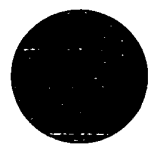PB81-228009

MICROFICHE AS A VEHICLE FOR TECHNICAL REPORTS

G. W. Reinhart

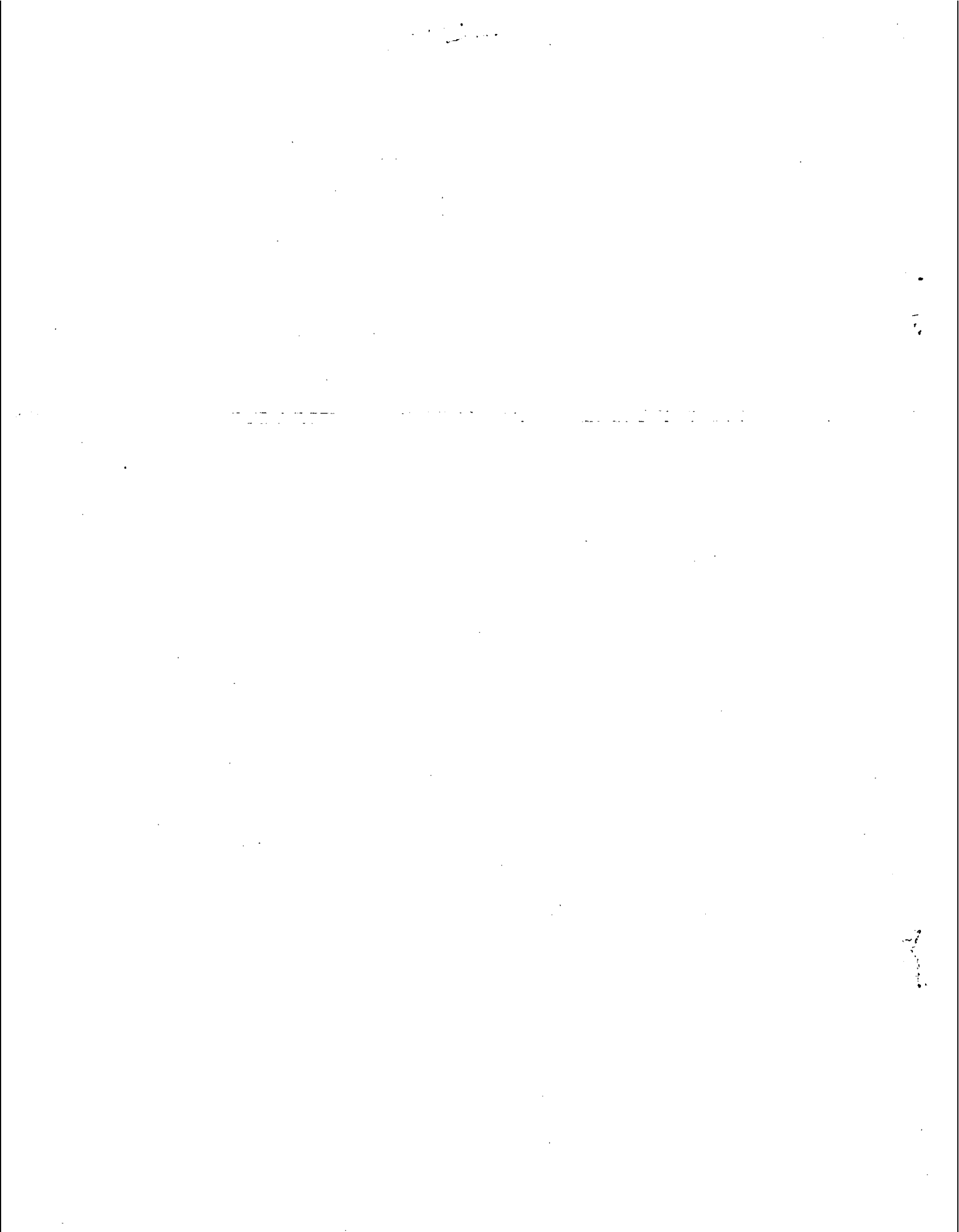National Technical Information Service
Springfield, Virginia

February 1981

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George W. Reinhart
Principal Investigator

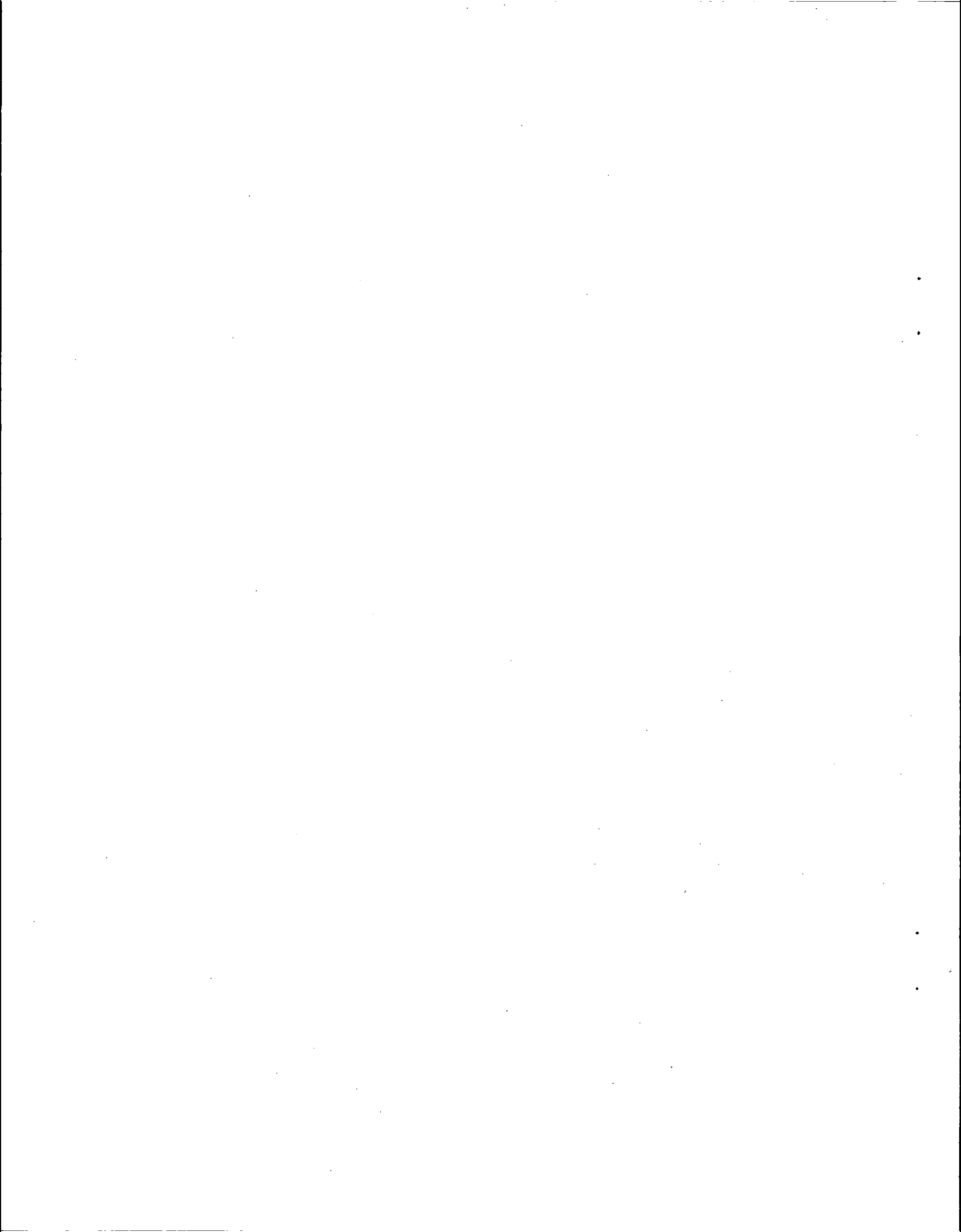Performed by the

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For the

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Opinions expressed in this report are those of the author, and
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The National Institute of Justice is interested in the possibility of improving the cost effectiveness of their information dissemination program by making a larger part of the dissemination in microfiche instead of paper copy. They commissioned this study on an interagency agreement to help them decide whether microfiche dissemination would have the desired effect.

The report concludes that, as presently used, most of the advantages of microfiche accrue to the producer, and most of the disadvantages to the user. There is likely to be considerable resistance to broadening the use of fiche for the intended audience of criminal justice professionals. Several alternatives are presented for lessening this problem, including emphasis on the role of libraries, promoting the availability of fiche-to-paper copiers, and using microfiche itself in innovative ways to facilitate information transfer, rather than as an attempt to duplicate the features of a paper publication in a reduced size.

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*Microfilm; *Technical reports; Film readers; Microfilm reader-printers; Information systems; Documentation; Document circulation; Document storage; Libraries; Acceptability; Marketing

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*Microfiche; *Micropublishing; Publishing; Information dissemination; User acceptance

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SUMMARY

The National Criminal Justice Reference Service under contract to the National Institute of Justice distributes and cite huge quantities of documents providing textual information on subjects of interest to the criminal justice community. They are vitally interested in improving the cost-effectiveness of such distribution, and are looking at microfiche as an alternative to paper copy.

Microfiche is used both in a records management and in a micropublishing role. It has achieved wide acceptance in records management because of its advantages in file density and integrity, with resulting reductions in access time and storage space requirements. Research applications, however, generally do not have the same requirements as records management functions do for instant access.

Microfiche presents significant advantages to the producer or distributor as an information transfer medium, because of the major economies it makes possible in reproduction and mailing. These advantages are much less important to the user of the information, however, although reduced prices and faster delivery may be important considerations in some cases.

To the user, there are significant drawbacks to the use of microfiche instead of paper copy. Most importantly, reading microtext requires the use of a viewer, which may not be conveniently available at the times and places where work has to be done. Viewers also represent a capital cost, and require maintenance.

Other disadvantages which users see in microfiche include the impossibility of annotating fiche copies, the relative difficulty of making copies of selected pages (because of the scarcity of fiche-to-paper copiers), and the fact that fiche don't fit conveniently into office shelving systems.

Microfiche technical reports are typically produced by photographing an existing paper copy of the document. For that reason, the results do not take into account the differences between the two media. Tables of contents and indexes meant for paperbound books are difficult to use in microfiche versions. Photographs and color do not reproduce well, or at all. Charts, tables, graphs, and other such "extra-text" material are frequently filmed "sideways" and are difficult to read. Having to move back and forth on a fiche, or (even worse) between fiche, makes it difficult to keep a train of thought, and is an inconvience at best.

Several steps are possible to make fiche somewhat more attractive to the research user. Standards can be put into place that will reduce the problems with indexing, sideways pages, and having to refer to remote frames. Where photographs are important to the information content, they can be produced as "negative originals" for filming, which will result in a positive image on the fiche -- much easier to interpret.

Organizationally, distribution and pricing strategies are possible (focusing mostly on libraries) that will make fiche a more attractive alternative to paper. The overall goal is to increase the convenience and reduce the cost to the user of using microfiche as opposed to paper copy. It should be worthwhile

to emphasize a browsing and previewing role for fiche, with paper copy still available of reports that will be heavily used.

Some attention should be paid to the possibilities for improved information transfer inherent in the basic characteristics of microfiche as a medium. One specific example is the innovative use made of the two-dimensional nature of the microfiche grid to present training course material in a manner to make study easier for the student. It should be possible to couple word processing technology with computer output microfiche (COM) to produce fiche "originals" without an intervening paper copy step, and so to take advantage of such techniques as the "microblock" format designed to improve the rate of information transfer and its retention.

INTRODUCTION

The National Criminal Justice Reference Service (NCJRS)
annually distributes approximately 900,000 publications of interest
to the justice community. In addition, NCJRS operates a document
loan program with an approximate volume of 10,000 items annually.
The material typically consists of case studies, research reports,
and reports on programs funded in whole or in part by Federal
grant money. This activity represents a considerable expense in
personnel time, in reproduction (printing) costs, and in postage.

Because of the economies inherent to the producer in
substituting microfiche for paper copy in such a reproduction,
distribution, and loan operation, NIJ determined to investigate
whether it would be feasible and cost-effective to shift some or
all of its information dissemination activities to microfiche,
and away from traditional paperbound printed reports. There
was little doubt that it would be possible to reduce costs in
this manner; the question was whether such a program would continue
to be an effective way of carrying out the agency's mission of
disseminating information. Having huge quantities of material
available for free or at very low prices would be useless if the
user community refused to accept the new format.

It was decided, then, to look into the extent to which
microfiche as an alternative to paper copy for technical studies
and research reports was currently being used in the target
communities, and what reasonable steps NIJ might consider to

increase that level of usage and acceptance, if that was determined to be the best approach. Because of the considerable experience which the National Technical Information Service (NTIS) has had with microfiche distribution, and because of the availability on NTIS staff of a person with local government information experience (on temporary assignment from the International City Management Association), NIJ chose to contract with NTIS for such a study.

An early goal of the research was to determine the extent to which State and local government agencies and personnel were already using, or were already prepared to use, microfiche as an acceptable alternative to paper copy for technical reports. The phrase "for technical reports" is emphasized, because State and local governments for quite some time have been using microforms of various types (as have the Federal government and the private sector) for record keeping and archival purposes. Of concern here, however, was the willingness of professional staff members to use fiche for their own information needs.

METHODOLOGY

The original plan, at the conception of this study, was to run it in parallel with another study on the use of Federally-sponsored information clearinghouses by S&L government agencies. Since the latter project required considerable contact with the community of S&L information users, the investigators hypothesized that many of the same people would be involved as "users" in both projects, and that economies of effort would result if the two projects were run together.

The reality, however, turned out to be considerably different. It would have been possible to study the extent of microfiche use by S&L professionals, their likes and dislikes about the medium, and their suggestions for improvements, if any significant level of microfiche usage had been discovered. That was not the case, however, and the study strategy had to be altered accordingly.

We found, in fact, that professional-level personnel in S&L government agencies had little if any acquaintance with microfiche as a medium for other than "filing and recording," and those that did have some passing acquaintance (as from using fiche during college studies) were not particularly eager to see its use expanded. No attempt has been made here to tabulate responses received from the people whith whom this was discussed, since the numbers are not large enough to result in any sort of statistical significance. It is worthwhile noting, however, that even the professional S&L-related public interest groups, which have much more of a day-to-day role in information collection and processing than personnel in the field, still are not themselves heavy users

of technical report microfiche -- even though they operate under significant budget constraints and fiche is often available at much lower cost than equivalent paper copy.

Instead of what would amount to a user survey, then, the project team began searching the existing literature for information on user acceptance of microfiche as a paper copy alternative. Our goal became to determine (1) just what advantages over paper copy microfiche offers either the producer/distributor or the user; (2) what disincentives there are to the user to increase use of fiche (that is, what do users actively dislike about the medium, or particularly like about paper copy); and (3) what sort of technical and programmatic changes might improve the likelihood of a succesful expansion of microfiche use and acceptance.

"RESEARCH" VERSUS "CLERICAL"
USE OF MICROFICHE

First, it would be well to discuss some of the differences,
whether objectively or subjectively "real," between two fundament-
ally different fields of microform use. This is important in
order to forestall the objection that S&L governments are
already using microfiche all the time, and it's just a matter of
spreading acceptance within the user community.

Microform technology is at present serving at least two
entirely different and largely unrelated fields: records management,
and (for want of a better term) micropublishing. In the former,
emphasis is primarily on storage of information generated in-
house, or within a higher-level agency, and kept for operational
reference or for legal/regulatory reasons. This is the typical
"filing" application, where fiche (or another microform) acts as
a substitute for paper (or sometimes for computer) files. Items
filed are not to be "read" in the sense one might read a book,
any more than the contents of paper file folders normally are.
One does occasionally browse files, or read a file cover to cover,
but that is not their normal use. Although implementation in the
S&L sector has been spotty to date, there is little conceptual
resistance to the idea of microfiche for records management
purposes. Any delays have been due mostly to lack of resources
or expertise, rather than to basic user objections.

The use of microforms for technical reports (and potentially
for other textual material, such as journals and newspapers) is
another matter altogether. There are distinct differences in

characteristics of both the users and the use itself, which are
summarized in Table 1 and further discussed below.

Table 1. Differences characterizing technical report
(micropublishing) versus records management (clerical)
use of microforms.

Technical Reports	Records Management
Sporadic use	Constant use
Varying locations	Fixed work stations
One of many information sources/tools	Main medium for the file worker
Immediate (instant) availability usually not crucial	Instant availablility often of the essence

Sporadic vs. Constant Use

Generally speaking, the kinds of professional personnel
in State and local governments make use of technical reports,
and of other documents which might be micropublished, do not do
so as a full time function. They are usually generalists rather
than specifically researchers, and have programmatic responsibilites
within their agencies. Finding a piece of information or doing
a study is normally only one of many things such a person does.
The records management specialist, file clerk, or customer service
clerk who uses microfiche in the normal working environment is
likely to do so pretty much in an ongoing manner, however, since
dealing with the files and records _is_ their job, rather than a
more-or-less incidental part of it.

Varying versus Fixed Location

Because of basic functional differences, records management personnel tend to have fixed work stations -- near the files. The types of personnel most likely to be using technical reports as part of their work are generally more mobile, and (as a matter of self image as much as anything else) like to work (or to think of themselves as being able to work) at home, in transit, or wherever. That's one reason that the briefcase (even if used only to hold one's lunch) is a symbol of the class.

One-of-Many versus Main Medium

The file specialist often deals solely with microform files to the exclusion of paper equivalents. This may not be true in many cases, but the records technician is at least used to dealing with fiched records as a major part of the work function. Microfiche materials are only one of a variety of media with which the generalist professional has to deal -- the bulk of information transfer coming from paper media, peer interaction, phone calls, and so on.

Instant Availability Requirement

The type of information needed from a technical report is typically needed on a time horizon of from several days to several months. Very rarely is it actually required within the next couple of minutes (although it might be nice). File information, on the other hand, is most typically required "right now." In some cases, such as servicing utility customers over the telephone, the access time requirement for effective performance might

literally be seconds.   This puts a high premium for the file
user on dense storage, file integrity, the ability to make and
distribute multiple copies of large files, the ability to access
files without having to run all over a file room, and so on.
None of these considerations (which make microfiche so desirable
in many records applications) are generally applicable to the
technical research function.

We have gone into some detail on the differences between the
orientations of two of the basic user groups (or potential group,
in the case of the technical report users) to make clear that it
is not necessarily a true statement to say that because such and
such town is using microfiche in Police Records they are necessarily
all the more ready to use if for technical report study purposes
in the Chief's Office.

The Library
        There is, of course, one place in which the approach of the
records manager and the general information user come together, and
that is in the library. The librarian is a warehouser of
information, and as such functions in a manner somewhat analagous
to a records technician. The library is a centralized work
station, in which the librarian spends most working hours. When
a user wants an information item, they usually want it _now_, so
instant availablility is a factor. Libraries are usually resource
poor, both as to money and space, and often as to staff time, and
so the cost- and space-saving aspects of microfiche, and the ease
of filing and retrieval, are all attractive. Librarians are

also used to dealing with the medium, from library school on,
and usually have the necessary tools (viewers and printers)
easily to hand. They therefore tend to be proponents of microfiche,
in spite of resistance from their users, and may occasionally
have succeeded in overcoming such resistance and developing
actual acceptance.

To the user blessed with a library well equipped with both
microfiche and the tools to use it, and provided that the library
itself is reasonably convenient and there are no organizational
or physical barriers to its use, fiche can present a much more
attractive alternative than it otherwise might. Such a
setup approaches the conditions recommended later in this report
for improving acceptance.

ADVANTAGES OF MICROFICHE

It is generally accepted that microforms in general, and microfiche in particular, have the following advantages over paper copy:

     Reduced storage space needs
     Reduced reproduction costs
     Reduced mailing costs (usually as first class
          matter, so with better service)

     And these primary advantages lead to the following
     secondary advantages:

          Improved portability
          Improved distributability

In detail, the primary advantages can be quantified as:

Reduced Storage Needs

The ISO and American Standard microfiche is a 4 inch by 6 inch piece of film. How many images of the U.S. standard 8.5x11 inch page can be recorded on such a fiche varies with the "reduction ratio," which can be defined as the number of diameters by which the result must be magnified to reproduce an image the same size as the original. Various reduction ratios are in use, but for the recording of existing documents onto fiche the twenty-four diameter reduction (usually referred to as 24x) is most popular, and indeed could now be almost considered a standard. At one time 20x was quite popular, and archival collections still contain much 20x microfiche. This does not usually present a problem, because 20x fiche can be read quite handily on equipment set up for 24x. The emerging standard for computer-output microfiche (COM) is 48x, and in a different grid format, so COM and filmed-document fiche may be considered to some extent

incompatible. This is not to say that they cannot be read on the same equipment, but either the viewer must be equipped to handle both reduction ratios, or the user has to scan over-large print from too high a blowback ratio, or read half-size print from too low a ratio. Either of these alternatives leads quickly to user fatigue, and can be done in practice only for short periods.

At the standard 24x reduction ratio, a 4x6 fiche holds the equivalent of up to 98 page images. Since the fiche itself is just slightly over one fourth of the area of a sheet of paper, and perhaps half again as thick, storage density ratios of almost 260 to 1 as compared to paper are theoretically possible. But there is a good deal of space "overhead" involved in the needed viewing and printing equipment, and in file envelopes, so the literature commonly speaks of density ratios "exceeding 100 to 1." In simple terms, particularly as a librarian might look at it, this means one can store the same volume of information in 1/100th the space, or 100 times as much information in the same space.

Reduced Reproduction Costs

Again, there are a great many variables to be considered when comparing the costs of reproducing a copy of a paperbound report versus the same report on microfiche. One major factor is volume, since one must amortize the cost of fiche duplicating equipment over the total number of copies made during the equipment's lifetime. If the volume of copies is low, then the operating expenses of the equipment (maintenance especially) on a per-fiche basis will be high, and the machine may become obsolete and need to be replaced before the actual expiration of its useful

life. Also, the per-fiche cost will be high when figured on a cash flow basis, because the capital is comparatively unproductive. If, however, the volume is only moderately high, then these factors become considerably less important, since the cost of low volume duplicating equipment has become quite reasonable.

The cost per fiche does not, of course, translate directly into a paper-comparable cost per copy, because of the varying number of pages in a document. A two or three page report might well cost more to reproduce as a microfiche than as a paper copy. A 90-page document, on the other hand, is only a single fiche, and so would be considerably less expensive to reproduce, especially if multiple copies were being made at the same time. The greatly reduced need for document collation can cut personnel time considerably, or alternatively can reduce the need for expensive add-on collating equipment. Other processes, such as jogging and stapling, are also eliminated.

At the high-volume end of the scale, microfiche can today be duplicated for between $0.08 and $0.15 per fiche. Low volume equipment results in much higher unit costs, but even so $0.30 is not an unreasonable estimate. Paper copy costs are on an average between $0.02 and $0.13 per page, again depending largely on volume. The potential for significant cost savings is obvious.

Mailing Costs

The investigators experimented and found that eight 4x6 microfiche in a standard mailer could be mailed at the one ounce rate. That is the equal of as much as 784 pages of paper copy, or 392 sheets printed back to back. Seven sheets of bond paper

weighed approximately one ounce, so very roughly the weight
ratios approximate 56 to 1. This assumes full microfiche, of
course, and does not take several other variables into account,
but the weight advantage is still clear. With postal costs in
an upward spiral there is a potential for truly impressive cost
savings in any mail-oriented effort to mass-distribute information.
Added to this is the advantage that fiche documents, because of
their low weight and convenient size, would normally be sent by
first-class mail, while paper documents are routinely sent third-
class or book rate. The difference in levels of service can also
be impressive.

Portability

Based on these fairly self-evident primary advantages of
fiche over paper copy, we can also derive certain secondary
advantages, the first of which is portability. As usually stated
(in NTIS advertising, for example), "you can easily carry the
equivalent of a fifty-volume professional library around in you
pocket." This is quite true, but neglects the need for a viewer
to make those fifty volumes useable. Even so, including a briefcase-
sized portable reader, one can easily carry a hundred or more
volumes on fiche with no more effort than carrying two or three
fairly bulky paper copy reports. (The question then becomes, how
often does one need to carry around a hundred-volume library?
This will be discussed later on.)

Distributability

The low cost of duplicating and mailing microfiche gives
rise to one of the characteristics that have made it truly a

mainstay of many filing systems, and that is its distributability.
By that is meant the fact that it is often less costly in a
microfiche filing environment to make multiple copies of an entire
set of files (as of customer account files, for example) and have
a complete set at each branch office, or even each work station,
than to be continually referring to a central facility for
information. This is true even though, in many of such applications,
the probability of any given fiche ever being read may be quite
small.

The closest corollary to this in the field of technical
information is the Selected Dissemination of Information (SDI)
service approach of routinely sending to clients the entire text
of documents, on microfiche, that fit an "interest profile" stored
for each client by the provider. (The NTIS Selected Research in
Microfiche program is an example of this system. Copies of almost
all reports entering the NTIS system are available though SRIM at
only 85¢ each, compared to the regular $3.50 on microfiche, and
considerably higher prices in paper copy.) This is done as an
alternative to advising the clients of availability of reports
by sending out notices or abstracts, because it is cheaper to
have clients ignore or throw away reports in which they are not
interested, than it is to service the individual follow-up requests
for specific desired reports. Also, branch libraries may receive
complete duplicate collections automatically of many series of
documents, making them immediately available to the branch's
patrons, and at a lower total cost than borrowing from the central
site. Even if the user in final analysis prefers paper copy, this

can still be cost-effective as a browsing and previewing tool,
allowing pre-selection of only those reports which in fact are
needed and have useful information. If fiche-to-paper printing
facilities are available, it may even be possible to print on the
spot only those particular few pages (of a document that might be
hundreds of pages long) that are of actual interest. Or, paper
copies of the relevant reports can be ordered from the document
supplier.

MICROFICHE DRAWBACKS & USER OBJECTIONS

The information in this section was derived partly by discussion with actual users (not necessarily S&L) of microfiche, and of "past users," in the sense that many people have been exposed to the medium previously -- at school or in another job -- but now either have no reason to use microfiche, or avoid using it. Further information came from published material on user attitudes to microfiche, with both annecdotal and survey data.

In summary, perceived drawbacks and objections are:

- o The need for readers/viewers

  - Cost
  - Availability
  - Portability (or lack thereof)
  - Power requirements (relates to portability)
  - Maintenance needs
  - Variety of reduction ratios
  - Special problems
      Bifocal wearers
      Dusty or high-glare environments

- o Can't annotate in margins

- o Inconvenient to copy (fiche-to-paper copiers are much rarer than paper-to-paper equipment)

- o Don't fit in with many offices' shelving arrangements

- o More easily damaged in handling than paper copy

- o No half-tones or color (in standard low-cost fiche)

- o Poor reproduction of photographs (especially in negative-reading fiche)

- o In non-text material (tables, etc.) small defects can irrecoverably blot out needed data

From the standpoint of an independent observer, some of these perceived problems may seem "real" and others more like "excuses," but all are advanced by people asked why they aren't

making more extensive use of microfiche, and all must be considered and dealt with if the goal is to broaden such usage.

Readers and Viewers

This is the most complex issue to deal with under this heading. Some of the problems involved are quite concrete and measureable, while others are more subjective. Some people simply feel encumbered by a piece of machinery, and say they "can't think" while sitting and staring at a machine. They express a need to be able to change environments, perhaps going to the library, or reading at home, or "on the bus in the morning," and feel hampered by having to have a viewer to hand when they want to take in information. More on this anon; in the meantime there are quite a few measurable drawbacks:

<u>Acquisition</u> <u>of</u> <u>microfiche</u> <u>reading</u> <u>equipment</u> <u>represents</u> <u>a</u> <u>(sometimes major) capital cost.</u> Many agencies have to budget seperately for such expenditures, and budgetary politics often militate against justifying a capital expenditure by an offset against operating cost savings (even though that would seem to be the rational approach to looking at capital investment). In other words, saying that spending so much on a few fiche readers now will enable us to cut so much in following years from our document purchasing budget is often not an acceptable argument, usually on the grounds that no actual cash savings are realized; instead, the money is diverted elsewhere in the operating budget. There is no actual tradeoff from one budget compartment to another, and it is doubtful in many cases whether the personnel making decisions about the operating budget would want there to be.

Tied to cost is the question of availability of viewing
equipment at the times and places the user would like to have
it. People don't want to be inconvenienced, nor broken out of
their established routines. If a user is accustomed to working
in a private office, then a reader would have to be available in
the office -- but it can't be there taking up space and "looking
ugly" when it's not being used -- but moving it in and out, or
setting it up and putting it away, is a nuisance -- and so on.
The problem may be less for those who are used to working in the
library, provided that there are enough readers available for
all those who might want them at any given time, and that all
those viewers don't crowd the library's facilities so much as to
annoy people (including our subject) who don't happen to want to
be using one at the moment. In short, there have to be viewers
(of appropriate types, with correct blowback ratios) available
to users where and when they are wanted, if they are not to be
perceived as a hinderance rather than a benefit; but those viewers
cannot be so obtrusive as to constitute a nuisance.

Closely related to the question of availability is that of
portability, insofar as the easier it is to move the readers that
you have around, the fewer readers you may need. Probably the
ideal portable reader would be about the size, shape, and weight
of a handy-sized book, with a self-contained power supply, and be
so easy to operate that the user could largely ignore the fact
that microfiche was involved at all, and could read from the
device pretty much as if reading from a book. Indeed, manufacturers
have been striving to reach that goal, with the "lap reader"

being the closest they've come yet. Most lap readers are in fact
similar in size and weight to a rather bulky book (such as an
encyclopedia volume). But they either require an external power
source, or their internal source requires frequent renewal.
Their "fiche transports" (the part of the machine that holds the
microfiche and moves it around so that it can be viewed) don't
operate as smoothly as turning the pages of a book. Depending on
background light, the state of the power supply, and the particular
model being used, the image may or may not be particularly clear.
Still, a great deal of progress has been made in reader technology
in the last few years, and more can be expected, so the ideal may
be approached much more closely with time. On the same "technology
curve," the constant-dollar cost of equipment can also be expected
to drop.

Other types of viewing equipment than the lap viewers are
available, and may be more appropriate for uses other than personal
study of microfiched material. Portable briefcase-sized viewers
perform the same functions, and often can be used to project an
image for group viewing. Libraries and other fixed study sites
will continue to use non-portable table top viewers, because of
greater dependability and ruggedness (one hopes) and because
they're harder to steal.

One must also consider the maintenance needs of fiche viewers --
particularly those portable units knocked about just anywhere and
used by people who have no idea how the insides of such a device
are put together, and frankly could care less. Even the best-built
unit will need new bulbs from time to time, need its lenses and

glass in its fiche transport cleaned, need its rechargeable
batteries replaced after they cease to be rechargeable, and so
on. From time to time (and on less sturdy units more frequently)
it will be necessary to correct alignment of the optical system
or of the fiche transport, and possibly lubricate the latter.
And then, of course, there is the question of major repair or
replacement in the event of accidental damage. All of these
functions take some degree of expertise, varying from minimal to
fairly sophisticated, and take time, and so represent a cost both
in dollar and nuisance terms.

We have already considered to some extent the question of
blowback ratios (or reduction ratios; it amounts to the same
thing). The fact that several different ratios are in use must
be considered in regard to the availability of equipment,
particularly if the particular using agency is likely to be using
both textual (generally 24x) and COM (generally 48x) microfiche.
Grabbing the wrong reader could be a real problem under such
circumstances.

There are special problems in using microfiche for some
users, or in some environments: Most bifocal wearers find it
very difficult to use most table top microform viewers, because
the viewer is in a fixed position that requires them to read
with their noses pointed at the ceiling. User discomfort and
fatigue are serious questions in this case. Also, most viewers
are ineffective in high-glare environments, because of insufficient
screen shading and contrast, and dusty environments make it
difficult to keep fiche and viewer readably clean, and can cause
scratching both of the fiche and the viewing optics.

Can't Annotate

Every user survey which we came across, and also those users we surveyed personally, mentioned something like "I can't write in the margins" as a major user complaint against microfiche. This is apparently perceived as an important drawback of the medium, and is of course true -- one can't write in the margins. The seriousness of the problem will vary from user to user, depending on one's personal study habits and the uses to which the material will be put, but many people give this as one of the more significant obstacles to their accepting the medium.

Inconvenient to Copy

This again is largely a question of hardware availability. Paper-to-paper photocopiers have become ubiquitous in the office environment, so any researcher or other professional who wants a copy of a particular journal article, or of a few relevant pages from a document to append to a report, can easily get them. The same is not true for fiche-to-paper copiers at the present time, although the technology is about equally advanced and such machines are readily available on the market -- mostly from the same companies as "traditional" photocopiers. Every office worker is familiar with the perennial problems of copy machines, however, and the thought of doubling the number of such machines around the office (one for paper and one for fiche) is not an attractive one.

Shelving Formats

Microfiche are most often distributed in close-fitting envelopes, approximately 4x6 inches in size. They are normally filed, either in or out of those envelopes, in the same kind of files used for 4x6 index cards. This (or other special methods of filing, such as in "visible indexes") is quite adequate for libraries, records centers, and other places that have fairly large collections of fiche.

Most professionals, however, have their own mini-libraries on a bookcase or two in their offices. These shelves are set up for "normal" books and journals. Microfiche are then relegated to a desk drawer, out of the normal stream of browsing and information flow. Accessing the fiche requires an additional step that is easy to forget, or just not to bother with.

More Easily Damaged

Microfiche out of their protective jackets are considerably more delicate than paper copies. Fingerprints, dust, and scratches can all damage the information carried by a fiche. Particularly in non-text material (tables, for example), where missing words cannot be determined from context, important information may be lost completely. In their jackets fiche are pretty tough -- they are not any more susceptible than paper to heat, cold, humidity, and other environmental hazards typically encountered in an office. And for long-term storage, fiche generally are considerably more stable than common office paper -- provided again that they are stored in archival-quality envelopes.

Halftones, Color, and Photographs

The common or garden-variety microfiche does not do a good job of reproducing photographs, for two reasons: To give the best rendition of printed type (and incidentally of line art), microfiche emulsions are deliberately very high contrast. This results in halftones (the typical printed photograph broken up into thousands of tiny dots) being washed out into blocks of black and white; greys are eliminated. Also, and even more important, the text in microfiche is usually best readable, with minimum eyestrain, in so-called "negative-reading" fiche -- that is, white print on a dark background. But photographs reproduced in this way are very difficult for the non-expert to interpret.

Finally, color reproduction is not available in standard fiche. Although high quality color microfiche do exist, they are considerably more expensive, and require specialized equipment for processing and duplicating.

IMPROVING MICROFICHE ACCEPTANCE AND USE

A review of the relative advantages and disadvantages of microfiche versus paper copy documents for technical reports shows one thing that should be carefully considered. Practically all of the advantages of fiche accrue to the producers/distributors of information, while most of the disadvantages are felt by the users. On the face of it, that would not indicate an easy-to-market product, except for certain special applications.

It is worthwhile to look at the drawbacks and disincentives once more, this time with an eye toward how they might be minimized, although the characteristics of the medium are such that most cannot be altogether overcome. Some attention will then be given to organizational, as opposed to technical, considerations that might improve usage rates -- whether or not by improving the actual level of acceptance (that is, appreciation) on the part of the end user.

And finally, the literature we reviewed contains some suggestions for making use of microfiche's unique characteristics as an information medium in a positive way, rather that trying to work around those characteristics in an attempt to imitate paper copy, which is a different medium altogether.

Microfiche Format Improvements

One of the most important sources of difficulty in trying to use microfiche as a medium for technical reports and other textual (as opposed to records) material, is that the source of the material recorded is usually an existing paper document. This

results in duplicating on the fiche those features of the paper document which are quite appropriate for a bound paper book, but not for the different medium of a microfiche. What are the differences in the media themselves with which we ought to be concerned?

Borrowing some terminology from the computer field, we can say that both media are essentially random access -- that is, one can turn to any page of a book, or to any frame of a microfiche, without having first to go through all the preceding pages or frames. (In this characteristic, fiche differs significantly from roll microfilm, for example.) However, they differ both in their indexing methods and in the size of a "physical record." Specifically, a paper book is indexed (paginated) one-dimensionally, from page 1 through page N. An individual fiche is indexed two-dimensionally, by row and column, according to a standard grid appropriate to the fiche's reduction ratio and layout. A paperbound technical report typically consists of a single volume, while the fiche version may (if the report is longer than 98 pages) consist of more than one fiche. In that case, fiche frames have a three-dimensional index -- fiche number, row number, and column.

To make a microfiche version of a document as easy as possible to use, these differences should be taken into account at the time the source document is created, or at the time the master microfiche is produced. This requires that the table of contents and the index of (at least) the fiche version provide their information by fiche and frame number as well as page number.

Alternatively, the American Chemical Society gives the page numbers of the beginning and ending pages of each row of a microfiche in eye-readable type in the left and right margins of the row. Their fiche publications consist of series of articles and papers; the upper right corner of the first (title) page of each article is clipped off, which produces an eye-visible triangle of light on that page's image on the fiche.*

One should always be careful never to break a sentence at the end of a microfiche, because the reader will completely lose the train of thought in the process of changing fiche. If possible, the integrity of paragraphs should also be maintained. This requires attention at the time of preparation of the original paper copy, and should be worked into specifications for technical report preparation. The final paper copy version should itself be produced in units of 96 pages to comply with the convention reserving the first two frames for titling and related information.

Document and fiche production should keep the limitations of the medium in mind in other ways too. Charts, graphs, tables, and other illustrations should never be "rotated" on the page, but should be kept in vertical format. A few microfiche readers have the capability of rotating a viewed image, but most do not, and the user will not take kindly to having to sit sideways to

Tables and other "out of text" materials should be repeated throughout the document as needed, rather than forcing the reader read the material.

*Marjorie A. Laflin; "New Developments in Micrographics: Professional Society Publishing Programs"; _Journal of Micrographics_, September/October 1978, pp. 59ff.

to refer back to them (extremely impractical if the table is on another fiche, and a nuisance even if on the same fiche). A rule of thumb, such as "The reader should never have to refer more than two frames away," would be appropriate. The same rule should be applied to footnotes and references, which should appear on the same page as their referents.

Where photographs contribute significantly to understanding the material being presented, and where the final fiche will be distributed in negative-reading form, one might want to consider having negative prints made of the photographs, and using those as the "source documents" for filming. They could simply be layed over the existing positive photos in the document at the time it is filmed. The results in the final microfiche will be positive-reading, and much easier to interpret than they would otherwise be, even though the halftone quality will still be lacking.

Outside the microfiche itself, consideration should be given to using a holder or carrier more compatible with office shelving arrangements. An 8.5x11 folder with a standard fiche envelope "tipped in" would allow shelf interfiling along with printed books, and would also allow title information and a copy of the document's table of contents and/or an abstract to be printed on the cover, as is done by The Journal of Vocational Education Research*. This of course loses some of the advantage in reducing reproduction expenses, and in savings on postage, but can make

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*Curtis R. Finch, George A. Copa and Joel Magisos; "Impact of a Microfiche Research Journal; Journal of Micrographics, March/April 1979, pp. 213ff.

it much more likely that the document will actually be used. It should be possible to remove the fiche envelope and use it seperately, for the user that prefers the card-file approach. Information inside the folder could be printed directly on the folder if a long run were being produced, or could be a paper insert (blown back from the fiche itself if appropriate) in a standard cover for short-run distribution. This is obviously the opening wedge of a "multi-media" product, which can take advantage of the best features of fiche and paper copy -- perhaps by using the paper folder as a vehicle for photographs (maybe in color), and possibly tables, graphs, etc. that can then be referred to while the fiche is held in the viewer to read text.

System (Organizational) Considerations

If the goal is to increase microfiche use so as to cut the costs born by the producer/distributor of information, then it may be worthwhile to consider what programmatic changes -- rather than changes to the microfiche itself -- might help toward that end.

We have discussed the fact that microfiche tends to be a fairly popular medium with libraries and librarians (who are a "user" to the fiche distributor), even though they might be less so to the ultimate user. Some consideration should perhaps be given to increasing availability of program material at the user's locale, or even on-site, by targeting an SDI or other broad-based dissemination program at libraries. Microfiche collections of criminal justice material could be built up at governmental reference, local public, university, and regional libraries, and persons requesting information could then be directed to the

appropriate local source. An adjunct to the present NCJRS database
could keep track of which libraries receive which material.
From the viewpoint of the final user, there has been a tradeoff
between the convenience of having a document available in paper
copy, and the convenience of having it immediately available
locally. As NTIS' experience has shown, many copies of a microfiche
document can be produced and mass distributed through an automated
system at much less than the cost of filling many fewer orders
one at a time -- on paper or fiche.

A great deal of promotional emphasis should be placed on the
browsing possibilities of such collections, and on the time and
wasted effort that can be saved by previewing documents on fiche,
even if the result will be ordering selected documents in paper
copy. We propose that, in many cases, the user will in fact not
find it necessary to order the paper copy after all, especially
if a reader-printer is available.

Coupled with any such program, to maximize its effectiveness
from the end user's viewpoint, there should probably be three
related subprograms: Some technical (and possibly even financial,
although this is an entirely different area of consideration)
assistance should be provided recipient libraries, when they want
it, in setting up systems to allow their patrons to make most
effective use of microfiche material -- whether from the criminal
justice collection or otherwise. Also, the end user should
still be given the option of purchasing a paper copy of any
desired document, but this can and should be arranged so that the
providing agency does not bear the expense. Because fiche

duplication equipment is not likely to be readily available at the local site, individual microfiche copies of documents should also be available on order (free or purchase) from a central source; this would also allow participating libraries to replace copies that are lost. Libraries should be strongly encouraged to provide at least one reader-printer; availability of this equipment could be made a condition of receiving free fiche.

Price is decidedly a factor. An American Chemical Society study in support of its own micropublishing program determined that:

> More than 75 percent of the people [surveyed] said they would prefer articles on microfiche if it cost 2.5 times as much to get them in hard copy.

> Ninety-five percent would prefer microfiche if the cost for hardcopy were five times as much.*

The audience studied in the ACS survey differs considerably, in their background and level of research sophistication, from the non-academic criminal justice community, so these results can't be accepted as quantitatively transferable. Nevertheless, it is probably legitimate to draw qualitative inferrences. If material were available free in microfiche, for example, but with a charge for paper copy, then some shift to microfiche usage might be expected. Again, emphasis on the use of fiche for previewing batches of reports might be fruitful.

Unique Opportunities

Microfiche is a unique medium, with characteristics all its

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*Marjorie A. Laflin; "New Developments in Micrographics: Professional Society Publishing Programs"; Journal of Micrographics, September/October 1978, pp. 59ff.

own. We have discussed several of those characteristics as
problems to be overcome when transfering information from paper
copy originals to fiche. For some applications, though, it is
worthwhile to think of those differences as presenting special
opportunities that are not inherent in paper copy.

The Air Force, as part of a study on substituting microfiche
for paper texts in certain training programs, developed a unique
format for the 20x five-row fiche which were then the Department
of Defense standard. Instead of emulating a paper book by placing
one frame's worth of material right after another, they took
advantage of the fact that fiche is a two-dimensional medium.
Each row in the fiche was assigned a specific function, arranged so
as to aid the student in absorbing the material. Specifically,
row C of each fiche (the center row) was used for the main text.
Row B (directly above) contained "additional explanation" of
material presented in row C, while row D carried "nice to know"
material that was supplementary, but not required knowledge for the
course. Row E was an outline, with each frame summarizing very
briefly the material in frames directly "up fiche," and row A
contained review questions, which in a paperbound book are
normally clustered at the end of a chapter. Figure 1 diagrams
the arrangement. Students found the innovative arrangement easy
to use, and said that it did aid their study.*

*Robert R. Grausnick, Anita S. West, James P. Kottenstette;
Microform Use in a Technical Training Environment -- An
Experiment; Air Force Human Resources Laboratory, Air Force
Systems Command, Brooks AFB, Texas (May 1971). AD733686.

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│  Eye-readable title and sequence information.        │
│                                                       │
├──┬──┬──┬──┬──┬──┬──┬──┬──┬──┬──┬──┤
│  │  │  │  A. Workbook & Review Problems  │  │  │  │  │
│ 1│ 2│ 3│ 4│ 5│ 6│ 7│ 8│ 9│10│11│12│
├──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┤
│  │  │  │  B. Additional Explanation   │  │  │  │  │
├──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┤
│  │  │  │  C. Main Text                │  │  │  │  │
├──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┤
│  │  │  │  D. Nice-to-know Material    │  │  │  │  │
├──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┼──┤
│  │  │  │  E. Outline                  │  │  │  │  │
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Figure 1. Format of special microfiche developed for an experimental training program by the U.S. Air Force.

Microfiche, especially when produced by computer, also lends itself to the "microblock" approach advocated by Grills* as an aid to the reader's comprehension of material presented on a screen. Taking the long view, serious thought should be given to the implications of combining automated word processing with COM, to produce textual microfiche directly without the intervention of paper copy except possibly for proofreading purposes. This

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*Caroline M. Grills; "Microblock: A New Method of Presenting Text for Visual Communications"; Journal of Micrographics, November/December 1979, pp. 87ff.

report, for instance, was prepared on a word processor with magnetic diskette storage. There is no technological difficulty with transferring those diskettes to a COM device, and having the "original" of the report appear in microfiche. Such applications are probably not worth developing as long as one thinks in terms of replicating a paper product as closely as possible. But if thought is given instead to what might be done with microfiche as the "original," systems might be developed that are both lower in cost than present approaches, and more effective in accomplishing the goal of information transfer.