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Sources of Information in Science and Technology: A perspective from Kashmir

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Abstract

Discusses the importance of information in science and technology. Classifies the science and technology literature as: 1) Primary Sources, 2) Secondary Sources, and 3) Tertiary Sources. Also discusses under each the various categories of the literature in different forms and importance of each source of information.

Introduction

Information is an asset necessary for the development and prosperity of a society. It is an essential material required for making decisions from the government level to the personal level. Today, a country is considered prosperous, in socio-economic terms, if it is rich in information—especially in the field of science and technology. Dependence on information has increased in daily life. Due to technological advances, it has become a basic resource, and as such, information generated should be procured, organized, and disseminated properly.

Historically, communication in science was achieved through person-to-person contacts. This was an unorganized and informal means of sharing information which

improved over time. In 1455, the invention of movable printing by Gutenberg in Germany brought a revolution in the history of written communication. This led to the production and dissemination of multiple copies of manuscripts, and, in this way, information was stored, organized, and disseminated through various means.

Information plays a significant role in all aspects of human activity. Whether it is research and development, business and industry, government affairs, or education and training, information has to be acquired, processed, stored, retrieved, and disseminated for effective communication. These activities will be accomplished only when the information is available in an adequate quantity and quality at the right time. In the field of science and technology, information has the power to convert natural resources into usable and consumable products. Since individuals have to work in an information communication environment of their own, an accurate assessment of the information needs of users should be made. Different categories of users have different information needs. The matching of information needs and sources of information is based on careful assessment of information needs.

Sources of Information in S & T

Many years ago, the number of scientists was limited, and information could be disseminated without large-scale organization. Personal individual endeavor was supplemented by organizing conferences, publication of proceedings (by learned societies and by professional institutions), and by the establishment of large libraries. In this way, a network of institutions and services grew, encompassing primary publications reporting original work, secondary publications like abstract journals, indexes, etc. At present, however, a multitude of sources of information in science and technology are found.

The whole literature of S & T is divided into three categories: *primary*, *secondary*, and *tertiary*.

Primary Sources

Primary sources comprise the first published records of original research and development. They represent the original unfiltered ideas and comprise of the most recent available information. Primary sources are unorganized sources and thus are difficult to be used without the help of secondary sources. Types of primary sources include: periodicals, research reports, conference proceedings, patents, standards, theses and dissertations, trade literature, etc.

1. Periodicals

Periodicals make up the bulk of primary source literature of science and technology. Periodicals include journals, bulletins, transactions, proceedings, and other serial publications, which appear regularly. The contents of periodicals vary in the kind of material included and in technical level as well. Professional, scientific, and technical

societies place emphasis on basic research and technical aspects of a subject, while the industrial and trade associations and private publishers lean towards the practical, personal, and popular side. Some other organizations like universities, research institutes, and government agencies publish their own work. Some of the examples of periodicals are:

1. Shetye, S. R. (Ed.) (2005). *Journal of Earth System Science*, 114.
2. Balaram, P. (Ed.). (2005). *Current Science*, 88.
3. Pandey, I. M. (Ed.). (2005). *Vikalpa: The Journal of decision makers*.30
4. Petersen, D. J. (Ed.). (2005). *Maternal and child Health Journal*, 9
5. Choudhury, P. (Ed.). (2005). *Indian Paediatrics*, 42.

2. Research reports

Research reports are an important part of the primary source literature in science and technology. They are of a less polished form as they are produced early in the research process. The vast growth in science and technology eventually revealed inadequacies in the system based mainly on journals; research reports emerged as the most successful alternative. They generally originate in research laboratories working under an organization and are generally distributed in microform or full-size copies to all organizations having interest in them. Examples of research reports in science and technology are:

1. *Research Report NIFS Technical Series*. (1990). Japan: NIFS
2. *Research Reports on Information Sciences, Series A Mathematical Science*. (2004). Tokyo: Institute of Technology.
3. *Research Report of Utilization of radiation by Isotope Users group*. (2004). Japan: Japan Atomic Industrial Forum
4. *Research report of Utilization of radiation by medical users' group*. (2004). Japan: Japan Atomic Industrial Forum.
5. *National Institute for fusion science. Research Report Tech series*. (2004). Japan: National Institute for Fusion Science.

3. Patents

Patents have proven to be an immensely valuable information source for invention, technology, business, and legal actions. One quarter of the technological and scientific publications produced every year are published by patent offices around the world. Modern researchers and technologists emphasize the need for rapid and accurate information; patent specifications meet such needs. Patents relate information much faster than any other form. Journals are considered to contain the latest information, yet the value of the patent might equal or surpass that of journals ([Saunderson, 1972](#)). Patents are used to evaluate specific technology, identify and alternate technology and its sources, improve an existing product or process, develop new products or processes, and monitor development in a specific technology. They form a valuable source for retrieving information on the history of technology. Some well-known patent resources

are:

1. Crowne, J. D. (Ed.) (2000). *BNA's Patent, Trademark and Copyright Journal*. Washington: The Bureau of National Affairs.
2. *European Patents handbook*. (2000). New York: Chartered Institute of Patent Agents.
3. *Food Patents Bulletin*. (2000). England: Leatherhead Food R.A.
4. *Hughes on copyright & Industrial design*. (2000). Canada: Butterworths.
5. *Patent office technical society. Journal*. (2000). Calcutta: Patent office technical Society.
6. Saunderson, K. M. (1972). *Patent as a source of technical information*. Aslib Proceedings. 24, 244-254.

4. Standards

Standards are rules for quality, size, or shape of industrial products. These help in simplifying the product's distribution by a manufacturer and eliminating the non-standardized items from the market. These are usually drawn up by organized agencies, governments, or quasi-governments like British Standard Institute (BSI) in Britain, Bureau of Standards in USA, and the Bureau of Indian Standard (BIS) in India. In India alone, BIS brings about 300 standards annually. Some of the standards in the field of science and technology are:

1. Ramsey, C. G. (1998). *Architectural graphic Standards for architects, engineers, decorators, builders and draftsmen*. New York: John Wiley and Sons.
2. British Standards Institution. (1955). *Summaries of British Standards for building materials and components for housing*. London: The Institution.
3. Society of Motor manufacturers and traders.(1957).*Standards for the British automobile industry*. London: The Society.
4. Maule, R.W. (1997). *Information networks and services: an over view of foundations, Standards and practices for modern information management*. California: Information Association Press.
5. Kahin, B. & Abbate, J. (Eds.). (1995). *Standards policy for information infrastructure*. Cambridge: MIT Press.

5. Trade literature

Industrial and commercial companies produce trade literature, which constitutes an important form of primary sources of scientific and technical literature. Trade literature aims to illustrate and describe equipment or goods relating to the manufacturers. They are issued by the manufacturers or dealers and are often very well produced. Trade literature may take the form of a technical bulletin, price list, data sheet, etc. UK is one of the largest producers of trade literature. The continuous flow of sheets, folders, pamphlets, and bound volumes containing original data on new products and processes, which has not previously appeared in the regular literature, raises these manufacturer's

publications to the level of a primary source of scientific and technical information. A few examples of Trade Literature are:

1. *Pharmaceutical Manufacturing Review*. (1996). England: Argus Business Media.
2. *Injection molding*. (1993). Denver, CO: Canon Communications.
3. *International Polymer Processing*. (1986). Germany: Hanser Verlag.
4. *Aviator Hotline*. (2004). USA: Heartland Aviation Group.
5. *Pea and Bean Progress*. (2004). London: Processors and Growers Research Organization.

6. Theses and Dissertations

Theses and dissertations form a very important primary source of the science and technology literature. They provide evidence from original research and thus form an important category of documents for the researchers in the concerned field. By 1982, it was estimated that in UK alone “two-third of all theses were in S & T” ([Grogan](#), 1982, p. 350). The main function of a thesis or dissertation is to demonstrate the candidate's grasp of a field. Almost half of all theses and dissertations appear later as articles in learned journals, conference papers, or even monographs, clearly demonstrating their value beyond the walls of the university. Some of examples are:

1. Adams, M. L. (2003). *Chemically tailored polymeric miscelles for drug delivery*. Unpublished Ph.D. thesis, University of Wisconsin, Madison.
2. Robertson, M. P. (2001). *Engineered regulation of an RNA Ligase ribozyme*. Unpublished Ph.D. thesis, University of Texas, Austin.
3. Ackley, J. A. (1997). *Weed management programs in potato, transported tomato and transplanted pepper with rimsulfuron and other herbicides*. Unpublished Ph.D. thesis, Virginia Polytechnic Institute and State University, Virginia.
4. Wang, Shensheng. (2001). *Weighting normalization in optimal predictive control*. Unpublished Ph.D. thesis, University of Missouri, Columbia.
5. Bennett, Elena Michele. (2002). *Patterns of Soil Phosphorus: concentrations and variability across an urbanizing agricultural landscape*. Unpublished Ph.D. thesis, University of Wisconsin, Madison.

Secondary Sources

Organized works and compilations that derive from or refer to primary source literature make up the secondary source of science and technology information. They index the selected portions of the primary literature and aid in finding what has been published on a given subject generally or specifically, recently or retrospectively. Secondary sources generally represent the “worked-over” knowledge rather than new knowledge and organize primary literature in a more convenient form. They not only serve as repositories of digested facts, but also act as bibliographical keys to the primary sources, which include: encyclopedias, dictionaries, monographs, indexing and abstracting

services, review of progress, handbooks, etc.

1. Encyclopedias

Encyclopedias are designed to give a summary of the background knowledge in a particular field. Scientists frequently turn to the encyclopedia for their everyday information needs. The task of an encyclopedia is to provide essential facts on a subject. They provide neither current nor exhaustive information, but furnish a vast wealth of facts which are easily found. Encyclopedias act as a bridge between the world of scholars on one side and an individual in search of information on the other. Some encyclopedias in science and technology are:

1. Finn, F. & Robinson, E. K. (1999). *International Encyclopaedia of Ornithology*. Delhi: Biotech Books.
2. Burton, M. & Burton, R. (1988). *Encyclopaedia of the Animal Kingdom*. London: Macdonald.
3. Trivedi, P. C. (2000). *Encyclopaedia Botanica*. Jaipur: Pointer.
4. *Cowles Encyclopaedia of Science, Industry and technology*. (1967). New York: Cowles Educational Corporation.
5. Parker, S. P. (Ed.). (1982). *McGraw-Hill Encyclopedia of Chemistry* (5th ed.). New York: McGraw-Hill Book Company.

2. Dictionaries

Dictionaries list words of a language or a subject, arranged in alphabetical order with each word's meaning, spelling, pronunciation etc. In science and technology the purpose of a dictionary is to define commonly used terms in the simplest manner. Etymology and pronunciation of terms may be included too. Thesauri, dictionaries of synonyms, provide an effective language interface between the user and a storage system. They help by grouping words according to their meaning rather than alphabetically. Thesauri are different from dictionaries, as they do not contain meanings or definitions of words, except to a very limited extent in the form of scope notes and synonyms. Some dictionaries in science and technology are:

1. Singh, O. P., & Srivastava, S. K. (1998). *Dictionary of Entomology Plant Pathology and Nematology*. New Delhi: Concept-Publishing.
2. Sharma, R. (Ed.). (2003). *Management terminology*. New Delhi: Lakshay.
3. Hartman-Peterson, P., & Pigford, J.N. (1991). *Dictionary of Science*. New Delhi: Universal BookStall.
4. Jain, A. (Ed.). (2003). *Medical Terminology*. New Delhi: Lakshay.
5. Read, P. G. (1982). *Dictionary of Gemology*. London: Butterworth Scientific.

3. Indexing Services

An index is an alphabetical list of the names, terms, formulae, and other significant items in a completed work, along with page numbers where the particular terms are found. It forms a backbone of any document. The index serves two purposes: to

minimize time and effort in finding information and to maximize the searching success of users. The index identifies the concepts or information present in a document and indicates their location in the volume. It gives users systematic and effective shortcuts to the information they need. One of the characteristic features of an indexing service of science and technology is an attempt to cover the whole field. Some of the examples are:

1. *Biocontrol Science*. (2000). Japan: Society for Antibacterial and antifungal agents.
2. *Index to Chemical regulations*. (2001). Washington, D.C.: The Bureau of National Affairs.
3. *Index Medicus*. (2000). Washington, D.C.: National Library of Medicine.
4. *American drug index*. (2000). St. Louis, Missouri: Facts and Comparisons.
5. *Current Physics Index*. (2000). New York: American Institute of Physics.

4. Abstracting Services

Abstracts are summaries of the content of publications or articles. Abstracting services act like a current awareness tool for the scientists or technologists, and perform a dual purpose by alerting them of newly published work, avoiding time consuming perusal of the original documents. They can act as surrogates when the original document is difficult to obtain. An abstracting service allows retrieval of specific information. It was estimated that by 1982 about two thousand abstracting and indexing services were available in science and technology ([Grogan](#), 1982, p. 184). Some examples of abstracts are given below:

1. *Chemical Abstracts*. (2000). Columbus, Ohio: Chemical Abstracts Service.
2. *Chemoreception Abstracts*. (2000). Paris: European Chemoreception Research Organization.
3. *Abstracts on hygiene and communicable diseases*. (2000). Wallingford, U.K.: CABI Publishing.
4. *Acoustics Abstracts*. (2000). London: Multi-Science Publishing.
5. *Current literature on Science of Science*. (2000). India: National Institute of Science, Technology and Development Studies.

5. Handbooks

Handbooks are the compilations of miscellaneous information in a compact and handy manner. These are most frequently used by the scientists and technologists and form handy information in other fields as well. Handbooks may contain data, procedures, tables, graphs, diagrams and illustrations, etc. They aim to bridge the gap between the normal textbook on theory and its practical application, thus facilitating economic and efficient practice. When a factual problem arises in a particular subject field, handbooks are consulted. It is believed that a library with no more than a sound collection of handbooks can answer 90% of quick reference queries as they contain vast amounts of diverse data, usually in a single volume. Handbooks can be called “one-volume

reference libraries”. ([Grogan](#), 1982, p.72). Some examples of handbooks are:

1. Bhattacharjee, S. K. (2000). *Handbook of aromatic plants*. Jaipur: Pointers Publications.
2. Bhattacharjee, S. K.(2004). *Handbook of medical plants* (4th rev.ed.). Jaipur: Pointers Publications.
3. *Handbook on Minerals and mines in India*. (2003). New Delhi: India Book Center.
4. Bunch, B. (1996). *Handbook of Current Science and Technology*. Detroit: Gale Research.
5. Sharma, R. P. (Ed.). (2001). *Handbook of Agriculture*. New Delhi: Indian Council of Agricultural Research.

6. Review of progress

Because the scanning of indexes and abstracts proves a cumbersome job for scientists and technologists, reviews of progress are prepared. These provide an evaluative summary prepared by a specialist about the developments in a particular field over a given period. The reviews of progress are regarded as a pathway through the jungle of literature. Some of the reviews of progress in science and technology are:

1. *Annual review of Astronomy and Astrophysics*. (2000). Palo Alto, California: Annual Reviews.
2. *Annual review of Physiology*. (2000). Palo Alto, California: Annual Reviews
3. *Advances in Botanical research*. (2000). New York: Academic Press.
4. *Annual review of Pathology*. (2000). Palo Alto, California: Annual reviews.
5. *Progress in Neurobiology*. (2000). Oxford: Elsevier Science.

7. Monographs

Monographs are separately published reports of original research which might be too long, specialized, or unsuitable for publication in a standard journal. Monographs are self-contained in nature. These summarize the existing theory or practice before presenting the author’s original and previously unpublished work. Very often, a monograph is brought out as a part of a series. Some monographs in science and technology are:

1. *Surface and Colloidal Science*. (2004). New York: Kluwer Academic Publishers.
2. *Dialogues on Work and Innovation*. (2004). Amsterdam: John Benjamins Publishing Company.
3. *Building Blocks in Total Compensation*. (2004). US: American Compensation Association.
4. *Cambridge Studies in Management* (2004). Cambridge, UK: Cambridge University Press.
5. *CROMTEC Working Paper Series*. (2004). London: Center for Research on

Organizations Management and technical Change.

Tertiary Sources

Access to all the primary documents is impossible for a researcher. Therefore, to have the list of sources and location of information of these primary documents, a number of secondary documents are published and made available. Though secondary documents act as keys to primary documents, they themselves are also quite large in number, making it difficult to go through each and every one of them. Hence, the tertiary documents are used to locate secondary sources. They are unusual in that most of them do not carry subject knowledge at all. Some of the tertiary sources are: directories, yearbooks, and bibliography of bibliographies.

1. Directories

Directories are lists of names and addresses arranged for reference purposes and are generally organized in alphabetical order. A directory may include indexes by subject field, geographical location, or some other desirable classification. These make up the largest single category of reference books. Some of the directories in the field of science and technology are:

1. *State-By-State Biotechnology directory*. (1990). Rockville, Maryland: Biotechnology Information Institute.
2. *Biogeographical Society of Japan. Bulletin*. (2000) Japan: Biogeographical Society of Japan.
3. *Federal Biotechnology transfer Directory*. (2000). Rockville, Maryland: Biotechnology Information Institute.
4. *Information Industry Directory*. (2000). Farmington Hills, Michigan: The Gale Group,
5. *Medical Company Guide to Japan*. (2000). Japan: Chemical daily.

2. Yearbooks

Yearbooks are reference books which describe the events pertaining to a particular year. In various disciplines of science and technology, much of the task of digesting the developments of a year is performed by annual reviews of progress, and this function is performed by yearbooks as well. In this way they form an important source of information in the field. Some examples of yearbooks are:

1. Butler, D. (Ed.). (2001). *The Nature Yearbook of Science and Technology*. U.K.: Nature publishing group.
2. *The World Competitiveness Yearbook*. (1999). Switzerland: IMD.
3. *Yearbook of Clinical Microbiology*. (2000). Boca Raton, FL: CRC Press.
4. *Yearbook of Physical Anthropology*. (2000). Hoboken, NJ: John Wiley & Sons.
5. *Yearbook of Agricultural Statistics of Bangladesh*. (2000). Bangladesh: Bureau of Statistics.

3. Bibliography of Bibliographies

For almost every subject, a significantly large number of bibliographies have appeared. The vast quantity of bibliographic information available makes it impossible for users to know the precise number and location of bibliographies available. Therefore it is necessary that there is some kind of control over bibliographies being published in different subjects. A bibliography of bibliographies serves this purpose. Some of the well-known bibliographies in S & T are as follows:

1. *A Botanical Bibliography: A guide to bibliographic material applicable to Botany.* (1970). Minneapolis, MN: Burgess.
2. Basterman, T. (1971). *Physical Sciences: A bibliography of bibliographies.* Lanham, MD: Roman Littlefield.
3. Ingles, E. (Ed.). (1994). *Bibliography of Canadian bibliographies.* Toronto: University of Toronto Press.
4. Basterman, T. (1965-67). *A World Bibliography of Bibliographies and of Bibliographical Catalogues, Calendars, Abstracts, Digests, Indexes and the like* (4th ed.). Geneve: Societas Bibliographica.
5. Tomey, A. F. (1977). *A World Bibliography of Bibliographies, 1964-74.* Lanham, MD: Roman and Littlefield.

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Grogan, D. (1982). *Science and Technology: An introduction to the literature* (4th. ed.). London: Clive Bingley.

Saunderson, K. M. (1972). Patent as a source of technical information. *Aslib Proceedings*. 24, 244-254.

Author's Bio

Dr. Muzamil Shafii has completed an MLISc. from the [University of Kashmir](#) and a Ph.D. from [Aligarh Muslim University](#), under the guidance of Prof. Shabhat Husain. The topic of her research was "Growth and Development of Science & Technology Journals in India since Independence: An Evaluative Study". At present she is working as Professional Assistant in the College of Teacher Education, at [Maulana Azad National Urdu University](#), Srinagar, Kashmir.

[Go to Top](#)