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Information Requirements of the Indian Space Technologists

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Explains the scope of information-requirements and the difficulties with respect to use of terms and concepts like 'need', 'want' and 'demand'. Enumerates typology of information needs and suggests probing nature and type of information required by scientists, engineers, technologists and technicians. Describes the overlapping classification of nature and type of information adopted in some earlier studies. Presents as a case study the nature and type of information required by the Indian space technologists based on a survey and the results are compared with the findings of the earlier studies. Discerns out of discussions with respondents, four types of changes in nature of work and their effects on information-requirements and future information-requirements of the Indian space technologists. Concludes by suggesting some of the implications of the findings for information system for the IST.

1 INTRODUCTION

I am deliberately using here the term 'requirements' rather than the 'needs', 'wants' and 'demands' as it represents all the three concepts (Britain, 1971). Yet the case study in the later part of the paper is concerned with nature and type of information required/sought by the Indian Space Technologists (IST).

The information-requirements refer to a lookout for a sort of relevance of information to a given user and to his areas of concern and interest and likes. In the process it is to know the amount of irrelevant information he is prepared to tolerate. Relevance is not a simple property inherent in information, but varies with content, format, context, the variety of uses of information as well as user himself (Cott, 1970). "The selection and reception of the information will depend upon the individual's conception of his own needs; one man's information is another man's noise ..." (McGarry, 1975, p 58).

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There have been numerous studies as well as reviews about user-needs and requirements, but with little accumulation of body of knowledge. Meaning, scope, levels and types of information-needs have varied very widely. Problems of defining terms and concepts, lack of theoretical frameworks and other problems and issues of an empirical study of information needs and requirements persist (Brittain, 1971, p 2). The successive reviewers like Menzel, Martyn and Crawford have pointed out (in ARIST, 1966, 1974 and 1978) the extremely complex, varied and difficult-to-measure nature of information-need. Menzel has even preferred to call 'information needs and uses' as a study of the behaviour and experiences of scientists and technologists. Hatt (1976, p 42-43) called them 'user behaviour studies' and Wilson (1981) advocated that the term 'information-needs' should be replaced by 'information-seeking towards the satisfaction of needs.'

While discussing the issue of information-needs, a natural assumption is to consider the needs as perceived by the users. But some are of the view that there is a need to create information-needs among users if they do not exist (Harris, 1985, p 2) and that information-seekers may be ignorant of the information that would be useful to them (Oldman, 1976, p 23).

Dervin (1976) has analysed the taxonomy of everyday information-needs of an average citizen and proposed a study of six linkages among the following four elements: (1) Information-sources, (2) The individual citizen, (3) Information needs, (4) Solutions to information-needs. Each one of the linkage represents interaction between two elements. Havelock (1976, p 211) provided a linkage model/process describing the internal problem-solving cycle within a user who is related to an external resource.

As noted earlier, information-needs are affected by many factors. Range and knowledge of information-sources/facilities available, varieties of uses to which information will be put, the background, motivation, professional orientation, discipline, type and area of work and other individual-characteristics of the user, the social, political and economic system as well as the consequences of information-use (Cronin, 1981, p 39; Lin and Garvey, 1972, p 8-10). Due to this contingency nature, generalised one-time conclusions about information-needs of users is impracticable. Of all the factors influencing or determining the user-needs, two factors which may not always be congruent, are the corporate objectives of the organisation where the user is employed, and the needs of the individual user.

2 TYPOLOGY OF INFORMATION-NEEDS

Studies relating to 'information-needs' categorise needs as 'perceived

needs' and 'actual or idealised needs', 'immediate needs' and 'deferred needs', 'continuous needs' and 'discrete needs', 'regular' and 'irregular needs'. Further, information-needs could be unexpressed or expressed/articulated, felt or unfelt, dormant or delitescent. In addition, information-needs of users can be expressed in terms of time (*ie*, urgency), content and amount or quantity of information. Accordingly, information-needs have been classified as needs for single facts or exhaustive information, uptodate, historical or current information, technical or business information. However, information-needs are frequently determined in terms of kind of message *ie*, nature and type of information, the types of document embodiments of information needed and the purpose of use. Many studies have investigated need for channels, but only a few have focussed on the need for substance or nature of material in terms of characteristics of texts (Lin and Garvey, 1972, p 12).

In the past, each study has adopted its own classification based on the nature and type of information sought by users. Some of the significant classifications are personal, technical and task-related information (Ford, 1973, p 88-89), current, specific and exhaustive information (Voigt, 1961, p 4), theoretical information, experimental results, data, methods and procedure information (Columbia University, 1960), educational information, methodical or how-to-do-it information and task-related information (Auerbach Corporation, 1966). Many others like Slater and Fisher (1969), and Hanson (1964) have attempted to determine the amount or level of information required in core versus peripheral areas of interest of users. In addition, the nontechnical information required, information requirements in new fields versus old fields have also been attempted. The profession and organisation-oriented, work-related information-needs are the main information-needs in all these studies apart from day-to-day personal needs, life-long learning or educational needs, and needs about the governing rules of the society around user.

3 NATURE AND TYPE OF INFORMATION SOUGHT BY SCIENTISTS AND ENGINEERS: SOME PAST FINDINGS

The findings of different studies on information requirements of scientists, engineers, technologists and technicians roughly indicate that basic S&T information, background information and everyday information on one hand and technical, physical, design and other technical data, facts or figures, product, process, method and equipment information on the other hand have occupied the highest position. For example, need for basic S&T knowledge (82%, Shuchman, 1981, p 32-33; 1982, p 106-109) by American industrial engineers, everyday information (68.8%, Wood, 1967, p 212) by British mechanical engineers and background reading coupled with uptodate

information by users of British technical libraries (27% + 19%, Slater and Fisher, 1969, p 32-33, 36, 47 and 49) as well as American technical libraries (49%, Rawdin, 1975, p 41-42) ranked highest in some studies. On the other hand, performance-characteristics and specifications (42%) followed by design technique, experimental processes, procedures (13%) ranked highest in DOD user-study (Auerbach, 1965, p 1-19). A closely similar situation of 33% seeking equipment information, properties of materials, design and performance of plant followed by 11% seeking operating procedures of equipment and plant was found by Cole (1958) and respondents of Herner and Herner (1959) sought process and method information (25.5%), physical, chemical and engineering properties of materials (24.6%), apparatus or equipment information (16.8%), physical and chemical constants (16.4%). A hefty 64% of respondents wanted facts in Raitt's study (1984, p 204-208). Thus analysed the World Federation of Engineering Organisations (WFEO, 1979, p 15): "...the most proper form of information for engineers is the factographic information, analytical-synthetical elaborations and state-of-arts"[1]. These types of factual data ranked second in the studies of Shuchman, Rawdin, Slater and Fisher. More than two decades ago, Hanson (1964, p 67-68) summarised that one-fifth of the times, scientists, engineers, technologists and technicians need figure or a single simple fact, between a quarter and a third of the times a description of an object, a process, a method or procedure and remaining half of the time general information and ideas from background reading.

At the lower end of the need came the business and general information (16%, Shuchman, 1981, 1982), exhaustive information (11%, Rawdin, 1975, p 41-42; 18.6%, Wood, 1967, p 12), ideas, advice and opinion (respectively by 23%, 10% and 8%, Raitt, 1984) and non-technical information (18%, Herner and Herner, 1959).

There were some interesting results about information-requirements of users in core areas as compared to peripheral areas, new areas as compared to developed areas and urgency of demand for information. Slater and Fisher (1969) not only found highest success rates of searches[2] (67%) in core subjects than peripheral subjects (58%) but also found higher demand for

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[1]Based on the replies from national members, WFEO (1979, p 21) identified eight types of data most needed by engineers *ie, (i)* property, *(ii)* design, *(iii)* product, *(iv)* standards, regulations, laws, *(v)* production and manufacturing procedures, *(vi)* companies and their marketing products, *(vii)* market information and *(viii)* socio-economic and ecology information.

[2]It is possible that respondents ignore failures of searches on areas not really connected with work and hence the actual difference in success rate might be even more.

information on core subjects in academic libraries and on peripheral problems in other types of libraries. The demand for information on core areas was highest (61%) among scientists and lowest (46%) among engineers and demand for information on peripheral and unfamiliar subjects was highest among engineers compared to skilled workers, technicians, teachers, etc. In support of this, Wood (1967, p 212) also found that 27.5% of the mechanical engineers needed information outside mechanical engineering. Further, the highest demand for information on practical problems was from engineers (16%) and lowest from scientists (6%) (Slater and Fisher, 1969). Hanson (1964, p 67) in his analysis of 'acts of library use' found that a third of use was for information on a specific subject and remainder mainly for browsing or reading current journals. Back (1962, p 20) speculated that scientists in upcoming and new fields had broader information-needs than those in fairly developed fields. Lastly, by introducing a crude measure of urgency of information-need in the survey, Slater and Fisher (1969) found that 59% of their respondents had some degree of urgency and for 30% time was no object.

4 INFORMATION REQUIREMENTS OF THE INDIAN SPACE TECHNOLOGISTS

The felt and expressed information requirements of the Indian Space Technologists (IST), in respect of nature and type of information, have been ascertained through a questionnaire independently designed and tested for the purpose as part of a larger information behaviour study (Sridhar, 1987). The response rate in this census survey was 68.5% and the defined population included over 800 scientists, engineers, technicians and technocrats of ISRO Satellite Centre, Bangalore. Data so collected is presented in *Table 1.* It is clear from the table that the respondents not seeking 'Statistical, economic, business and general information' (J-26.3%), 'Standard and patent specifications and codes of practice' (G-24.1%), 'Computer program and model building information' (F-23.0%) and 'State-of-the-art and review literature' (A-19.4%), are quite considerable. Other types of information as shown in *Table 1* are required by more than 90% of the respondents.

On the other hand more respondents have highly sought 'Scientific and technical news' (I-47), 'Experimental designs, results and applications' (C-102), 'State-of-the-art and review literature' (A-84) and 'Theoretical background/basic scientific and technical information' (B-84), than other types of information. An interesting feature is that, the state-of-the-art and review literature is not required by 101 respondents while it is highly sought after by 84. The histograms in Diagram 1, by showing 'Not required' and 'Rarely required' on one side and the remaining on the other (positive) side, pictorially depict the response[3].

As per the weighted mean, the rank order of the nature and type of information required by the IST is as follows:

Rank	Code	Nature and Type of Information
1	I	Scientific and technical news
2	B	Theoretical background/Basic scientific and technical information
3	C	Experimental designs, results and applications
4	H	Physical, technical and design data
5	D	Methods, process and procedures[4]
6	E	Product, material, equipment and apparatus information[4]
7	A	State-of-the-art and review literature
8	F	Computer programs and model building information
9	G	Standard and patent specifications and codes of practice
10	J	Statistical, economic, business and general information.

Adding/subtracting one standard deviation to/from mean in *Table 1*, one can statistically say that, nearly 68% of respondents have sought 'Scientific and technical news' (I) with the weightage ranging from 1.86 to 3.78; 'Experimental designs, results and applications' (C) with weightage ranging from 1.47 to 3.65; 'Physical, technical and design data' (H) with weightage from 1.45 to 3.37; 'Methods, processes and procedures information' (D) with weightage from 1.15 to 3.39; and 'product, materials,. equipment and apparatus information' (E) with weightage ranging from 1.1 to 3.32.

The top ranked need for basic S&T information and S&T news by the space technologists is close to that found by Shuchman (1981, p 32-33; 1982, p 106-109) about American industrial engineers, Wood (1967, p 212) about British mechanical engineers, Slater and Fisher (1969, p 32-33, 36, 47 and 49) about users of British technical libraries and Rawdin (1975, p 41-42) about users of American technical libraries.

The next in the rank order, the space technologists sought experimental

[3]The percentages and other interpretations to the open ended category 'others' (K) have to be viewed with caution. Under responses to 'others', five were explicitly for 'information about educational opportunities in the country and abroad', three about 'management-techniques-related information', and two about 'internal/local procedural information like administrative and accounts procedures', three were closely related to category I, 3 to H, 2 to E and one each to A,C, and D. The rest were vague and a conglomeration of more than one category.

[4]The requirement of methods, processes and procedures interrelated moderately and positively (r=0.46) with the requirement of product, material, equipment and apparatus information.

Table 1

Nature and Type of Information Required

	Nature and Type of Information	Not required (0)		Required						Mean	SD
								Total			
		No.	%	1	2	3	4	No.	%		
A	State-of-the-art and review literature	101	19.4	94	97	144	84	419	80.6	2.03	1.37
B	Theoretical background/basic scientific and technical information	7	1.3	35	126	280	84	525	98.7	2.75	0.85
C	Experimental designs, results and applications	29	5.5	59	129	207	102	497	94.5	2.56	1.09
D	Methods, processes and procedures	46	8.8	69	170	173	65	477	91.2	2.27	1.12
E	Product, material, equipment and apparatus information	43	8.2	79	195	137	69	480	91.8	2.21	1.11
F	Computer programs and model building information	120	23.0	147	135	75	45	402	77.0	1.57	1.24
G	Standard and patent specifications and codes of practice	125	24.1	163	121	77	32	393	75.9	1.47	1.19
H	Physical, technical and design data	16	3.1	70	178	198	59	505	96.9	2.41	0.96
I	Scientific and technical news	10	1.9	34	147	192	147	520	98.1	2.82	0.96
J	Statistical, economic, business and general information	136	26.3	215	122	36	9	382	73.7	1.16	1.20
K	Others	17	36.2	10	4	9	7	30	63.8	1.55	1.50

Key: 0, Not required; 1 Rarely required; 2 Occasionally required; 3 Frequently required; 4 Highly sought-after; SD Standard Deviation.

Note:
1 Three hundred and fifteen have left the open-ended category 'Others' (K) blank.
2 Invalid and not answered responses upto a maximum of 17 in any category are excluded.
3 The mean score for anonymous responses worked out to 1.55, 3.10, 2.30, 2.07, 2.03, 1.14, 1.43, 2.27, 2.57, 0.86 and 0.05 respectively for categories A to K.

designs, facts, data, methods, procedures and product information which again is close to the second ranked type of information in the studies of Shuchman, (1981, 1982), Rawdin (1975) and Slater and Fisher (1969). However, this type of information ranked topmost in the studies of DOD users by Auerbach (1965, p 1-19), Cole (1958), Herner and Herner (1959) and Raitt (1984, p 204-208). At the lowest end of the rank the space technologists needed general information (similar to that found by Shuchman, 1981, 1982 and Herner and Herner, 1959), state-of-the-art and review literature (similar to that found by Rawdin, 1975, p 41-42 and Wood, 1967, p 212), model building information and specifications. The above differences appear to be due to differences in structure of the populations studied in DOD user study and by Raitt, the way nature and type of information is grouped and methodology (in case of studies of Cole, Herner and Herner and Slater and Fisher).

Discussions with selected respondents revealed that general information to keep abreast with current developments and specific work related information to solve practical problems are two main types of information required by the space technologists and they seek information only when it is essential. A typical respondent said "I gather information only if utmost needed". However, for information of general interest, they "browse news magazines, technical journals and conference proceedings to keep informed about the latest developments, and use the NASA and ESA reports for futuristic systems planning". They also appear to have moderately strong need for internally generated information and product information. A mission operations person writes that he has greater need to "have full knowledge about every sub-system of satellite" and hence turns mostly to internally generated information. It is interesting to discern from what another respondent has written about how his need for equipment, product and component-related information leads him to seek theoretical background information. He said "when I want some information on any component or equipment I go through the text books to build up the theoretical background and then refer to data and product catalogues and application notes. Then I go through the journals, if necessary." Thus, there appears to be an intermittant and intermixed use of different types of information by the IST.

5 EFFECT OF CHANGE IN NATURE OF WORK ON INFORMATION REQUIREMENTS

A follow-up discussion held with selected respondents who had substantial change in the nature of work in recent years showed broadly four types of changes in nature of work and their effect on information requirements and information-seeking activities: (*i*) Changing from operational activity, testing, design and development to supervision and planning has generally increased the need for information. In case of pure R&D works, the original activities

continued and for additional responsibilities delegation of information-gathering work became inevitable; (*ii*) Changing from a specialised area to project work (*ie,* from a more specific area to general area) has considerably decreased the need for information except routine information and vice versa. Delegation of information-gathering becomes a way of doing work in project, though the need for subject-information is reduced; (*iii*) Changing from a project work to a facility/service and production sector resulted in further reduction in need for information as the lack of any information did not drastically affect the work in facility/service and production sector. Lack of time and motivation are two major reasons for not seeking information in this area; (*iv*) Changing from engineering and technology-oriented work to slightly science-oriented work has resulted in increased need for information, particularly, theoretical background and basic S&T information.

6 FUTURE INFORMATION REQUIREMENTS

A free discussion with selected space technologists about their future information requirements revealed that a large majority (over 60%) do not foresee any significant change in their information requirements in the near future. Even if there is a little change they do not find it difficult to adapt to the circumstances over time. Out of the rest who thought of some changes in their information requirements in future, some expressed their fear at the problem of availability of increased quantity of information than what one could digest (*ie.* the problem of 'information overload'). This is not merely because of increased production of information, but because of enlargement of boundary of interest and activities of the organisation. Others thought of the impact of electronics boom and some others explained how the organisation has to intensify its activities, increase its capabilities, reliability, quality and hence risks. The outcome of the discussion is that they are recognising the need for some condensed information services, new media of information and fast serving information agents. A sort of digesting agents as intermediary professionals are likely to come up in the core teams of projects both to cut short delays and face the problems of information-overload.

7 CONCLUSION

There is a dire need for proper definition and use of terms in information-requirements studies. The typology of information-needs as well as the way nature and type of information is classified need to be standardised for enabling comparison of similar studies.

Requirements of S&T news and basic S&T information has ranked top to the IST in congruence with the top ranking motives and purposes of the IST like acquiring knowledge about the latest developments, self improvements

and keeping update in the field. It is pertinent to note that the IST require simple facts, data, methods and experimental results than state-of-the-art reviews and standard and patent specifications.

Information system design and operation for the IST has to take note of changes in nature of work of the subset of the IST and corresponding changes in the nature and type of information required. Lastly, the futuristic trends of information services and facilities expected by the IST are also to be kept in mind for further planning of information system.

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