

Some of these are shown in Figure 1. In Table I we give the distribution of duplicates in each set of isomeric alkanes.

We searched the class of alkanes for counterexamples because the special structure of trees allows a very efficient method of computing the ID numbers (20 000 computer operations for a single alkane).

The obtained results may be summarized as follows: (1) The ID numbers are highly discriminating indices, but they are not unique. (2) There exist structures with very small differences in their ID numbers (see Figure 2). (3) For complicated structures (e.g., polyhexes) the ID numbers are not easily computed.<sup>8</sup>

In concluding this paper we point out that with this work we once again demonstrated the usefulness of developing generating algorithms that produce *all* members of a given family of (chemical) graphs and that thus make easier the check on many conjectures proposed in the field of (chemical) graph theory.

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## End-User Searching: The Amoco Experience<sup>†</sup>

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The history of training scientists and engineers to do their own online searching of technical information is reviewed briefly. Searching services have been provided at Amoco for decades, computer searching for 15 years, and online services since 1973. In late 1981, it became apparent that several Amoco scientists and engineers wanted to learn to do at least some of their own online searching. We viewed this phenomenon as an opportunity, not a threat, and have provided training and assistance to our active, growing group of end-users since early 1982. We have divided the training into two parts: classroom background for local information resource awareness and individualized, hands-on training in online searching techniques. The program seems to be quite successful in retention of trained end-users, and most, if not all, participants seem to have significantly enhanced awareness of searching technical information.

"Can I do my own computer searching?" "Should I do my own computer searching?" Chemical information specialists have occasionally been asked these questions for the last decade, and the frequency is increasing. There seems to be no single reason for the increase in curiosity by the chemist on this subject, but greater familiarity with computers and computing is probably most important. Using titles similar to "The Library at Your Fingertips", authors in the recently erupted microcomputer trade press would have you believe that everyone will soon have their own microcomputer and will do all of their own searching. Although we do not believe this extreme scenario will happen, we do believe that end-user searching by at least some chemists and chemical engineers is here to stay. We will present a brief history of end-user searching and will then describe our experiences in training

end-users at Amoco Corp. and the Amoco Research Center.

First, some definitions. "End-user searching" has come to mean literature searching by the eventual recipient of the information, namely, the customer, client, the expert (or the would-be expert), or decision maker. This "end-user", if an expert in a technical subject, is usually in research. Computer-based searching, specifically online, is implied.

Apparently, end-user searching appeared on the scene shortly after the beginning of readily available online searching in general, which, by our definition, is July 1973. We recall end-users in training classes for online systems or data bases as early as 1974-1975. By 1976, a paper had appeared titled "Nonmediated Use of Medline and Toxline by Pathologists and Pharmacists",<sup>1</sup> and additional work was cited. In 1977, Charles Meadow addressed the topic,<sup>2</sup> and in 1979 he published the pivotal paper of the field.<sup>3</sup> Meadow briefly reviewed the history of programming, and more specifically programmers, and then compared the two with online searching and search intermediaries on nine key issues. It is not our intent to summarize the paper extensively, but some quotes are very interesting. Programmers and intermediaries are described as having "...the keys to the kingdom..." and are often found

<sup>†</sup> Presented, in part, before the Division of Chemical Information, "Symposium on Training Chemists To Do Their Own Computer Searching", 187th National Meeting of the American Chemical Society, St. Louis, MO, April 11, 1984; American Chemical Society: Washington, DC, 1984; CINF 32; and "Symposium on Direct End-User Access to Chemical Information", 3rd Joint Meeting of the ACS Great Lakes Region and Central Region, Western Michigan University, Kalamazoo, MI, May 25, 1984; American Chemical Society: Washington, DC, 1984; paper 154.

behaving accordingly. In closing, he is less strident than the subtitle would indicate, by predicting that intermediaries would spend less time "...hand-holding and more to problem solving".

Meadow's paper inspired a fair amount of published comment<sup>4-6</sup> and has been cited at least 17 times. We are in basic agreement with Meadow's main point that at least some end-users could, should, and would do more of their own searching. However, at that time we agreed with his last point that "...search costs will decrease steadily...." Actually, costs of searching several files have increased since then.<sup>7</sup>

Descriptions of some end-user training programs have been published,<sup>8</sup> and several others (nonacademic) were described in a symposium at the Spring 1984 American Chemical Society Meeting, of which several papers,<sup>9</sup> including this paper, have been submitted for publication. A symposium at the Fall 1984 American Chemical Society meeting<sup>10</sup> dealt with programs in academia. Academic training for use of the chemical literature is the main topic currently being addressed by the Education Committee of the ACS Division of Chemical Information. An academic viewpoint of end-user training has been published by Faibisoff.<sup>11</sup>

At Amoco, some of us have been contemplating training end-users for several years, but the demand was difficult to estimate when we only received one or two questions per year like "Do you think I should do my own searching?" The stock answer came to be the following: "If you're going to search twice a year, forget it. If you're going to search twice a week, where have you been? If your searching will be somewhere in between, it's largely up to you—but we can assist." With two exceptions, we had no candidates.

The turning point came in 1981. The number of requests for searching training began to increase, and the topic was discussed at various information-oriented meetings and workshops. The concept was energetically discussed in one of our group meetings and continues to be discussed. We confronted the skepticism that exists to some extent in all of us with the following philosophy: "End-user searching is inevitable. Participate in the training of end-users or, either by inaction, or, worse yet, by active resistance, participate in your own demise." End-user training was made one of the goals for one of the authors (R.E.B.) at performance review. By January 1982, the project was funded to some extent with an allocated overhead account, but as usual, we collectively had little time. Thus armed, we plunged in.

There are at least three approaches to training end-users to search: user-friendly systems,<sup>12</sup> user-friendly interfaces,<sup>13</sup> and user-friendly intermediaries. We decided to concentrate on user-friendly intermediaries because we already had some, and they are less capital intensive than the other two.

At the time we started, we knew of only a few other non-academic projects for chemists and chemical engineers, mostly by word of mouth and some meeting reports. As a result, we planned our program pretty much from scratch and attempted to incorporate both what we thought the end-users needed and what they (and their supervisors) would be willing to do. We perceived two needs: first, for general background and awareness on the types and use of available information and, second, for the actual hands-on use of online systems. As a result we set up a class format for the former need and organized individualized, one-to-one training for the latter. We also predicted that at least some class attendees would only acquire the awareness and not take the next step to learn to search.

Surprisingly or not, all of our predictions came true and continue to do so. Consistently, almost two-thirds of our course attendees elect not to acquire online searching skills. However, we have every reason to believe they are better users of information, not only in their interactions as customers of the

Information Services Group but also as users of more traditional sources of information. We have found little evidence for prior formal education and training in the use of chemical information among the participants of the program.

The first part of end-user training is the formal training, which consists of two courses that are offered at no charge. Course I is dedicated to all forms of *Chemical Abstracts*. Course II covers primarily the following topics: American Petroleum Institute (API) files, patents (general, Derwent, and IFI), *Engineering Index (Compendex)*, *Physics Abstracts (INSPEC)*, *Science Citation Index (SCISEARCH)*, and marketing and technical business sources (*PROMT* from Predicasts and *CIN* from CAS). The Research Center professional training coordinator provides course announcement and sign-up services. The courses are announced to professionals on-site, but three technicians have taken the course. We ask for a supervisor's signature, and credit is given for an in-house continuing education course.

Both courses have met for three 1-h sessions, approximately a week apart. We have observed our client's attendance of meetings for years, and we thought this was both the optimal format and the maximum amount of time that a typical chemist or engineer would spend on such a course. The first session of each course covers the background and scope plus use of each type of information product or index. In the second session, background of computer searching is discussed, and use of the appropriate online files is demonstrated live. For the third session, class attendees are encouraged to submit sample search questions of current interest. The instructor works out a strategy ahead of time, and as many searches as possible are demonstrated in class.

Session one of the *Chemical Abstracts* course is the only session that has a basic text: "How to Search Printed CA"<sup>14</sup> (formerly "Searching CA"). The lecturer goes through most of the booklet with comments and expansion on key points. Supplemental material, mostly from "CAS Printed Access Tools",<sup>15</sup> is also presented with overhead slides and handouts. All of the *Chemical Abstracts* products are described, as *Chemical Abstracts* does, as parts of one large data base. The session closes with a brief description of the CAS ISS (Individual Search System) current-awareness service, which is available to all staff on-site by subscription. A sample copy is made available.

The second session opens with a discussion of computer searching in general including a brief discussion of Boolean logic. For the online demonstration, an edited printout is distributed, but the class is encouraged to follow the demonstration on the monitor. Class size is effectively limited to 16 so that all can see the monitor and overhead slides. We did not use edited printouts for this session at first, but we soon perceived that attendees would benefit from something permanent to take with them and that it would not detract from the live demonstration. Chemical structure and substructure searching by systematic nomenclature has already been demonstrated and the session closes with a brief description of, and distribution of, a handout about chemical structure and substructure searching with either CAS ONLINE or DARC-Questel. The systems are not demonstrated live because of the lack of equipment capable of large-screen presentation of graphic display.

The SDC Search System loading of the *Chemical Abstracts* files is used for a number of reasons. Because the three most commonly used files on-site to answer customer requests are *Chemical Abstracts*, API, and Derwent, we feel that SDC and these three data base families will be of most interest to both the aware customer and the active end-user. (SDC is the only online vendor with all three files.) Also, the flexible formats of printing results on SDC make demonstration easier. Until

recently, the SDC loading of the *Chemical Abstracts* bibliographic files featured the only full-formatted indexing most analogous to the printed cumulative indexes, and therefore the best for educational purposes. Saveable search items may be selected from expand lists on SDC, and strategies can be modified more easily. Finally, SDC has graciously issued short-term demonstration passwords for educational purposes, allowing us to present courses for no charge in what is basically an unfunded project. (For educational use on the DIALOG Information Services system, one must ask permission and then claim the appropriate credit when paying the bill the next month.)

We have never had too few sample search questions for the third session. The problem is usually which to use and which to cut. Although the attendees are encouraged to make the search requests realistic yet "doable", some cannot resist submission of a free "monster search". These are whittled down to a manageable size or searched briefly on *Chemical Abstracts* with the caveat that additional files are either needed, more appropriate, or both. An edited printout is again handed out. Usually, only a search of the current CAS file is shown, and the search is repeated on the back-files in class.

Course II is taught in similar fashion. Because of the variety of material, there is no basic text for session one. Of the various indexes described above, we only have the API indexes and *Engineering Index* in printed form. Since comprehensive searching is better with the online analogues because of deeper indexing, we do not teach the use of the printed indexes. However, we do describe the various services that produce the indexes including subject coverage. The API *Thesaurus* is described, and considerable time is spent on the use of patents as an information source. For online demonstrations, both DIALOG and SDC are used because most of the files are exclusive to one or the other. Edited printouts are provided for files with novel functions or formats, like *SCISEARCH*, *PROMT*, and *CIN*. As in course I, the submission of sample searches is requested for the third session. (We plan to revise course II and present 90-min modules on patents, reference works, API, and business/marketing sources.)

At the end of each course, attendees indicate if they wish individual online training. Password request forms are sent to those interested. We ask for a project number as well as a supervisor's signature because all use of the password and materials that are ordered will be charged to the end-user. All passwords are maintained under a group account. End-users avoid the paper work of paying the bills, but receive a copy of their bill after payment. By coordinating the billing process, Information Services can monitor usage for the whole site. We also ask them to provide their own terminal (or borrow one from their local computer room) because capitalization of terminals over and above our own capital needs would be impossible with our budget. However, we recently made a terminal available for walk-on use in the Amoco Central Library. Our boom in end-user searching preceded the recent increase in the acquisition and use of PC personal computers, but lately the PC is the most common terminal used by new end-users.

In some cases, we have encouraged prospective users to proceed with online training without taking either course. These users have included physicists, planning engineers, computer scientists, and executives. Because the data bases they need are primarily on DIALOG, we secure DIALOG passwords and arrange for DIALOG training, both by us and by the vendor.

Course I has been given 10 times, and course II has been given twice. Of the 160 attendees, 59 or 36% requested online training. Of the 59, 48 have been trained, and 10 dropped out before they could be trained. Of the 48 trained, only three

have dropped out. Five end-users have been trained on DIALOG without taking either course.

The Information Group staff has provided hands-on training on a one-to-one basis. We considered training more than two end-users at a time for efficiency but determined that trainers would have a difficult time simultaneously monitoring more than one or two new users at terminals. In addition, every new user has unique needs, talents, and learning rate, so we try to truly individualize the training. On one occasion, we trained two chemists simultaneously (sharing the same terminal) because they worked in the same group, were charged on the same project number, and presumably had similar searching needs.

Training materials have been a problem. SDC has a self-instructional manual, but it seems to be aimed at the future full-time searcher. We thought no part-time searching chemist would spend the time required to work through the manual. SDC gave a 1-day course on searching for chemists, but it was experimental, and the materials were mostly course slides, which are not really suited for instruction outside of the course environment. (The materials were improved recently.) We have not had the time to both instruct and write our own material, so we refer to the handout printouts from the classes and also use an annotated glossary of search terms. The latter also has sample printouts showing system access via the networks or direct dial.

All of the information staff who search are asked to be online trainers. Hopefully, the trainer knows the end-user, has a somewhat similar background, or has been the searcher doing searches for the new end-user. However, schedules do not always allow the most optimal assignments.

When a new password is obtained, the glossary/search guide and the SDC Quick Guide are sent to the end-user trainee. The online instructor makes an appointment to provide individual training, hopefully using the same terminal that the end-user will be using for future searching. The end-user is asked to furnish relevant search questions and performs all keyboard operations throughout the session. The trainer has additional search aids available. By mutual agreement, there may be future hands-on training sessions, but in any case, the new end-user is strongly encouraged to consult with the Information Group staff at any time with any questions. Several end-users continue to seek out their instructor, printout in hand, indicating that they thought they did an adequate search but ask for any suggestions on how to do better. The trainer is also encouraged to periodically inquire about the end-user's progress.

We have supplemented our training program by making vendor training available. SDC has given basic system, beginning, chemical, and advanced chemical training sessions on-site. The DIALOG course on chemical searching for chemist end-users (similar to the one presented at ACS national meetings since 1983) was presented at Amoco by one of the authors of the paper.<sup>9</sup> A DIALOG representative gave a business file searching seminar. We have also had two data base producer seminars: the inaugural API course for end-users and a CAS ONLINE course for end-users and intermediaries. We also encourage end-users to take advantage of vendor training given in the Chicago area. Several end-users now have DIALOG passwords in addition to their original SDC passwords.

We also have organized an informal Amoco Research Center users group (ARCOG). The meetings are irregular and have included Information Group staff presentations on search strategies and most of the vendor and data base producer training mentioned above. A recent transferee to our library staff, in addition to coordinating the Standard Oil Information Network (SONET), works part-time on end-user

administration including coordination of training, materials, ARCOG administration, and a newsletter.

In late 1983, we asked our end-users to fill out a questionnaire on the end-user program. Most of the active end-users who had taken both a course and individual training responded. We had been forming our own impressions about the performance of the program, and the results of the questionnaire largely confirmed them. We plan to survey active end-users annually.

By observation of their information habits, both as customers and as end-users, we feel all who took the courses have a better awareness of technical information and information sources available. The information staff does not consider online searching as an end unto itself, but rather as an extremely valuable tool to accomplish the retrieval of information. Without really stressing the point, we feel that our two-part training program fosters this same attitude in end-users and extends their "arms-reach" resources somewhat further.

Questionnaire responders rated the courses good to good plus, and other course attendees have made favorable comments personally to the information staff. Overall, the online training received a good rating with the materials receiving the lowest marks. Presumably, they want more materials.

Surprisingly, end-users in general did not want much formal follow-up training. Basically, they say, "don't call us, we'll call you." However, they continue to respond well to vendor training classes and other ARCOG functions.

Reported usage has varied from less than once per month to over 5 times per month. Most responders thought their optimal usage was somewhat more than what they actually did, and most wanted to search more (and wanted more time to search). Online usage by end-users has averaged about 20% of overall site usage for 1983. It is obvious that the information group does most of the searching on site: 80% of the connect hours with 20% of the passwords.

The end-users were also asked about the effect of training on their habits as customers of information. As expected, none of them thought they increased the number of search requests they made to the Information Group. Several perceived no change, and even more said their number of requests had decreased. All of us (end-users and information staff) agree that the end-users tend to do the simpler data, reference, or single-subject searches themselves and still request large, comprehensive searches of the Information Group. A few end-users have become gatekeepers and do some searching for colleagues, advise them on searching matters, or promote searching and searching services in general.

The 1984 survey, although more brief, attracted fewer respondents (still a healthy majority). The results are still being analyzed, but responses to similar questions have changed very little from the responses to the 1983 survey.

We feel the Information Group staff has an evolving role. We will continue to instruct and assist our end-users. We feel that the majority of our customers will not become end-users. Far from putting ourselves out of business, we still have more than enough search requests to fill. However, the search requests now tend to be more complex. Given enough time, we have always tried to provide at least some editing, analysis, or evaluation of search results. With the continued high growth rate of the technical literature, we foresee an even greater role for analysis and evaluation in the future, as well as increased participation on our part. In addition, we see a need for participation by the information staff on project teams, especially in the early, formative stages of new projects. Finally, we must continue to educate end-users to recognize those instances when a search should be done by the Information Group staff.

The handwriting is on the wall. To paraphrase what we said before, end-user searching, for some, is inevitable, and we suggest that you participate, or step aside. The results can be an all-win situation for everyone. After all, this ancient Chinese saying still applies:

If you give a man a fish,  
He will have a single meal.  
If you teach a man to fish,  
He will eat all his life.

Kuan-tzu

We would like to acknowledge our co-workers<sup>16</sup> for training, preparation of materials, and general support. Although we feel we have much to improve, we must be doing something right. However, the high retention rate is also due to the high-quality, self-motivated scientists and engineers that have participated in this program. Therefore, we salute the end-users.

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## Can You Teach Me To Do My Own Searching? Or Tailoring Online Training to the Needs of the End-User<sup>†</sup>

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The increasing computer literacy among technical employees in corporations coupled with the need to locate technical information in a constantly expanding volume of publications has made the prospect of "instant" access to computerized information sources an attractive alternative to dealing with a search intermediary. At American Cyanamid's Chemical Research Division (CRD), the training options include in-house courses prepared and delivered by the information staff and training by the database vendor. The training programs used and the results achieved with technical and nontechnical trainees, both on-site and geographically removed, will be discussed.

In offering training in the searching of external databases to the R&D staff of American Cyanamid's Chemical Research Division (CRD), the objective has been to provide the sort of instruction that would enable the researcher to carry out fairly routine, straightforward searches—to locate electronically the sort of information that might have been sought manually before. We felt and still feel that instruction in the basic commands and techniques for manipulation of an online system, taught against the context of the appropriate files, should enable the researcher to meet some of his information needs more efficiently and enthusiastically than would be possible with the hard copy. It was also hoped that the introduction of electronic techniques would encourage greater use of information resources by those people that for one reason or another do not use the library resources.

End-user training was first offered at CRD in 1980, in part because a few researchers had expressed interest in learning to do their own online searching but largely because it seemed to be an idea whose time had come. Researchers were using internal computer systems for monitoring laboratory experiments, for molecular modeling, and for database management. Instruction in the manipulation of external systems was a logical extension of the work being done on internal systems. Although we have experimented with on-site training by a database vendor and some end users have taken training from the vendor, there never was any question but that the majority of the end-user training program be designed and presented by the Cyanamid Technical Information Services (TIS) staff. We have been fortunate in having staff information scientists that are enthusiastic about teaching search skills and do it well. A just completed training session was a cooperative effort on the part of three information scientists, and any future efforts will also be a shared venture. Keeping the entire training an in-house operation allows maximum flexibility in scheduling class times, choosing course content, providing hands-on time and individual attention, and generally adjusting the pace of instruction to the needs of the participants. In short, "a do-it-

yourself" approach provides the freedom to adjust scope and pace to the needs of the participants—a most important consideration in any kind of training situation. It also firmly establishes the resident staff as resource persons in the minds of the novice searchers.

Except for two instances, which will be described later, instruction has been confined to the chemical databases, and the teaching format, with minor variations to suit the circumstances, is that conceived in 1980 by Joan Gallagher,<sup>1</sup> who was the Manager of Technical Information Services at that time. The formats of the various programs used will be reviewed and the results summarized.

Before beginning their instruction, the participants are sent two questionnaires. The first is of a general nature to determine the types of information that are of interest to the user—chemical reactions, preparations, uses; news about companies, marketing, products; patents, statistics, or publications to an author. We ask how often information is sought and for the sources most often used.

The second questionnaire is an assignment that is to be completed with hard-copy *Chemical Abstracts* (CA). The questions are intended to point up the sort of information that can easily be found by a manual CA search and that which cannot be so readily looked up. The questions are also structured to require the use of all the index tools—the *Index Guide*, *Formula*, *Author*, and *Subject Indexes* and *Patent Concordances*. Some representative questions are as follows:

Are there any references to the preparation of isocoumarin?

Find a reference to a paper that appeared in the *Journal of Organic Chemistry* on 4(5H)-oxazolones.

Is there a U.S. equivalent to Japanese Patent 7831844?

Note the index entries that will give all papers authored by Harry B. Mark, Jr.

Are there any references, since 1977, to the preparation of  $C_6H_5-CH=CH_2$ ? Hopefully, this exercise also fixes in the user's mind the fact that there is, indeed, a relationship between the paper and electronic versions of *Chemical Abstracts*. The variety of answers and approaches to using CA is also quite revealing. Most of the students admit that they did not know CA as well as they thought they did! These same questions are used during the instruction, as in-class examples or

<sup>†</sup> Presented, in part, before the "Symposium on Training Chemists To Do Their Own Computer Searching", Division of Chemical Information, 187th National Meeting of the American Chemical Society, St. Louis, MO, April 11, 1984, CINF 29.