

If you give full consideration to these suggestions and incorporate them in your work, a successful effort is not necessarily assured. However, your system development

work will surely start off on a sounder basis and you can concentrate on making other mistakes.

## Library Information Retrieval Program

By GRETCHEN W. KORIAGIN

Missiles and Space Systems Engineering,  
Douglas Aircraft Company, Inc., Santa Monica, California  
Received May 17, 1962

The Missile and Space Systems Engineering Library was first established as a small department library in 1956. At first all technical reports were indexed according to originating company and author only and were filed by originating company. There were no title or subject files. In early 1958 the expansion of the library holdings made improved report indexing a necessity. Various indexing systems were studied, nearby technical and university libraries were visited, and librarians consulted. The manual Uniterm System of Coordinate Indexing<sup>1</sup> was adopted, and these files and procedures were established late in 1958:

1. The cataloger completed a work sheet indicating the titles, authors, originating agencies, date and subjects<sup>2</sup> of the document.
2. The subjects were uniterms, or unit concepts, selected from the document.
3. The subjects, with appropriate cross references, were compiled in a card file authority list for use by the catalogers.
4. Accession numbers (prefix "ML" for Missile Library) were assigned to each document.
5. The documents were filed by this accession number to conserve filing space (previous files of documents by originating agency required leaving spaces for expansion in each file), to eliminate misfiling, and to aid in retrieval of documents.
6. Card files were established by originating company, title, author, and accession number so that a report could be located by many types of reference.
7. The index card files were made by typing masters from the work sheets, printing on card stock, and cutting to 3" x 5" size. Many copies of each card were made to be placed in the various files. The filing points were indicated by red lines.
8. The subject index for the documents consisted of the 5" x 8" Uniterm Subject card for each subject used. The accession numbers were manually posted on the Uniterm Subject cards from the work sheets.

The Library performed manual literature searches upon request. The manual literature search of the documents was, and still is, conducted as follows:

1. One or more uniterms which best describe the subject are selected.

2. The Uniterm Subject cards for each subject are compared for common accession numbers. Those accession numbers which are common to all of the cards represent the technical reports on that subject in the Library.

3. The numerical accession number file is then consulted to further identify the selected documents.

During investigation of indexing systems used in southern California, we examined closely the Uniterm System that was being used at the Douglas Aircraft Company, Inc., Long Beach Location Library. They were pleased with the system but were also finding that it was becoming cumbersome to match cards for heavily posted subjects. At that time the number of reports indexed exceeded 10,000. While we felt that the advantage of the Uniterm System outweighed this disadvantage, we were aware that growth would soon cause a similar problem in the Missile and Space Systems Library. Our cataloging volume was almost 5,000 documents a year. Therefore, the Library was extremely interested when representatives of the Computing Engineering Section approached it in January 1959 with questions and ideas regarding mechanization of information retrieval systems. We had the problems of an indexing—retrieval system that would soon become difficult to operate manually. The Computing Engineering Section had high speed computers and printing equipment, and an interest in this information retrieval problem. We began a period of close cooperation and study of operating retrieval systems with the Computing Section. We found the work done by Mr. B. K. Dennis at General Electric especially interesting.

ABSTRACT <input type="checkbox"/>		CHARGE TO:	
ML NO:	13,750		
COMPANY:	Douglas Aircraft Co., Inc.	SM-39617	
		AD	
TITLE:	Mechanized Information Retrieval System for Douglas Aircraft Company, Inc., Status Report.	PB	
		DES	Information Retrieval Libraries Computer Searching IBM 7090 IBM 1401
AUTHOR:	G. W. Koriagin, L. R. Bunnow		PERM RET TO:
DATE (PERIOD)	January 1962		CHECKED 1-2-62
			LOGGED 1-5-62
			CAT BY LHM
			FLEXED
			PROOFREAD
			REFLEX
COPY # (NOTES)	copy 1		PRICE

<sup>1</sup>Presented before the Division of Chemical Literature, ACS National Meeting, Washington, D. C., March 23, 1962.

Fig. 1.—Worksheet

As the detailed analysis of the mechanized system progressed, it was decided to divide the system into sub-systems to be developed in the order which would be of the greatest benefit to the Library and its users.<sup>4</sup> These sub-systems are: (1) the bibliographic data sub-system which includes the putting of the bibliographic data into machinable form, printing the accession bulletin, posting lists, index cards and statistics lists, and (2) the dictionary sub-system which includes the printing and updating of the dictionary of terms used in indexing, and (3) the automatic selective dissemination of information and mechanized retrieval sub-systems. Sub-systems one and two are operational, and the third sub-system is in the analysis stage. A detailed description of the sub-systems is given.<sup>5</sup>

2. The computer load sheet (Fig. 3) is completed whenever the paper tapes are sent to Computing Engineering. The kind of output desired is indicated on it. The use of this form permits a great deal of flexibility. A set of cards for each accession number (company, title, author,

ml 11,400	
wright air development str	waac tr 55-130 ad 23 892
respiratory response to oxygen breathing with a full-head oxygen mask. 12p	respiration oxygen breathing masks
elizabeth comfort, kent w. millespie	
april 1953	
copy 1 (photocopy)	

  

ml 13,750	
douglas aircraft co., inc.	sm-39617
mechanized information retrieval system for douglas aircraft company, inc., status report.	information retrieval libraries
g. w. koriagin, l. r. burrows	computer searching
january 1962	tom 0090 tom 1461
copy 1	

Fig. 2.—Flexowriter "Hard Copy"

[illegible]

Fig. 3.—Library Request Form

ML 13,750	
DOUGLAS AIRCRAFT CO., INC	SM-39617
MECHANIZED INFORMATION RETRIEVAL SYSTEM FOR DOUGLAS AIRCRAFT COMPANY, INC., STATUS REPORT.	INFORMATION RETRIEVAL LIBRARIES COMPUTER SEARCHING IBM 7090 IBM 1401
G. W. KORIAGIN, L. R. BUNNOW	
JANUARY 1962	
COPY 1	

Fig. 4.—Index Card for the Accession Number

and call number) duplicate cards for any particular accession number, or complete production (including a complete set of cards for each accession number plus an accession list statistics and error notes) can be requested.

3. The index cards (Fig. 4, 5, 6, and 7) are printed by the computer with the filing fields indicated, not by the previous red line method, but by being printed at the top of the cards. The cards are mechanically alphabeticalized for each file. This alphabetical sorting makes interfiling much easier, and greatly reduces filing time.

DOUGLAS AIRCRAFT CO., INC ML 13,750	
DOUGLAS AIRCRAFT CO., INC	SM-39617
MECHANIZED INFORMATION RETRIEVAL SYSTEM FOR DOUGLAS AIRCRAFT COMPANY, INC., STATUS REPORT.	INFORMATION RETRIEVAL LIBRARIES COMPUTER SEARCHING IBM 7090 IBM 1401
G. W. KORIAGIN, L. R. BUNNOW	
JANUARY 1962	
COPY 1	

Fig. 5.—Index Card in Order by Originating Agency

printed. This list and spot check of the output provide the reliability testing for this part of the program.

**B. Abstract Capability.**—This program can store and print abstracts of the documents indexed. This capability is not being used at this time because the bibliographic data presently being selected, including the list of descriptors, give quite a clear picture of the document.

**C. Additions Under Development.**—A program is now being written for the IBM 7090 which will print an up-to-date file of Uniterm Subject cards (uniterms followed by accession number) (Fig 12). A complete new

L. R. BUNNOW ML 13,750	
DOUGLAS AIRCRAFT CO., INC.	SM-39617
MECHANIZED INFORMATION RETRIEVAL SYSTEM FOR DOUGLAS AIRCRAFT COMPANY, INC., STATUS REPORT.	INFORMATION RETRIEVAL LIBRARIES COMPUTER SEARCHING IBM 7090 IBM 1401
G. W. KORIAGIN, L. R. BUNNOW	
JANUARY 1962	
COPY 1	

MECHANIZED INFORMATION RETRIEVAL SYSTEM ML 13,750	
DOUGLAS AIRCRAFT CO., INC.	SM-39617
MECHANIZED INFORMATION RETRIEVAL SYSTEM FOR DOUGLAS AIRCRAFT COMPANY, INC., STATUS REPORT.	INFORMATION RETRIEVAL LIBRARIES COMPUTER SEARCHING IBM 7090 IBM 1401
G. W. KORIAGIN, L. R. BUNNOW	
JANUARY 1962	
COPY 1	

Fig. 6.—Index Card for Title

G. W. KORIAGIN ML 13,750	
DOUGLAS AIRCRAFT CO., INC.	SM-39617
MECHANIZED INFORMATION RETRIEVAL SYSTEM FOR DOUGLAS AIRCRAFT COMPANY, INC., STATUS REPORT.	INFORMATION RETRIEVAL LIBRARIES COMPUTER SEARCHING IBM 7090 IBM 1401
G. W. KORIAGIN, L. R. BUNNOW	
JANUARY 1962	
COPY 1	

Fig. 7.—Index Cards in Order by Author

4. The Library publishes bi-monthly lists of document acquisitions. These lists are in two parts: a subject index, and a reproduction of the index cards in order of Library accession number (Fig. 8 and 9). The subject index is an inverted listing of uniterms with accession numbers. This subject index serves as a posting list for the manual listing of the accession numbers on the 5" x 8" Uniterm Subject cards. These cards will soon be machine posted.

5. As paper tapes are input, the computer screens for typing errors and prints error notes (Fig. 10). Many types of errors can be found by the computer, *e.g.*, errors in the format of the date entry, errors in accession numbers, too many or too few fields (material added or omitted). Entries with errors must be re-typed correctly on the Flexowriter, thus generating a new tape.

6. A list by accession numbers, showing the number of cards printed for each accession number in each filing field is also generated (Fig. 11). This statistics list is used to check for machine and input errors, and to determine whether the right number of cards has been

PAGE 13		
CROSS-COUPLING ML 11545	CURVES ML 11579 ML 11557	ML 11395
CROSSWIND ML 11402	CUTTING ML 11557	DAMAGE ML 11315 ML 11316 ML 11317 ML 11318 ML 11319 ML 11320 ML 11321 ML 11322 ML 11323 ML 11324 ML 11325 ML 11326 ML 11327 ML 11328 ML 11329 ML 11330 ML 11331 ML 11332 ML 11333 ML 11334 ML 11335 ML 11336 ML 11337 ML 11338 ML 11339 ML 11340 ML 11341 ML 11342 ML 11343 ML 11344 ML 11345 ML 11346 ML 11347 ML 11348 ML 11349 ML 11350 ML 11351 ML 11352 ML 11353 ML 11354 ML 11355 ML 11356 ML 11357 ML 11358 ML 11359 ML 11360 ML 11361 ML 11362 ML 11363 ML 11364 ML 11365 ML 11366 ML 11367 ML 11368 ML 11369 ML 11370 ML 11371 ML 11372 ML 11373 ML 11374 ML 11375 ML 11376 ML 11377 ML 11378 ML 11379 ML 11380 ML 11381 ML 11382 ML 11383 ML 11384 ML 11385 ML 11386 ML 11387 ML 11388 ML 11389 ML 11390 ML 11391 ML 11392 ML 11393 ML 11394 ML 11395 ML 11396 ML 11397 ML 11398 ML 11399 ML 11400 ML 11401 ML 11402 ML 11403 ML 11404 ML 11405 ML 11406 ML 11407 ML 11408 ML 11409 ML 11410 ML 11411 ML 11412 ML 11413 ML 11414 ML 11415 ML 11416 ML 11417 ML 11418 ML 11419 ML 11420 ML 11421 ML 11422 ML 11423 ML 11424 ML 11425 ML 11426 ML 11427 ML 11428 ML 11429 ML 11430 ML 11431 ML 11432 ML 11433 ML 11434 ML 11435 ML 11436 ML 11437 ML 11438 ML 11439 ML 11440 ML 11441 ML 11442 ML 11443 ML 11444 ML 11445 ML 11446 ML 11447 ML 11448 ML 11449 ML 11450 ML 11451 ML 11452 ML 11453 ML 11454 ML 11455 ML 11456 ML 11457 ML 11458 ML 11459 ML 11460 ML 11461 ML 11462 ML 11463 ML 11464 ML 11465 ML 11466 ML 11467 ML 11468 ML 11469 ML 11470 ML 11471 ML 11472 ML 11473 ML 11474 ML 11475 ML 11476 ML 11477 ML 11478 ML 11479 ML 11480 ML 11481 ML 11482 ML 11483 ML 11484 ML 11485 ML 11486 ML 11487 ML 11488 ML 11489 ML 11490 ML 11491 ML 11492 ML 11493 ML 11494 ML 11495 ML 11496 ML 11497 ML 11498 ML 11499 ML 11500 ML 11501 ML 11502 ML 11503 ML 11504 ML 11505 ML 11506 ML 11507 ML 11508 ML 11509 ML 11510 ML 11511 ML 11512 ML 11513 ML 11514 ML 11515 ML 11516 ML 11517 ML 11518 ML 11519 ML 11520 ML 11521 ML 11522 ML 11523 ML 11524 ML 11525 ML 11526 ML 11527 ML 11528 ML 11529 ML 11530 ML 11531 ML 11532 ML 11533 ML 11534 ML 11535 ML 11536 ML 11537 ML 11538 ML 11539 ML 11540 ML 11541 ML 11542 ML 11543 ML 11544 ML 11545 ML 11546 ML 11547 ML 11548 ML 11549 ML 11550 ML 11551 ML 11552 ML 11553 ML 11554 ML 11555 ML 11556 ML 11557 ML 11558 ML 11559 ML 11560 ML 11561 ML 11562 ML 11563 ML 11564 ML 11565 ML 11566 ML 11567 ML 11568 ML 11569 ML 11570 ML 11571 ML 11572 ML 11573 ML 11574 ML 11575 ML 11576 ML 11577 ML 11578 ML 11579 ML 11580 ML 11581 ML 11582 ML 11583 ML 11584 ML 11585 ML 11586 ML 11587 ML 11588 ML 11589 ML 11590 ML 11591 ML 11592 ML 11593 ML 11594 ML 11595 ML 11596 ML 11597 ML 11598 ML 11599 ML 11600 ML 11601 ML 11602 ML 11603 ML 11604 ML 11605 ML 11606 ML 11607 ML 11608 ML 11609 ML 11610 ML 11611 ML 11612 ML 11613 ML 11614 ML 11615 ML 11616 ML 11617 ML 11618 ML 11619 ML 11620 ML 11621 ML 11622 ML 11623 ML 11624 ML 11625 ML 11626 ML 11627 ML 11628 ML 11629 ML 11630 ML 11631 ML 11632 ML 11633 ML 11634 ML 11635 ML 11636 ML 11637 ML 11638 ML 11639 ML 11640 ML 11641 ML 11642 ML 11643 ML 11644 ML 11645 ML 11646 ML 11647 ML 11648 ML 11649 ML 11650 ML 11651 ML 11652 ML 11653 ML 11654 ML 11655 ML 11656 ML 11657 ML 11658 ML 11659 ML 11660 ML 11661 ML 11662 ML 11663 ML 11664 ML 11665 ML 11666 ML 11667 ML 11668 ML 11669 ML 11670 ML 11671 ML 11672 ML 11673 ML 11674 ML 11675 ML 11676 ML 11677 ML 11678 ML 11679 ML 11680 ML 11681 ML 11682 ML 11683 ML 11684 ML 11685 ML 11686 ML 11687 ML 11688 ML 11689 ML 11690 ML 11691 ML 11692 ML 11693 ML 11694 ML 11695 ML 11696 ML 11697 ML 11698 ML 11699 ML 11700 ML 11701 ML 11702 ML 11703 ML 11704 ML 11705 ML 11706 ML 11707 ML 11708 ML 11709 ML 11710 ML 11711 ML 11712 ML 11713 ML 11714 ML 11715 ML 11716 ML 11717 ML 11718 ML 11719 ML 11720 ML 11721 ML 11722 ML 11723 ML 11724 ML 11725 ML 11726 ML 11727 ML 11728 ML 11729 ML 11730 ML 11731 ML 11732 ML 11733 ML 11734 ML 11735 ML 11736 ML 11737 ML 11738 ML 11739 ML 11740 ML 11741 ML 11742 ML 11743 ML 11744 ML 11745 ML 11746 ML 11747 ML 11748 ML 11749 ML 11750 ML 11751 ML 11752 ML 11753 ML 11754 ML 11755 ML 11756 ML 11757 ML 11758 ML 11759 ML 11760 ML 11761 ML 11762 ML 11763 ML 11764 ML 11765 ML 11766 ML 11767 ML 11768 ML 11769 ML 11770 ML 11771 ML 11772 ML 11773 ML 11774 ML 11775 ML 11776 ML 11777 ML 11778 ML 11779 ML 11780 ML 11781 ML 11782 ML 11783 ML 11784 ML 11785 ML 11786 ML 11787 ML 11788 ML 11789 ML 11790 ML 11791 ML 11792 ML 11793 ML 11794 ML 11795 ML 11796 ML 11797 ML 11798 ML 11799 ML 11800 ML 11801 ML 11802 ML 11803 ML 11804 ML 11805 ML 11806 ML 11807 ML 11808 ML 11809 ML 11810 ML 11811 ML 11812 ML 11813 ML 11814 ML 11815 ML 11816 ML 11817 ML 11818 ML 11819 ML 11820 ML 11821 ML 11822 ML 11823 ML 11824 ML 11825 ML 11826 ML 11827 ML 11828 ML 11829 ML 11830 ML 11831 ML 11832 ML 11833 ML 11834 ML 11835 ML 11836 ML 11837 ML 11838 ML 11839 ML 11840 ML 11841 ML 11842 ML 11843 ML 11844 ML 11845 ML 11846 ML 11847 ML 11848 ML 11849 ML 11850 ML 11851 ML 11852 ML 11853 ML 11854 ML 11855 ML 11856 ML 11857 ML 11858 ML 11859 ML 11860 ML 11861 ML 11862 ML 11863 ML 11864 ML 11865 ML 11866 ML 11867 ML 11868 ML 11869 ML 11870 ML 11871 ML 11872 ML 11873 ML 11874 ML 11875 ML 11876 ML 11877 ML 11878 ML 11879 ML 11880 ML 11881 ML 11882 ML 11883 ML 11884 ML 11885 ML 11886 ML 11887 ML 11888 ML 11889 ML 11890 ML 11891 ML 11892 ML 11893 ML 11894 ML 11895 ML 11896 ML 11897 ML 11898 ML 11899 ML 11900 ML 11901 ML 11902 ML 11903 ML 11904 ML 11905 ML 11906 ML 11907 ML 11908 ML 11909 ML 11910 ML 11911 ML 11912 ML 11913 ML 11914 ML 11915 ML 11916 ML 11917 ML 11918 ML 11919 ML 11920 ML 11921 ML 11922 ML 11923 ML 11924 ML 11925 ML 11926 ML 11927 ML 11928 ML 11929 ML 11930 ML 11931 ML 11932 ML 11933 ML 11934 ML 11935 ML 11936 ML 11937 ML 11938 ML 11939 ML 11940 ML 11941 ML 11942 ML 11943 ML 11944 ML 11945 ML 11946 ML 11947 ML 11948 ML 11949 ML 11950 ML 11951 ML 11952 ML 11953 ML 11954 ML 11955 ML 11956 ML 11957 ML 11958 ML 11959 ML 11960 ML 11961 ML 11962 ML 11963 ML 11964 ML 11965 ML 11966 ML 11967 ML 11968 ML 11969 ML 11970 ML 11971 ML 11972 ML 11973 ML 11974 ML 11975 ML 11976 ML 11977 ML 11978 ML 11979 ML 11980 ML 11981 ML 11982 ML 11983 ML 11984 ML 11985 ML 11986 ML 11987 ML 11988 ML 11989 ML 11990 ML 11991 ML 11992 ML 11993 ML 11994 ML 11995 ML 11996 ML 11997 ML 11998 ML 11999 ML 12000 ML 12001 ML 12002 ML 12003 ML 12004 ML 12005 ML 12006 ML 12007 ML 12008 ML 12009 ML 12010 ML 12011 ML 12012 ML 12013 ML 12014 ML 12015 ML 12016 ML 12017 ML 12018 ML 12019 ML 12020 ML 12021 ML 12022 ML 12023 ML 12024 ML 12025 ML 12026 ML 12027 ML 12028 ML 12029 ML 12030 ML 12031 ML 12032 ML 12033 ML 12034 ML 12035 ML 12036 ML 12037 ML 12038 ML 12039 ML 12040 ML 12041 ML 12042 ML 12043 ML 12044 ML 12045 ML 12046 ML 12047 ML 12048 ML 12049 ML 12050 ML 12051 ML 12052 ML 12053 ML 12054 ML 12055 ML 12056 ML 12057 ML 12058 ML 12059 ML 12060 ML 12061 ML 12062 ML 12063 ML 12064 ML 12065 ML 12066 ML 12067 ML 12068 ML 12069 ML 12070 ML 12071 ML 12072 ML 12073 ML 12074 ML 12075 ML 12076 ML 12077 ML 12078 ML 12079 ML 12080 ML 12081 ML 12082 ML 12083 ML 12084 ML 12085 ML 12086 ML 12087 ML 12088 ML 12089 ML 12090 ML 12091 ML 12092 ML 12093 ML 12094 ML 12095 ML 12096 ML 12097 ML 12098 ML 12099 ML 12100 ML 12101 ML 12102 ML 12103 ML 12104 ML 12105 ML 12106 ML 12107 ML 12108 ML 12109 ML 12110 ML 12111 ML 12112 ML 12113 ML 12114 ML 12115 ML 12116 ML 12117 ML 12118 ML 12119 ML 12120 ML 12121 ML 12122 ML 12123 ML 12124 ML 12125 ML 12126 ML 12127 ML 12128 ML 12129 ML 12130 ML 12131 ML 12132 ML 12133 ML 12134 ML 12135 ML 12136 ML 12137 ML 12138 ML 12139 ML 12140 ML 12141 ML 12142 ML 12143 ML 12144 ML 12145 ML 12146 ML 12147 ML 12148 ML 12149 ML 12150 ML 12151 ML 12152 ML 12153 ML 12154 ML 12155 ML 12156 ML 12157 ML 12158 ML 12159 ML 12160 ML 12161 ML 12162 ML 12163 ML 12164 ML 12165 ML 12166 ML 12167 ML 12168 ML 12169 ML 12170 ML 12171 ML 12172 ML 12173 ML 12174 ML 12175 ML 12176 ML 12177 ML 12178 ML 12179 ML 12180 ML 12181 ML 12182 ML 12183 ML 12184 ML 12185 ML 12186 ML 12187 ML 12188 ML 12189 ML 12190 ML 12191 ML 12192 ML 12193 ML 12194 ML 12195 ML 12196 ML 12197 ML 12198 ML 12199 ML 12200 ML 12201 ML 12202 ML 12203 ML 12204 ML 12205 ML 12206 ML 12207 ML 12208 ML 12209 ML 12210 ML 12211 ML 12212 ML 12213 ML 12214 ML 12215 ML 12216 ML 12217 ML 12218 ML 12219 ML 12220 ML 12221 ML 12222 ML 12223 ML 12224 ML 12225 ML 12226 ML 12227 ML 12228 ML 12229 ML 12230 ML 12231 ML 12232 ML 12233 ML 12234 ML 12235 ML 12236 ML 12237 ML 12238 ML 12239 ML 12240 ML 12241 ML 12242 ML 12243 ML 12244 ML 12245 ML 12246 ML 12247 ML 12248 ML 12249 ML 12250 ML 12251 ML 12252 ML 12253 ML 12254 ML 12255 ML 12256 ML 12257 ML 12258 ML 12259 ML 12260 ML 12261 ML 12262 ML 12263 ML 12264 ML 12265 ML 12266 ML 12267 ML 12268 ML 12269 ML 12270 ML 12271 ML 12272 ML 12273 ML 12274 ML 12275 ML 12276 ML 12277 ML 12278 ML 12279 ML 12280 ML 12281 ML 12282 ML 12283 ML 12284 ML 12285 ML 12286 ML 12287 ML 12288 ML 12289 ML 12290 ML 12291 ML 12292 ML 12293 ML 12294 ML 12295 ML 12296 ML 12297 ML 12298 ML 12299 ML 12300 ML 12301 ML 12302 ML 12303 ML 12304 ML 12305 ML 12306 ML 12307 ML 12308 ML 12309 ML 12310 ML 12311 ML 12312 ML 12313 ML 12314 ML 12315 ML 12316 ML 12317 ML 12318 ML 12319 ML 12320 ML 12321 ML 12322 ML 12323 ML 12324 ML 12325 ML 12326 ML 12327 ML 12328 ML 12329 ML 12330 ML 12331 ML 12332 ML 12333 ML 12334 ML 12335 ML 12336 ML 12337 ML 12338 ML 12339 ML 12340 ML 12341 ML 12342 ML 12343 ML 12344 ML 12345 ML 12346 ML 12347 ML 12348 ML 12349 ML 12350 ML 12351 ML 12352 ML 12353 ML 12354 ML 12355 ML 12356 ML 12357 ML 12358 ML 12359 ML 12360 ML 12361 ML 12362 ML 12363 ML 12364 ML 12365 ML 12366 ML 12367 ML 12368 ML 12369 ML 12370 ML 12371 ML 12372 ML 12373 ML 12374 ML 12375 ML 12376 ML 12377 ML 12378 ML 12379 ML 12380 ML 12381 ML 12382 ML 12383 ML 12384 ML 12385 ML 12386 ML 12387 ML 12388 ML 12389 ML 12390 ML 12391 ML 12392 ML 12393 ML 12394 ML 12395 ML 12396 ML 12397 ML 12398 ML 12399 ML 12400 ML 12401 ML 12402 ML 12403 ML 12404 ML 12405 ML 12406 ML 12407 ML 12408 ML 12409 ML 12410 ML 12411 ML 12412 ML 12413 ML 12414 ML 12415 ML 12416 ML 12417 ML 12418 ML 12419 ML 12420 ML 12421 ML 12422 ML 12423 ML 12424 ML 12425 ML 12426 ML 12427 ML 12428 ML 12429 ML 12430 ML 12431 ML 12432 ML 12433 ML 12434 ML 12435 ML 12436 ML 12437 ML 12438 ML 1243

ML 11,330 CONVAIR NORTHROP CORP. AEROSPACE RESEARCH FACILITY THE EFFECTS OF REACTOR RADIATION ON THE ELECTRICAL PROPERTIES OF ELECTRONIC COMPONENTS. PART VI: RESISTORS AND VACUUM TUBES. E. S. PALMER, D. HOWELL 7 JUNE 1961 COPY 1	ML 11,340 NORTHROP CORP. NORDAIR DIV MATERIALS RESEARCH LAB DEVELOPMENT OF FORMING AND JOIN- ING TECHNIQUES FOR SPACECRAFT STRUCTURES. 27P A. P. ROMAINE, H. SHALLEN 29 APR 1959 COPY #24	ML 11,340 NORTHROP CORP. NORDAIR DIV MATERIALS RESEARCH LAB DEVELOPMENT OF FORMING AND JOIN- ING TECHNIQUES FOR SPACECRAFT STRUCTURES. 27P A. P. ROMAINE, H. SHALLEN 29 APR 1959 COPY #24	ML 11,340 NORTHROP CORP. NORDAIR DIV MATERIALS RESEARCH LAB DEVELOPMENT OF FORMING AND JOIN- ING TECHNIQUES FOR SPACECRAFT STRUCTURES. 27P A. P. ROMAINE, H. SHALLEN 29 APR 1959 COPY #24
ML 11,341 CALIFORNIA INST OF TECHNOLOGY JET PROPULSION LAB A LASER SYSTEM FOR RADAR ASTRONOMY. 19P W. H. MICA JUNE 15, 1961 COPY 1	TECH. REPT 152-103 S-BAND SOLID STATE PLANETARY REFLECTIONS RADAR ASTRONOMY INSTRUMENTATION	ML 11,342 - C CALIFORNIA INST OF TECHNOLOGY JET PROPULSION LAB SOLID-PROPELLANT ROCKET CAPA- BILITIES FOR SPACECRAFT PRO- PULSION. 22P WINSTON GIN, EDITOR APR 17, 1961 COPY #HC 125	TECH. REPT 152-70 PROPELLANTS CAPABILITIES FOR SPACECRAFT PROPULSION RADAR ASTRONOMY INSTRUMENTATION

Fig. 9.—Card Image, Part II of Accession List

THE FOLLOWING ERROR IN INDEX CARD(S) ML 12807  
INCORRECT SPACING BETWEEN FIELDS

THE FOLLOWING ERROR IN INDEX CARD(S) ML 11826  
ERROR IN DATE EITHER LOCATION OR  
CONTENT

THE FOLLOWING ERROR IN INDEX CARD(S) ML 12451  
TOO FEW FIELDS

THE FOLLOWING ERROR IN INDEX CARD(S) ML 13205  
LINE TOO LONG

Fig. 10.—Input Error Notes.

ACC NO.	COMPANY	TITLE	AUTHOR	ABSTRACT
12829	1	1	0	0
12836	1	1	2	0
12837	1	2	0	0
12838	1	1	0	0
12842	1	1	3	0
12853	2	1	5	0

Fig. 11.—Statistics list: Check List of 3 by 5 Cards

set of cards can be requested to eliminate errors made by manual postings, or to produce a more legible set of cards. Or, the Uniterm Subject cards can be updated by having individual cards printed for all subjects used in a given period. This would mean the new 5" x 8" cards would be printed including all new accession numbers, and thus hand posting on the individual Uniterm Subject cards would be eliminated.

Another program will handle the automatic binding of uniterms. It will search each index card in the magnetic tape file for a given uniterm or set of uniterms. If the required combination is found, the uniterms will be removed and replaced by one or more given uniterms; or an additional uniterm will be added to the index card on the master tape. A posting list or new Uniterm Subject card will be printed to show the changes.

**D. Operation Costs for the Bibliographic Data System.**—Though the bibliographic data system has been expanded to include other Company Libraries, the figures are for the Missile and Space Systems Library only, and

60-367 (8-58)									
IBM 1401									
0	1	2	3	4	5	6	7	8	9
5530	7211		11,433			306			529
13,750						7718			13009
						11,006			

Fig. 12.—Uniterm-Subject Card

are based on its experience with an operating system since May, 1961. All figures are for a one-week period unless otherwise stated.

1. Assumptions: (a) The Library catalogs and inputs to the system approximately 100 documents per week. (b) The cost of printing the index cards is approximately equal to the cost of previous preparation methods. (c) The operator time for the Flexowriter is equal to the time required to type the masters under the old system. (d) Forms, load sheets, paper tape and conversion equipment are ignored because of their negligible costs.

2. Tangible Costs: (a) Seven minutes of IBM 7090 running time. (b) Three man hours required of the Computing Engineering Section for machine operation and coordination with the Library. (c) Eight man hours required of the Library for submitting input, checking output and coordination. (d) The purchase cost of the Flexowriter.

3. Tangible Savings: (a) Approximately 6 man hours per week are saved in the manual posting of the Uniterm Subject cards when the computer-printed posting list is used. This is a 60 per cent saving over previous posting methods. This figure will be further reduced by machine posting. (b) Approximately 7 man hours per week are saved in sorting and inter-filing index cards, as they are printed in the required order. This is a 50 per cent saving over previous methods of ordering and filing the index cards.

4. Intangible Savings and Benefits: (a) The accession list has been improved with the addition of a subject index, and by the printing of the index cards in order of accession number. (b) Statistics are provided which were costly to derive manually. (c) With the data in machinable form, many other capabilities such as special reports, security information, etc., may be added easily. (d) The program can make many reliability checks of the bibliographic data for cataloging, clerical, and typing errors. (e) As the system was expanded to include other Douglas Libraries, with a common method of indexing and a common vocabulary, the problem of costly duplicate indexing could be attacked. Though there are possibilities for computer control of this problem, we thought that a union catalog of corporate authors at each library would be an immediate manual solution. Therefore, the program prints extra copies of all corporate authors cards for use in each library.

We have concluded that the tangible benefits almost equal the cost of the operating system. The additional cost seems insignificant when considering the intangible benefits, the most significant being the generation and storing of bibliographic data in machinable form.

#### E. Tape Handling for the Bibliographic Data System.—

1. Input: (a) The paper tapes are converted to punched cards by the Systematics equipment. (b) The punched cards are then loaded onto magnetic tape. (c) The 7090 computer program stores the index card images on magnetic tape serially by accession number. This becomes a master reference tape. If a change is made to an accession number previously on tape, the newer or most recent entry is accepted.

2. Output: (a) The Library load sheet (Fig. 3) dictates the accession numbers to appear on the next accession list, posting lists and cards. (b) The computer program extracts the requested index cards from new input or from the master reference tape and sorts them in accession number order. (c) The requested accession numbers are written in ascending order by accession number on a print tape for the accession list and the index cards. (d) The uniterms are extracted, along with the accession numbers, and sorted in order by uniterm on a print tape to print the posting list. (e) The filing points are simultaneously extracted from each index card and the cards are sorted by each filing point. The index cards (company, title, author) are written in filing order on the print tape. (f) Statistics are also extracted during the processing. (g) The print tapes are used by the 1401 to print the output: (1) the master for the accession list, and (2) the index cards in filing order.

The 7090 is used to extract information and to prepare the output in the desired order; the 1401 to perform the duplicating and printing features required.

## II. THE DICTIONARY SUB-SYSTEM

One of the first steps taken in the mechanization of our indexing system was to have IBM cards punched for each subject and reference included in the authority list of subjects. These cards were sorted and printed as a tool for the catalogers, and were up-dated as new subjects were used.

The Dictionary has since developed into a major sub-system of the program, primarily due to the incorporation of the other Douglas Libraries into the system. Though a single concept uniterm approach has been our goal, company needs and usage often have necessitated the "binding" of terms, the additions of many "scope notes" for semantic clarity, and the inclusion in our dictionary of examples of frequent uses of terms. The inclusion of four different spheres of interest and four types of work into one vocabulary took many hours of concerted effort. The disciplines represented in the final product are airframe manufacturing, materials research and testing, fighter and commercial aircraft manufacturing, underseas warfare, life sciences and missile and space systems engineering, and the related technical fields.

This Dictionary has presently 7,467 terms, including the *see* and *see also* references. A sample page (Fig. 13) shows

terms, cross references and some examples of word combinations. We are finding that the rate of vocabulary growth is slowing, though additions and changes are made whenever necessary. New words are added by means of a load sheet that results in IBM punched cards. The computer program reflects the changes to the dictionary by printing an up-dated, complete dictionary, or a supplement which lists only additions and changes. When changes are made to the dictionary the program checks for clerical or cross-referencing errors. An IBM 7090 program maintains a copy of this *Dictionary of Terms* on magnetic tape. The dictionary tape is used to print the dictionary upon request, check the validity of uniterms on index cards before they are added to the master reference tape, and assign unique code numbers to uniterms for use by the retrieval programs when searching the tape files. These code numbers are internal to the computer program and are not used as input or reflected in the output of the computer program.

## III. AUTOMATIC SELECTIVE DISSEMINATION OF INFORMATION (ASDI) AND MECHANIZED LITERATURE SEARCHING SUB-SYSTEMS

A. ASDI.—To provide complete service to library users, some method must be found to advise them on new information recently catalogued in their fields of interest. The regularly published accession lists are helpful, but there is some time delay in their publication, and generally many pages must be examined to select reports of interest.

12-30-61	PAGE 177
HAWAII	
HAWK	SEE ALSO XM-3
HAWK II	
HAWK PULSE ACQUISITION RADAR	
SEE HPAR	
HAZARDS	
SEE ALSO SAFETY	
E.G. RADIATION HAZARDS	
HAZARDS OF ELECTROMAGNETIC RADIATION TO ORDNANCE	
SEE HERO	
HEADS, HEAD	
SEE ALSO SKULL	
HEADGEAR	
SEE ALSO HELMETS	
HEADING (METALLURGICAL)	
SEE UPSETTING	
HEADPHONES	
HEALTH	
HEARING	
HEART	
HEAT-DISSIPATING	
E.G. HEAT-DISSIPATING SHIELDS	
HEAT-RESISTANT	
E.G. HEAT-RESISTANT MATERIALS	
HEAT SINKS, HEAT SINK	
HEAT TRANSFER	
HEAT TRANSFER REACTOR EXPERIMENT	
SEE HTRE	
HEAT TREATABLE	
HEAT TREATMENT	
SEE ALSO REHEAT TREATMENT	
E.G. SOLUTION HEAT TREATMENT	

Fig. 13.—Dictionary Page

In studying methods of automatically sending this type of notification, we benefited in particular by the work done by H. P. Luhn of IBM.<sup>6</sup> Our sub-system for ASDI is in the analysis stage. We anticipate that it will proceed as follows:

1. The library will interview the users of the ASDI system to establish their interest profiles. These profiles will be described in the terms of the vocabulary used in indexing. This program will begin with a select group of users, and will be expanded when it is beyond the experimental stage.

2. The library will use a load sheet to input the interest profiles into the ASDI program. A magnetic tape file of all profiles will be maintained, and when an accession list is printed, these new references will be screened against all interest profiles.

3. A copy of the index card for the selected reference is printed with a tear-off stub containing the user's identification. Provisions will be made for him to indicate his interest in the document (Fig. 14).

ML 13,750 DOUGLAS AIRCRAFT CO., INC. MECHANIZED INFORMATION RETRIEVAL SYSTEM FOR DOUGLAS AIRCRAFT COMPANY, INC. STATUS REPORT. G. W. KORIATIN, L. R. BUNNOW JANUARY 1962 DO Y 1	SM-39217 INFORMATION RETRIEVAL LIBRARIES COMPUTER SEARCHING IBM 7090 IBM 1101	John J. Smith Computing ML 13,750 ____ Would like to see document. ____ In Field-of-Interest, but not wanted at this time. ____ Does not apply to Field-of-Interest. ____ Other:	Expt. No. 7962 Jan. 28, 1962
--	--	---	---------------------------------

Fig. 14.—Automatic Selective Dissemination of Information Reply Card

4. The user may retain the index card for his personal file. The stub will be mailed to the Library for action on the document request. Then the engineer's identification and response will be punched into IBM cards and input to the ASDI program. This program will accumulate and print statistics which the Library will use to adjust the interest profiles.

5. Analysis of the statistics supplied, and experimentation by manual adjustment of the interest profiles will result in a proven system for automatic adjustment of profiles which will then be mechanized.

**B. Literature Searching.**—A majority of the search techniques will be common to the ASDI program because the same search logic and the same input will be used. Mechanized literature searching will take place when the search logic has been proven by experience with the ASDI program, and when enough of the libraries' holdings are on magnetic tape to make a search of the tape file meaningful. The catalogued holdings of all the participating libraries in the Company will be searched upon request. Parallel searches can be made, to cover all aspects of a question, with little addition to the cost. A literature search will be conducted as follows:

1. A user will describe his literature search question to a librarian familiar with the vocabulary used in cataloging.

2. If the librarian decides that the search should be performed by the computer, the user and the librarian complete the required load sheet using the indexing vocabulary. Criteria for this decision are: scope of the

question, volume of postings per term and how soon it is required.

3. The literature search will be made that evening unless priority warrants faster service.

4. The bibliography will be in the form of 3" x 5" cards or a listing of the images of the index cards.

The 7090 computer program will be capable of performing at least 100 literature searches simultaneously. However, a 1401 program will also be written which will search the magnetic tape file as fast as the 7090 program, but with the capability of making only a few searches simultaneously. The 1401 program will cost less to run and will be used when the number of required searches is small. We estimate that the 7090 and 1401 programs will search the magnetic tape file at the rate of 150 references per second.

## EVALUATION

Experience with the system has modified our initial ideas and we have made some additions and refinements we had not anticipated in the original proposal. The program has always been considered to be flexible. Time has been the biggest factor in the development of our program. All aspects of the program could not be ready simultaneously. Not only do the analysis and the programming take time, but time is needed to evaluate what has been developed to know the direction to proceed. Steps which seem natural at the program's inception are not always logical when the system begins to operate.

The vocabulary of indexing is the key to the whole system. The vocabulary evaluation done by the participating libraries has been difficult and time consuming. It is very helpful to consult subject specialists or to use someone else's vocabulary but this is not always possible. The ASTIA vocabulary, for example, was published more than a year after we started our program, however we have found it very helpful. If "pure uniterming" is used, there is no need for generic postings as each term is free or single. But, as concepts are combined for compromise or clarity, we feel that generic postings, handled by machine, should be considered.

The system has no provision at this time for the use of links or roles. The problem of "false drops" or incorrect information resulting from literature searches has not been a large one. Though it can definitely be a problem and many examples can be created to show how false drops can occur, we have not found this to be a significant problem after three years of operation. The careful selection of indexing terms and the depth of indexing is an important feature of the system. We average twelve terms per document at this time, but are planning to index even more deeply. Some specific advantages to the system we have developed are:

1. The library is deriving output in the form of computer-prepared index cards, posting lists and accession lists, in the process of putting information on tape. The computer has saved much time and clerical effort by producing index cards in filing order and by organizing the accession lists. This mechanization of the library card files would never in itself justify the use of a large

computer program, but the number of items on tape is constantly being increased. As the tape file grows, literature searching becomes more valuable.

2. A sufficient number of components of our data is in machinable form to allow for great future flexibility in our output. The rules that form the input typing requirements are detailed so that other information can be extracted at a later date if desired. The following have been considered: (a) Additional statistics as the number of times descriptors have been used, or the average number of descriptors per document. (b) Document usage statistics for "weeding" purposes. (c) Lists of documents by security classification for classified document inventories. (d) Lists by date of document for declassification purposes. (e) The possible replacement of index card files by book indexes. (f) The addition of generic relationships to the "Dictionary of Terms," which would be handled automatically by the computer.

3. The maintenance of the normal library card files and the manual uniterm search methods in conjunction with the computer program is advantageous in that multi-level access to material is available. We feel that the computer prepared output, dissemination of information automatically, and literature searching techniques will supplement, and will be supplemented by the library card indexes.

4. The fine working relationship with Computing Engineering has been a major advantage to the program. The cooperation and interest in our common problems

have resulted in a system we feel is unique—one that is both user, Library and machine oriented.

At this point, what is operational is proceeding well and is being received with satisfaction. We feel that we have the flexibility to expand and grow. We are looking forward to the development of the third and most important phase of our program, the ability to handle literature searches mechanically.

## REFERENCES

- (1) "The Uniterm System of Indexing, Operating Manual," Documentation Incorporated, Washington, D. C., 1955.
- (2) The words: "subjects," "uniterms," "terms," "descriptors" and "unit concepts" are used interchangeably in this report.
- (3) Bunnow, L. R., "Study of and a Proposal for a Mechanized Information Retrieval System," Report No. SM-37418, Douglas Aircraft Co., Inc., Santa Monica, Calif., May, 1960.
- (4) Koriagin, G. W. and Bunnow, L. R., "Mechanized Information Retrieval System for Douglas Aircraft Company, Inc., Status Report," No. SM-39167, Douglas Aircraft Co., Inc., Santa Monica, Calif., Jan., 1962.
- (5) Unless otherwise stated, all information refers to the Missile and Space System Engineering Library.
- (6) Luhn, H. P., "Selective Dissemination of New Scientific Information with the Aid of Electronic Processing Equipment," November 30, 1959, International Business Machines, Advanced Systems Development Division, Yorktown Heights, New York.

## PACIR: Practical Approach to Chemical Information Retrieval\*

By JULIUS FROME and PAUL T. O'DAY

U. S. Department of Commerce Patent Office,  
Office of Research and Development, Washington, D. C.  
Received May 18, 1962

### I. INTRODUCTION

This paper describes a "Practical Approach to Chemical Information Retrieval" (PACIR). The object of the PACIR system is to provide a flexible universal approach to specific compound retrieval that is not limited to the unique characteristics of a particular area of chemistry, that is adaptable to various types of hardware, that employs a maximum of machine assistance in the analysis, that provides a file that may be organized according to the need of the user, and that is practical from the economic viewpoint.

It will be apparent that emphasis is placed on problems of efficiency and accuracy in analysis. To a great extent, it is in this area that the economic feasibility of a given approach is determined. Complications in analysis, imposed by complexities of translation of the analyzed subject matter to useful machine recognizable symbology, can easily add confusion and inaccuracy to the analysis

step. This can well render a system that is theoretically sound an empirical failure. The PACIR system attempts to keep these rigidities and dangers to a minimum.

The keywords at all steps in creating the system have been flexibility, clarity, and simplicity.

### II. EVOLUTION OF THE SYSTEM

Over the past five years, the Office of Research and Development of the U. S. Patent Office has experimented with and put into operation a number of chemical retrieval systems<sup>1-6</sup> employing a variety of machines and approaches. A description of the contributions of these projects is necessary for full understanding of the reasons behind many of the features of the PACIR approach.

Early efforts were made to solve the problems of searching the rapidly growing and important area of steroid chemistry. This led to the use of a composite one-punch-card-per-document approach which has been revised and updated and is now in general use, both in

\*Presented before the Division of Chemical Literature, ACS, National Meeting, Washington, D. C., March 23, 1962.