The Cost of On-Line Bibliographic Searching

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A cost analysis of 411 on-line bibliographic search requests was conducted. The study involved monitoring the time that thirty-five individuals in four public libraries spent processing these requests. The study identified a set of seven tasks that are performed for each request and determined the average time and cost for each of the tasks. The average total direct search cost was $28.41 exclusive of telephone line charges. This figure included the data base connect charges of $17.29. The average time to process a request was 7.8 calendar days. A wide variation in the cost and time figures was found among the four libraries.

INTRODUCTION

On-line bibliographic searching is becoming commonly used as an aid to the reference librarian and researcher. Commercially available systems, such as Lockheed's DIALOG and System Development Corporation's ORBIT, provide access to a multitude of machine-searchable data bases for this purpose. Many issues remain unresolved with respect to on-line searching and include questions such as the effectiveness of on-line searching, methods for training searchers, and optimal search strategies at the terminal. This paper examines the cost of on-line searching: the charges that are incurred for connection to a commercial search service, the cost of printing bibliographic citations, and the cost of the reference librarians' time.

There are a number of reasons for studying the cost of on-line searching. First, on-line searching is a close substitute for some forms of non-computerized bibliographic searching. If this is the case, and if the end product is the same, then it is important to know how the costs of the alternatives compare. Second, the provision of any new service implies either additional funding or a diversion of funds from one type of service to another. Finally, costs can provide a basis for making pricing decisions. It seems quite likely that in the future users will have to pay for on-line bibliographic search services. The question is, how much? While there are numerous ways to set prices (e.g., loss leader, marginal costs, cost recovery),

costs can play an important part in their establishment.

The cost data reported in this paper were compiled as part of a project conducted by the Lockheed Palo Alto Research Laboratory under the sponsorship of the National Science Foundation's Office of Science Information Service. As part of the study, Lockheed's on-line reference retrieval service (DIALOG) was made available to the public through four public libraries in the San Francisco Bay Area. On-line search services were provided at no cost to patrons during the first year of the project (August 1974 through May 1975) and at a reduced cost during the second year (June 1975 through May 1976).

Lockheed and the Cooperative Information Network (CIN), an intertype library consortium in Northern California, placed terminals in four CIN public libraries: Redwood City Public Library, the San Mateo County Library, the Santa Clara County Library, and the San Jose Public Library. These libraries cover urban, suburban, and rural areas. Two large universities, numerous private and community colleges and many research and development centers are close by. The libraries themselves include two decentralized county libraries, and two centralized city libraries with branches of various sizes.

The individuals who performed interviewing and the on-line searching had, for the most part, no previous experience with on-line searching.* They were given Lockheed's usual training course and during the project developed their competence as searchers, but they received nowhere near the intensive training that, for example, the National Library of Medicine gives its MEDLINE searchers.

The experimental nature of this project differentiates it from the normal search situation. During the first year of the project, search time was free, and searchers were able to experiment with the system while conducting patron searches. They were under no pressure to keep the searches short and efficient. On-line search times, and subsequently connect costs, reported in this paper may be somewhat higher than they might be were this not an experimental project.

PREVIOUS STUDIES

The development of adequate statistical (time, cost) monitoring mechanisms in on-line systems has been slow. Monitoring programs took a large leap forward with the advent of commercial systems which require precise recording of user-system interaction time for accurate billing purposes.

Monitoring of the user-system interaction can take many forms. The simplest measurements deal with elapsed search time, time spent searching particular data bases, and frequency of command utilization. In one of the earliest studies Summit reported elapsed search time, number of index

* It should be noted that one of the authors of this paper was also one of the searchers being studied, an employee of San Mateo County Library. It is hoped that no bias resulted.

terms used in a search, number of Boolean expressions used in a search, and number of citations printed by the system.[1] Another analysis of particular note was a study by Benenfeld et al., who computed the time required to discuss the search with the patron, the search time at the terminal, the number of citations printed out, and the total user cost of the search.[2] Benenfeld's experience indicated user costs per search in the range of $28 to $56, depending on the data base used. Lawrence, Weil, and Graham also gathered cost data on bibliographic searching, and Elman surveyed some of the previous studies and presented his own computations, indicating that an average on-line search cost $47.[3,4] Another aspect of on-line search costing that has received some attention in the literature is the cost of operating the computer equipment. Lancaster has reviewed some of the literature.[5] It is apparent that this area of cost analysis needs considerably more investigation before the internal economies of on-line searching can be settled.

METHODOLOGY

The procedure for obtaining the data from which to compute the cost of on-line bibliographic searching required the cooperation of all individuals engaged in processing the on-line search requests. A set of seven tasks was defined, including reference interview, originating library preparation, DIALOG library preparation, search, DIALOG library follow-up, originating library follow-up, and follow-up with patron. A form was then developed to collect data describing the amount of time spent on each task, the date on which the task was performed, and the individual who performed the task. This time sheet traveled with the search request through its processing. As completed time sheets were received, they were numbered and coded for computer processing.

Costs were developed both for each search performed and for each task within a search. Each task could be performed by a different individual. In order to arrive at the direct labor cost for a search, it was necessary to multiply the pay rate for each individual involved in the search by the number of minutes each spent at a particular task.

In addition to the labor cost of a search, two other costs must be considered. The first is the fee paid to the commercial search service (in this case, Lockheed) to access their data base. This fee is a function both of the length of time one is connected to the system via telephone line and of the particular data base (such as ERIC, NTIS, Psychological Abstracts, etc.) being searched. For each request, multiple data bases may be searched. In computing the on-line cost for a search, the cost per hour of accessing each data base was multiplied by the connect time to arrive at a total data base connect cost.

The second nonlabor cost element is the number of bibliographic citations printed at the vendor's computer center and sent by mail to the searcher's location. A charge is made for these off-line prints, adding to the total cost of the search.

Several other factors could be included in the cost of a search. The major omission of this study was the cost of telephone line charges. Since all the libraries were relatively close to Lockheed's computer center, they dialed directly to the center without the use of an intermediary service such as TYMNET. If an intermediary service had been necessary, these charges would have to be included in the total search cost.

Other cost elements excluded from the study were terminal rental costs, physical space charges, and indirect costs of overhead, administration, supplies, etc. Basically, the cost figures presented here summarize the direct costs of on-line searching.

The data for this study were collected during February, March, and part of April of 1975, six months after the project had begun and while the service was still free to all users.

It should be emphasized that the data come from self-reports of the library personnel. Such a method is less accurate than an outside measure but was the only practical way to collect the amount and variety of data needed.

At the end of the data-collection period, 411 usable time sheets had been collected from the four DIALOG libraries. Of these 411, 33.6 percent (138) were from Redwood City Public Library, 25.1 percent (103) from Santa Clara County Library, 22.6 percent (93) from San Mateo County Library, and 18.7 percent (77) from San Jose Public Library. Branch libraries and other CIN libraries took requests and relayed them to the DIALOG libraries; 16 percent of the requests during the reporting period showed some participation by these other libraries.

THE REQUEST PROCEDURE

A general outline of the DIALOG request procedure is flowcharted in Figure 1. For the data collection, the process was divided into seven tasks which formed the basic reporting units on the time sheet.

The tasks were defined by both where and at what stage of the search process the activity took place. A maximum of two possible types of libraries participated in each search: a library with a terminal (called "DIALOG library") and a cooperating library, a branch library, or other CIN member (called "originating library") which could relay user requests to a library with a terminal. The tasks were defined as follows:

Reference Interview: time that the user spent negotiating the request with a library staff member. This could take place at either a DIALOG library or an originating library.

Originating Library Preparation: if the reference interview were at a cooperating library, the staff there might spend some time recording, researching, and transmitting the request.

DIALOG Library Preparation: time spent on the request at the DIALOG library with no patron present and before performing the on-line search. Typical activities included recording the receipt of the request, filling out forms, and researching search terms.

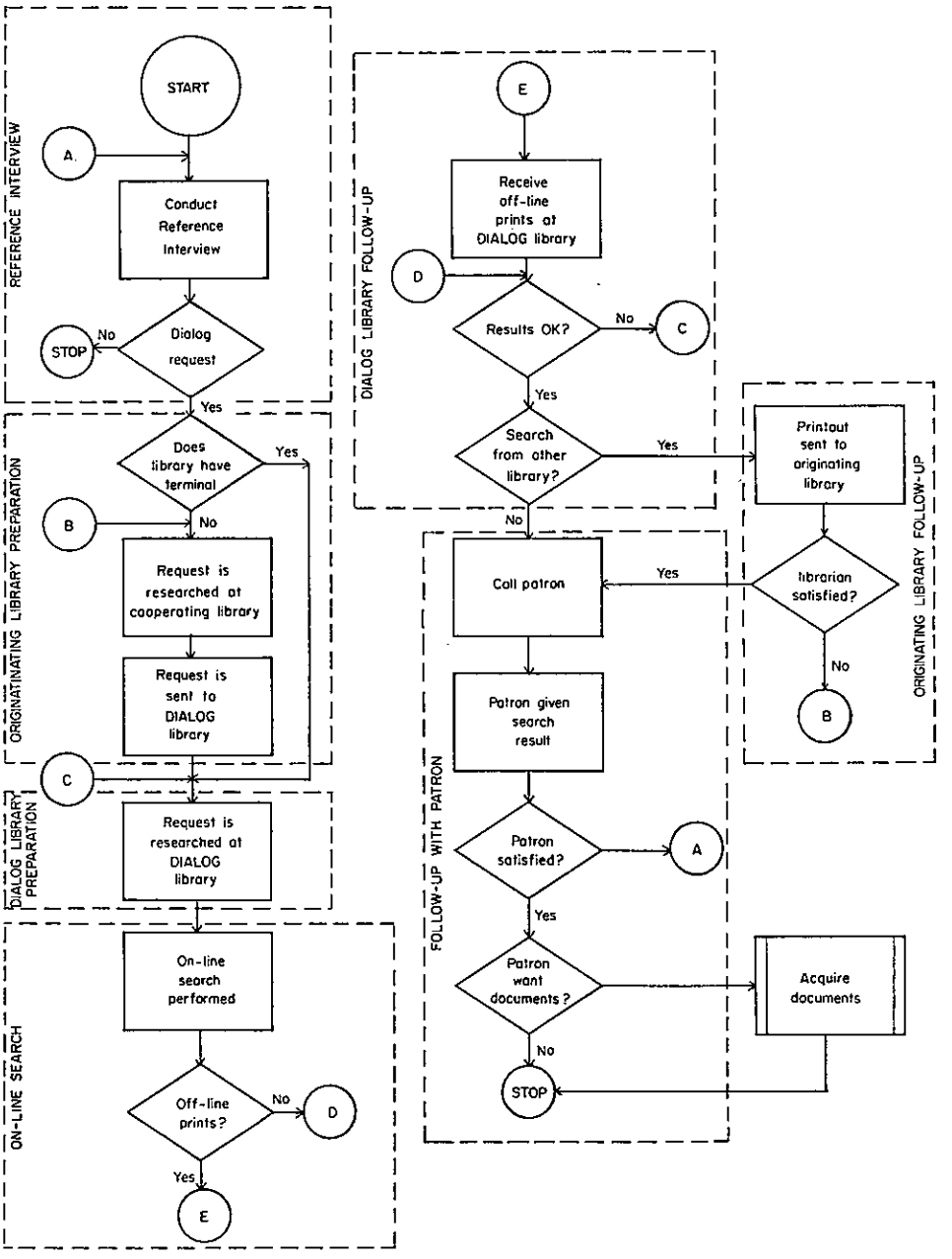

Fig. 1. Flowchart of DIALOG Request Process.

DIALOG Connect Time or *On-Line Search Time:* the actual DIALOG search.

DIALOG Library Follow-up: time spent after the on-line search, with no patron present. Typically this would include filling out reporting forms, examining search results, and notifying the patron or originating library.

Originating Library Follow-up: analogous to DIALOG library follow-up, but at a cooperating library.

Follow-up with Patron: at either type of library, the staff might spend time with the patron explaining the results of the search.

The only one of these activities that was essential was the actual on-line search. Any combination of the other activities might be performed, depending on the nature of the request and on the library or libraries involved. The individual libraries varied this general form in accordance with their own needs and policies.

STAFF

One major decision for a library instituting this kind of service is that of how to staff the service. The libraries considered two major alternatives. First, they could designate one or two people to perform all the searches. The advantage to this approach would be that the searchers would quickly become highly skilled. Also, the responsibility for DIALOG and DIALOG-related activities would be clearly assigned. However, it would mean that at times the search staff would not be available to users with questions or problems.

The alternative was to have all of the reference personnel add DIALOG searching to their usual repertoire of reference skills. This would diffuse the searching and, therefore, diffuse both the experience and the responsibility. However, it would increase the availability of trained personnel to users so that a request could be handled efficiently by virtually anyone at the reference desk.

Three of the libraries opted for the second alternative. At the fourth library, however, due to special circumstances, most of the searching eventually devolved on one person.

The salaries of the thirty-seven employees involved in processing the on-line search requests ranged from a low of $658 per month for three library assistants to a high of $1,325 for a supervisory librarian. Librarian I's, who did most of the searching, had salaries averaging $955 to $1,000 per month. Librarian II salaries ranged from $1,052 to $1,112 per month.

Data were collected on the frequency with which various employees performed each of the seven tasks connected with a search. For the entire experiment, 1,595 tasks were performed for the 411 search requests, averaging about 3.6 tasks per search. Four hundred twenty-nine searches were performed for the 411 requests, indicating that very few duplicate searches were made for each request. There were 301 reference interviews, 46 originating library preparations, 252 DIALOG library preparations, 429

searches, 353 DIALOG library follow-ups, 38 originating library follow-ups, and 176 follow-ups with the patron.

DATA BASES

The choice of data base for a search significantly affects the cost of a search since the fees for use vary from a low of $25 per hour to a high of $150 per hour (Table 1).

The most commonly used bases for all the libraries taken together were NTIS (accounting for 17.84 percent of the bases used), Psychological Abstracts (16.57 percent), and ERIC (13.35 percent) (Table 1).* All three of these data bases could be expected to be of use to many public library patrons. The next most-used bases were Social Science Citation Index (9.51 percent), COMPENDEX (COMPuterized ENgineering InDEX; 9.29 percent), and Chemical Abstracts Condensates (8.23 percent). The least-used bases were all Predicasts bases, including PATS Source (.11 percent), PATS Claims (.21 percent), and PATS Chemicals and Electronic Market Abstracts Weekly (.85 percent).

Table 1. Data Base Connect Charges and Usage

Data Base Name	*Charge per Connect Hour*	*Charge per Off-Line Print*	*Total Uses*	*Percent Distribution of Uses*
ERIC	$ 25	$0.10	125	13.35%
CHEM. ABSTRACTS	45	0.10	77	8.23
EXCEPT. CHILD. ABS	25	0.10	16	1.71
NTIS	35	0.10	168	17.84
SSCI	70	0.10	89	9.51
COMPENDEX	65	0.10	87	9.29
AIM-ARM	25	0.10	10	1.07
NAL/CAIN	25	0.10	40	4.27
PSYCH ABSTRACTS	50	0.10	155	16.57
INSPEC-PHYSICS	45	0.10	25	2.67
INSPEC-ELECT. EN	45	0.10	20	2.14
INSPEC-COMPUTERS	45	0.10	9	0.96
ABI/INFORM	65	0.10	62	6.62
PATS CMA/EMA	90	0.20	23	2.46
PATS C/EMA WEEKLY	90	0.20	8	0.85
PATS F and S	90	0.20	20	2.14
PATS Source	90	0.20	1	0.11
IFI/Claims	150	0.10	2	0.21

OFF-LINE PRINTS

The number of off-line prints requested was a major variable in the cost of the search. San Mateo County tried not to print more than fifty citations per search, but that was not a hard and fast rule. There were two reasons for this guideline. First, the number of prints available under the terms of the grant was limited (although no library overran this limit during the first year of the study). Second, if the patron received too many

* More than one base may be used on a search; these are the proportions of bases used, not of searches performed.

prints with too much irrelevant information, the precision of the search was lessened.

Whatever its effect on the quality of the search, San Mateo's practice of limited off-line prints had a marked effect on searches completed at that library. San Mateo County printed an average of twenty-nine citations per search off-line, whereas San Jose printed sixty-six, Santa Clara County seventy-one, and Redwood City seventy-five. No off-line prints were requested from more than half of the data base uses; this could be because the search results were not satisfactory or because the relevant citations were printed on-line. Further analysis indicated that the searchers varied widely when deciding how many citations were necessary and/or acceptable to the user.

TIME PER TASK

Another major cost factor was the staff time devoted to each task. Table 2 indicates the mean time per task, by library, for all nonzero entries only, i.e., once it is decided that the task is to be performed, this figure gives the average time for the task. The individual libraries' values do not differ far from the group mean. The single exception is search time, which varies from a low of 14.09 minutes for San Mateo County to a high of 30.42 minutes for Santa Clara County, with an overall mean of 22.72 minutes.

Table 2. Mean Time per Task by Library (in Minutes)

	Mean Task Time by Library									
	Redwood City		*Santa Clara County*		*San Mateo County*		*San Jose*		*Overall Mean Time*	
Task	*Mean*	*No. of Observation*	*Mean*	*No. of Observation*	*Mean*	*No. of Observation*	*Mean*	*No. of Observation*	*Mean*	*No. of Observation*
Reference Interview	9.65	91	12.92	89	9.97	59	8.57	56	10.50	295
Originating Library Preparation	21.00	1	8.33	2	19.58	42	5.00	1	18.65	46
DIALOG Library Preparation	12.07	45	11.44	45	9.72	76	9.47	57	10.48	223
Search	19.63	138	30.42	103	14.09	91	28.31	76	22.72	408
DIALOG Library Follow-up	9.34	66	12.64	91	16.31	83	9.40	67	12.21	307
Originating Library Follow-up	18.00	2	15.00	2	10.60	38	—	—	11.48	42
Follow-up with Patron	7.58	31	8.03	66	7.79	43	6.52	31	7.61	171

In order to determine statistically if there were differences in the time taken to perform each of the seven tasks across the four libraries, a set of analyses of variances was conducted. These variances are reported in Table 3. The table shows that there were significant differences in the times

taken to perform the reference interview, search, and DIALOG library follow-up.

While the analysis of variance indicated some differences in group means, by itself it did not indicate which of the four libraries' task times was significantly different from any other. To determine this, systematic comparisons of all possible combinations of task time mean values were performed and the results evaluated using Scheffe's test.* Table 3 shows that for the reference interview there was a significant difference between Santa Clara's (SC) time and the times of Redwood City (RC), San Mateo (SM), and San Jose (SJ) but that there was no difference between the latter three means. Similarly for search time, Redwood City and San Mateo were significantly different from Santa Clara and San Jose.

Table 3. Analysis of Variance for Task Times

Variable Name	*Source of Variance*	*Degrees of Freedom*	*Mean Squares*	*F Ratio*	*F Probability*	*Scheffe's Test*
Reference Interview Time	Between Groups	3	270.97	10.24	.000	(RC,SM,SJ) vs (SC)
	Within Groups	291	26.46			
Originating Library Preparation Time	Between Groups	3	184.66	0.21	.892	
	Within Groups	45	897.27			
DIALOG Library Preparation Time	Between Groups	3	85.45	1.16	.327	
	Within Groups	219	73.84			
Total Search Time at Terminal	Between Groups	3	5528.85	21.37	.000	(RC,SM) vs (SC,SJ)
	Within Groups	406	258.71			
DIALOG Library Follow-up Time	Between Groups	3	830.86	19.80	.000	(RC,SJ) vs (SC) vs (SM)
	Within Groups	304	41.96			
Originating Library Follow-up Time	Between Groups	2	111.95	1.36	.272	
	Within Groups	41	83.20			
Follow-up Time with Patron	Between Groups	3	16.73	1.064	.366	
	Within Groups	167	15.71			
Total Time for Search	Between Groups	3	14142.62	19.90	.000	(RC) vs (SC,SM,SJ)
	Within Groups	407	710.70			

PATRON'S PRESENCE

One decision that the participating libraries had to make was whether the requestor should be present during the search. On the one hand, the requestor was often much more familiar with the subject than the librarian was and could provide both an instant evaluation of how well the search was going and perhaps also suggest alternative search strategies. The process of the search might help draw out a noncommunicative patron and help him/her understand what the librarian needed to know.

On the other hand, a user unfamiliar with the search process could slow the search, requiring lengthy explanations during the terminal sessions. The librarian might also prefer not to have someone watching over his/her shoulder during the search.

Ultimately, only one library made a regular practice of allowing the

* The test was conducted at the 0.05 level of significance.

patron to be present during the search. Thus figures are available on the relative lengths of searches with and without the patron, but only for one library.

Of the 103 searches reported, 60 were performed without the patron, and 43 with the patron. The average search time for those with no patron present was 25 minutes versus 37.9 for those with patron present, a difference which is significant at the .01 level. However, the total time required for all tasks varied little; without patron, the average was 56.3 minutes, with patron it was 61 minutes, a difference significant at the .075 level. Thus it is not conclusive that the patron's presence at the search has an adverse effect on total search time. It may be that the patron's presence at the terminal shortens the time required for either the reference interview or for the follow-up with the patron.

COSTS

All the data on times can be translated into costs, using salary and fee schedules. The procedure followed was to calculate directly the actual costs for each search based on the time required, the salary of the person performing the task, and the data base(s) used.

The mean salary costs for each task, by library, are presented in Table 4. The figures for the individual libraries cluster reasonably around the means for the group as a whole. The one exception is originating library figures, for which only San Mateo County had enough observations to be meaningful. The costs were quite low, averaging $1.03 for the reference interview, $1.95 for originating library preparation, $1.02 for DIALOG library preparation, $1.16 for follow-up at the DIALOG library, $1.07 for originating library follow-up, and finally $.74 for the postsearch time spent with the user.

Table 4. Mean Salary Cost per Task by Library (in Dollars)

	Mean Task Cost by Library				
Task	*Redwood City*	*Santa Clara County*	*San Mateo County*	*San Jose*	*Overall Mean*
Reference Interview	$1.04	$1.21	$1.02	$ .80	$1.03
Originating Library Preparation	1.14	.76	2.10	.45	1.95
DIALOG Library Preparation	1.21	1.06	.97	.87	1.02
Search	2.03	2.83	1.47	2.70	2.24
DIALOG Library Follow-up	.87	1.17	1.61	.87	1.16
Originating Library Follow-up	.53	1.39	1.08	—	1.07
Follow-up with Patron	.79	.75	.81	.60	.74

Table 5 presents another analysis of the costs incurred in the on-line search itself. The overall average was $17.29 for computer time, $9.16 for off-line printouts, and $2.24 for the labor at the terminal. This, combined

with $5.02 for all other labor (detailed in Table 4), brings the cost for the entire search process, for all libraries, to an average of $28.41.

The individual libraries differed significantly from this mean, ranging from a low of $19.74 (San Mateo County) to a high of $35.19 (San Jose) and $35.17 (Santa Clara County). Redwood City was a little below the average at $25.33. No one item accounts for the differences.

Table 5. Search Costs (in Dollars)

	Mean Task Cost by Library				*Overall*
Cost Element	*Redwood City*	*Santa Clara County*	*San Mateo County*	*San Jose*	*Mean Cost*
Data Base Charges	$14.51	$22.16	$10.55	$23.69	$17.29
Off-Line Print Charges	9.73	12.60	3.64	12.96	9.16
Search Labor Cost	2.03	2.83	1.47	2.70	2.24
Labor Cost for All Other Tasks	3.64	5.91	6.22	4.93	5.02
Total Cost of Search*	25.33	35.17	19.74	35.19	28.41

* The total cost is not additive due to differences in the number of observations for each cost element.

COMBINATIONS OF TASKS

In the description of the DIALOG process as it is performed in each library, it was pointed out that the libraries differed in the emphasis placed on different tasks. For instance, one library made no special effort to perform either a reference interview or to spend postsearch time with the patron. On the other hand, another library tried to have the patron submit to a reference interview with a DIALOG staff member.

The greatest number of tasks that might possibly be performed would be for a search that originated in a library without a DIALOG terminal, for which all seven tasks listed on the time sheet could be performed. For a request originating at a DIALOG library, the maximum number of tasks would be five, eliminating the two tasks that are specific to non-DIALOG libraries.

Table 6 shows the 11 (out of 128 possible) combinations of tasks that were most frequently performed. These 11 accounted for 328 of the searches performed, or 80 percent. The most-used single pattern of tasks was number ten in Table 6. This pattern consisted of reference interview, DIALOG preparation, search, DIALOG follow-up, and a follow-up with user; the "complete" DIALOG library pattern. The next most common was pattern seven, the same as ten but with the DIALOG preparation omitted. Given that different patterns of tasks mean that more or fewer steps are performed for each search, it follows that different patterns result in different costs.

Table 6 also shows the mean total search cost for each of the frequently occurring combinations of tasks. The lowest overall mean is the sixth

Table 6. Most Frequent Combinations of Tasks Performed for DIALOG Searches and Total DIALOG Search Cost for These Combinations

Combination Number	Combination of Tasks							Frequency of Occurrence	Mean Total Search Cost for this Combination
	Reference Interview	Originating Library Preparation	DIALOG Library Preparation	Search	DIALOG Library Follow-up	Originating Library Follow-up	Follow-up with User		
1	0	0	0	1	0	0	0	21	15.67
2	0	0	0	1	1	0	0	22	25.50
3	0	0	1	1	1	0	0	21	25.97
4	0	0	1	1	1	0	1	11	25.97
5	1	0	0	1	0	0	0	35	23.43
6	1	0	0	1	0	0	1	10	9.75
7	1	0	0	1	1	0	0	44	28.13
8	1	0	0	1	1	0	1	41	38.08
9	1	0	1	1	1	0	0	40	31.09
10	1	0	1	1	1	0	1	70	34.23
11	1	1	1	1	1	1	0	13	26.07

Note: 0 indicates task not performed; 1 indicates task was performed.

instance, which consisted of a reference interview, the search, and follow-up with patron.

Interestingly, the bare bones search—no task performed other than the actual on-line search—although inexpensive, at $15.67 (number one), was the second least expensive combination.

The most expensive combination, considering all libraries together, was combination number eight, reference interview, search, DIALOG library follow-up, and follow-up with user, at $38.08. The next most expensive was pattern number ten, which includes all the tasks in combination eight plus DIALOG library preparation. The additional task lowered the cost to $34.23. These data on task combinations imply that there is no direct correlation between the number of tasks performed and the cost of the search.

ELAPSED TIME

Two measures of time are important to the user of any kind of search service. One is the time that the user or his/her surrogate actually spends on the search. The use of on-line searching reduces this measure from hours, even days, which must be spent leafing through abstracting and indexing publications, to only minutes spent conferring with the search personnel.

The second measure is waiting time—how long the user must wait from the initiation of the request until the results are received. The waiting time is an indication of how quickly the search service processes the request.

The mean time that requests spent in the system, from the first patron contact until the last task (whatever that was) for all of the libraries together was 7.79 days (calendar, not working, days). For the individual libraries the figures were: Redwood City, 6.02 days; Santa Clara County, 4.87 days; San Mateo County, 14.67 days; and San Jose, 6.79 days. The minimum time possible is one day, and that is for same-day service. In addition, all of the libraries would expedite rush requests, if the patron had a good reason.

When the distribution of waiting time over the tasks performed was further analyzed, the extreme value for San Mateo County was explained by the high incidence of participation of other libraries. An average of five days elapsed between the time that the originating library and the DIALOG library worked on the request before the search, and six days between the time that the DIALOG library finished with it and the originating library took some action after the search. Although the reason for relaying request from branch libraries was the patron's convenience, the patron paid for it in delayed results.

SUMMARY AND CONCLUSIONS

This study has reported the costs of on-line bibliographic searching in

four public libraries in the San Francisco Bay Area using the Lockheed DIALOG system. This study was conducted during a period when search time was provided to the libraries without charge and the searchers were moderately experienced. It was found that there were seven different tasks involved in the search process. In the course of the study thirty-five individuals from the four libraries reported their own processing times for 411 search requests.

Two limitations should be considered in evaluating the results of this study. One is the self-reporting nature of the data. Participants recorded time spent on search tasks rather than being observed and measured by others. Consequently, a possible bias is introduced, depending on the accuracy with which the searchers recorded their times. A second limitation is the experimental nature of the project. On-line searching of the DIALOG system was provided at no cost to the public libraries through a grant from the National Science Foundation. Thus the searchers were under little economic pressure to perform effectively.

Considerable variation in the time required to perform search tasks was found between libraries and between searchers. For example, the average connect time to a data base for an individual search was 22.72 minutes. But this varied from 19.63 minutes at one library to 30.42 minutes at another to 28.31 minutes at a third. Similar variations were found in the overall cost of a bibliographic search: one library's average was $25.38, another's was $35.17, the third was $19.74, and the fourth $35.19. The overall average for the 411 searches was $28.41. The most expensive portion of the overall cost was the actual on-line search time, which averaged $17.29 for all searches. The next most expensive element of the total cost was that of off-line prints—this averaged $9.16 for all searches.

The only element that was omitted from the cost calculations was telephone line charges. This was due to the fact that the four libraries were in close physical proximity to Lockheed's computer center. If this situation did not hold for other searching locations it would be necessary to add the telephone costs. Assume a $15 per hour telephone connect charge through a utility such as TYMNET, and a mean search time of 22.72 minutes. This results in an average telephone charge of $5.68 which, when added to the $28.41 search total, totals $34.09 for the average search.

An understanding of the cost of on-line searching is an important step in evaluating this relatively new technological development. But there are many other issues that need to be studied. It seems particularly important to conduct a comparative cost analysis of manual searching and on-line searching for a similar set of requests. In addition, the costs of the search should be analyzed with respect to measures of user satisfaction in order to arrive at the cost-effectiveness of the process. Little is known about searchers' behavior at a terminal; this should be studied in relation to user satisfaction and search cost. Finally, there are some slight suggestions in the present results that costs are minimized when one spends more time

performing a reference interview or research before beginning an on-line search. This issue needs to be explored further.

The economics of on-line searching are beginning to be understood. Considerable additional work needs to be conducted before the picture is complete.

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