failure. The reason for this does not lie in any lack of attention or inadequate effort allocated to the problem, since very large sums of money have been expended on storage and retrieval systems for scientific and technological information. Rather, it is due to the nature and complexity of the information, itself, and to the uncertainty and *very personal nature of each user's needs*." The objective of our manual system precisely is to cope better with the complexity of the information and to cater to personal needs of users. On the one hand, the direct involvement of scanners in the evaluation, dissemination, and user feedback makes them a partner in research and allows for a better understanding of the nature and complexity of the information needed. On the other hand, their direct involvement with the above described media, also summarized in Figure 2, gives them the opportunity of optimizing knowledge of the very personal nature of each user's needs and of participating more effectively in the information transfer process.

THE FUTURE

The above mentioned user study, the results of which will be published separately, confirm that the expectations inherent in our previously mentioned objectives have been realized. Our system is the result of a growth achieved over the years through adjustments to changing needs. In the future, we will, of course, maintain the attitude and motivation favoring such dynamic growth and permitting adaptation of the system to changing circumstances. Also our system design activities will continue to maintain careful evaluation programs both in terms of new developments in the field of information science and needs of the Celanese Research Co. For instance, the following parameters will continue to be under constant surveillance for comparative studies:

Cost and quality of manual scanning and input.
Cost and quality of computer scanning and input.
Cost and quality of outside SDI services.
Cost and scope of outside computer tapes with information base used internally.
Cost of man-Computer interface.
Research staff's acceptance of computer systems and printouts.
Currentness of computer tapes and processing.
Consistency and relevancy yardsticks achieved.
Results of pilot computer operations using commercial computer tapes.

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User Study of Current Awareness and SDI at Celanese Research Company

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This paper presents the results of a user study conducted in February 1970 with a view of assessing the usage of and needs for current awareness services at Celanese Research Company (CRC). These services, which consist of a weekly *Review of Current Technical Literature*, a weekly *Patent Bulletin*, and Selective Dissemination of Information (SDI), have been described in a previous paper.[10] The study was carried out in line with our permanent dialogue with the research staff, the importance of which was stressed in the same paper. Apart from obtaining information for assessment of needs and usage, we also wanted to measure cost effectiveness of the services and let the research staff determine their value for research projects. We also wanted to know more about the informational behavior of the research staff so as to reinforce further the technical information staff's involvement with the research teams. This is in line with our belief that in order to achieve effective permanent person to person

The *Review of Current Technical Literature, Patent Bulletin,* and Selective Dissemination of Information (SDI) service have been submitted (February 1970) to a user study by written questionnaire. The response was 86%. On the basis that the three services cost the equivalent of 40 minutes per week of the average professional's time, 62% of the staff rated their value high and 86% high and medium. If they were to receive none of the services, 92% considered that the additional time they would spend in meeting their current awareness needs would be more than 40 minutes per week. The effects of the services on research projects have been rated medium and high by 38%. SDI is read regularly/frequently by 94%; the *Review* by 89%; and the *Patent Bulletin* by 55.5%. Heavy/moderate reliance on SDI is 76%; on the *Review* 77%; and on the *Patent Bulletin* 62%.

communications with the user, the knowledge of the user's habits and needs is an essential prerequisite. In this sense relating current awareness to users is primarily a sociological function which conditions transfer of knowledge and information.

Studies of information habits of industrial research workers are not new. For instance among several others, those of Allen,[2] Maizell,[3] and Paisley[4] made important contributions to a better understanding of the informational behavior of engineers and scientists. Their work provided us with basic inspirations toward the realization of our study.

QUESTIONNAIRE, APPROACH, AND RESPONSE

The literature on techniques employed for user studies in the field of technical information is abundant.[5] From the various methods, we selected the written questionnaire with an optional indication of the respondent's name. The contents as well as the arrangement of the questionnaire (which may be obtained from one of the authors—J. J. M) were based on inputs from various sources:

Literature on user study techniques in technical information.[4, 5]

Managers at CRC (individual interviews, submittal of draft questionnaires, and meetings).

Random selection of research staff members at CRC (individual interviews and submittal of draft questionnaires.

Technical Information Committee at CRC (at a special meeting members representing each research section were requested to present ideas as to what would be appropriate questions which would lead to meaningful data on usage and needs).

Our own user study experience reinforced through the strong interface with the research staff during the creation of the new Technical Information Center in 1967 described in an earlier paper.[7]

The total response to the questionnaire was 86% of the staff. The following is a numerical break down by contributing groups:

# Management Group	
President Vice-president Directors Managers	11
Section heads Group leaders	22
# Research Staff Group	
Senior research associates Staff associates Research associates	20
Senior research chemists Research chemists	53
Senior research engineers Research engineers	18
Other	4

In some cases the response by the section head and group leader group seemed to be more in line with the response expressed by the management group and, in other cases, with the research staff groups. Accordingly, in the text below, the response of the section head and group leader group has sometimes been reported with the management group, and sometimes with the research staff groups. Each time this has been done, it is explicitly stated.

VALUE OF CURRENT AWARENESS SERVICES AND S.D.I. TO THE STAFF

In order to come up with an assessment on what the staff thinks of the value of our current awareness services, we indicated in the questionnaire, as a yardstick of measurement, that the package of three current awareness services at CRC costs the equivalent of 40 minutes per week of the average professional's time. In one question, the staff was asked whether, in their judgment, the value of the services they received in relation to this yardstick is high, medium, or low. The response to the question was as follows:

High	Medium	Low
62.2%	23.6%	14.2%

A peak of 70% high was recorded for the senior research associate and the research associate category. This was to be expected, since this group is particularly active in transferring information within work groups and from one work group to another.

In another question we asked the staff if they were to provide entirely for their own current awareness needs—i.e., if they were to receive none of the current awareness services now provided—would the additional time spent in meeting their current awareness needs be more, the same, or less than 40 minutes per week. The response was:

More	Same	Less
92.0%	3.2%	4.8%

REVIEW OF CURRENT TECHNICAL LITERATURE

A set of four questions was submitted to all staff members:

1. How often do you read the *Review of Current Technical Literature?*

Regularly	Frequently	Occasionally	Never
55.9%	26.5%	15.2%	2.4%

As would be expected, we found a difference between the reading behavior of the research staff and management if one considers that the managerial group (directors, section heads, group leaders) account for 54% regularly/frequently and the research staff for 89.6% regularly/frequently.

2. Do you read the *Review* by section, by scanning the entire bulletin or otherwise?

By section	Scanning entire *Review*	Other
34.0%	64.2%	1.8%

Interdisciplinary interests, and the need for a cross-sectional view of the published information, may be the reasons for a majority of 64.2% scanning the entire *Review*. This would be confirmed by answers to question 3 below related to the reliance pattern.

3. How much do you rely on the *Review* for up-to-date general information from journals, government reports, etc.?

Heavily	Moderately	Slightly	Not at all
33.1%	44.1%	19.7%	3.1%

As would be expected, we found that there is an inverse relationship between the response of the managerial group and the research staff—i.e., the reliance is the lowest at the managerial level and the highest on the research staff level as shown below. This may be due to differences in information needs between managers and research staff reported in the literature.[9]

Pres., v-pres., directors, and managers:	27.0% heavily/moderately
Section heads, group leaders:	77.3% heavily/moderately
Research staff:	85.3% heavily moderately

4. What changes would you recommend for the *Review?*

Add index of keywords	Breakdown into more specific sections	No change	Other
19.0%	24.8%	44.6%	11.6%

Management (excluding section heads and group leaders) seems to be most in favor of changes—i.e., 60% for either adding an index of keywords or breaking down into more specific sections with a preference toward the latter. The same trend is apparent for the research staff—including section heads and group leaders—but to a lesser extent as evidenced by a 45% of "no change."

PATENT BULLETIN

A set of four questions was submitted to the research staff.

1. How often do you read the *Patent Bulletin?*

Regularly	Frequently	Occasionally	Never
32.0%	23.4%	33.6%	10.9%

Only 9.1% of the managerial group (president, vice-president, directors, managers) appear to read the *Patent Bulletin* regularly. The section head/group leader group account for 18.2% regularly and 31.8% frequently. The senior research chemists/research chemists group appeared to be the biggest readers with 45% regularly. It is worth noting that the section heads, research associates, research chemists and research engineers grouped together accounted for approximately 58% regularly/frequently. It is also interesting to note the difference in the readership pattern between the research chemist (43% regularly) and the research engineer group (27.8% regularly) which would be due to differences in the nature of projects and informational needs. We wonder whether this difference should be attributed to the difference in informational behavior between scientists and technologists which has been discussed in the literature.[10]

2. Do you read the *Patent Bulletin* by section, by subjects using the index, by scanning the entire bulletin, other?

By section	By subjects using the index	Scanning the entire *Bulletin*	Other
27.6%	42.2%	25.9%	4.3%

As would be expected, most professionals read the *Patent Bulletin* by subjects using the index or by section. However, it is worth noting that more than 25% scan the entire bulletin which may be explained by strong interdisciplinary interests of certain research staff members. It is worth noting that 70.6% of the research engineer group use the keyword index as opposed to 38.5% of the research chemist group among whom 28.5% read the *Patent Bulletin* by section and 23.1% scan it entirely. This difference may again be due to reasons mentioned above.

3. How much do you rely on the *Patent Bulletin* for your general current awareness on technology disclosed in domestic and foreign patents?

Heavily	Moderately	Slightly	Not at all
30.8%	30.8%	29.9%	8.5%

It appears that approximately 34% of the research staff (section heads, research associates, group leaders, research chemists, and engineers) rely heavily on the *Patent Bulletin* against 10% of the managerial group (president, vice-president, directors, managers). Approximately 65% of the research staff rely heavily/moderately against 30% of the managerial group. As would be expected, the reliance is the lowest at the managerial level and the highest at the research staff level. This may be due to reasons mentioned above.

4. What changes do you recommend for the *Patent Bulletin?* Group Bulletins? Refine Index of Keywords? Send out SDI Notices? No Change?

Group bulletins	Refine index of keywords	Send out SDI	No change	Other
22.3%	17.9%	24.1%	32.1%	3.6%

The research staff (including section heads and group leaders) seems to be more or less equally divided as to

the three categories of changes: group bulletins, refinement of keywords, and SDI. Approximately 45% of the senior research chemist/research chemist group requests No Change. This group seems to favor group bulletins and refinement of keywords rather than SDI notices.

SELECTIVE DISSEMINATION OF INFORMATION (SDI)

A set of three questions was submitted to the research staff.

1. Do you read the SDI sheets? Regularly? Frequently? Occasionally? Never?

Regularly	Frequently	Occasionally	Never
83.2%	11.2%	5.6%	0%

Above mentioned readership trend appears to be uniform through all title categories—i.e., approximately 94% of the professional staff reads SDI notices regularly/frequently.

2. How much do you rely on SDI notices for alerting you to information specifically related to your projects?

Heavily	Moderately	Slightly	Not at all
35.2%	40.8%	20.8%	3.2%

Approximately 45% of the management group (excluding section heads and group leaders) relies heavily on SDI and approximately 64% heavily/moderately. The research staff group (including section heads and group leaders) relies about 40%. Approximately 65% of the research engineer group relies heavily and 89% heavily/moderately. The research chemist group relies 72% heavily/moderately and the research associate group, 100% heavily/moderately.

It is interesting to note the difference in the reliance pattern between the research chemist group (23.5% heavily) and the research engineer group (64.7% heavily). This may be explained through differences in information needs and types of projects and would indicate that engineers are more in need of quick, short, and personalized information than research chemists. It is interesting to oppose this finding to above mentioned differences in reading behavior between engineers and research chemists where, for instance, 27.8% of the engineers read the *Patent Bulletin* regularly as opposed to 43% of the research chemists.

3. Is layout and quantity of information on SDI notices acceptable?

Yes	No
91.1%	8.9%

Suggestions submitted by staff members expressing a "no" opinion can be summarized as follows by order of frequency:

Add full-length articles or more information than abstracts or quotation.

Delete trade journals.

Make it possible to request Xerox copies of full-length articles.

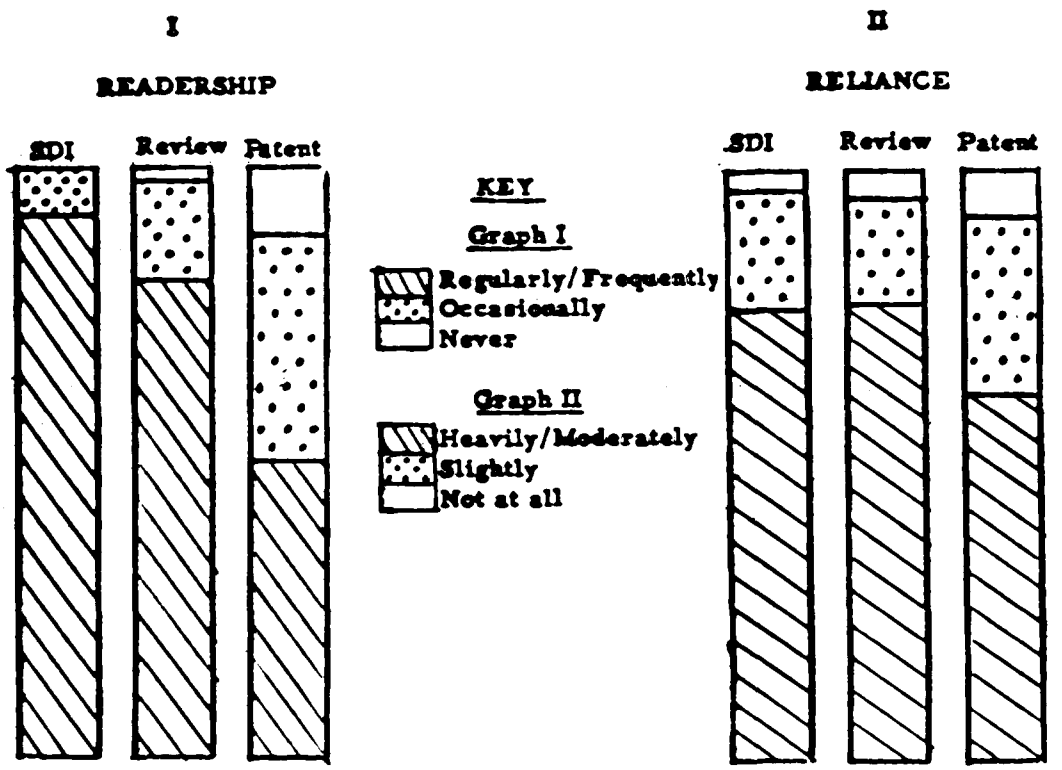

Figure 1. Readership and reliance on current awareness services

THE THREE SERVICES COMPARED

Graph I in Figure 1 gives an over-all view of the response from the total professional staff to the question of "How often they read" the three services. In summary, it may be concluded that, from one service to the other, there is a variation in the reading pattern for SDI, 94% regularly/frequently; for the *Review*, 81.1% regularly/frequently; for the *Patent Bulletin*, 55% regularly/frequently. This variation may be due to the following factors:

SDI can be read easily and is personalized.

Journal literature is more easily read than patent information.

Patent information essentially seems to be a service used more at the bench level than by the rest of the staff thus reducing readership. This would be confirmed by the findings on the reliance pattern outlined above and below.

Graph II in Figure 1 gives an over-all view of the response from the total professional staff to the question "How much they rely" on the three services. In comparison to the reading pattern shown in Graph I, there is much less variation in the reliance pattern from one service to the other: for SDI, approximately 76% heavily/moderately; for the *Review*, approximately 77% heavily/moderately; for the *Patent Bulletin*, 62% heavily/regularly.

We asked the research staff to rate the importance to them of each current awareness service. The results can be summarized as follows for all the professional staff:

Review: 84% of the staff's rating is medium to high (40% high and 44% medium).

SDI: 77% of the staff's rating is high to medium (40% high and 37% medium).

Patent Bulletin: 54% of the staff's rating is medium to high (29% medium and 26% high).

As far as the *Patent Bulletin* is concerned, it is worth noting that the research staff (including section heads and group leaders) rate it 56% medium to high against 27% medium at the managerial level. The variation between these figures would indicate that the *Patent Bulletin* essentially is a service used more at the bench level.

EFFECTS OF CURRENT AWARENESS ON R&D

We have been aware of published studies on the effects that information services have on research. For instance, Martyn reports that 22% of research workers discovered published information once or more during a project that they wished for at the beginning;[9] a survey by the Advisory Council on Scientific Policy of the United Kingdom Government indicates that 21% of physicists and chemists have sometimes unwittingly duplicated research and 33% have met research delays owing to ignorance of results of previous or current research.[1] In order to estimate the effects current awareness services specifically have on our research activities, we asked the staff to rate them (by using the following scale: 1 = High, 2 = Medium, 3 = Low, 4 = None) in terms of 10 parameters some of which have been selected from an SDI evaluation study by Wixon and Housman.[14] The following is a summary of high and medium responses:

Review, %	*Patent Bulletin*, %	SDI, %
New research leads and ideas		
45	35	40
Revealed valuable documents that probably would not have been otherwise discovered		
67	52	63
Saved reading time		
80	55	75
Affected technical decisions in work area		
29	36	33
Shortened time required to complete a particular task		
27	19	24
Indicated that planned lab work was unnecessary		
9	13.5	13.5
Changed course of work		
12	18	17
Indicated important competitive activity		
53	57	54
Provided important process or equipment clues		
29	34	30
Noted potential end uses for research and development		
38	28	44

It may be stated that the effects which the *Review*, the *Patent Bulletin*, and SDI have on the staff's work have been rated within the same range of value. An exception is the saving in reading time where the *Review* and SDI, respectively 81% and 73%, stand out in comparison with the *Patent Bulletin* with 55.5%. This pattern is understandable if one considers the remarks made in the *Patent Bulletin* section.

Worth noting is that the *Patent Bulletin* is on the same or even higher level as to effects on technical decisions (36%), changed course of work (18%), indicated competitive activities (57%), provided important process or equipment clues (34%).

It is appropriate to mention the intangible nature of the over-all impact of cumulative bits of information on research and development and the difficulty in pinpointing their dollar value. However, some of the following medium and high averages for the three services combined may be an indication of research and development dollars saved:

the effects on decisions (33%)
the new research leads and ideas (40%)
the shortened time required to complete a particular task (23%)
changed course of work (16%)
indication of competitive activity (55%)
provide important process or equipment clues (31%)
noted potential end uses (37%)
indicated that planned lab work was unnecessary (12%)

CREATION OF PERSONAL DOCUMENTATION FILES

The staff uses current awareness services for the creation of personal documentation files in support of activities at CRC as follows:

Patent Bulletin	*Review*	SDI
50%	64.3%	72.6%

The research associate group indicates the highest usage with 89%, 79%, and 73% for SDI, *Review*, and *Patent Bulletin*, respectively.

We communicated with a number of respondents representing a random cross section of the research staff in order to learn the reasons for the creation of personal documentation files. Most staff members feel that, at one time or another, they are looked upon as experts in a given field; therefore, they feel that personal documentation files arranged idiosyncratically are most useful as active back up tools in the field of their expertise.

CONCLUSION

The following general conclusions could be drawn from this study:

The current awareness services constitute an important time saver for the researcher as expressed by more than 90% of the research staff. This finding at our end is in line with the results of an ACS survey[3] which includes indications as to time savings achieved by current awareness services.

The strong readership and reliance on the service with as broad a scope as the *Review* and *Patent Bulletin* may be based primarily on interdisciplinary interests. It may also be due to a need for information related to peripheral areas which provide new ingredients for creative and innovative thinking, and to permit keeping up with current developments in remote areas in order to gain perspective.

Readership and reliance percentages are even higher for the research staff alone. This would indicate that the services are essentially bench services.

The strong readership and reliance on personalized SDI service would indicate its value as an insurance against missing information critically related to projects and which is provided within a minimum amount of time (one to two weeks from time of publication).

One of the prime reasons for 67% of the staff rating the services high and 86% high and medium may be based on the fact that they speed up and amplify, by several orders of magnitudes, the access to the journal, patent, and government literature.

It is difficult to put a dollar value on the effects the services have on research projects. However, the high and medium averages recorded for effect parameters, described under "Effects of Current Awareness on R&D," indicate a significant impact of the services on research performance.

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