Information Sources for Research and Development

Use of Engineering Literature

Edited by K W Mildren

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Engineering Literature

Editor
K. W. Mildren, B.SC., A.L.A.,A.I. INF.SC.
Engineering Librarian, Portsmouth Polytechnic

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Preface

As part of a series of guides to information sources, this book has been produced in an attempt to assist engineers, librarians and information officers in their awareness and use of published literature. It is hoped that it will be of value to others involved in the organisation of courses for undergraduate and postgraduate students in librarianship, information science and the various engineering disciplines.

Material included in the chapters has been chosen on a selective rather than a comprehensive basis and the items mentioned are those found to be of most use by the respective contributors. Each author naturally has his own style and this is reflected in the presentation of the chapters, which have not therefore been subjected to restrictive editing.

Chapter 1 provides an insight into the structure of the literature and the channels of communication. This is followed by a chapter on classification and indexing in engineering. Chapters 3–11 deal with the various forms of literature and other services. Chapter 12 gives a somewhat introductory guide to literature searching and Chapter 13 discusses the problems of personal indexes. The remaining chapters are concerned with the literature in the various engineering fields.

The contributions were completed during 1974 and minor alterations and additions have been made at proof stage. Owing to space limitations, the place of publication of books cited has been omitted except in isolated cases where the publisher is not, perhaps, well known.

I should like to express my thanks to the contributors and to the numerous colleagues who have made helpful suggestions and comments on parts of the manuscript, and supplied source material.

Special thanks are due to Mr D. Jackson, Mrs D. J. Northcott and Mrs F. M. Littlefield for their assistance.

I am also indebted to several organisations for allowing parts of their publications to be reproduced, namely GEC Power Engineering (*Thesaurofacet* in Chapter 2), Institute of Electrical and Electronics Engineers (*Table 3.1*), National Translations Center (*Translations Register-Index* in Chapter 4), HMSO (*About Patents: Patents as a Source of Technical Information* in Chapter 6), Institution of Electrical Engineers (*Electrical and Electronics Abstracts* in Chapter 16), and British Standards Institution and Institution of Mining and Metallurgy (UDC Summary as used in *IMM Abstracts*, based on *BS 1000, Figure 35.1*). Thanks are also due to Clive Bingley Ltd for providing *Figure 13.2*, as used in A. C. Foskett's *A Guide to Personal Indexes* (2nd edn, Bingley, 1970).

Portsmouth, 1975 K.W.M.

Contents

1

Structure of the literature and channels of communication

D. Jackson

Many attempts have been made to define the term 'engineering', none of which would be acceptable to all engineers. However, one definition serves to show the wide range of human activities that engineering encompasses and to indicate the extent of the information needs of the engineer.

> Engineering is the profession in which a knowledge of the mathematical and natural sciences, gained by study, experience and practice, is applied with judgement to develop ways to utilise economically the materials and forces of nature for the benefit of mankind.
>
> Engineers' Council for Professional Development

The engineer, like the scientist, is totally dependent on his ability to acquire and subsequently retrieve information. It is necessary for him to keep aware of current progress in his own field. Specific items of information, or factual data, are continually required in his everyday work and occasionally it may be necessary to acquaint himself with work outside his own field. The information requirements of the engineer vary widely according to the nature of his work. The research engineer who is involved with theoretical information and the concepts of pure science has totally different needs from those of the design engineer, who applies existing materials, devices and systems to particular situations. As the volume of information is growing at an ever-increasing rate, the task of acquiring relevant information is becoming more and more difficult. A great

deal has been written on the communication problems of scientists and technologists and proposals made for their solution (e.g. Meadows, 1974; Passman, 1969; Committee on Scientific and Technical Information (SATCOM), 1969). Much less has been written on the specific requirements of engineers and the use they make of existing sources of information (e.g. Lufkin, 1966, Waldhart, 1974, Wolek, 1969). An international symposium, entitled *Information Systems for Designers*, was held in 1971 and the proceedings were published by the organisers, University of Southampton, Department of Mechanical Engineering. A useful source for further references on this subject is *Annual Review of Information Science and Technology*, currently published by the American Society for Information Science. A cumulative index to the first seven volumes was published in 1972.

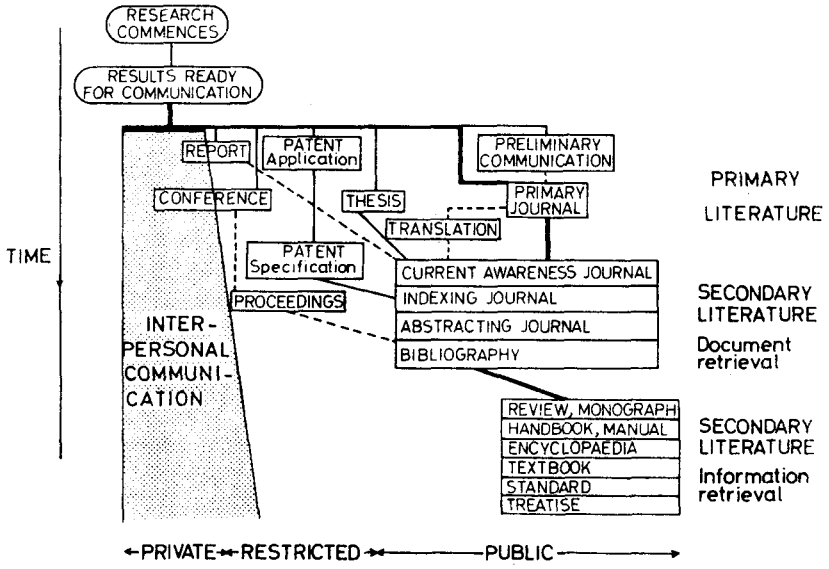

Figure. 1.1 Structure of the literature and channels of communication

A large number of formal and informal communication channels have evolved to satisfy the varying information requirements of scientists and engineers. In order to exploit them to the full, it is necessary to understand the relationships between the channels and the structure of the literature (Bottle, 1973). *Figure 1.1* illustrates

the progress of an item of information through a variety of communication media from the time its discoverer commences his research until it is accepted into the body of recorded knowledge. Major information transfer pathways are indicated by heavy lines, while broken lines represent steps which have a lower probability of occurring, e.g. information communicated at a conference may progress into a formal publication, but there is a chance that it may not and the information may effectively be lost. The horizontal axis represents increasing availability of the information to the community and the vertical axis represents the relative time-lag until its appearance in each communication medium.

INTERPERSONAL COMMUNICATION

Informal interpersonal communication is probably the most important information channel for the majority of scientists and engineers. At its simplest level this may mean the engineer discussing his work with colleagues in his own organisation. Unless positive barriers are erected to preserve secrecy, novel information can be transmitted in this way to an ever-widening group.

From the point of view of the recipient of information, interpersonal communication has many advantages. If the source is selected carefully, information can be acquired rapidly and with little effort on the part of the enquirer. There is the possibility of a dialogue, which improves the efficiency of the channel and avoids misunderstandings. Information not usually carried in other channels, e.g. practical expertise, is often available. From a study of engineers in an industrial environment, it has been shown that certain individuals are recognised as good information sources and are relied upon as 'technological gatekeepers', bridging the gap between colleagues within the organisation and formal and informal channels outside (Allen, 1970).

THE PRIMARY LITERATURE

The first documentary record of new information is likely to be in the form of a **technical report**, a term which covers everything from a laboratory notebook recording day-to-day work and submitted to the research supervisor, to more formal documents, which have been produced as a result of a contractual obligation in return for research funds. There has been a great proliferation in the published and semi-published report literature since World War II, due to the increased sponsorship by government of industrial and academic research

(Brearley, 1973). By means of a technical report, information can be disseminated rapidly to a controlled population of users. The information content is usually very detailed, giving a full account of the research history with illustrations, tables and discussions of unsuccessful approaches. However, as an archival record reports have certain disadvantages. They may not be adequately refereed, so that false or misleading information may be included, and the difficulties of bibliographical control may mean that useful information is lost. Report literature is discussed in more detail in Chapter 5.

Conferences, held at local, national or international level, provide a further link between the informal and formal channels of communication. A great deal of information is communicated by personal contact between people with similar interests brought together by the conference. Equipment manufacturers take advantage of this and send representatives to conferences and organise displays of their products. The documentary record may take the form of duplicated sheets circulated to conference delegates or more formally, but at the expense of speed, the presented papers may be published as one-off volumes, as part of a series, or as articles in journals. The communication processes taking place at conferences have been analysed in depth by the Centre for Research in Scientific Communication at Johns Hopkins University, with the ultimate aim of providing guidance on conference presentation and control, to facilitate information flow (Garvey, 1970). A fuller description of conferences and the bibliographical control of their proceedings may be found in Chapter 3.

If a new discovery is likely to be of economic significance, it may be first communicated to the outside world as a **patent**. The patent system effectively guarantees the discoverer of a new invention or technique a temporary monopoly in the exploitation of his discovery in return for making the knowledge public as a patent specification. Although the main function of the patent system is to establish legal priority for inventions and discoveries, patent specifications are an important primary medium of communication. The national and international patent system and the use of patent specifications by the engineer are described in Chapter 6.

Information produced as the result of a research project in an academic institution may be published in the form of a **thesis** or **dissertation**. The thesis may be considered as a specialised form of report, presented to the awarding body in partial fulfilment of the requirements of a higher degree, and exhibits most of the characteristics of the technical report literature discussed earlier. The use of theses as an information source is considered in Chapter 3.

The **journal** has been the main medium for the announcement of

new knowledge for the last 300 years and, at the same time, is expected to form the fundamental archival record of science and technology. The two functions, unfortunately, have different requirements as far as the publisher is concerned. The archival function, and the need to maintain the reputation of the journal, requires time-consuming and expensive refereeing of submitted articles by eminent workers in the field. The announcement function requires, above all, speed of publication and to this end a new breed of **preliminary communication journals** has arisen, e.g. *Electronics Letters*, in which the time-lag is reduced to a few weeks. The need for speed of publication and economic considerations have led some publishers to experiment with microfilm as the publication medium. It has also been suggested that conventional journal publication should be discontinued. Primary articles would be kept on microfilm in central stores from which hard copy enlargements would be available on demand. A conference on the *Future of Scientific and Technical Journals* was held in 1973 and the proceedings were published in the September, 1973 issue of *IEEE Transactions on Professional Communication.* The journal literature of engineering is analysed in Chapter 3.

THE SECONDARY LITERATURE

Abstracting and indexing journals provide a key to the documents which make up the primary literature. Approaching 2000 titles are now available in science and technology, not counting those produced for their own use by individual firms or institutions. They range from the comprehensive international, e.g. *Engineering Index*, to those limited to specific subject areas, e.g. *Steel Castings Abstracts*, or forms of literature, e.g. *Dissertation Abstracts International.*

The provision of deep indexing and informative abstracts is an expensive and time-consuming process, but is vital if the service is to provide efficient access to the archive of primary documents. Abstracting and indexing journals are also expected to aid the announcement function of the primary literature and with this aim are usually issued at frequent intervals, with cumulative editions covering longer periods. Again the two requirements are obviously incompatible, and, during the last 20 years, the functions have been separated by the publication of **current awareness journals**. These may take the form of reproductions of contents pages of primary journals, e.g. *Current Contents—Engineering, Technology & Applied Sciences*, or lists of articles arranged under broad subject headings, e.g. *Current Papers in Electrical and Electronics Engineering.* In some cases, rudimentary computer-produced indexes based on keywords in the

title of the article are also provided. Current awareness journals are produced very rapidly, in some cases concurrently with the publication of the primary journal. They have no archival function and can be discarded when the material has been covered in the conventional abstracting and indexing journals.

The scanning of abstracting and indexing journals can be a time-consuming process and a **selective bibliography**, if available on the subject, is more convenient as a short cut to the primary literature. Bibliographies may be published as books, as pamphlets or in journals, but often they are not formally published and are only available to a limited group of users.

Computer-based information systems, e.g. COMPENDEX (Computerised Engineering Index), which can match articles with individual or group user interest profiles and produce current or retrospective bibliographies, have recently become available. Such services are very convenient as far as the user is concerned, but at the moment they are expensive and their efficiency is totally dependent on the quality of the indexing of the articles and the preparation of the user profile. There is little scope for the accidental discovery of interesting articles, which can be so rewarding when browsing through primary journals, abstracting journals or even current awareness lists. The major abstracting and indexing journals in engineering are reviewed in Chapter 11.

The forms of secondary literature so far discussed refer the user to documents only and carry limited information themselves. Each primary document is treated as an integral unit and no attempt is made to relate the information content to other articles on the same subject and the general framework of knowledge. The next stage is for the information to be evaluated and consolidated to give a state-of-the-art review which represents a synthesis of contemporary knowledge on the subject complete with an extensive bibliography of the literature on which it is based. **Review** articles may be published in journals or in series of the 'Annual Reviews in . . .' or 'Progress in . . .' type. Alternatively, covering a wider area, the review may be published separately as a **monograph** or as part of a multi-volume **treatise**.

The information may also be reprocessed into forms aimed at particular types of use. **Encyclopaedias**, designed for quick reference, may be thought of as collections of short reviews arranged in alphabetical order of subject. Textbooks contain the information in a form suitable for students and their teachers. The practising engineer is served by **handbooks** and **manuals**, which contain factual information in easily retrievable form as tables and diagrams. Practically orientated reviews and news of new methods and equipment may be

found in **trade journals**, which are highly prized by the engineer, not least for the advertising material they contain. Product information is also to be found in **trade catalogues** and brochures, issued as publicity material by manufacturers. **Standards**, issued by national and international organisations, and covering a wide range of topics, include glossaries of terms, definitions and symbols; specifications for quality, safety, performance or dimensions; and codes of practice.

BARRIERS TO COMMUNICATION

The total literature/information system described has evolved over 300 years to attempt to satisfy man's search for comprehensive awareness and retrieval of information. However, the system has many inherent imperfections which act as barriers to effective communication, leading to delay and loss of valuable information (Basu, 1972).

Perhaps the greatest barrier is formed by the sheer size of the body of recorded knowledge from which information can be retrieved and the rate at which it is growing. This problem is made worse because the literature archive includes a large proportion of duplicated information. This may be a result of the 'publish or perish syndrome' which prevails in academic research, where an individual is often judged by the number of publications to his credit. Alternatively, it may be due to unconscious duplication of research effort, itself arising from a failure in communication. Such duplication, carried forward uncritically into abstracting and indexing journals, leads to frustration and time wasting.

The literature archive also contains misleading and often contradictory information, and therefore it is important that information should not be used uncritically. Factual data are continually being updated, with the introduction of new instruments and techniques, and old theories are superseded. Some false information may be included as a result of imperfections in the refereeing system. Conversely, however, over-zealous refereeing may result in useful information being suppressed.

More than one-third of the world's engineering literature is in languages other than English and this proportion is growing as more countries develop their technologies. The dangers of neglecting the Russian and Eastern European literature were recognised in the late 1950s and ambitious and expensive translation programmes were initiated by western governments. The share of less familiar languages from Asian countries is increasing rapidly and is likely to pose an even more difficult problem in the near future as China improves contacts with the western world. It is increasingly likely,

therefore, that, having retrieved a document, the extra step in the information transfer process of acquiring a translation has to be overcome before it can be understood. Foreign-language literature and the availability of translations are discussed in Chapter 4.

Valuable information may not reach the engineer because he is ignorant of relevant information sources and how to use them effectively. The importance of this barrier has been recognised and proposals that lectures on the literature should be introduced into the curricula of engineering courses at all levels are slowly being put into effect (Wood, 1969). It is hoped that this book, in addition to providing a basis for such courses, will be used by practising engineers to alleviate their information problems. Others guides to the literature of engineering and related subjects are listed in Chapter 10.

LIBRARIES AND INFORMATION CENTRES

The printed word remains the main medium for the storage of information and inevitably the engineer will acquire a large collection of documents in the course of his work. Guidance on the organisation of personal document collections is given in Chapter 13.

The growth in the volume of information has been paralleled by an increase in the size and number of libraries to which the engineer may have direct or indirect access. The general aims of a library are to acquire the records of human knowledge in whatever form they may appear, and to store and organise them in a way which facilitates the retrieval of individual documents and the information they contain. The stock and services of an individual library are determined by the needs of its clientele. Owing to the increasing cost of providing comprehensive collections, it is no longer possible for a library to be self-sufficient. However, any library can act as an access point to the total library resources of the country, through inter-library co-operation and lending, backed up by the services of a comprehensive national library. It is possible, therefore, for an individual library to rationalise its acquisition and withdrawal policies, concentrating on the most relevant and up-to-date literature and relying on national resources for the remainder.

The services provided in libraries also vary widely according to the demands made on them by their users. The most fundamental service is to provide access to the material they contain, and in the majority of libraries the shelves are normally open to all users. However, in some libraries, which are required only to supply particular documents on demand, or for reasons of security, access to the shelves may be denied to all but the library staff. In most

open-access libraries the material is arranged in a logical manner to facilitate its use. Journals may be shelved in alphabetical order of title, and then by date of publication, or some subject division may be made. Books are normally arranged according to a standard subject classification system, so that books on similar subjects are placed near to each other on the shelves (Maltby, 1972). A subject index to the classification scheme is provided. There may be separate sequences for different types of material, e.g. reports, standards, patents or microforms. The catalogue provides a key to the holdings of the library, usually allowing individual items to be located by means of an author, title or subject approach. Catalogues may be found in a wide variety of forms, the most common being a file of 5 × 3 in cards. However, microfilm catalogues are likely to become more common. The catalogues of large libraries are important bibliographic tools in their own right and may be reproduced and published for use in other libraries, e.g. *The Classed Subject Catalog of the Engineering Societies' Library* in New York has been published in 13 volumes (G. K. Hall, 1963). Supplementary volumes are published periodically. Libraries also provide facilities for the use of the material they contain in the form of reading rooms, microfilm readers and listening booths. Documents may be borrowed from the library for use elsewhere or, where allowed by the copyright law, reproductions of material may be supplied. Because of the variations in the ways in which different libraries achieve the same general aims, most libraries issue guides to their own particular systems. Several general guides to the effective use of libraries have been published. One example is *Using Libraries*, by K. Whittaker (3rd edn, Deutsch, 1972). Classification and indexing with special reference to engineering is discussed in Chapter 2.

Most libraries which cater for the needs of the engineer extend their services beyond the provision of documents to include the information contained in them. In recent years librarians with subject qualifications, who can understand the language and the problems of the specialist, have become more common and added to the efficacy of library services. Literature searches may be performed by the library staff to prepare bibliographies or to provide specific information on request. Abstracts and indexes to the literature may be produced and current awareness lists circulated to users. The library staff may liaise between the engineer and computer-based information services. A translations service may also be offered. Further, 'specialist information centres', where the service is extended to include the critical evaluation of information and the preparation of authoritative state-of-the-art reviews in specific areas, have been developed on an international basis (Mountstephens, 1971).