page, preface, if any, abstract or executive summary, table of contents, list of illustrations, tables, etc.

Cover and Title

Simple, plain cover page and title layout are used for technical reports. Many a time, an institution uses same type of cover layout for all the reports it brings out (for example NASA, RAND Corp, etc). Thus the reader is able to recall and link the institution as soon as the distinct layout is seen. Bibliographic details of the report like the title name(s) and address(es) of author(s) or corporate author, contracting agency (if any), the publisher or issuing authority, and month and year of issue are included in the title page. Many report issuing agencies, for example, NASA, NTIS, RAND Corporation etc, use a unique report number for each and every report. This number is included on both the cover and title pages. Most of the reports can be identified by the library if this report number is correctly provided by the reader. An attractive, well balanced title page makes an everlasting impression on the reader.

Preface

This is usually written by the project leader or head of the establishment and includes the historical background to the project. This is excluded when a detailed introduction including the genesis of the project is provided in the document.

Table of Contents

This is an index which lists titles of all sections and the pages on which they start. The contents page provides an overview of the

report's organisation, depth and emphasis of the subject dealt. When a report is large, only two levels are used in the contents. The levels of the divisions, sub-divisions, etc are maintained by following indenting, numbering or typography styles (caps, bold, italics, etc). The list of illustrations includes all the figures, flow charts, and tables included in the report.

Abstract

A short account of the contents of a document is called an abstract. It is consulted by a reader before attempting to read the whole text, and so, is expected to stand alone. Two types of abstracts are used: indicative and informative. The former is generally short in length (150 words) and as the name suggests, outlines the contents of the document. The latter is long (250 words) and includes the methodology, results and main conclusions, albeit in brief.

Summary

Summary is a restatement of the major findings and conclusions of a document. This is placed after the text of the body and is intended to help readers comprehend and review the text [8]. However, in technical reports, summary is placed before the text of the body. Summary should include the problem, purpose, major facts, conclusions and recommendations. Executive summary, provided some times with a report, is a digest of information intended to provide salient points which generally help in decision making. These include the financial, material and infrastructural implications, major findings and the recommendations for further action.

Both abstract and summary are meant to help readers to find out the relevancy and to ascertain if the document is to be read without actually reading the entire document, keep abreast of current developments and to get an overview of the document [9].

Body of the Report

Introduction, materials and methods, analysis of the data, discussion of results, conclusions and recommendations form the main body of the report.

Introduction

This forms an important part which orients the reader to the contents of the report. Introduction includes brief literature survey,

the statements of objective and scope. A brief survey of literature is included to establish the status of the ongoing research on the topic. In case the report deals with experimentation, the materials and the methodology including alternative methodologies, if any, are described in detail. If the report deals with surveys, investigation, etc, the nature of population, the method used for survey and the reasons for selecting the method are to be described. The data which was collected during the study will be analysed using various statistical principles. While the objective statement clearly states the purpose and aim of the report, the scope statement reveals the topics covered and the boundaries of the study. The methodology describes the procedure or process followed in the study to meet the objectives of the report. This section is followed by the problem and background statements, which introduces the reader to the problem and the circumstances in which the problem originated. A well-written introduction arrests the attention of the reader and established the tone, subject and its limitations.

Conclusions and Recommendations

Based on the analysis and facts, the conclusions are inferred and recommendations are suggested. The conclusions section emphasizes the most important, significant data and ideas in the report. So, all the conclusions should be related to the facts and data presented in the report. The conclusions should be written in a brief manner devoid of lengthy commentaries. When the conclusions are precise and clear, the main recommendations are obvious. Each recommendation is numbered and the first recommendation should deal with the problem of the report and also its solution.

End Material

Acknowledgements, references/bibliography, abbreviations used in the report and appendices are regarded as the end material.

Acknowledgements

Author receives help from many sources while writing the technical report. These include grants from institutions, material, infrastructural and laboratory facilities from parent or other collaborating establishments, useful discussions with colleagues, suggestions from peers for improvement, and help from staff members in data collection or analysis, typing etc. Author may with to thank all

those who helped and these are included in the acknowledgements. However, care is to be taken to include only those who have actually and significantly involved in the preparation of the report.

References

A scientific study is based on already published material, which is used in problem formulation. These intellectual debts will be paid through citations (in text) and references (at the end). Some times author wishes to suggest documents for further reading, a bibliography is included. Whereas the sources listed under references are all necessarily consulted, those listed under bibliography need not necessarily be consulted while preparing the report. A section discusses later in detail about citing and listing references.

Abbreviations

Abbreviations used are listed at one place, usually at the end. However, the author should keep their usage to a minimum and avoid using non-familiar and non-standard abbreviations and symbols.

Appendices

Supportive material like legislative laws and acts which do not form part of the text but is needed for better understanding of the concepts; long and complicated tables, flow charts, and question-naires, the placement of which will not affect the readers' under-standing of the report; computer algorithms, long extracts from other reports, notes, glossaries, and mathematical proofs which were used in the text but do not hamper the readers comprehension of the ideas are included as appendices to the report. It is presumed that the inclusion of these in the text would distract the attention of the reader and so are excluded from the main text. However, these are to be kept to a minimum; otherwise it would be construed that the original report has very little content. It should be borne in mind that the best written report is one which includes only a few or no appendices.

Technical Report Writing Process

Effectiveness of a technical report depends on many factors. These include knowing the target readers, quality of the contents, structural organisation of the report and clarity of the communica-tion. These are briefly described in this section.

Audience Analysis

The writer should know the readership of the technical report. Depending on the target readers, the tone and the contents of the report can be modified to suit the purpose. For example, a proposal is to be written in a different manner compared to a feasibility report or a final report of an R&D project. The contents and the style of presentation of a technical communication will surely be different when it is intended for well informed research community from that of a document written for neo-literates and public at large. In other words, the level of understanding of the audience would decide the 'technicality' in writing.

Planning a Report

Before venturing actual writing, the author must first make an outline of the topic and various sub-topics. This skeletal framework helps in delimiting a topic, i.e., identifying only those facets which must be dealt in the report and avoiding those which are peripheral to the topic. Also, additions and alterations are possible when the author is clear about what is to be included in the document.

Once the skeleton is decided, the next step is the literature survey and data collection. The sources could be formal publications (journals, patents, monographs, standards, reports, electronic data-bases etc), informal communication (personal letters), and non-scientific literature including trade catalogues, house bulletins, etc.

Quality of Contents

The intrinsic value of a technical report depends upon the quality of information contained, which in turn depends upon the subject expertise of the author. The currency of information, the adequacy and authenticity of the data and the facts, the reliability of methodology followed, and the originality of research enhance the effectiveness of a technical report.

Clarity of Communication

Clarity of communication depends on two factors, viz. the structural organisation of the report and the command of the author on the language. Logical organisation of a report according to a set pattern (say, IMRADS or SIDCRA), effective usage of illustrations and style of presentation will have a greater impact on the reader.

Drafting and Revision

To make a report readable, a writer has to make drafts and revisions. When the planning and outlining of a report is completed, the writer has to explain the ideas in a coherent and logical way. This is very difficult as it demands author's command over the language and also expertise in the subject field. Thus the first draft may be refined and revised over and over again until the final draft is ready. At this stage, the writer may add headings, sub-headings, illustrations, tables, etc for clarity of communication. References and appendices are also included while revising the draft.

Style of Presentation

While clarity of expression, elegance of presentation, and simplicity of format are powerful means of enhancing understandability, consistency of format and style of presentation enhance readability. Mathew Arnold said "The secret style is to have something to say and say it as clearly as you can".

Text

Usage of simple sentences (with a maximum of 20-25 words), parallel structure for coordinate elements, and active voice enhances effectiveness of a writing. Accuracy in style results from precise use of terms and proper sentence structure precision in expression would eliminate redundancy leading to brevity and clarity [10]. This makes the author use, to a certain extent technical terms and formal standardised sentence structures. However, over usage of jargon would result in poor presentation resulting in unreadable and incomprehensible text. Use of icons, special symbols like bullets, and special typography enhances elegance, clarity and readability. Abbreviations are to be kept to a minimums as these distract the attention of the reader.

Language

Confucius said, "If language is not correct then what is said is not what is meant: if what is said is not what is meant then what ought to be done remains undone". Surely proper words in proper places makes the communication understandable.

The general principles governing technical writing are avoiding superfluous words; choosing familiar, short and precise words;

avoiding abstract expressions, double negatives and dangling modifiers; and ensuring the agreement of subject with verb and pronouns with their antecedents. The author's command over the vocabulary, grammar and diction would help in achieving better results.

Apart from this, consistency in the use of spelling (for example, American and British spelling) and punctuation is also important. Improper punctuation makes the text incomprehensible and confusing. Usage of capitals, bold or italics are to be kept to a minimum as they affect the readability of a document. Acronyms and abbreviated names of institutions are written without full stops (for example, UNESCO, NATO, USA, IISc, IIT, etc and not U.N.E.S.C.O., N.A.T.O., U.S.A., I.I.Sc., I.I.T., etc).

Tables

A table is a simple tool for listing exact data for comparison and analysis. Tables should supplement, and not duplicate the data and figures. While constructing a table it should be noted that the information always reads down from the boxhead to the end of the table; information controlled by stub heads reads across [11]. Also, independent variables should be taken in the first column (stub). The other columns are taken to denote dependent variables (column heads).

The essential elements of a table include the stub, stub head, and boxhead (for single column table). It may have different column heads and spanner heads (a common head for two or more columns) and field spanner (a common sub-head for all the columns, see Figure 1). Tables should be mentioned by their numbers and not as the below given Table, or the following Table etc. They should be typed on separate sheets and arranged in the same sequence as they are referred to in the text.

Usually, numerical data is aligned on the decimal point (when decimals are used) or units. Zero is before decimals less than unity (for example, 0.35 and not .35). Do not add zeros on the left side of decimals. It is advisable to use Indo-Arabic numerals and lower case typography to enhance readability.

Figures and Illustrations

It is said that one picture is worth a thousand words. Visuals are used for better communication and understanding. These include line

diagrams and photographs. Line diagrams comprise line graphs, bar charts, pie charts, drawings, flow charts, special illustrations, etc.

Line Graphs

Line Graphs are used to illustrate trends over a period of time or data with many successive values, comparison of similar type of data over fixed or variable time period, and frequency distribution. *Bar charts* or histograms can be presented to provide a three-dimensional view. These are used when one wishes to compare two or more items having at least one common parameter, or a single item at different points or many items at a single point.

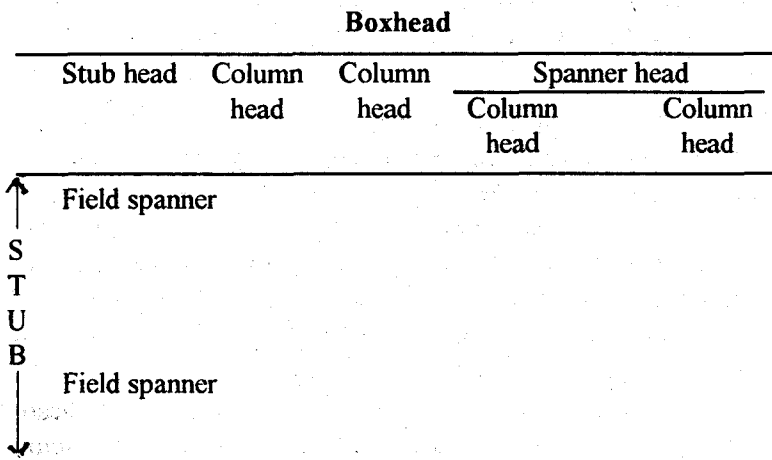|			Boxhead	
Stub head	Column head	Column head	Spanner head	
			Column head	Column head
Field spanner				
Field spanner				

(Left vertical label: STUB ↕)

Fig. 1. Major Parts of a table (12)

Pie charts are a variant form wherein the relationship between parts and whole, and their relative distribution is presented. *Drawings* are used to illustrate a process, an equipment or apparatus used in a given study. *Flow charts* generally show the sequence of stages or steps involved in completing a task or organisational set-up, or the sequence of operations in a computer algorithm. Apart from these, *special figures* such as NMR, IR, ECG charts or structural formulae of chemical compounds are also used. Colour or black and white photographs are used for beauty and esthetics. These are reproduced as half-tones.

Care is to be taken to label each of the figures, providing them with a caption and adding index or key when abbreviations, etc are used. While preparing the illustrations, the final reproduction size of

the figures is to be kept in mind and 'accordingly the size of letters, text, symbols and units used are to be drawn in the original figure. It is important to draw the figures in India ink. The figures are sequentially referred in the text of the report and numbered accordingly. They should be cited in the text as Figure 1, Figure 2, and Figure 3 and 'not as the Figure above, the following Figure' etc.

While table caption precedes the table, figure caption follows a figure and ends with a full stop. When a table or a figure already published is taken for reproduction in a report, proper acknowledgement is to be made. Even when author modifies or prepares a new figure or table out of the already published material, it is important to add, as a footnote, the statement 'based on data from XYZ' or 'modified version of figure from ABC' and list the citation under references.

Standard Style for References

According to the Bureau of Indian Standards, a bibliographic reference is "a sequence of items of information needed for enabling a reader of a work to identify, locate and ascertain the relevance of a document referred to" [13]. International Standards Organisation (ISO) defines it as "a set of data sufficiently precise and detailed to enable a publication or a part of a publication to be identified" [14]. British Standards Institution (BSI) defines it as "a set of data describing a document or a part of a document, and sufficiently precise and detailed to identify and locate it"[15].

The main purpose of providing a reference is to identify, locate and to ascertain if it is relevant for further study. Therefore, care should be taken that references contain sufficient information necessary to retrieve a cited document.

Need of References

A research report builds its base upon earlier scholarly work which is done by linking the reporting paper with related work in the same subject area or field of research which was reported earlier. This linking is usually done through references, which are designed to guide readers of new work to sources they may want to consult further. References are designed to repay intellectual debts through open acknowledgement [16]. Authors refer to previous material to

support, illustrate or elaborate on a particular point. They may also be referred to contradict or negate the conclusions or findings of a reported article. The basic idea in referring an already published work is its relevancy and usage.

References play an important role in the life of a technical report. They will enable readers to understand and decide whether they should read the original publication which is referred to in the text. If the users want to consult/study it, the reference should enable them to get easy access with a minimum effort. Hence references ought to be sufficiently complete, i.e., all the elements of the cited work must be given.

There is a lot of variation in providing references because of confusion over the inclusion of different elements of references, viz, author(s), title, affiliation, volume number, issue number, date, month and year, pagination, publishers, etc, their sequence of occurrence and typographical representation. There are many types of documents, i.e., journal articles, conference proceedings, monographs, simple and composite books letters, dissertations, theses, reports, standards, catalogues, etc, which make the problem more complex.

Citing References in Text

There are different practices of citing of references in the text. Some journals give author's name and year in brackets, for example, (Garfield, 1980). The year only is given in brackets when the author's name is a part of the sentence. This is known as Harvard style and also nearer to the Vancouver style followed by biomedical journals. Two or more cited documents published by the same author in the same year are differentiated with alphabetical or numerical suffixes (for example, Price 1980a, Price 1980b etc). Periodicals such as Journal of Documentation, IASLIC Bulletin, etc use a sequential number as superscript over the name(s) of the author(s); the Journal of the American Society for Information Science uses parentheses within the text for this number.

Listing of References

The listing of references at the end of the main text is usually based on the citing practice in the text. They are either arranged alphabetically by author's name (Harvard or Vancouver styles) or in

the order of their occurrence in the text. In the Harvard system, the year of publication follows the author's name. In the alphabetical and sequential systems, the year of publication comes after the name of the journal or publisher. In the case of a review article, alphabetisation needs more time because of the large number of references cited.

Standards on References

Many style manuals are available for manuscript preparation which include guidelines for the preparation of references. However, the do not agree on a single style for references. The national standards on references suggest two types of references. International Standard suggests abridged and expanded references. British Standard (BS) recommends minimum and expanded references. American National Standard suggests abbreviated and comprehensive references. The Indian Standard (IS) identifies two types of elements—essential and supplementary—and leaves the choice to the user. It recommends the use of any catalogue code for punctuation. The International Standards Organisation (ISO), the British Standards Institution (BSI) and the American National Standards Institution (ANSI) do not enforce any single style but recommend to follow examples given by them.

As regards to typography for a reference, ANSI recommends the use of single type face for the sake of simplicity and convenience. IS recommends to differentiate the various items of information and highlight essential items in an entry and advises that a uniform practice should be followed in the same publication. One marked difference in these standards is that ANSI prefers to use the author's name(s) in ordinary upper/lower case, whereas IS, BS and ISO recommend capitalisation. ANSI limits the maximum number of authors of a multi-authored work to two, while ISO/BS limit to three. All the four standards recommend title of journal article to be include in the reference.

Suggestions for preparing References

Standardisation practice in citing and listing references would help authors, readers and librarians alike. For efficient and unambiguous information retrieval, the following suggestions are given to arrive at a standard style of references:

(a)   The main purpose of providing a reference would not
      be served if the title of the document being cited (i.e.,
      journal article, a paper from a proceedings, a chapter
      from book, the title of a report, etc) is not included. It
      is important for arriving at a quick decision whether a
      cited work is to be consulted or not.

(b)   Dividing the reference into convenient groups or
      parts—say three or four—would make the references
      unambiguous. For example, author(s)/editor(s); title
      of the cited document; title of journal, volume (issue
      no), year of publication in parentheses, inclusive pages
      with appropriate punctuation or conference/sympo-
      sium name (preceded by 'paper presented t'), place,
      month and year; title of the original work followed by
      editors' name (in the case of a composite book); place
      of publication, publisher, year, etc. are some conve-
      nient groupings separated by a full stop.

(c)   Inclusive pagination also provides the information
      regarding the size of the document cited in terms of
      pages. It helps the user as the librarian in calculating
      the cost in case the document is to be procured from a
      copy supply centre such as INSDOC or BLDSC.

(d)   Usage of upper and lower type faces for author's
      name would be simple and also easy for typesetting.

(e)   Giving imprint information in parentheses avoids con-
      fusion with place and year of conference/symposium
      in the references of conference/symposium proceed-
      ings.

Bibliographical Control of Technical Reports

.   As report literature is difficult to access, technical reports are
referred to as 'gray literature'. This is because, unlike books and
periodicals, proper bibliographical control mechanism does not exist
for reports. The nature of contents—security classification like
restricted, confidential, secret—also poses problems making some
of them inaccessible. The policy of the government (or sponsoring
agency) in certain areas of R & D (for example defence, space,

atomic energy, etc) does not permit corporate institutions to publish or disseminate reports brought out in these subject fields. Further very few sources are available for knowing the existence of a report. The large number of report issuing agencies further compounds the problems [17].

Because of all these factors, it has become too difficult to procure technical reports. No vendor readily takes up supply of these reports. Though the scene has changed in recent times with the coverage of technical reports in abstracting and indexing periodicals like Scientific & Technical Aerospace Reports (STAR), International Aerospace Abstracts (IAA), Government Reports Announcements & Index (GRAI), Nuclear Science Abstracts (NSA), and to a limited extent, Biological Abstracts and Chemical Abstracts, their coverage is inadequate. Of late, exclusive periodicals covering R & D reports are being published by national bibliographical control agencies (for example, the British R & D Reports of British Library Documents Supply Centre (BLDSC). Though there are agencies (UK : BLDSE : USA : NTIS & UMI : CANADA : CISTI) dealing with bibliographical control and also supplying technical reports when demanded, in India, no such central agency is available to cater to the needs of the users. Though a national document delivery centre for technical reports was suggested to be created, no action has been taken on it yet. However Department of Science & Technology is striving to bring out reference tools in this direction. As technical report literature can promote greater industrial cross-fertilisation in overcoming the technology gap, a national centre for the bibliographic control and supply of these reports is very much needed.

References

1. Rude, Carolyn D. Technical editing. Wadsworth Publishing, Belmont, 1991, p. 311. 430 p.

2. Indian Standards Institution. IS : 8010 (Part 1) - 1976 : Guidelines for preparation of technical reports: Part 1 : Research and development reports. BSI, New Delhi, 1976.

3. Weisman, H.M. Technical report writing. Merril Books, Columbus, 1966.

4. Grogan, Denis. Science and Technology : An introduction the literature. Clive Bingley, London, 1970. pp. 163-9.

5. IGNOU. MLIS course material on technical writing; Block 3: Structure and functions of technical communication. IGNOU, New Delhi, 1995, p. 28.

6.   Passman, Sydney. Scientific and Technological Communication. Pergamon, Oxford, 1969. pp. 43-67.

7.   IGNOU. MLIS course material on technical writing; Block 1: Communication process. IGNOU, New Delhi, 1995. p. 25.

8.   ANSI Z. 39. 14-1979. American National Standard for writing abstracts. ANSI, New York, 1979.

9.   Pauley, Steven E and Riordan, Daniel G. Technical report writing today, Ed. 4. Houghton Mifflin, Boston, 1990. p. 107.

10. IGNOU, MLIS course material on technical writing; Block 2: Linguistics. IGNOU, New Delhi, 1995. p. 80.

11. Dukes, Eva. Table construction : Do's ans dont's. *IEEE Transactions on Professional Communication*, 1989, 32(1), 36-40.

12. Buecheler, M.F. Table design—when the writer/editor communicates graphically. *In* Proceedings of 27th ITCC, 1980. PP. G. 68-G. 73.

13. Indian Standards Institution. IS : 2381-1975 : Recommendations for bibliographical references : essential and supplementary elements (first revision). ISI, New Delhi, 1979. 16p.

14. International Standards Organisation. ISO : 690-1975(E): Documentation-bibliographical references—essential and supplementary elements. ISO, Switzerland, 1975. 8 p.

15. British Standards Institution. BS : 1629-1976 : Recommendations : bibliographical references. BSI, London, 1976. 11 p.

16. Merton, Robert K. Foreword. *In* Citation indexing: its theory and applications in science, technology and humanities, edited by Eugene Garfield, John Wiley, New York, 1979. p. vii.

17. Dictionary of reports series codes published by Special Library Association, New York lists over 20,000 codes.