

THE FLOW OF INFORMATION

Paper delivered to ICIK '87

by

Michael W Hill

President, International Federation for Information and Documentation
and Associate Director, the British Library, Science, Technology & Industry

When the organisers of this Conference invited me to give a paper, they specified that it should be on information flow and also that it should make reference to links between bibliographic information and data. It has proved a challenging remit and I am grateful to them for setting it.

In very primitive societies information flowed by conversation between human beings. Even in the most advanced sectors of modern society this is still the principal method of information flow. Any discussion of information flow must keep the preponderance of and preference for oral communication clearly in mind throughout. Written information is an ancillary aid. Even certain types of data, such as meal times or the prices of some commodities or weather forecasts, are commonly transmitted orally: on the other hand, much scientific data and all bibliographic information are normally communicated in writing.

Reverting to primitive times, news then travelled only as far and as fast as people travelled. This remained true even after the invention of writing and of printing. Of course, when written down, the flow of information no longer depended on the memory of the traveller. It was stored in permanent form as a letter or a book and the store transported to one or many people. However, its flow still depended on a human being, who transported that store either by hand or by vehicle (with the human as driver).

Attempts to transmit information over a distance without human carrier were, until the last century, very limited and most (animal or bird carriers are the exception) involved some form of coding. Smoke signals, beacons, semaphore signalling and drumming all involved converting the message into a code which was understood and interpreted by the recipient. Of course, writing itself is a code, a fact we sometimes forget and so too are the words of speech. What we regard as codes, whether Morse Code or the binary code of computer work, are but codes for codes and in some cases it can be important to remember that, except for message transmission by pictorial means, we are relying on codes of one sort or another to enable information to flow.

The greatest step forward in information flow, greater even than the invention of printing, was the use of electricity to transmit messages over a distance. The electrical telegraph, invented in the last century, was the first device which allowed message transmission over large distances without human or animal carrier of some form or another. Today's computer-to-computer communication via satellite link is but a development of that first message transmission by electricity along a wire.

Let us turn now to considering what we actually mean by the term "information flow". Most of us are probably clear in our minds about the distinctions between information and data on the one hand and between information, ideas and knowledge on the other. Nevertheless, it must be admitted that the boundaries

are far from clear and there is scope for misunderstanding. Equally, the phrase "information flow" is capable of two interpretations. A common use of the term implies the spontaneous or automatic spread of information: if you like, its dissemination by gossip or via the news media. If we use information flow in this sense, we would have to admit that bibliographic information - which I understand to mean the data which appears in a library catalogue or the reference at the end of a journal article - never does flow. Nor does data except in specific cases such as I mentioned earlier, eg weather forecasts, stock market reports and a few similar items of data which are regarded as 'news'. Since our remit is to include consideration of the flow of bibliographic information and data, this cannot be the sense meant, otherwise this paper would stop here.

Clearly then, the term "information flow" must be used in the other, broader sense of information transmission whether from person-to-person direct or via some intermediary store such as a book, journal article or computerised file. Thus not only dissemination is covered but so too is the ability to retrieve information or data from a store whenever it is wanted and this, in turn, brings in the question of awareness of the existence of information or of the existence of a store wherein required information or data might be housed. We are concerned, to use an analogy with water flow, more with the pipework, taps and valves, than with rivers and streams.

Since the 1984 British Royal Society Conference on information, an enormous amount has been written on information transmission. All that it is practicable to do in a short paper is, therefore, to review briefly some of the issues that are currently outstanding. The flow of information among scientists, the role of the journal article, the use of abstracting services, the relative importance of informative and indicative abstracts, and the significance of the "invisible college" are standard text book material for most information science courses. Interest more recently has focussed on the effect of the new information technologies and what impact, if any, their adoption as a means of communicating will have on the traditional means. I shall return to this topic later but in assessing the impact of electronic mail, facsimile transmission and electronic bulletin boards one has also to take into account changes in external factors such as the deterioration in traditional cheap postal services, the growth of more expensive courier services and the decrease, for scientists, in travel funds and the consequentially reduced ability to meet colleagues at international conferences.

Although attention has been paid to information flow among scientists, more attention has been given in recent years to that within and between organisations, especially industrial and commercial firms. The practical value of encouraging good information flow while, at the same time, ensuring that what does flow is within the capacity of the recipients to absorb and use it, has been clearly demonstrated and is accepted by all progressive firms. Indeed, in large multi-national firms and in those commercial activities which take place on a worldwide basis (banking, selling stocks and shares, airline bookings for example) the planning, management and execution of information flow is a major activity.

En passant let me comment that one consequence of the arrival of the information society is that there can no longer be a single information profession any more than when the industrial society grew there could be the single "profession" of industrialist. We must accept that, in a society in which information in a variety of formats is the basis of commerce, there will be an increasing number of different groups of people, specialising in narrower and narrower aspects and that any dream of a unified profession covering all those aspects cannot now be realised. However, it is likely to be some time before the comings and goings of

new groups and changes of older groups will settle down to any stable pattern and during that time the opportunity exists for established groups, if they can, to adjust to the new requirements and define their roles.

That was a digression. To return to information flow in industry, the effectiveness of the large multi-national companies and the availability of efficient means of communication cannot be unconnected. Though the telephone made possible the easy and quick contact between remote parts of a company that is essential for business, there were signs in the 1970s that very large agglomerates were becoming unwieldy. With the arrival of dedicated company wide networks to which all manner of gadgets can be linked and instant communications achieved which do not require a man to be sitting in his office beside a telephone, the viability of large multi-national companies has been re-established.

However, one consequence has been that serious questions have arisen about the nature of the information which should flow between one country and another but still within a single organisation, questions which have still to be resolved. Differences in national policies on the handling of personal data, for example, inevitably have consequences for companies which need to transfer information on people between their offices in different countries. Questions concerning copyright inevitably arise when such a company needs to transmit the content of a publication to another office. Two colleagues in the same office block can share a copy of a print-out from a databank: why then should not two colleagues in the same organisation do so even if they are in different continents?

Such problems arise and are generally resolved ad hoc. Providers of information are having to establish policies with international implications. No doubt they do so in concert with their fellow information suppliers but such examples illustrate that national governments are less and less able to determine the course and pace of developments. They can influence but they cannot determine. The same was true, but to a lesser extent, during the industrial revolution.

The dependence of economic and social development on information flow should give hope that the means exist for reducing some of the discrepancies between countries. Information handling can, in principle at least, be as efficiently carried out in a developing country as in an industrialised one. In this respect multi-national companies with offices in the developing countries can bring to them the benefits of the new technologies and train local staff to use them. The UN agencies, such as UNIDO and UNESCO, are also doing much to make electronic sources of information more readily available in the poorer countries and international organisations like FID are also helping the profession to train for the new systems. Education remains an essential need and the efforts given to raising the level of literacy need to be intensified since literacy and numeracy have become in the information society even more essential than they were before. In industrialised countries, the highest levels of unemployment are among those who previously were the backbone of industry, namely the manual workers and machine minders. Sadly, only a small proportion retain for long the intellectual skills they were taught at school and as a result most cannot be retrained to find a place in the information workplace.

This brings me to another aspect of information flow, namely comprehension. In the field with which we are concerned, the flow of information always starts with one human being, or a group of them, and ends with another. The problems of communication between human beings are only too well experienced, though not properly understood, and the communication of scientific and technical information and knowledge is prone to the same problems. I am sure that everyone hearing or reading this paper will misunderstand some of the points I am trying to make. This applies even to those whose native language is English, because understanding is dependent not only on the words heard or read but also

on the recipient, his background, his mental make-up and his expectations. Fortunately, the scope for differences of understanding has been largely eliminated in the case of bibliographic information by the adoption of standards of presentation. This is not true, however, of any classification or indexing terms applied, as the comparison of different language versions of a classification scheme will show. Nevertheless, classification symbols can be used to help bridge language differences.

In the case of data, much has been done to ensure precision of meaning and even if statistics are still capable of varying interpretation, the figures that appear on bank statements and many scientific constants are precise and equally understandable to everyone. In the presence of experts from CODATA, I shall not expound further on understanding the precision of scientific data save to comment that any figure requires both knowledge of the conditions under which it was determined (these are often accepted standards) and the level of accuracy achievable by the measuring equipment. Even precision has its limits.

Of course, not all information that flows is correct. Irrespective of any question of understanding, some information we receive is wrong. In fact a remarkably large proportion is wrong but even more remarkable is that sometimes information that is wrong can lead ultimately to correct actions. For example, I was told that it would be worth my contacting a certain official. I was given his name and Ministry. The name proved wrong but I was given a phone number to try to find out the right person. That proved wrong too but by chance the person answering did know the name and phone number of the right person. No doubt everyone can think of similar or better examples.

It is also well-known that when human beings receive and retransmit messages orally they are liable to rephrase them and to introduce error thereby. A message transmitted orally via many intermediaries can suffer almost total change. What then may happen when intermediaries are involved, as they commonly are, in information transfer?

Intermediaries, including the "gatekeepers" identified and categorised many years ago by Tom Allen, play an important role in our information world. On-line searches are commonly performed by intermediaries. So are patent searches. Abstractors are intermediaries too. Do they always describe correctly the article they are abstracting? When the intermediary is an expert on the subject with which the information being transferred is concerned, and when he can add extra information or reshape the information to suit the recipient's problem, then he is a very valuable aid to the information process. Many databanks nowadays are being designed so that the end-user can search them for himself. Often this can be efficient but sometimes it can be more effective to use an intermediary. Nowadays, when computer systems are being designed to make the intermediary who has to work the terminal unnecessary, we need to re-examine the role of the intermediary and make sure that the value he can add to information during its flow is not lost. At the same time let it be recognised that useful intermediaries are exceptional people and the value they add must be paid for.

Finally, then, having just mentioned searching of databanks, let me comment on the new technologies and their effect on information flow. Despite our feeling that nowadays everything changes very rapidly - and it does, compared with past ages - the fact is that most new technologies take some time to gain acceptance. However, once they are accepted then a wealth of applications seems to open up very rapidly. Facsimile transmission has been used for a long time in the newspaper industry - an industry that is certainly concerned in all senses with information flow - but it has taken a long time for it to become widely adopted for other types of information transmission. There are a number of

reasons for this - not least that for adoption convenience, ease of use, speed, cost and wide applicability all need to reach a level that learning to use the new technology becomes preferable to continuing to use only traditional methods. Frustration with the postal service, the faster speed (and hence lower transmission cost) of Group III machines and their wide availability (there are as many fax as telex machines nowadays) means that at last they are being used for urgent document transmission. Fax also handles diagrams easily.

Electronic mailbox systems are beginning to be accepted now that a great many organisations have them either built onto their own mainframe computer systems or as a service from external suppliers or both. We in the British Library have an in-house system and also use the public BT-Gold mailbox network which we access through our in-house system. Provided that internal communications are good, that is to say that people are conditioned to communicate readily with each other at all levels of the organisation, then electronic mail systems, local area networks and wide area networks can serve to make information flow even more effectively. They will do nothing in an organisation in which people are secretive or mistrustful and do not communicate readily. Where the systems do work, the ability to send one message simultaneously to each member of a group of people is a great bonus for information flow.

Experiments with electronic journals have shown that on the whole scientists are reluctant to entrust their papers to the system. But as has been shown in the BLEND experiments in which a range of means of communicating electronically were included and as has been confirmed by the introduction of such systems elsewhere, scientists find communicating informally by bulletin boards very useful and the use of computer-to-computer communication for writing multi-author papers has also been successful.

People are using intelligent terminals, or more often now microcomputers linked to telephone systems, to communicate with each other. The salesman sends reports to his company or even uses his portable micro to get instant quotations and place on-the-spot orders. The field scientist can communicate back to his laboratory to get data more reliably than by oral telephone communication. The quality of information flow is being enhanced by the new technologies.

Nevertheless, there are limits to acceptance. The new technologies must fill a need rather than just replace an older and often popular way of doing things. Teleconferencing, for example, is only rarely and reluctantly used as an alternative to meeting a group of people because it is both less popular and less effective.

Around us grow the new means of communicating more quickly, more cheaply, and to more people in more places. Cable TV, direct broadcasting by satellite, viewdata systems, wide band systems are all providing ways of enabling information to flow more readily. Access to both information and data, wherever it is stored, is easier and easier.

At the same time optical discs, office automation systems and other technologies are making it easier to store and retrieve the information in its original form. As a result, the need for bibliographic information as an intermediary stage, as a label for information is decreasing. Nevertheless, our true understanding of the fundamental principles of information transfer is still incomplete and there is need for well focussed basic research. As one component of this, the time has probably arrived when, under the aegis of FID, a major programme should be mounted of examining and evaluating the various methods of knowledge representation in the context of information flow in the technologies of today and tomorrow.