Management Information Systems in a Network Environment

What do the terms management, information and system imply? Management implies control, monitoring and some type of role. Information is more than data, and it is not always knowledge—it can lead to knowledge. The term system implies organization, order and plan.

In looking at a management information system (MIS), a system which supplies management information or information to management, we need to look first at the function of management. Peter Drucker has given a number of definitions on both management and the role of managers. One of these is: "Management exists only in contemplation of performance." This suggests that management is not an end in itself but a means to an end, and that same aspect of it applies to management information systems.

Since we are librarians trained in engineering, the dual approach of a technologist and a humanist seems appropriate. Thus, combining system analysis with an assist from Rudyard Kipling's "Six honest serving men," we should examine the questions, what, why, when, how, where, and who. We at OCLC need to look at management information from several different perspectives, which we will discuss more fully under "who." But much of what we collect and provide must be from the library manager's perspective.

What

MIS's focus is primarily on allowing us to do a better job as managers—not to create a system for acquiring information. While this point has been made by others, it deserves emphasis, for too often its
meaning is lost in the masses of data we can accumulate through systems, particularly through automated systems. In the OCLC network we process approximately 2 million messages per day, generating six to eight reels of tape or equivalent disc files.

Our problem with automated systems is not a lack of data, but how to sift through the mass of data available to find useful information, how to translate that information into knowledge that will enable us to make better decisions, and how to better plan, monitor and control the use, growth and development of the systems.

We need to segregate those things that we should examine in detail from those things we can look at in aggregate. There is really little point in reviewing transactions that fall within the norms. On the other hand, for those transactions that lie outside the norms, we may need to look at detailed information to ascertain the reasons for their abnormality. For example, if it appears that all books on an order which take longer than nine weeks to receive are books coming from overseas, we may want to add some different parameters that allow extra time for such books. Maybe the only books we want to select are ones that take longer than twelve weeks (i.e., we may need different norms for different classes of materials). The same idea can apply to cataloging of materials. Different formats and/or different subject areas may require different amounts of time and effort.

We can ask many questions of management information systems, and we can get many answers, but are we asking the right questions? What do we need to know to improve the operation of our libraries, and for whom—the library manager, library staff or user?

Too often the tendency has been to focus on suboptimization (e.g., to make acquisitions or the cataloging process happen in the fastest possible manner). More recently, technical services departments have sought to ensure that materials move through the technical services area in toto in the fastest possible way, rather than moving them through quickly by individual subunits.

We really need to look at the overall library operation and not the individual parts. The process, from the request for materials (if our procurement is triggered on that basis) to the actual provision of the material to the end user, may be one parameter. We may be trying to provide materials in advance of requests. In that case we may want to see how successful our selection criteria has been. How many times has a particular item been used that we have recently acquired? If it has not been used at all, what are the reasons for its nonuse? Did we select correctly or not? How does this relate, not only to our current users, but to future users? These are all questions that must be answered, particularly in these times of limited budgets for materials and staff.
Why

Having discussed some aspects of what, we should also consider why we need information. What are our criteria for success? Do we measure them based on the number of books processed, patrons served or user satisfaction? We have few measures of satisfaction other than our use of statistics or surveys relating to users and nonusers. The latter information is difficult, costly and time-consuming to acquire. However, if the library were to become a community information source accessible to every home in that community, we could acquire considerably more data easier, and in a more timely manner. Mr. Dowlin has described one system with this potential—Maggie's Place—elsewhere in these proceedings.

For a number of years, and particularly in recent planning, public libraries have been focusing on user satisfaction as a major criterion. Considering the political process in which libraries are involved with taxpayer support, this may be an appropriate measure of usefulness for a public library.

Academic institutions have always felt that their facilities were established for current users as well as for future users; they were equally concerned about building a scholarly collection for both the present and the future. It is more difficult to anticipate and establish objective measures of how well the library meets that future use. We can only do it by looking at how well we have met the needs of scholars in building our retrospective collections, and can only hope to guess correctly about the future.

When

When we need information can often be as critical as what information, and why we need that information. Timing is, in many instances, determined by the nature of the process or by cycles within our parent institutions, such as a calendar or fiscal year. We have more control over information generated for our internal management needs. We often fall prey to the belief that we need instantaneous access to current information. Computer systems offer us two major advantages. They offer us virtually instantaneous access to much information, as well as access to vast amounts of data that can be readily analyzed in many ways.

Computers can offer us information in real-time, but we need to think carefully about that use. There are times when delays in our systems work to our advantage. In designing systems we need to consider how to provide that kind of tolerance. We may at times feel something is abnormal in relation to a present situation but, if examined later on a long-term basis, may have been a minor blip—no major problem. We need to build certain tolerance levels into our systems to provide this aspect, so we take action when needed, but not unnecessarily.
We also need to recognize that much of our data is historical—i.e., it is based on our current systems and technology and our present methods of use. When we use historical data to predict the future, we must recognize that they will predict the future only insofar as the future is like the past. But if conditions occur where significant changes may happen, we need to explicitly acknowledge such changes and estimate the impact they may have on our history-based projections.

This is one of the major challenges we face in designing online catalogs. Since much of our information is derived from catalog use studies, we must not extrapolate the limitations of card catalog access into a new tool (the online catalog). We need to separate those aspects of information-seeking which are not dependent on the tools used—but are inherent in the process—from those things which are really based on the form or medium used.

How

The focus of this clinic is primarily on management information in automated systems. Used carelessly, computer systems can increase our information overload so that we have too much information to make the decisions we need to make. Rather than reducing our risk, these systems increase our confusion and literally make decision-making impossible. On the other hand, if we use those systems to create normal patterns and ignore what falls within the norms (i.e., have the system select the items we should look at), we can reduce the volume of information and concentrate on matters that need our attention.

Computers have a fantastic ability to process large amounts of information rapidly and whittle the information down to important items of concern to us. To date, they do not have the ability, however, to make decisions based on that information. They can merely alert us to the fact that some kind of action should be considered.

In data collection we must focus on automatic means of collecting data which are a normal part of the process for a particular activity. It should not require separate actions or unique actions just to generate that data. If it does, we run two risks: (1) someone will forget to take the action to collect the data, or perhaps more likely (2) we will add to the cost of our overall processing by collecting such data. Information has a cost. We must ensure that the cost of collection and analysis does not outweigh the usefulness of the information.
Where

Management information is pervasive and affects all parts of our operation. We were asked to look at this topic within the context of the network environment. Consequently, we will limit our remarks mainly to this environment.

At OCLC much of our early work focused on acquiring only those pieces of data which we actually needed to run and support the operation—in particular, the information required for billing. The design of our systems from a management support perspective leaves much to be desired. We are trying to rectify that in the design and implementation of system enhancements, but more importantly in the design of new systems.

For example, a major function to be added within the OCLC Interlibrary Loan Subsystem version three is the statistics-generating capability that will allow users to document the kinds of activity that take place within the interlibrary loan operation for both borrowers and lenders. Clearly, this is only the tip of the iceberg. Much more information is available and could be collected, but it represents consensus among users of the Interlibrary Loan Subsystem for those items they consider to be important. One can identify similar needs within acquisitions, cataloging and serials control.

Another aspect of "where" relates to whether such analysis and collection are performed online or offline. Not all processing needs to be online. Where quick, short, unique answers are needed, online has advantages from both a management and systems perspective. If long reports are being generated, these are better done offline. Much depends on the manager's needs and time frame and the system's design and flexibility.

Often what is needed is not merely to see a library's performance in isolation, but to see that performance over a period of time, preferably in comparison with other libraries. The OCLC system has the capability for providing such comparisons.

Some time has been spent by OCLC staff in designing, in a broad way, a MIS. Whether the system will ever exist depends on the needs of our users, the priority they give management information as opposed to additional indexing enhancements, and new features for other subsystems including subject access. At the moment, management information seems to be a low priority. Thus, while it is highly desirable and could be useful to library managers, other things are more important.

We are doing a much better job of designing management information into the local library system from the beginning rather than as an afterthought. We have reviewed what libraries need to know in regard to local library functions, and how we can provide this information in a cost-effective manner. Libraries will be able to collect statistics on just
about everything. The need, however, is to determine the key factors in terms of library performance, and to collect and analyze that data rather than collecting everything. This will only answer one of the questions I have posed, namely, how the library relates to itself, and will not give answers about how the library relates to other libraries. That information must originate outside the institution, and could be provided through the mechanism of the central system. Some work has been done in this area (e.g., the Council for the Advancement of Small Colleges has used the HEGIS data), and using input data from a library will provide information to the library on its own processing in relation to other libraries.3

Who

In looking at information from a network perspective, we need to consider the different types of people who require and use management information. Our preceding discussion provides the necessary background. We have the end user or the operator at a terminal. We have library management, regional network management or service representative. We have the network itself or the service provider. Within each of these groups are subgroups which need other types and levels of information.

The focus of management information systems has been, and continues to be, the manager. While that is important, our focus should be on how to achieve the kind of performance we consider desirable. If we were doing this, our focus would be on the individual operator and worker rather than on the manager. This change of emphasis is most important within automated systems.

Operators need instant feedback on what they are doing right and what they are doing wrong. Sometimes this feedback is merely the response—"The system did not understand your last command"—or it may be more complex, depending on the nature of the system. The operator should be able to ascertain performance measures for each session completed. Few systems presently provide these performance measures. This is the kind of information we should be designing into future systems.

Users of online systems want to know: How can I get the information I want most easily? What am I doing wrong? How can I fix those things that are wrong? Library staff are interested not only in those facts, but also: How long did I take? How much did I do? How well did I relate to what others have done?

Library managers may be interested in parameters associated with individual operators if they are immediate supervisors. Senior management is more interested in how the library is doing in relation to its past performance, trends and growth in activity, how the library performance relates to other libraries, and what are the means of focusing on those areas
which deviate from the normal performance range so as to take whatever corrective action is necessary.

In addition, senior management is also interested in assessing "what if" situations. "If my budget were reduced 10 percent, how would that affect resources available for staff, serials, monographs, and other library activities?" Would it be better to take a 10 percent cut in staffing, in materials area or different percentages of cuts in each? Should one area be favored over another? Historical data and models can help the manager assess the impact these changes might have on the library and its operation. They are not a substitute for intelligent judgment, and one must always look at the underlying assumptions, particularly when using historical data.

Regional network managers are interested in matters very similar to those of the library manager—e.g., the past versus the present; trends versus growth; this network versus other networks; high and low usage, and the reasons behind such usage; errors and problems incurred by users with the system; and the "what if" situation.

Bibliographic cooperative management is similarly interested, but from a somewhat different perspective. They are interested in present activity versus past, in trends and growth, particularly in relation to system performance and future capacity planning. They are less interested in their performance versus other cooperatives, but are very interested in how different groups of libraries are performing in relation to each other and as a whole. They are interested in high and low usage, and reasons for such usage. They also have an interest in error prevention and operator problems. Again, models and "what ifs" can be used to pinpoint potential problems, their impact on capital equipment procurement decisions, and the timing of those decisions. While each level is not necessarily interested in the same information, they are still operating from a common base (i.e., system activity), and this relates back to how an individual operator uses and responds to the system.

If we give the terminal operator or user the kind of information needed for the activity being performed, it should be somewhat easier to pass along the information the manager needs, and so on up the chain of command. The important thing is to select for each level of use the items that matter at that particular level, and not to prepare a mere mass of data. It is to select information that helps in the decision-making process—as in the case of the operator—to improve his/her performance. In the case of the manager, to plan, monitor, control, and alter the operation of the overall system.
Research Activities

In moving from management information systems to the individual users, we will bring together two research and development activities taking place in libraries today. These research and development activities are those of online cataloging and library MIS. We will start by reviewing some of the initial findings, assumptions and research activities relating to both online catalogs and MIS.

Before discussing these areas, it is important to note the connection between management information systems and online catalogs or OPACs (Online Public Access Catalog systems). The connection between these two areas is that of cause and effect. Used together, they create an atmosphere for "user studies deluxe!" The record of use that is possible to create from an online catalog provides a library's management information system with accurate data on how the catalogs are being used by patrons. Catalogs are the key to library collections, and an understanding of their use would be a key to understanding library use. These online catalogs, however, have a number of barriers.

The initial findings discussed earlier come from a number of different studies. All of these studies have been conducted in part or in their entirety by the Office of Research at OCLC. These studies are on three major topics: subject access, terminal requirements (queueing), and the online catalog.

Subject Access Project

The subject access project's objective was to determine the features of an automated subject retrieval system that would support the present search tactics employed by library users. The final report for the project will be issued this fall as part of the OCLC's Office of Research "Research Report Series." This report, like the first one originating from this project, will be authored by research scientist, Karen Markey. Two other papers on the subject have also been published during the course of this project.

Terminal Requirements Project

The second study, "Terminal Requirements for Online Catalogs in Libraries," is being conducted with funds from the National Science Foundation. Its purpose is to develop and to test an algorithm for estimating the number of public computer terminals needed by a library to support an online public catalog. The results of this study will be published in the literature, and the guidelines for the use of the algorithm will be offered as part of OCLC's monograph series (Library, Information, and Computer Science Series). This work, coauthored by Neal K. Kaske and John Tolle, will be available in 1983.
**Online Catalog Project**

The last of the three study areas is devoted to the online catalog and consists of three major activities. The first one is reported by Kaske and Ferguson in a report issued by the Council on Library Resources, Inc. (CLR), the major funder of these three projects. The second activity, "Online Public Access Systems: Data Collection Instruments for Patron and System Evaluation," which has just been completed, was composed of three basic phases. The first phase was to assist in the development of patron assessment tools. Phase two was to examine and compare several online patron access systems. The third phase recommended a uniform online catalog patron monitoring technique. Most of this report (phase two) has been published separately as the monograph *Online Public Access Catalogs: The User Interface*, by Charles R. Hildreth and is available from OCLC.

The third activity is the Online Catalog Research Project funded by CLR and titled, "Online Public Access Systems: Data Collection and Analysis." The ultimate goal of this research is to improve, through the design and enhancement of online catalogs, the patron's ability to access information. The project is divided into three major phases. The first phase is data collection and analysis via patron questionnaires and focused-group interviews. The second phase analyzes the current patterns of use made of online catalogs via transaction logs and activity reports. The final phase evaluates and integrates the findings for library management decision-makers.

**Initial Findings**

An initial key finding from these research projects was that there are a number of barriers which prevent library patrons from effectively using (or in some cases from even using) online catalogs. The barriers are the computers themselves, the system's language, and the bibliographical information.

The first barrier is computerization itself. Many people believe computers to be complex and that formal training is necessary to use computer-based systems. Some fear that they may "break" the computer, or inadvertently cause the computer system to malfunction if they do not use it correctly. People also find the computer to be dehumanizing and, as a result, do not want to learn about it. Some say that computers put individuals out of work, and therefore, should not be used. Thus, the computer (or terminal) and how it operates is a basic barrier to its use.

Patrons remember using the card catalog as an old familiar friend. There are many people who prefer the card catalog because it is more private—i.e., others cannot easily see what one is searching. It is also easier
to look scholarly while intently scanning a series of catalog card entries. In contrast, the online catalog is generally in a public area where others may easily view a search in progress. This may have significant implications for where terminals are located and how many are required.

Another barrier is that the operation of various terminals is somewhat different. One of the most frustrating things for individuals to overcome in first learning how to use a computer terminal is to remember to depress the return key so the computer will read the message that they have keyed in. There are other idiosyncratic characteristics about computer terminals, many of which become trivial when one learns how to operate them. But until a few basic operations have been learned, terminals may be as foreign to a user as a manual transmission is to one who has driven only an automatic transmission.

Another major barrier is the system's—or command—language. Here we must learn how to ask the computer a question and get an answer. Is it an AU/ and the first four letters of the author's last name, or is it something even more bizarre and complex such as A/T with the first four characters of the author's last name and the first four characters of the first significant word of the title?

Some systems have two levels of command languages: one for the novice—which none of us admit to being—and another for the expert—a level we have not yet achieved. How about that vast majority in the middle? To these the system acts as a barrier.

The third barrier is bibliographical information itself. It seems that no matter how often people are given lectures on bibliographical information, they arrive at universities and public libraries with either near full knowledge or no knowledge at all of how to interpret bibliographical information displayed on a 3 by 5 inch card, a COM (computer output microfilm) catalog, or information on a computer terminal. A lesson to learn here is that major elements of bibliographic records should be clearly labeled with words easily understood by the majority of users.

The barriers then are computers, systems language and bibliographical records. The first barrier will soon disappear as computer users become more numerous, be it via the home computer or classroom instruction. We should see real improvements in the second as we make system languages more understandable and "user friendly." The third barrier, bibliographical records, remains to be addressed.

Another initial finding is that while information needs are not all alike, there are two key elements. These elements are time available to research a topic and knowledge of the subject. Most informational needs have an attached time constraint. That time constraint may be only a matter of minutes or hours, or it may be open ended in the sense that it will last for years. An example of an informational need that must be satisfied
in hours or possibly minutes is one expressed by the student who walks up to the reference desk and says: "I've go to give this speech next period on birth control. What do you have in the library on birth control?" Or by a student who says: I have to have an essay ready by next period on the subject of the Falkland Islands. Have you ever heard of the Falkland Islands and, if so, where can I find information?

Other informational needs may develop over years. An expert on herbs and herb gardening, when traveling about the country on vacation or business, may take advantage of different libraries and examine their collections as to holdings. The individual will probably also make an effort to visit different herbariums. As the knowledge grows, the informational needs change indicating that informational needs are time related.

An individual's subject knowledge is important in satisfying any given informational need. The novice in a field needs a great deal of information—e.g., definitions and basic works. The expert, on the other hand, needs to find that last elusive informational package on a subject, held by who knows what library; and the information should be current—perhaps from the latest journals or other information resources.

Assumptions

With this knowledge that people's informational needs are time related, and that they are at different levels of knowledge on given subjects, we need to make some assumptions. We must start by reviewing previous catalog studies though they will be about card catalogs, book catalogs or COM catalogs—not about online catalogs. More important than the fact that the catalog medium is different is that previous catalog studies were only time slices; they were not longitudinal studies. Consequently, earlier studies have limited application to the design and use of online catalogs.

People do not perform "known item searches" for most of their informational needs. They do all types of searches in more than one library location (the college library, the public library, etc.) to satisfy their informational needs. Figure 1 shows that as the patron moves "across time" in different library locations, they will do many kinds of searches for information. For example, in the first library they may search under author, then under title, then under subject. They may also be knowledgeable enough to use titles as subjects, depending on the division of the catalog. If it is a dictionary catalog, this is done many times unwittingly. If a catalog is divided, a person looking for a subject item and only starting with the subject may use the title catalog or the author/title catalog as a subject catalog, hoping the first significant word in the title, minus the articles, will be the subject they are looking for. They then find a book with that kind of title, note the Library of Congress subject heading on the card and
promptly switch to a subject catalog to find their subject material. If their information need is more than a few hours or a few days, people may move on to another library to search its holdings in a similar way. They may continue at a third and fourth library, again searching by author, title, subject, and by title as subject. To gain a clear picture of how people conduct subject searches, longitudinal time studies need to be performed.

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Fig. 1. Patron Searching Pattern Overtime

**Transaction Analysis**

Having examined some initial findings and having looked closely at our underlying assumptions, we should be able to provide some answers to our research questions—How are online catalogs being used? An overview of the related projects has been reported earlier. How do we obtain answers to these questions? Our solution is transaction analysis (TA).

The kind of TA we are going to discuss is not transactional analysis of the popular sense, but it is transaction analysis. The kind of TA we are discussing is the type that makes use of the transactions log produced by computers. This log is a record of the computer dialogue between the user and itself. These dialogues are recorded so that if computers fail, the transactions log can be used to recreate the processes, and by replaying them, bring the system back up from a "crash." This is done so people can continue to work as they were before the computers failed. The data elements that need to be captured so we can study them are listed and briefly explained in the following:
1. **Session identifier.** The unique identifier associated with the particular session being monitored.
2. **User identifier.** The unique identifier associated with the individual user being monitored.
3. **Database or file being used.** If relevant, the name of the file currently being accessed by the user in a given database.
4. **Date.**
5. **Time stamp.** The time at which each transaction occurs. Time stamps should provide as much accuracy as possible, although a time stamp resolution exceeding hundredths of a second is not generally useful. The point at which the time stamp will be applied must be specified. Ideally, the input time stamp should be applied when the user completes the input (e.g., depresses the Enter, Return or other special function key), and the output time stamp should be applied when the first character of output is delivered to the user. Since these exact times are not often available how the time stamps differ from the ideal time stamps should be stated.
6. **The source of each transaction.** Possible sources should include at least the terminal user, system and other transaction source (e.g., stored command files or operator messages).
7. **System-dependent state information.** If other information about the transaction is readily available, it should be included. Common examples include a transaction code generated to govern internal processing or special error or return codes.
8. **Blank space.** This is needed for state code assignment during post-session analysis.
9. **Length of text portion.** Number of characters in the input or response.
10. **Text portion.** Contains the text of the user input or the system response. The complete text is preferred when practical, but it may be truncated.

Why do we want to perform transaction analysis? The answers are simple: to have better online services, to provide better access to libraries, to make libraries respond to the informational needs of the public who uses them, to provide the dream—"a library at your fingertips"—and foremost, to make libraries the people's choice for information seeking.

**Summary**

In this discussion we have considered from our perspective how we define management information systems in the network environment and have considered Rudyard Kipling's "Six honest serving-men." We have reviewed general concerns that apply to any management information system, but have also looked at this from the network perspective. We have
focused heavily on users and their needs since they are the primary reason libraries exist. We have looked at the patron’s use of online catalogs; have considered the barriers to catalog use, including computer knowledge, systems and command languages; and, in the organization, the content of bibliographic information. We considered informational needs as changing over time and with experience level. We have examined the impact of library location on the search type, and we’ve looked briefly at transactional analysis of the kinds of information that can be collected and some of the analyses possible.

Three other issues we will touch upon but not fully deal with are integration, privacy and power. We obtain management information not from one system, but from many external, as well as internal, sources. Presently we have left the integration of this information to the individuals. This lack of integration was a driving force behind OCLC’s concern for designing a management information system that uses not only network and institutional information generated on the network system, but also allows the manager to draw on other information sources such as HEGIS, Bowker, census data, etc. In addition, it allows entry of other information. At present this is a dream, but it can become a reality provided librarians and managers believe such a system is useful and satisfies their needs. Without user support, it remains simply an interesting concept.

Privacy issues are many and varied, and have been discussed at some length in the library literature as well as in more general areas. There has been considerable concern over the problems of computers—i.e., their ability to amass and analyze information related to individuals. There have been a number of laws passed overseas and also within the United States relating to the individual’s right of access to such information to ensure its correctness and validity. We must also consider these issues in designing MIS for any kind of monitoring of a user’s interaction with a computer-based system. These issues are critical when we seek to monitor the activities and behavior of individual library staff members. How do we relate our management functions? And what right of protection or redress does the individual have in relation to such information? Management information systems represent power in this sense, and we need to ensure that proper consideration is given to the individual and his rights to privacy.

This, of course, leads us to the whole question of power within management information systems. As was indicated by Mr. Olsgaard, there is potential within management information systems for centralizing and controlling information, for restricting access to it, and, consequently, for it to be a source of power. While that is possible, it is also possible that we will see a democratization of information rather than a concentration and restriction of information as we are developing more computer-based systems, particularly microbased systems which are linked to a central
database but which may act independently and maintain their own separate stores of information. That information will be more readily available to others who in turn can manipulate, access, analyze, reformat, and draw conclusions from such information.

Earl Joseph, a futurist from Sperry Rand, has stated that we have considerable difficulties with the development of distributive systems because we have no models. Our religions and our culture all tend toward hierarchical structures. We are not used to systems in which all parts are equal. The U.S. Government represents a departure from democracy in a political way. So too, distributed systems represent a new approach to systems design and to the potential for democratization of system access to and use.

We now face considerable challenges: how can we provide the integration of the systems we require and the information sources we need? How can we provide privacy for the individual with relation to his/her rights and privileges? How can we use power effectively—not to restrict information, but to make our systems work better and more effectively?

So, what do we see for the future? We will have the option of creating, internally, our own systems which operate on microcomputers or minicomputers. At OCLC we have used not only mainframe data collection and analysis, but also such microbased tools as Visicalc and Supercalc for both our system performance projections and preliminary budget analysis.

We will have access to information sources through such services as EDUNET and EDUCOM, including the HEGIS data. We will likely have library management-related services available from other information providers such as BRS and Lockheed, as well as OCLC and RLIN. Our challenge as managers will be to take those various information sources and integrate them so as to provide us with the information we need to manage our individual enterprises. The questions remain to be answered. How can we better manage our networks, our consortia, our libraries, to better serve our users both present and future?

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