A USER ASSESSMENT OF THE CHEMICAL INFORMATION SYSTEM

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FOREWORD

The Life Sciences Research Office (LSRO), Federation of American Societies for Experimental Biology (FASEB), provides scientific assessments of topics in the biomedical sciences. Reports are based upon comprehensive literature reviews and the scientific opinions of knowledgeable investigators engaged in work in specific areas of biology and medicine.

This technical report was developed for American Management Systems, Inc., in accordance with the provisions of Subcontract No. 2881-1 under Definitive Task Order No. DTO-5146-50 of EPA Contract No. 68-01-5146. It was prepared and edited by Philip L. Altman, Senior Staff Scientist, and Kenneth D. Fisher, Director, LSRO, FASEB.

The LSRO acknowledges the contributions of the investigators and consultants who assisted with this study. The report reflects the opinions expressed by an ad hoc study group that met at the Federation on April 13 and June 3-4, 1982. The study participants reviewed a draft of the report and their various viewpoints were incorporated into the final report. The study participants and LSRO accept responsibility for the accuracy of the report; however, the listing of these individuals in Section VII does not imply that they specifically endorse each study conclusion.

The report was reviewed and approved by the LSRO Advisory Committee (which consists of representatives of each constituent Society of FASEB) under the authority delegated by the Executive Committee of the Federation Board. Upon completion of these review procedures, the report was approved and transmitted to American Management Systems, Inc., by the Executive Director, FASEB.

While this is a report of the Federation of American Societies for Experimental Biology, it does not necessarily reflect the opinion of each individual member of the FASEB constituent Societies.

September 28, 1982
Date

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This report reviews the responsiveness of the Chemical Information System (CIS) in meeting the needs of the user community. It addresses the ability of CIS to meet user needs, its quality assurance criteria, the adequacy of CIS procedures, and attributes of CIS management.

Data systems within the Environmental Protection Agency (EPA) fall short of the needs of the Agency and the rest of the regulatory community for integrated information on chemical substances. Greater attention should be given to coordinating the EPA database systems in terms of reducing duplicative effort and maximizing internal utilization. To meet the needs of individuals seeking toxicology data, CIS would have to put more toxicology databases online. They should be reloaded and repackaged to make them relatively compatible with other databases in the system. Also, data elements and descriptors should be standardized for the purpose of attaining uniformity among CIS components.

Developers of each database, rather than CIS, have the responsibility for assuring data quality. However, a few minimal requirements that CIS might request from each component database would enable users to determine for themselves the extent to which they can rely on the data to be accurate and timely. Also, consistency in at least the most common abbreviations and terminology among CIS components should be encouraged. Guidelines should be drafted for transmittal to organizations or agencies requesting that their databases be accepted as CIS components.

CIS is unique and useful in providing access to multiple numeric databases through one system, and in maintaining online databases that have a restricted user population but are of importance to certain segments of the user community. The usefulness of CIS can be enhanced by standardizing, insofar as possible, formats and terminology among database components, improving the level of communication between user and system in terms of search mode consistency, improving user training, and adding more databases to the system. In the past, CIS had a good record of providing supplemental user services, but recently they have become deficient; user services should be restored to their former high standards. Greater emphasis should be placed on quality documentation, the "User's Manual" should be kept up to date, and good user training sessions must be available.

An expanded marketing, or combined marketing/training, program for CIS should be considered that would make more potential users aware of its capabilities. As a system model of numeric databases, CIS is well integrated, has good modes for switching from one database to another, and has useful pointers to different
files. The concept of CIS is endorsed, but improvements in management are required if the existing CIS model is to gain greater acceptance. In terms of cost effectiveness, CIS is not out of line with other databases or systems, but the $300 advance fee is considered a deterrent to prospective users. Also, improvement in the efficiency of the billing system is a current need expressed by CIS users.

The study concludes that the Federal Government has a role in the development of numeric chemical databases and systems. Charges for, and use restrictions of, copyrighted material create increased costs on the part of databases using such material. This will become an increasingly serious problem as operating budgets decline and online costs increase. A solution will require the cooperation of the Federal Government, the private vendors, and the organizations charging for copyrighted material. The Federal Government should provide leadership for the development and fostering of information services, but aspects related to management, maintenance, and resource enhancement may be more logically assumed by the private sector.

The recommendations outlined in this report, with respect to CIS, should be considered in terms of practicality, costs of implementation, and possible alternatives by EPA. These recommendations are based on the observations and opinions of the User Assessment Panel members in their work experiences with CIS, and represent a consensus of the group.
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I. INTRODUCTION

The Chemical Information System (CIS) was developed jointly by the National Institutes of Health (NIH) and the Environmental Protection Agency (EPA), and has been available online since June 1978. It is an information resource that provides access to data of interest to a diverse group of research investigators, reviewers, regulators, and other persons whose work requires knowledge of chemical, physical, or toxicologic properties of chemical substances. CIS is an example of the type of online resource that is being developed by the public and private sectors to fill the information needs of this diverse user community. It is unique in being an integrated system comprising separate data files covering a broad spectrum of data on chemical substances. For additional information on CIS, consult the recent article by Milne, et al., 1982*.

Under contract with American Management Systems, Inc. (AMS), the Life Sciences Research Office (LSRO) of the Federation of American Societies for Experimental Biology (FASEB) conducted a user review and evaluation of CIS for EPA, and of the Toxicology Data Bank (TDB) for the National Library of Medicine (NLM). Each online data resource was reviewed and evaluated in terms of content, procedures for entry and validation of data, accessibility, data quality assurance, user utility, and other aspects of efficiency and effectiveness. The review, conducted by AMS and LSRO, was based on deliberations of a User Assessment Panel (UAP) selected by LSRO and composed of nationally respected experts in various pertinent disciplines (see Section VII, Study Participants).

This report is concerned only with the findings related to CIS. A similar assessment of the TDB is contained in a separate report†.

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II. ABILITY TO MEET USER NEEDS

A. SYSTEM EXPANSION

The members of the User Assessment Panel (see Section VII, Study Participants) were selected on the basis of their experience as searchers or end-users of toxicology data. However, CIS components cover not only toxicologic data, but also spectroscopic, crystallographic, and other physical-chemical information, as well as regulatory data. Admittedly, the UAP was experienced in accessing only the toxicologic aspect of CIS. Most of the Panel members were from private industry, whereas a significant percentage of CIS users are individuals in agencies of the Federal Government. It is quite possible that internal government utilization of CIS is as great as or greater than its use by the private sector.

Assessment: The UAP was aware that it may not accurately reflect user needs with respect to CIS. Also, the Panel was handicapped in not having available a systematic survey of the user community that would indicate the orientations of CIS users. However, the UAP was able to determine that even though the EPA supported the development and maintenance of CIS as well as other data systems, these EPA-sponsored systems fall short of the needs of the Agency and the rest of the regulatory community for integrated information on chemical substances. The UAP received little information to counter the observation that these data systems seem to be under separate management, they function as separate entities within EPA, and their respective managers rarely communicate on issues of common concern.

Of the CIS databases, the ones that toxicologists use most are the Registry of Toxic Effects of Chemical Substances (RTECS), the Oil and Hazardous Materials Technical Assistance Data System (OHMTADS), Clinical Toxicology of Commercial Products (CTTCP), and the Structure and Nomenclature Search System (SANSS). The only one specifically providing toxicity data is RTECS, which is also available from NLM. Though RTECS in CIS and at NLM is essentially the same, the software is different. Because CIS is a numeric database system, a file such as RTECS can be manipulated differently than in the NLM mode.

Recommendation: Greater attention should be given to coordinating the EPA database systems in terms of reducing duplicative effort and maximizing internal utilization. Subsequently, EPA should consider making such a coordinated system publicly available through CIS or, perhaps in the future, through the Chemical Substances Information Network (CSIN), a computer-based networking system with a switching technology among databases whether numeric or bibliographic.
To meet the needs of individuals seeking toxicology data, CIS would have to put more toxicology databases online. A step in the right direction is the plan to mount the Chemical Evaluation Search and Retrieval System (CESARS) and Scientific Parameters in Health and the Environment, Retrieval and Estimation (SPHERE) as CIS components. If OHMTADS became a major part of CIS by greatly expanding and improving its coverage of toxic substances disposal methods and cleanup information, it could effectively serve the needs of emergency response personnel. Other databases to be considered as CIS modules are those of the Environmental Mutagen Information Center (EMIC), Environmental Teratology Information Center (ETIC), National Institute of Occupational Safety and Health Technical Information Center (NIOSH/TIC), and Chemicals in Commerce Information System (CICIS), which together with RTECS, CTCP, and an improved OHMTADS would provide a nucleus of numeric toxic substances data.

B. DATABASE UNIFORMITY

When a private vendor obtains a new database it is never put into the system as is. The file is manipulated to include certain check tags that match, a special program is written, and the entire file is reloaded so that it is relatively compatible with other databases in the system.

Assessment: Most searchers of toxicology data prefer other systems to CIS because so few of the CIS components serve user needs and because those CIS databases they can use do not have uniform programs. As a result, users have difficulty in going from database to database, and must remember the differences to be found in shifting from one CIS component to another. However, CIS is valuable as a pointer to, or locator of, other databases and information through SANSS.

Recommendation: If CIS is to meet user needs more effectively, the databases accepted for the system should be reloaded and repackaged as is the practice among private vendors. The current lack of uniformity among CIS components should be eliminated by standardizing the data elements and descriptors. The resultant uniformity and consistency would make it possible for the user to go from one database to another within the system without being confronted by varying modules. Thus, CIS searchers would find a system whose software is easier to learn and understand. The more comfortable the user is with the system, the greater the likelihood that it will be more frequently accessed.
III. QUALITY ASSURANCE CRITERIA

A. DATA QUALITY

It is the policy of CIS to accept databases that will constitute components of the system without data quality screening. The responsibility for assuring quality of the information is considered to be that of the developers of each database rather than that of the CIS group acquiring databases as components of an interactive linking system.

Assessment: The problem of data quality is readily apparent in CIS because it consists of components drawn from a multiplicity of private as well as government sources. Also, when a data bank or system is created by a government agency, users tend to consider the data retrieved from such a bank or system to be more credible than that obtained from other sources. Therefore, to maintain such credibility, CIS must assume some measure of responsibility for the quality of its components. The UAP acknowledges that it would be impractical for CIS to dictate precise acceptance requirements for data quality to its linked constituents, but believes that some general steps can be taken that would not be oppressive or obtrusive.

Recommendation: A few minimal requirements that CIS might request from each component database include: (1) an explicit indication of the degree of data content evaluation, (2) an indication of coverage in terms of latest month and year, and (3) a list of the names of the experts who developed and/or maintain the database. This information should be available online, and in a one-sheet summary that also provides a systems update for each component database. Such information would enable users to determine for themselves the extent to which they can rely on the data to be accurate and current. Moreover, UAP members believe it would be useful occasionally to contact the experts who are responsible for the database to obtain additional information about the source and quality of the data.

B. DATABASE QUALITY

The acceptance of CIS components without requiring that certain guidelines be met results in varied formats and terminology. This places a burden on the user who must constantly adjust in going from one CIS component to another, and must remember that similar terms are abbreviated differently in each database.
Assessment: In its present state, the quality and source of the CIS databases are unknown to the users. As a result, many information specialists hesitate to use the system, and when they do use it, they are unable to provide end-users with a positive statement on database quality or data quality. When end-users begin to question database quality, or information specialists are rendering negative opinions, use of the system is severely reduced.

Recommendation: The requirement of minimal criteria for a database before inclusion in CIS would provide a much needed service to the user, as well as a valuable indicator of data quality assurance. Consistency in at least the most common abbreviations and terminology among CIS components should be encouraged. Because it is now, and should continue to be, a common data point in various databases, a Chemical Abstracts Service Registry Number should be included for every substance. Such consistency has been achieved by commercial vendors; if included in CIS, greater use of the system would result.

Guidelines should be drafted for transmittal to organizations or agencies requesting that their databases be accepted as CIS components. It would be easier to achieve a degree of uniformity with databases that are being developed than with those that already exist. However, the effort should be made to bring current CIS components into conformity with established criteria even if CIS has to request financial assistance to reformat the records. The quality assurance resulting from a greater focus on management aspects of guidelines and criteria with minimal standardization would contribute greatly to the confidence of information specialists and end-users alike in CIS.
IV. ADEQUACY OF SYSTEM PROCEDURES

A. SYSTEM ENHANCEMENT

CIS is unique and useful in providing access to multiple numeric databases through one system, and in maintaining online databases that have a restricted user population but are of importance to certain segments of the user community. The concept of a linking system together with an index (SANSS) represents an approach to numeric database delivery that should be expanded and emulated.

Assessment: Despite the obvious advantages of linking several databases in a system, such as CIS, by the chemical name and/or the registry number through SANSS, the information retrieved does not inspire confidence in the system. In part, this is related to the quality of the data in the various files, but primarily it is the result of differences in format and terminology.

Recommendation: Several steps can be taken to further enhance the usefulness of CIS, and bolster the confidence of its users. Formats and terminology among database components in the system should be standardized, insofar as possible. Other enhancements of the system should be considered, such as improving the level of communication between user and system in terms of search mode consistency, improving user training, adding more databases to the system, and increasing the files referenced in SANSS.

The EPA has a mandate to develop systems that facilitate exchange of research data on toxic chemicals among federal, state, and local regulatory agencies. In part, CIS does meet the intent of this mandate, but it would need to be expanded substantially to completely fulfill the requirements of such a mandate. The CIS managers have been successful in having other EPA offices add their databases to the system, even though CICIS, which was developed at considerable cost by EPA, is presently available through CSIN but not through CIS. However, a greater effort is required in identifying non-EPA databases and obtaining them for inclusion in CIS. The UAP believes that among those to be considered are the databases of EMIC, ETIC, and NIOSHTIC.

B. USER SERVICES

In the past, CIS has had a good record of providing supplemental user services, such as a current "User's Manual," an informative newsletter, and a responsive help desk. Recent indications are that the "User's Manual" is out of date, the newsletter is being discontinued, and the help desk is not readily available and provides inadequate assistance.
Assessment: User services should be restored to their former high standards. It is suspected that the frequent change of contractors has resulted in an erosion of user services. As a result, continuity and constancy are disrupted and the confidence of the user in the system is diminished. For example, current user information for the UAP, such as a CIS Overview and a CIS Sampler (dated February and March 1982, respectively), was not acquired until after the UAP Meetings in April and June. If this represents a typical lack of responsiveness, then user disillusionment is understandable.

In terms of response time, CIS is not only slow, but at the peak hours of 10:00 a.m. to 3:00 p.m., it is difficult to get online. Users get bumped off the system far more frequently than occurs with other systems; the documentation on how to get back into CIS without having to start over again is poor. If the user gets into the CIS monitor, it is so difficult to get off that it is necessary to start again; this is both time-consuming and frustrating.

Recommendation: There are other deficiencies that require attention if users are to derive maximum benefits from CIS. Greater emphasis should be placed on quality documentation; at present, the written documentation is poor and often outdated. The "User's Manual" should be checked for accuracy before it is issued so the user does not have to go through it inserting corrections frequently. Corrections are made more easily by inserting a new page than by writing them on a page. The confidence of the CIS user is reinforced if the contractor maintains an up-to-date "User's Manual" by issuing revised sections as they become available. If necessary, funds should be obtained for this purpose.

Good user training sessions are essential because CIS is different from other systems and involves many databases. Regional training sessions should be instituted so that users do not have to come to the Washington, DC, area to learn how to use CIS. Training could be offered at national meetings of representative scientific, information, and library associations. A greater effort should be made to reach information specialists, who are the major searchers, as well as contacting end-users for training.
V. SYSTEM MANAGEMENT CAPABILITIES

A. MARKETING PROCEDURES

A well-conceived marketing program adds to the value of a data resource by making it available to those who require the information it has to offer. Such a program increases awareness of system availability and capability among potential users, increases communication between the organization making the data resource available and the users, increases communication among the users themselves, and identifies the user group in need of the data being offered.

Assessment: CIS is not marketed effectively either to information specialists or end-users. In general, government agencies have a reputation for not using marketing procedures as well as does the private sector, which seems to be motivated by the competition of the free enterprise system into formulating and using marketing procedures more effectively.

Recommendation: It would be wise for CIS to emulate those procedures used by database suppliers in the private sector whose objective is making a profit. If, for example, a data file is put on a commercial vendor's system, the language is simplified, the file is widely exposed and well publicized, and the file is well marketed. As a result, it is more extensively used than the same file offered by the public sector.

Mechanisms should be explored for achieving an expanded marketing, or combined marketing/training, program that would make more potential users aware of CIS and its capabilities. Greater emphasis should be placed on the special files that constitute CIS, and the unique integrated linking capability of the system. Much can be learned from private vendors on how to contact prospective users; for example, contacts can be made at scientific and specialty meetings, or even corporation meetings. Also, well publicized regional training sessions should be instituted to attract interested individuals from the nearby area. Other efforts to improve marketing should include better dissemination of online information, better quality and more current documentation for CIS use, and restoration of effective periodic newsletters devoted to CIS.

B. CIS AS A SYSTEM MODEL

From the user's point of view an ideal system would combine bibliographic, numeric, and narrative databases. Such a system would interface more successfully with the user, provide a
rapid switching capability from one database to another, and pro-
vide information on what might be available in associated data-
bases.

Assessment: Convenient as it might be to have a textual file that
combines narrative, numeric, and bibliographic databases, it is by
no means certain that the available software could adequately
handle such a mix. It might be more practical to consider combi-
ing numeric databases into one system, and bibliographic databases
into another. As a system model of numeric databases, CIS is well
integrated, has good modes for switching from one database to
another, and has useful pointers to different files. If an excel-
 lent word-processing capability were added to CIS together with a
networking capability, it is possible that there would be no need
for CSIN. Conversely, if CSIN were made a database generator and
the unique features of CIS were integrated into CSIN, possibly CIS
as a separate entity could be discontinued.

Recommendation: As presently constituted, the UAP endorses the
concept of CIS, but not the existing CIS model as related to cer-
tain aspects of management. If CIS management could be improved
using commercial vendors as examples, CIS could become far more
useful and gain acceptance as the numeric database system model.
To achieve such status, CIS must improve its standardization of
format and terminology, add more toxicology databases for those
seeking toxicology data, improve user services, reduce the fre-
quently changes of contractors, and improve billing procedures.

Consideration should be given to reaching a decision on
whether to invest in improvement of CIS, or to alter the scope and
concept of CSIN to incorporate the useful features of CIS. It
seems reasonable to conclude that one system could meet user needs
if it had the desirable features of both CIS and CSIN.

C. COST EFFECTIVENESS

In terms of cost effectiveness, CIS is not out of line
with other databases or systems. However, the yearly fee of $300
in advance is considered a deterrent to potential users, especially
in academic institutions and in foreign countries.

Assessment: The $300 advance fee is a psychological barrier that
keeps many individuals and organizations from signing on to use
CIS. A related problem for users is the CIS billing system. Costs
are not itemized to show the individual charge for each time a
database in the system was used. Also, bills arrive months after
they were due. These problems inconvenience users and make dif-
ficult their planning and budgeting for use of CIS and other data
processing sources.
Recommendation: The UAP members believe that if the $300 fee were eliminated and the difference made up by charging more for online use, it is likely that the number of users would increase. Also, improvement in the efficiency of the billing system is a current need expressed by CIS users.
VI. GENERAL CONCLUSIONS

The User Assessment Panel considered several issues that pertain to database systems in general, including CIS. It was agreed that the Federal Government plays a vital role in the development of numeric chemical databases and systems that private vendors would find too costly or unprofitable to provide. Recovery of development costs for such databases would be impractical, but a reasonable pricing policy for their use, at least, would assure recovery of operations and maintenance costs.

Online costs tend to be held down when a database that is accessible from one or more private vendors is also available from the Federal Government. This is true as well when a database developed by a government agency is no longer available from the government, probably because the private vendors marketing the database have signed a licensing agreement that stipulates a lower fee from users. Competition among private vendors also seems to keep user costs down, but when a private vendor has an exclusive database, user charges are highest.

Too often the private vendor takes from the Federal Government those databases that are widely used and assure a healthy profit while ignoring those that may be just as valuable but have a more limited use. Given the role of federal agencies in database development, the government may wish to market, as a package, a widely used database and one with a limited use that have been developed together and are complementary.

Charges for, and use restrictions of, copyrighted material such as registry numbers create increased costs on the part of databases using such material. The results are fewer searches and a shift to databases that can supply the needed data at lower cost. This will become an increasingly serious problem as operating budgets decline, whether in actuality or as a result of inflation, and online costs continue to escalate. A solution will require the cooperation of the Federal Government, the private vendors, and the organizations charging for copyrighted material.

Experience has indicated that the software available for searching an online data file maintained by a private vendor usually interfaces more successfully with the user than the same file available from a government agency. Therefore, it may be logical to have the private sector offer databases created and updated by government agencies even when they are available from the public sector. However, both sectors have a role to play in meeting the needs of users for information resources, products, and services. Whereas government should provide the leadership required for the development and fostering of information services, the private sector should assume responsibility for the management, maintenance, and enhancement of the information.
resources. Pricing policy for databases created with public funds should not be set to recover development costs but only to recover the costs of accessing the data bank and retrieving the data.

These general conclusions of the UAP are in agreement with a far more detailed set of recommendations of an independent task force assembled and funded by the National Commission on Libraries and Information Science*.

The recommendations outlined in this report, with respect to CIS, should be considered in terms of practicality, costs of implementation, and possible alternatives by EPA. These recommendations are based on the observations and opinions of the UAP members in their work experiences with CIS, and represent a consensus of the group.

VII. STUDY PARTICIPANTS

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