AD 742532

Annual Report
Covering the Period 15 April 1971 through 15 April 1972

SRI-ARC 10045

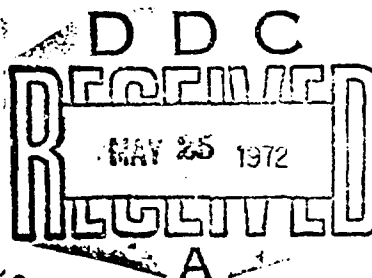# EXPERIMENTAL DEVELOPMENT OF A SMALL COMPUTER-AUGMENTED INFORMATION SYSTEM

By: D. C. ENGELBART, *Director*
    Augmentation Research Center

Prepared for:

INFORMATION SYSTEMS BRANCH
OFFICE OF NAVAL RESEARCH
DEPARTMENT OF THE NAVY
ARLINGTON, VIRGINIA 22217

Attention: MR. A. KENNETH SHOWALTER

CONTRACT N00014-70-C-0302

D D C
RECEIVED
MAY 25 1972
A

STANFORD RESEARCH INSTITUTE
Menlo Park, California 94025 · U.S.A.

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified

1 ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
Stanford Research Institute Menlo Park, California 94025	Unclassified
	2b. GROUP

3 REPORT TITLE

EXPERIMENTAL DEVELOPMENT OF A SMALL COMPUTER-AUGMENTED INFORMATION SYSTEM

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)
Annual Report Covering the Period 15 April 1971 through 15 April 1972

5 AUTHOR(S) (First name, middle initial, last name)

D. C. Engelbart, Director
Augmentation Research Center

6 REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
24 April 1972	22p.	13
8a. CONTRACT OR GRANT NO	9a. ORIGINATOR'S REPORT NUMBER(S)	
N00014-70-C-0302		
b. PROJECT NO	Annual Report for SRI Project 8622	
c.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.	SRI-ARC 10045	

10 DISTRIBUTION STATEMENT

11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY
	Information Systems Branch Office of Naval Research Department of the Navy

13 ABSTRACT

During the second year of current work, ARC put its major effort into three categories of its investigation: development of augmented management and operational techniques for running a research intelligence system, further building of the data base, and improvement of the computer aids supporting the processes. A "People Services Operation" was established with procedures to aid throughput of incoming information and entry into the data base. Procedures for citation formation and citation file-building were refined, and the data base was expanded using these. Progress was made in development of a coordinated automatic process for entry and storage of catalog data and for catalog and index production.

DD FORM 1 NOV 65 **1473** (PAGE 1)

S/N 0101-807-6801

14		LINK A		LINK B		LINK C	
KEY WORDS		ROLE	WT	ROLE	WT	ROLE	WT
Research Intelligence System							
online system							
ARPA Network							
Intellect Augmentation							
Man-Machine Communication							
NLS							
TNLS							
DEX							
Deferred Execution of Input							
Catalog File-building							
Data Elements							

DD FORM 1 NOV 65 .1473 (BACK)

(PAGE 2)

EXPERIMENTAL DEVELOPMENT OF A SMALL COMPUTER-AUGMENTED INFORMATION SYSTEM

By: D. C. ENGELBART, *Director*
        Augmentation Research Center

Copy No. ....

INTRODUCTION   1

The ONR Research Contract No. N00014-70-C-0302 is a
development project on a small computer-augmented information
system oriented toward serving the "intelligence" needs of a
research (and/or development) community. We call the system
"RINS" (Research INtelligence System).   1a

Over the years, the Augmentation Research Center (ARC) has
developed an extensive set of computer tools and techniques.
Among these is an emerging set designed to aid the management
of our computer-held files and memos. Developments toward
this end have been made (mainly by ARPA-supported activity) in
the following areas: 1b

(1) Special catalog files, with structure and syntax
conventions for encoding arbitrary types of data elements
into individual "entries," each of which describes some
discrete item that is to be kept track of, searched for.   1b1

(2) Special computer processes for: 1b2

(a) Analyzing a catalog entry for the nature and
content of its data elements   1b2a

(b) Collecting a desired set of entries from the
catalog files by scanning a specified set of catalog
files and selecting entries according to specified
content analysis (which may be directly programmed and
compiled by the user)   1b2b

(c) Sorting the entries selected by content analysis
into new order depending upon (multilevel) sort keys
extracted and generated during the analysis of each
entry   1b2c

(d) Formatting information extracted (or conditionally
generated) from an entry by an analysis process into an
arbitrary display/printout format   1b2d

(3) Methods for producing hard-copy listings and indices
for any given sub-collection of items, using special
versions of all of the above processes.   1b3

Within the ARC, RINS is a relatively small project in a
long-term activity, all of whose components are continuously
developing. RINS is intended to become an operating
intelligence system that will supply an active community of
system developers with what they need to know about their

1

outside world. Initially (during the current ONR-supported
phases), RINS is being developed to serve the 35 people in
ARC.   1c

    It is ARC's plan to expand steadily the number of R&D
groups that interact and collaborate to mutual advantage
via computer-network and on-line services. In the planned
future, RINS would serve the aggregate needs of these
groups for collecting and digesting intelligence data about
products, techniques, concepts, and activities pertaining
to computer-systems development and operation.   1c1

    The fact that ONR is supporting development work on a
research intelligence system carries no implication as to
who will support the subsequent operation of such a system.
ARC's assumption is that the operating costs will be borne
by the party or parties making use of the system.   1c2

SUMMARY OF RINS ACTIVITY   2

    During this second year, ARC has put its major effort into
three of the four categories in its investigation effort: the
development of augmented management and operational techniques
for running a research intelligence system, the further
building of the data base, and the improvement of the computer
aids supporting the processes.   2a

    We have explicitly established a "People Services
Operation," providing organized supporting operations, with
developing procedures that aid in the throughput of
incoming information and its entry into the data base.   2a1

    We have continued the building of a reference data base.
Procedures have been developed for improved citation form
and citation file building, and many documents have been
recorded with these procedures.   2a2

    We have also directed effort toward the development of a
coordinated automatic process for entry and storage of
catalog data and for catalog and index production.   2a3

  A fourth activity -- integration of the RINS developments
into the working life of ARC researchers and ARPA Network
Information Center (NIC) users -- has been delayed.   2b

    Use of the ARPANET has been slower to evolve than we
expected, and the efforts required of ARC in that activity
were much heavier than expected -- consequently, the ARC
staff has been too involved with operational tasks to

participate in the research use of an intelligence data
base.   2b1

In regard to ARC's giving NIC users access to the RINS
developments, it should be noted that because of the recent
extension plans for the ARPANET membership, it may well
prove unsuitable to offer RINS data and tools to the whole
community being served by the NIC. ARC plans instead to
involve only selected Network users.   2b2

PEOPLE SERVICES OPERATIONS (PSO)   3

During the past year ARC has developed several service
functions (mainly under our ARPA-supported contract) that are
now becoming operational for ARC users and in some cases
providing service to external users.   3a

These functions (from activities such as RINS, NIC, Baseline
Record, and Journal) and the forthcoming use of new Deferred
EXecution (DEX) techniques have created several new types of
needs for people services support.   3b

As a result, we concentrated some of our effort on
reorganizing these activities to allow more effective and
efficient handling of routine and other tasks and to allow for
easier expansion of the group size to meet needs for an
increasing amount of throughput. The three aims were: 3c

   Getting the throughput up to meet demands.   3c1

   Getting in position to be rapidly expandable (in
   throughput quantity) to meet fluctuating service demands.   3c2

   Working at minimizing costs while maximizing
   responsiveness to customers' needs/values.   3c3

We launched a new approach to ARC's "people services
operations". (see -- 7834,1a)
   The main thrusts were: 3d

   Organization   3d1
   Physical Location and Configuration   3d2
   Procedure Establishment and Documentation   3d3
   Transcription Activities   3d4
   Terminals   3d5
   Personnel   3d6
   Training   3d7

Organization   3e

   A group with skills in handling paperwork and messages, in
   using TNLS and DEX, was explicitly identified as PSO, and a
   group of advisors with skills in administration,
   documentation, and training was assigned to assist in
   getting PSO into formal operation.   3e1

Physical Location and Configuration   3f

   Office and workroom areas were expanded and relocated, to
   give the growing support operations more efficient location
   and arrangement. New tables, shelves, cabinets, and files
   were acquired and their configurations worked out.   3f1

Procedure Establishment and Documentation   3g

   Manuals and procedures were written for use of TNLS (see
   -- 7470,) and DEX (see -- 9934,).   3g1

   Procedures were established and written for handling of
   transcription and other service requests.   3g2

   Procedures for all related ARC activities, clerical and
   secretarial, were established and documented.   3g3

Transcription Activities   3h

   Types of work to be handled: 3h1
      Handwritten drafts   3h1a
      Tape recordings   3h1b
      Dictation notes   3h1c
      Off-line documents   3h1d
      On-line documents to be edited   3h1e

   Techniques for transcribing material into on-line files
   were developed: 3h2

      Deferred Execution (DEX)   3h2a

         This process (developed on an ARPA-supported
         contract) makes use of terminal and magnetic tape
         recording equipment for initial input of data with
         actual entry into computer files deferred until
         periods of relatively low system use (thereby
         resulting in less expensive use of the system for the
         processing of this work).   3h2a1

DEX is preferred for most work. Pieces of work can
be spooled by priority.   3h2a2

Where and how long to store entered tapes for
backup, the conventions for hierarchical statement
entry treatment, and when the transcriber should try
to put hierarchical structure into documents are
still under development.   3h2a3

TNLS   3h2b

In some cases TNLS is used, particularly for
high-priority items during off-peak load hours.   3h2b1

DNLS   3h2c

Display NLS is used for otherwise difficult final
formatting and other appropriate tasks.   3h2c1

Receiving process   3h3

We set up a central receiving station.   3h3a

There is one person with an alternate who can handle
users' questions regarding job status, time and cost
estimates, etc.   3h3b

Priority determination process   3h4

A requester specifies his preference for priority: 3h4a

    Immediate service (1-4 hours)   3h4a1
    Normal service (4-12 hours)   3h4a2
    Deferred service (a week or two)   3h4a3

Temporary storage of unassigned work   3h5

A log system using appropriate work request forms has
been set up.   3h5a

We have a central storage place, organized for control
of work by priority.   3h5b

Assignment process for transcription work   3h6

A work scheduler assigns incoming work to group
members, balancing priority request with members'
capabilities and workload.   3h6a

Later, priorities may be established by a bidding
scheme.   3h6b

It is contemplated to enlarge this effort to allow
assignment to an outside pool of workers trained in DEX,
both SRI people and contract manpower.   3h6c

Output processes   3h7

We have developed conventions for naming of temporary
input files (special and separate for the catalog
process) with provision for special instructions from
the author.   3h7a

We have developed procedures for delivery of completed
work to the requester.   3h7b

Terminals   3i

We have made a thorough study of available teletype
terminals and magnetic tape devices, and after experimenal
use of several, have leased nine TI terminals and six
Termicettes, for use with DEX.   3i1

Personnel   3j

We have added several new staff members with contributions
to make to RINS. Two writers who can also teach were active
in PSO development. Three new staff were added to the
document preparation, transcription and distribution
efforts.   3j1

Training   3k

Classes in TNLS and DEX were held for ARC and network
people. Manuals were prepared.   3k1

BUILDING A REFERENCE DATA BASE   4

Selection of additions to the data base   4a

The ARC Master Catalog is a group of files containing the
catalog-entry statements for all informational items that
we hold for purposes of control, retrieval, and access.   4a1

Active experimentation in the collection of information
items and interaction with other existing data bases is
still in the future plans of ARC. However, during the past
year ARC took the opportunity to input the contents of some

data bases gathered elsewhere, and to output the contents
in new formats.   4a2

Data bases thus added include: 4a3

   A bibliography prepared for use of the attendees at the
   January 1971 AFIPS Workshop on the User Interface. The
   bibliography and indexes processed by ARC programs were
   published in the volume of Proceedings of the Workshop.
   (see -- 9474.)   4a3a

   An extensive bibliography on networking prepared by
   Peggy Karp of MITRE. Each reference cited was obtained
   in full-size copy and was coded and entered in the
   Master Catalog. (see -- 6025.)   4a3b

Special "subcollection catalogs", such as for the NAS
Information Sciences Panel, for the AFIPS Workshop, for the
ARC Journal or for the Network Information Center, are
created by (automatically) collecting a copy of every entry
statement in the Master Catalog having a descriptor code of
NAS, AFI, JOU or NIC respectively in its "*z2 field."   4a4

Design of data elements   4b

Usefulness of a data base of citations to information items
depends on the elements of data selected to describe the
items. The selection criteria and their implementation
become even more important when the items of information
include forms of information other than published books,
articles and reports, e.g., films, slides, letters, photos,
ads, meeting agenda, maps.   4b1

A continuing effort has been the refinement of a set of
data elements. The requirements are: 4b2

   Data elements should be adequate to describe all species
   of information items which are anticipated to be added
   to the RINS collection.   4b2a

   Data elements should be adaptable to economical use by
   programs developed for gathering and formatting the
   citations into catalogs and listings and for on-line
   retrieval.   4b2b

The present list of data elements and guidelines defining
their application is appended. (see -- 9868.)   4b3

7

Entry of items into the data base   4c

As noted, items of information relevant to ARC appear in
many forms. Reference to these items is simplified by
assigning a master catalog number, a serial number, to
each. To record the item to which the catalog number
refers, a description of the item using the data elements
noted above is coded by ARC and entered as a "statement" in
an NLS file.   4c1

Procedures necessary to ensure a consistent, clean, data
base are vital and difficult to hammer out. Much effort has
gone into this area over the past year.   4c2

An example of a catalog-entry statement with typical coded
data elements: 4c3

    (A6088) *a1 A. W. Whiteney *a2 W. E. Blasdell #2 org *b2
    General Electric Company #3 Electronics Laboratory #5
    Syracuse, New York *c1 Study of Computer Graphics and
    Signal Classification Applications #1 Final Technical
    Report #6 147p. *d1 September 1970 *d3 17 March 1969 to
    17 April 1970 *f1 r *f2 o *r2 RADC-TR-70-148 *s1 Rome
    Air Development Center #3 Air Force Systems Command #5
    Griffiss Air Force Base, New York #6 F30602-69-C-0227 #7
    5581 #9 Task 558104 #w2 2-2-71 *y1 Signal classificaton
    problems, Technical or signal preprocessing and
    classificaton, Functional description of a system,
    Software requirements and system design. *z3 new *   4c3a

Design of catalog formats   4d

A set of special programs has been written at ARC to
collect, sort, analyze, and reformat the entry statements
to produce catalogs and indices such as those in the
Current Catalog of the NIC Collection, (see -- 5145,) and
those used in NAS Panel and AFIPS Workshop meetings.   4d1

These programs, described below, are the result of much
thinking and experimentation to produce catalogs and
indexes of maximum usefulness, given the present printing
constraints.   4d2

Examples of the listings and indexes now produced are: 4d3

Catalog listing by number: 4d4

    Study of Computer Graphics and Signal Classification Applications   6088
    (Final Technical Report).

        A. W. Whiteney and W. E. Blasdell (General Electric Company,
        Electronics Laboratory, Syracuse, New York).

        September 1970. (147 p.)

        Signal classification problems, Technical or signal
        preprocessing and classification, Functional description of a
        system, software requirements and system design.

Author index: 4d5

Titleword index: 4d6

Number index: 4d7

COMPUTER-PRODUCED CATALOGS AND INDEXES   5

Introduction   5a

We have directed effort toward the development of a Catalog
Support System (CSS), needed initially to support clerical
processes for maintaining current on-line catalogs of the
Master Collection and several subcollections and for
producing various indices (hardcopy and on-line) to these
collections. Subsequently, support will be needed for
augmenting various on-line user-level information-handling
processes.   5a1

The CSS is concerned with the following principal
processes: 5a2

Input, editing, proofing, and verification of catalog
entries.   5a2a

Updating of the Master Catalog and subcollection
catalogs.   5a2b

Production of incremental and cumulative, hardcopy and
on-line indices to various collections.   5a2c

Overall Design Goals and Elements   5b

The basic goals relevant to providing aids to these
processes are: 5b1

Maintaining integrity of the master catalog files with
maximum protection from both human and mechanical
errors.   5b1a

Making possible a smooth flow of input from ARC clerks
with good facilities for proofing and correcting all
clerical input.   5b1b

Removing as much load as possible from the computer
system during prime use times through the use of
Deferred Execution techniques.   5b1c

The initially implemented element of the Catalog Support
System is the Catalog Production Processor (CPP).   5b2

The CPP is the basic output port of the CSS and is
designed to allow the production of on- and off-line,
incremental and cumulative, indices and listings of
various kinds, using the Master Catalog as the ultimate
data base.   5b2a

One objective in the design of the CPP, in fact of most
of the CSS, is not to add new basic capabilities to our
augmentation system, but rather to bring together
existing ones in such a way as to reduce our commitment
of resources to clerical tasks.   5b2b

The basic design goals which the CPP must meet are the
following: 5b2c

It should permit flexible specification of the types
and frequencies of production of the various catalog
indices and listings needed by DSS, NIC, DPCS, etc.   5b2c1

It should function as automatically as possible and
with a minimum consumption of ARC personnel and
equipment resources.   5b2c2

The CPP implementation has now progressed to the stage
of final testing and is expected to be used

operationally in the production of the next ARC Journal
and NIC catalogs in the next few weeks.   5b2d

Use with the entire ARC Master Collection as an aid
to completely integrating the various subcollection
citations will follow. The CPP will then be available
for ARC use on any desired subcollection
catalog-production work, either Journal, NIC, or
special subsets.   5b2d1

SUMMARY OF INVESTIGATION PLANNED DURING THE COMING YEAR   6

ARC plans the following activities for the next (third) year
of ONR-sponsored development of our Research Intelligence
System.   6a

We plan to continue on our present course, with the following
developmental tasks: 6b

(1) Add to our developing research-intelligence data base
over a limited subject domain.   6b1

(2) Continue integrating the data base and tools of RINS
into the working life of ARC researchers and selected
Network users.   6b2

(3) Add to or modify the computer aids that will be used
to support RINS processes.   6b3

(4) Continue developing augmented management and
operations techniques for running the research-intelligence
process.   6b4

We assume that a steady addition of other resources will
become available for the development of the RINS data base and
supporting techniques -- a cooperative activity that ARC at
present considers calling its System Developer's Intelligence
Service (SDIS).   6c

The SDIS data base will be directly oriented to the needs
of people doing research in or development of
computer-based information systems.   6c1

ONR's funding will represent the initialization resource
for what is expected to become a set of resources from a
number of sources.   6c2

11

REFERENCES

1. ARC 7834, J. C. Norton, "Outline for Establishing People
   Service Support Team (PSST)," Augmentation Research
   Center, Stanford Research Institute, Menlo Park,
   California, 2 November 1971.

2. ARC 7470, "NIC TNLS User Guide," Functional Document,
   Augmentation Research Center, Stanford Research Institute,
   Menlo Park, California, 23 September 1971.

3. ARC 9934, "Deferred Execution User Guide," Augmentation
   Research Center, Stanford Research Institute, Menlo Park.
   California, April 1972.

4. ARC 9474, "Interactive Bibliographic Search: the User
   Interface," Proceedings of the Workshop, AFIPS Press,
   1971.

5. ARC 6025, P. M. Karp, "Bibliography of Literature on
   Computer Networking," (at MITRE Corporation), December
   1970.

7. ARC 5145, "Current Catalog of the NIC Collection,"
   Functional Document, Augmentation Research Center,
   Stanford Research Institute, Menlo Park, California, April
   1972.

BIBLIOGRAPHY

1. ARC 3906, D. C. Engelbart, "Augmenting Human Intellect: A
   Conceptual Framework," Summary Report, Contract AF
   49(638)-1024, SRI Project 3578, Stanford Research
   Institute, Menlo Park, California, AD 289 565, October
   1962.

2. ARC 5139, D. C. Engelbart and Staff of Augmentation
   Research Center, "Computer-Augmented Management-System
   Research and Development of Augmentation Facility,"
   RADC-TR-82, Final Report of Contract F30602-68-C-0286, SRI
   Project 7101, Stanford Research Institute, Menlo Park,
   California, April 1970.

3. ARC 5140, D. C. Engelbart and Staff of Augmentation
   Research Center, "Advanced Intellect-Augmentation
   Techniques," Final Report NASA Contract NAS1-7897, SRI
   Project 7079, Stanford Research Institute, Menlo Park,
   California, July 1970.

7

7a

7b

7c

7d

7e

7f

8

8a

8b

8c

14

CODE-MANUAL (Codes used in the Master Catalog)

  GENERAL

    Abbreviations

      Abbreviation is avoided except in copying any actually present in proper names and titles.

      Exceptions:

        Codes of ARPA network sites may be entered in *a#2 and *b5#2, but only in citations for
          informal documents.

        Code "org" may be entered in *a#2 when information is identical to *b2 or *b4. See *a1 for
          further information.

    Added information

      Information known or very probable and of importance to the reference, such as an unstated
        author, organization, date of publication, should be given in brackets [ ].

      In general, only information actually in the document is to be recorded. Recording presumed
        information is risky, and is poor practice also because copies of the document don't carry
        the information thus supplied.

    Proper names

      All proper names will be entered in direct order, omitting only "the", beginning corporate
        names, and any title in personal names.

    Document reference numbers

      These numbers will be typed without parentheses; and if there are more than one, without commas
        between them, just a space. i.e., *n1 5891 5892 5893

  *a1 FIRST AUTHOR --
    Author's name, as given, in direct order, omitting Dr., Ph.D., etc. (No limit to number of
    authors.)

    #1 JOB TITLE --
      If given in the document.

    #2 CORPORATE AFFILIATION --
      If the author's organization is the publisher of the document, enter the letters "org" in #2,
      as the same information can be retrieved from *b2 (see below for multiple authors). For ARPA
      Network nodes, this may be entered in the code: "ARC", "LINC", etc. If author's organization
      is not the publisher of the document, as in a periodical article or meeting proceedings, enter
      the organization information as given. When two or more consecutive authors of an article
      have the same org, enter the org after the last. When *b2 is used and two or more consecutive
      authors have the same org, type "org" in #2 after the last author of these. For other notes
      on organization names, see notes on *b2.

    #3 SUBORGANIZATION --
      If more than one subordinate level is given, select one.

    #4 STREET ADDRESS --
      Use this element for building name or number, suite number, or other specific of address when
      practicable, the intent being to allow construction of a mailing address from #1-#5. When an
      organization, e.g., Chemical Abstracts Service, is situated at another org, but is not a
      sub-org, use #4 for the site, e.g., Ohio State University. cf. *b2#2.

    #5 CITY, STATE, ZIP --
      Spell out, e.g.: Washington, D.C. 20202; New York, New York 10036; Menlo Park, California
      94025.

    #7 IDENT --
      Not used for manual input; supplied by journal.

  *b2 FIRST ORGANIZATION --
    Use for agency preparing or issuing a report, or other case of non-commercial publisher. For
    agencies, such as National Library of Medicine, which usually appear independently, enter these
    as *b2, not as subordinate to U.S. HEW. Ambiguous names, such as Office of Education, should be
    entered in #3, with U.S. HEW as *b2.

    #2 INTERMEDIATE ORGANIZATION --
      Use when essential to completeness, as in some government organizations. Always use #3 for
      significant suborganization, inserting #2 when essential.

    #3 SUBORGANIZATION --
      Use for significant suborganization, skipping #2 unless an intermediate is important for
      clarity. Avoid using when an organization is a smaller unit, e.g., an Institute, but only
      based physically at the larger, such as a university. Place the Institute in *b2, and the
      university in *b2#4.

  *b3 SECOND ORGANIZATION --
    Use for a second agency (not a government sponsor) in case of joint effort resulting in a
    document bearing both names.

  *b4 PUBLISHER --
    Use for commercial publishers, when documenting books, or noting periodicals as entities.

1

*b5 FIRST ADDRESSEE OF LETTER OR MEMO --
   To be used, even when addressee list is so lengthy as to cause use of *b9. Can be a group or
   class, even when non-explicit, such as /ARPA Network Working Group/. Use ident. in *b1*. Use
   form of address in #1, #2, etc. given in the document, do not try to standardize (NOTE: 1. no
   control over outside entries. 2. Retrieval may be by entry as given, as often as not).

*b6 through *b8 additional addressees

*b9 ARC DOCUMENT NUMBER OF ADDRESSEE LIST --
   When an addressee list is attached, or when list of addressees exceeds 4, a separate document
   should be indicated or created, and referenced here.

*b10 DISTRIBUTION LIST IN IDENT FORM --
   For group ident, when addressed to Network Working Group or other recognized group whose
   membership is given in its ident file.

*c1 TITLE OF ITEM --
   Title of report, article, book or journal considered as a whole.
   When a memo contains the line "Subject: ..." or "Re: ..." this text, including "Subject," or
   "Re:", is entered as the title.
   Title is essential; letters with no explicit title should have descriptive title in brackets.
   Example: /transmittal letter/.
   When the item referenced is a review or abstract of another work of the same title, add /review/
   or /abstract/.
   Limitation on use of a document should be indicated by /L/ following the title, with an
   elaboration in *y1.

   #1 SUBTITLE --
      Include any subordinate phrase in the title rather than as subtitle, as a rule.
      Use subtitle only for lengthy title strings or for alternate titles, and for series notes.
      Vol. 1 etc. of books goes into subtitle when subtitle is title of vol. only.

   #6 PAGES --
      Use for page data when *c2 is not present or when *c1 is independently paginated. Examples:
      263p. /for book with 263 pages/.

*c2 TITLE OF MORE INCLUSIVE DOCUMENT --
   Use for name of journal when *c1 is an article from it.
   Use for name of book when *c1 is a chapter from it.
   Use for Proceedings when *c1 is a paper published in it.
   Use for encyclopedic work or series when *c1 is a volume from it.
   Use for functional document name when *c1 is a part or section of contents. Example: Section 3,
   Network User Guide.

   #1 SUBTITLE --
      Use only when inclusion in *c2 is awkward.

      Examples: *c2 MICRODOC #1 Journal of the Microfilm Association of Great Britain *or* *c2
         Bulletin de Documentation Bibliographique #1 Pt. 2 of Bulletin des Bibliothèques de
         France.

   #2 VOLUME --
      Examples: Vol. 35, for volume of periodical. Vol. 35 for volume of encyclopedia or a series.
      Vol. 1, etc. of books goes into subtitle when subtitle is title of vol. only.

   #3 NUMBER --
      Use for issue number of periodical.
      Examples: No. 10
      No. 106 when no volume number exists.

   #6 PAGES --
      Use for articles or other parts of documents. Include p.
      Example: p.256-275

*c4 ALSO PUBLISHED IN: --
   When such information is given. Use *d5 for date.

*c5 ALSO PUBLISHED AS: --
   When such information is given. Use *d5 for date.

*c6 ALSO TO BE PRESENTED AT: --
   For reports or articles which contain such a statement. Code as *f1 p after *f1 r or *f1 s. Use
   *d5 for date.

*d1 DAY AND/OR MONTH AND/OR YEAR ISSUED --
   Use for all types of items. Use for date of publication of published items, for date of letter
   or memo. Use *d2 if an earlier date of preparation is given. Use *d4 for a meeting date or dates
   whether the same as or different from *d1. Use form: 12 November 1969.

*d2 DATE WRITTEN OR SUBMITTED --
   Use in addition to *d1 when an earlier date of preparation or submission is known. Use form: 12
   November 1970.

*d3 PERIOD COVERED --
   Use for progress reports, etc., when indicated by cover, title or abstract. Use form: 1 July
   1969 - 30 June 1970.

*d4 DATE OF CONFERENCE OR MEETING --
   Use in addition to *d1 whether or not *d1 gives date of published proceedings. Use for: 12-15
   November 1970
   30 November - 2 December 1970

16

*d5 DATE OF *c1, *c5 or *c6

*d6 DATE OF FILE REVISION --
    Example: 1/20/72

*d7 TIME OF FILE REVISION --
    Example: 1920:32

*f1 FORM OF ITEM --

NOTE: MULTIPLE CODES MAY BE USED, e.g., r p - numbered report to be given at a meeting; a tr -
    translation of an article. FIRST CODE DETERMINES FORMAT. This element has two uses: formatting
    for the printed catalog, and search keys for online retrieval.

  a - ARTICLE --
      article in journal

  ad - ADVERTISEMENT --
      advertisement, from newspaper, periodical (compare br - brochure; pg - meeting progr-m).

  b - BOOK --
      for commercially published work, usually hardbound.

  b1 - BIBLIOGRAPHY --
      may be a separate, or a part of a larger work primarily coded cn

  br - BROCHURE --
      for separate promotional material, even 1 page.

  ch - CHAPTER --
      chapter or portion of book not a proceedings volume.

  d - DRAFT --
      use when stated or known to be a draft, not a finished product

  ds - DISSERTATION

  f - FILM --
      Use for movie or sound. Not for microfiche

  g - PROCEEDINGS --
      Use when *c1 is a proceedings volume.
      When a paper *c1 from a proceedings is indicated, use p.

  gr - GRAPH OR CHART --

  i - ABSTRACT OR REVIEW --
      Use when the item catalogued is an abstract or review, as well as bracketing the wor
      following the title in *c1.

  j - ARC OR NIC JOURNAL ITEM

  k - PERIODICAL, NEWSPAPER --
      periodical, newsletter, journal, use when journal, etc. in its entirety is meant. Fo- an
      article use a, for a newsletter issue use n.

  l - LETTER --
      Use for a personal letter or where the term appears.
      For an unspecified letter to several addressees, usually use m.

  lt - TRANSMITTAL LETTER

  m - MEMO --
      Use when the term appears, and when a group of addressees are indicated.

  ma - MAP --

  n - NEWSLETTER ISSUE --
      A newsletter as an entity, not a specific issue, should be indicated i.

  p - PAPER --
      Use for an individually issued preprint or reprint of a presentation, as well as for a paper.

  pg - PROGRAM --
      Program of meeting, including first announcements. When ARC member is speaker, etc., indicate
      in abstract, and note in keywords; e.g., DCE speaker.

  pi - PICTURE, PHOTO --
      Use for references to photographs or pictures when separately catalogued in *c1.

  pr - PROPOSAL

  qu - QUESTIONNAIRE

  r - REPORT --
      Use for technical reports and short publications not known to be articles, papers, etc.

  re - PRESS RELEASE --
      Intended for announcements so labelled, and other announcements not meeting programs,
      advertisements, or brochures.

3

s - SLIDE

sp - SPECIFICATION, STANDARD

t - TALK -
    Use ' .. 'al presentation recorded on audio or video tape, and for a written version of an
    oral : ation not expected to be published.

th - THESIS

tr - TRANSLATION --
    May be accompanied by original or original may be separately cataloged, e.g., an original in
    Japanese may be attached to a translation, rather than separated.

u - FUNCTIONAL DOCUMENT --
    Use when major content of the document is subject to addition, deletion or substitution.
    Examples are directories or catalogs.

z - CONTENTS OF FUNCTIONAL DOC --
    Use as primary code for any document made a part of a functional document. In conjunction,
    use #c2 to contain the name of the functional document. Examples: #c2 Part, ARPA Network
    Resource Notebook. #c2 Section J, Network Information Center User Guide.

#f2 MEDIA

a - CARBON COPY --
    Use if copy in hand is a carbon copy.

c - COPY, NOT ORIGINAL --
    If photocopy received at ARC is obviously a copy made of an existing document such as a
    periodical article.

f FILM --
    Use for movie and/or sound film. Not for microfiche.

l - MICROFILM --
    Use for roll microform.

m - MICROFICHE --
    Use for items on sheet film.

o - ORIGINAL --
    Original as first issued. Use c if photocopy received at ARC is obviously a copy made of an
    existing document e.g., a periodical article. Use p if copy is a photocopy made at ARC. Use a
    if copy in hand is a carbon copy.

p - PHOTOCOPY BY ARC --
    Use for photocopy made at ARC. Compare pa.

pa - PARTIAL PHOTOCOPY
    Use for photocopy of cover, title page, etc. sometimes made to capture part of a document when
    the whole is not obtainable or retainable.

r - MACHINE READABLE --
    Use to indicate existence of item in machine readable form. May be used in addition to o,
    etc.

s - SLIDE --
    Use to indicate a chart, photograph etc, is in form of slide.

t - PAPER TAPE --
    Use to indicate existence on paper tape.

x - REFERENCE --
    Used to indicate ARC has recorded the reference but does not have the full document.

#f3 SOURCE FILE NAME --
    Use for name of machine file if document is machine-readable.

#m1 SPONSOR OF MEETING --
    Name of sponsor of conference or meeting. Use for name of organization holding or sponsoring
    meeting.

#1 NAME OF MEETING --
    examples: Conference On Image Transmission. Annual meeting.

#5 CITY, STATE OF MEETING

#n1 ITEM THAT INCLUDES THIS ITEM --
    ARC number of item that includes this item. Use to record ARC number of book, Proceedings,
    transmittal letter, etc., where item in hand is a part, attachment, or enclosure. Example: 5606

#n2 ITEMS(S) THIS ITEM INCLUDES --
    ARC number(s) of item(s) this item includes. Use to record ARC numbers of subordinate parts or
    enclosures, etc. of item in hand. Example: 5603 5604

#n3 DOC(S) THIS ONE SUPERCEDES --
    ARC number of document this supercedes. Use to record document superceded, in conjunction with
    element #15 on citation for that document.

#n4 DOC(S) TO WHICH THIS REFERS --

18

Codes Used in the Master Catalog   JAN 1972   9868

ARC number(s) of ARC document(s) to which this refers. Use to record explicit reference by
document in hand to other ARC documents.

*n5 DOC THIS ABSTRACT DESCRIBES --
ARC number of document this abstract describes. Use to record number of complete document when a
condensation is in hand.

*n6 DOC(S) THIS ONE ACCOMPANIES --
ARC number(s) of documents this one accompanies. Use to record transmittal letter for doc, and
such.

*n7 DOC(S) TO WHICH THIS ONE IS RELATED --
Use for related documents not necessarily received or filed together.

*p1 PROJECT NAME ASSIGNED BY ISSUER --
Use when explicit; use for code names. Examples: Project MAC: MEDLARS

*p2 PROJECT NUMBER ASSIGNED BY ISSUER --
Use when organization assigns a project number, often in addition to a sponsoring agency's
number.

*r1 NUMBER(S) ASSIGNED BY ISSUER --
Serial or or code number(s) assigned by issuer. Use for serial or codes assigned to the
individual title by the agency issuing it. Examples: TM 42; Report 17; SBN 13-165969-3

*r2 NUMBER(S) ASSIGNED BY GOVT AGENCY --
Serial or code number(s) assigned by government. Use for numbers assigned to individual report
titles. Examples: AD 651 730; PB 117 190; LC 70-79429

*s1 SPONSORING AGENCY --
Use for funding agency, private or governmental.

  #3 SUBORGANIZATION --
  Use for most significant subdivision of relevant sponsor, skipping #2 unless an intermediate
  is important for clarity.

  #5 CITY, STATE, ZIP --
  Use in full.

  #6 CONTRACT OR GRANT NUMBER --
  Use as given, excluding "No." or "#".

  #7 PROJECT NUMBER --
  Use for sponsor's project number if any

  #8 ORDER NUMBER --
  Use for sponsor number so designated

  #9 OTHER NUMBER --
  Use for any other number(s) attached by the sponsor

*s2 SECOND SPONSORING AGENCY --
Use for second sponsor with same subelements as *s1

*w1 DATE RECEIVED AT ARC --
Use form: 12-27-70

*w2 DATE CATALOGED AT ARC --
Use form: 12-28-70

*w3 INITIALS OF CONTRIBUTOR --
Use for attribution to ARC source when desired. Use form: dce

*w4 SOURCE IF NOT *s1, *s2, or *w3 --
Use as credit to donor or as indication of future source. Examples: John F. Bennett, IB. Los
Gatos; CFSTI; ERIC CLIS

*w5 CLERK SUBMITTING FOR AUTHOR --
Ident of person creating online file for author

*w6 DATE LAST EDITED --
Use when changing a statement

*w7 IDENT OF PERSON CHANGING --
Used with *w6 when changing a statement

*y1 BRIEF ABSTRACT --
Use abstract in report, if brief and informative. Use modified abstract from copyrighte.
publication. Use for clarification when title is not informative. Use (with (L) in title) for
statement of any limitation imposed on the contents or citation. Example: LIMITATION: T-is
document not to be cited.

*y2 KEYWORDS FROM DOC OR AUTHOR --
Keys to subject content. For keywords assigned by report producer or NTIS, etc.

*y3 KEYWORDS ASSIGNED AT NIC --
Keys to subject content. For keywords assigned by NIC in absence of ones given in the document or
index.

*y4 KEYWORDS ASSIGNED AT NIC --
For use in special cases.

5

Codes Used in the Master Catalog   JAN 1972   9066

*y8 "UPDATED BY xxxx;" "UPDATES xxxx;" "OBSOLETES xxxx;" --
     Documents updated or obsoleted.

*y9 "OBSOLETED BY xxxx" --
     Notice of documents which obsoletes

*z1 NIC HOLDINGS --
     Use when transmission or general distribution is made. Examples: All; MAC, SDC, UCSH

*z2 SUBCOLLECTION --
     Use to indicate status of an item as a part of one or more subcollections. Examples: NIC, NAS,
     NIC SHF, NIC NWG

*z3 ARC CATALOG MANAGEMENT CODES --
     ARC master catalog management descriptions. Use for notation of data management, such as form of
     entry. examples: Old, Walt 1; new

*z4 ARC HOLDINGS --.

*z5 LOCATION(S) OF COPY --
     e.g., original DCE; partial photo ARC.

6