ENGINEERING INFORMATION NEEDS AND SERVICES

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1 Engineering Information

Engineering finds an optimum solution to convert the abstract into concrete giving due weightage to all the parameters involved whether these are in scientific, technical, economic or social fields. A Good Engineer has necessarily to take into account simultaneously all such parameters which influence the final engineering decision. In doing this the Engineer acts as a converter of available resources into meaningful and concrete wealth in the form of goods or services for the benefit of the society. An engineer is essentially the Manager of Man, Materials, Machinery and Money (the 5 Ms). An important input in the Management which properly binds these 5 Ms is "information" of the right kind at the right time in the right dose. Unlike scientist whose main preoccupation is in the furtherance of knowledge and in the generation of new knowledge, an engineer's main preoccupation is in creating material objects or purposeful services by utilizing such available knowledge as the engineer might need in a given situation.

Broadly speaking, therefore, scientific information, engineering information and management and social sciences information can be viewed as three distinct spheres of information, though one may overlap the other in certain respects (Ref. Fig. 1). Whenever we talk of engineering information, we refer to the central sphere which is contiguous with the scientific information on the one side and the management and social sciences information on the other; some aspects have naturally to overlap.

2 Magnitude of the Problem

It is estimated that 30 million technical books already on the shelves are being expanded at the rate of almost 600 a day; in addition, about 1,00,000 special journals are published every year - 35 percent of them carrying some three million articles dealing exclusively with science and engineering. By extrapolating growth rate of technical literature it may be conjectured that by the end of the present century the total number of scientific and engineering journals published would reach nearly one million. Thus the system of collection, compilation, translation and transmission of information published in millions of scientific and engineering papers, books, journals.

conference proceedings in hundreds of different disciplines and in many languages is perhaps one of the most difficult tasks in the development and transfer of science and technology.

But an engineer's needs extend even beyond what is provided as information in this form and so the problems become even more complicated. He should have at his disposal, systems which would, in addition to the above, generate, collect, store, retrieve, interpret and use knowledge available in the form of drawings, specifications, standards, patents, project reports, feasibility reports, construction reports, design development models, photographs, films, etc.

3 Engineering Information Needs

The broad expanse of engineering information for industry is often underestimated. People who never have worked in an industrial enterprise do not realise the complex and diversified activities necessary to keep a factory running and to make a business a success, to continue uninterrupted service to the community or to construct something. The main sources of failure need not be only the lack of technology, but also may include among other things the lack of cost/benefit analysis, maintenance and market evaluation. Engineering information must, therefore, cover many - and some unexpected - aspects. For example,

a) Raw materials and semi-finished goods as far as used in the industrial processes; world-, regional- and national-production; market situation; quality standards; prices; international and domestic trade; new materials substituting for traditional ones;

b) Economic infrastructure - Possibility of use of indigenous resources, new industrial uses for by-products, public utilities, water and power availability, prices, transportation, rates, capacity, labour, technical education, training facilities, trade unions, recruitment.

c) Technology - Process and techniques, technology appropriate to local conditions, machinery, power requirements, innovations, problems of maintenance and repair, performance characteristics, spare parts, service availability, factory design, productivity, automation problems, rationalisation, technical management, quality control, labour requirement.

d) Products - Product design, fashions, packaging problems, quality control, markets, domestic and foreign competition, prices, sales organisation, cost/benefit analysis, export opportunities, supply and demand situations, clients.

e) Suppliers of equipment and formulae for products, including the names and addresses of suppliers, types of machinery available, costs, conditions for purchase, and delivery procedures and schedules.

f) Standardization and Standards, including standardization systems, standards adopted by the industrialised nations, other developing countries and
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international standards, industrial regulations, testing facilities, specific product standards, and materials specifications.

g) Markets and marketing, including data on present and future markets, international prices and trends, exporters of products concerned, and productivity and production rates of other nations and future trends.

4 International Engineering Information Services

Whilst a great deal of attention has been given to information services in general in the world, organisation of Engineering Information Services has till now received less than scanty attention. The international information system UNISIST of UNESCO, provides an international forum and has planned a programme for the development of an international information system. Even so, the attention, as is evident, has been heavily on non-engineering or non-industrial information aspects of information science and service:

There are several other international organisations which in their own way have been seized of some aspects of information service or the other. The International Federation for Documentation (FID) is yet another organisation which is promoting through international cooperation research in and development of documentation which includes inter-alia the organisation, storage, retrieval, dissemination and evaluation of information; the increasing interest of FID in promoting Engineering Information is reflected, amongst others, in the WFEO-FID-CRI project sponsored on the Cement Research Institute of India. The International Council of Scientific Unions is another body which addresses itself to the problems of abstracting services in the world of science and technology through its abstracting agency, ICSU-AB. Similarly, ICSU-CODATA has been busy in the field of scientific and technical data which is perhaps one of the closest activities to engineering information aspects, especially in relation to design.

Mention may also be made of the International Atomic Energy Agency (IAEA) for nuclear information and the International Organisation for Standardisation (ISO) for standards information. There are several national bodies in different countries which have been doing considerable work and have had international impact, too. But it is the World Federation of Engineering Organisations (WFEO), through its Committee on Engineering Information, which is making the greatest impact yet in each one of these international bodies to get engineering information recognised in its own right so as to provide for it in their systems.

WFEO has also been trying on its own: (i) to determine the information needs of engineers, (ii) to compile a directory of the presently available engineering information services in the world, (iii) to develop lexicographic tools of value to engineer, and (iv) to establish systems and a clearinghouse for engineering data. The industrial Information Services which have recently been developed by the United Nations Industrial Development Organisation (UNIDO) is yet another attempt to meet the information needs of engineers and industrial entrepreneurs on a global basis.

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5 Engineering Information Services in India

Most of the engineering information services in India are being rendered by professional engineering societies, such as the Institution of Engineers (India); research and developmental organisations such as, Council of Scientific & Industrial Research, Atomic Energy Commission, Defence Research & Development Organisation, Research Designs and Standards Organisation of the Ministry of Railways, Laboratories under various Ministries, Endowment Research Institutions and R&D units in Industrial Houses. Certain industries have developed their own technical information groups as those which exist in Hindustan Steel Ltd., Tata Iron & Steel Co., Bharat Electronics, Bharat Heavy Electricals, Heavy Engineering Corporation, Oil & Natural Gas Commission, Indian Telephone Industries, Associated Cement Cos Ltd., Fertilizer Corporation of India, etc.

6 Future Plans for Engineering Information Services

The notable amongst the plans for engineering information services in the future are the establishment of National Data Banks and National Information System in Science and Technology (NISSAT) which have engineering information as a component.

61 National Data Banks

In the National Data Banks proposed to be established, all types of data - both numerical and descriptive - in respect of aspects such as, R&D activities in all agencies, completed projects for these available for commercial exploitation, status of technology, industrial processes, licenses issued, joint ventures, production, etc., will be collected. These banks will select appropriate information, analyse it with user interests and store it either in a conventional or a machine-readable form.

62 National Information System in Science & Technology (NISSAT)

On behalf of Department of Science & Technology of the Government of India, the NISSAT is to be developed with the nucleus of information facilities available in the laboratories of Government Scientific Agencies, public and private sector industries on a total national basis.

Amongst the three tiers of the proposed NISSAT scheme, engineering information services will be mainly rendered by the Branch Information Centres (BICs). The main role of BICs is to provide the following services:

a) specialized current indexing and abstracting services, and Selective Dissemination of Information;

b) subject bibliographies;

c) subject union catalogues;

d) information retrieval on request;
e) information on patent specifications and standards data;

f) information on scientific, technical and economic data; and

g) preparation of surveys, state-of-art reports, scientific and technological forecasting, and other types of techno-economic and special management information service.

With particular reference to engineering information, several areas have been identified for the establishment of BICs within the NISSAT framework. Considerable progress has already been achieved towards developing adequate information base capable of providing national service, in the National Aeronautical Laboratory, Bangalore; the Central Food Technological Research Institute, Mysore; the National Metallurgical Laboratory, Jamshedpur and the Cement Research Institute of India, New Delhi and a number of others. An Electronic Information Centre is already in operation under the auspices of the Electronics Commission.

63 National Information & Documentation Centres

In their programme for establishing a national information network, the NCST assigned the task of evolving framework for such networks in several areas of science and technology, of which the Planning Group on Information and Documentation for Housing and Building Technology has done considerable work. An agency which can provide a comprehensive, systematic and organised service to the Housing and Building Industry in the country is envisaged to be the National Information and Documentation Centre on Housing and Building Technology. The objectives of the centre will include, amongst others, the following within the sector on Housing and Building Technology:

- To act as a national clearinghouse for information in this sector,

- To collect, store, organise, retrieve, translate and disseminate technical literature,

- To bring to the attention of engineers, scientists, architects, etc. engineering information including current practices relevant to their work,

- To maintain liaison with all the related institutes in the world for mutual exchange of information and publications,

- To provide reprographic services,

- To publish relevant periodicals, handbooks, reports, data sheets, training manuals and directories,

- To organise seminars, lectures, conferences, film shows and exhibitions to promote communications of engineering information,

- To maintain a register of R&D activities in the sector in the country,

- To compile and maintain a roster of specialists in various disciplines of the sector, etc.
7 Technology Transfer Interface System for Industrial Information

Technology transfer can take place singly or jointly in a number of ways including dissemination of information through published literature, conferences, lectures, communication media, movement of people, discussions and visits; through the process of standardization; through foreign investments and associated transfer of know-how; through input of machinery and equipment; through technical cooperation programmes; and through licensing of know-how, patents and trade marks.

It is well known that for an effective transfer of technology, the transferee should have developed the requisite competence and be equipped enough to receive, assimilate and utilize the new technology by adapting, if necessary, to the transferee's own conditions; the transferer should also be willing and cooperative in this process. In any such system of transfer of technology, actual mechanics can considerably vary from situation to situation but it is now well established that the most important single factor which would contribute to the success of transfer is the creation of proper interfaces in the system. In any given circumstance, every centre of technology has four clear interfaces two in the vertical direction and two in the horizontal direction as illustrated in Fig. 2.

The transfer should be both vertical and horizontal, but what is important is the proper interfacing and a proper linkage, so that the knowhow is transmitted from one level to the next and is absorbed and used. Any effort at transfer without being clear about its interfaces might lead to infructuous expenditure of resources and efforts.

The upper vertical interface takes the inputs and the lower vertical interface delivers the output. At the upper vertical interface, the relatively more fundamental or basic knowledge of information or raw data or the more sophisticated aspects of the knowhow and technology are put in. These are processed in the centre and converted into more readily utilizable forms to be given out as the output. In other words, this vertical transfer results in the pure science or raw data at the top face leading through successive interfaces to more applied forms of technology till finally the last output of technology results in a concrete hardware or a definite usable instrument of service to the society or industry.

In the horizontal direction, one of the interfaces feeds the centre with the scientific, technological, economic and social information generated in one context for application in its own processes and at the other interface disseminates the knowhow which has been generated within itself for application in other contexts.

Whilst this concept of interfacing is a basic one and the philosophy of interfacing is an essential prerequisite in any effective system for transfer of technology, it is not always necessary that the centre for transfer of technology be a separate institution, organization or entity; it is possible to bring about such a transfer even within the framework of a single entity or institution as long as the transfer mechanics is realized as a closed orbital loop in which every link has an interface with the preceding one and the following one.
The Cement Research Institute of India (CRI) - the national centre for R&D in cement and allied industries - is a cooperative venture with the active participation of all concerned. The activities of the Institute encompassing the needs of all its constituent participants cover the entire spectrum with cement as the pivotal theme, starting from the raw materials available in nature and their exploitation towards making cement through the manufacturing processes, the design and development of cement plants, the cement technology, the concrete technology, construction technology and finally the concrete structures where cement finds its ultimate place of rest.

Activities of CRI with Particular Reference to Industrial Information Services

The Management structure of the Institute comprises two distinct structures - the Infrastructure and the Operational Structure. The Infrastructure has three different limbs - the Faculties, the Facilities & Services, and the Management Controls, in addition to which the physical units in which the infrastructure is housed form another part. The Operational Structure, on the other hand, has Technology Generation and Technology Transfer Activities as the two distinct limbs; the independent testing activity forms an additional part in this. Above all, with a view to bringing in a working culture in the Institute which leads to the best utilization of resources put in, there is the Matrix System of R&D management to coordinate all aspects. The crux of the Matrix System is to bring out a conceptual distinction amongst the various activities of the Institute whilst retaining the infrastructural wholeness of the talent, equipment, environment, services and controls, and achieving the objective fulfilment through a balanced integration of these.

The organs of the Institute which have been entrusted with activities relating to the engineering and industrial information have been conceptually designated as the Technology Transfer Sciences Faculty, the Technical Communications Services Division and the Industrial Information Centre. Whilst these three exist as conceptual organs, each and every individual within the Institute is a participant in these organs contributing in the respective field of his specialization. With a view, however, to streamline the working procedure as well as assigning respective responsibilities, the areas of activities of these three organs, as an illustration, are listed below:

Technology Transfer Sciences Faculty

i) Current awareness techniques including selective dissemination of information.

ii) Performance criteria for information retrieval systems.

iii) Indexing languages, their components and characteristics and other lexicographic tools.

iv) Mechanised information retrieval systems.
812 Technical Communications Services Division

1) Keeping the various R&D Groups of CRI promptly informed of the latest scientific and technological advances, parallel investigations and developments of relevances to the concerned R&D Group.

2) Library & Documentation

   i) Acquisition of technical literature, cataloguing and classification;
   ii) Maintenance of card catalogue file;
   iii) Preparation of 'CRI Current Contents' and 'Express Current Awareness Lists';
   iv) Compilation of bibliographies;
   v) Assigning keywords and UDC number to 'CRI Abstracts';
   vi) Procurement and maintenance of trade literature file;
   vii) Procurement and maintenance of reprint file;
   viii) Maintenance of newspaper clipping file;
   ix) Procurement and maintenance of patents information file;
   x) Providing translation services to R&D Groups in CRI;
   xi) Acquisition of microfilms;
   xii) Providing reprography services to R&D Groups in CRI;
   xiii) Subscription to periodicals;
   xiv) Maintenance of Kardex; and
   xv) Membership of Professional bodies/Societies

3) Development of Photographic Facilities.

813 Industrial Information Centre

1) Keeping the industries being served by CRI informed of the latest scientific and technological achievements, trends and developments of interest and use to these industries;

2) Technical enquiries relating to all the scientific and technological activities of the Institute;

3) Technical liaison through exchange of technical documents, project reports, catalogues, patents, specifications, models, etc.

4) Planning and organization of display centres;

5) Editing, printing and publishing of all CRI publications and the work connected therewith;

6) Providing translation services;

7) Providing reprography services;

8) Maintenance of up-to-date mailing list for CRI publications; and

9) Organization of seminars and symposia.
To support the activities relating to engineering information, the Institute has at present about 12,000 volumes including technical books, bound volumes of periodicals, research reports, standard specifications, etc. It is getting over 300 periodicals titles in the field of cement and concrete. In addition, over the years, it has collected more than 2,000 trade catalogues, and reprints. It is also organizing a patent information file. The library is maintaining a Central Information File which is planned to have all the microdocuments indexed, for retrospective search and for compiling subject bibliographies. The pattern of information collected for eventual dissemination revolves round cement as the nucleus.
Fig. 2: The Technology Transfer Interface System

Upper Vertical Interface
Intakes relatively more fundamental or basic knowledge & information

Horizontal Interface
Absorbs necessary disciplines and knowledge from parallel organizations

Industrial R & D Establishment

Lower Vertical Interface
Diffuses the output in the form of findings utilizable by the industry

Horizontal Interface
Disseminates knowledge and information to parallel organizations
The Library has also established liaison around the world with similar organizations, for exchange of technical publications. In the NISSAT plan, the Cement Research Institute of India will find a place both at the BIC level and the LIU level.

8.2 Quantification of Benefits Accrued from CRI's Engineering Information Services

The benefits derived through various technology transfer services including technical and industrial information, standardization, training, seminars, etc., since its inception nine years ago, have been estimated to be approximately Rs. 40 million.

9 Conclusion

In order that the information service becomes really effective, one has to look into the detailed system and endeavour to make it a really integrated one. Indeed, information science has become a science in its own right just like any other branch of science providing answers to how to deal with various situations under various circumstances. Engineering information has its own special components, hitherto not handled by information science experts, such as drawings, models, audio-visual aids and so on. As such, a great deal of attention is called for to work out effective systems to deal with such information aids.