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ARMY MATERIALS AND MECHANICS RESEARCH CENTER
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**ANNUAL REPORT
METALS AND CERAMICS INFORMATION CENTER**

NOVEMBER 1972

H. DANA MORAN
BATTELLE-COLUMBUS
Columbus, Ohio

[Handwritten signature]

ANNUAL REPORT -- CONTRACT F23015-71-C-1087

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Prepared for

**ARMY MATERIALS AND MECHANICS RESEARCH CENTER
Watertown, Massachusetts 02172**

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METALS AND CERAMICS INFORMATION CENTER**

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FOREWORD

This report was prepared by the Metals and Ceramics Information Center operated by Battelle's Columbus Laboratories, 505 King Avenue, Columbus, Ohio 43201, under USAF Contract F33615-71-C-1067. The work described herein was accomplished under Project Number 8975, Materials Information Analysis Centers. This effort has been administered under the direction of the Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, with E. Dugger (DO) as project engineer. Commencing in FY73, this effort will be administered by the Defense Supply Agency with Technical Supervision by the Army Materials & Mechanics Research Center, Watertown, Massachusetts, Dr. J. J. Burke, Contracting Officer's Technical Representative.

This report covers the period of work August 1, 1971, to July 31, 1972.

The report was released by the author November 1972.

ABSTRACT

The Department of Defense, in 1955, established the Titanium Metallurgical Laboratory at Battelle-Columbus, expanding the scope and changing the name to *Defense Metals Information Center* in 1958. The *Defense Ceramic Information Center* was assigned to Battelle in 1967. The two Centers were combined in 1971, forming the current Metals and Ceramics Information Center (MCIC). This is the first annual report on the new MCIC program, but its historical data are derived from the seventeen continuous years of these DoD information service activities.

In addition to the merging of the two Centers, Fiscal 1972 was marked by the introduction of the full service-charge policy, which became effective for all MCIC services as of 1 January 1972. The first change was reflected in new formats and, to some degree, new services; the second has had a substantial effect on the dimensions and directions of the Center's efforts.

During the contract year reported, 3247 references were added to the approximately 100,000 items in the MCIC files. 580 technical inquiries were processed (more than 80 percent of these before the introduction of inquiry charges). 61 issues of the *Reviews of Metals and Ceramic Technology* were published; the *Reviews* now are sold under subscription through NTIS. Nine formal state-of-the-art reports were published, and three new handbook programs were initiated. Several special studies were conducted for the Office of the Director of Defense Research and Engineering.

The Center met its contractual goal for recovery of product and service costs, although the major portion of the returns were from special studies, rather than from direct 'sales'.

The information operations of MCIC were converted totally to the computerized system which was initiated in 1970. Arrangements were implemented for use of National Technical Information Service (NTIS) for marketing and distribution of MCIC publications.

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ANNUAL REPORT

METALS AND CERAMICS INFORMATION CENTER

November 1972

In 1955, the Department of Defense established at Battelle the Titanium Metallurgical Laboratory; three years later, this program was expanded in scope, and became the Defense Metals Information Center (DMIC). Based somewhat on the DMIC example, the Air Force established the Ceramics and Graphite Technical Evaluation Center at Wright-Patterson Air Force Base in the early 1960's. Later chartered as a DoD information analysis center, this program was assigned to Battelle in 1967 as the Defense Ceramic Information Center (DCIC).

The Metals and Ceramics Information Center (MCIC) resulted from the merger of DMIC and DCIC, effective 1 August 1971. To effect the combination contractually, the scope and objectives of Contract F33615-71-C-1067, which previously had covered the DMIC program only, were modified to incorporate coverage of ceramic materials. In November 1971, a substantially revised work statement for that contract was approved, authorizing the service charge policies discussed below. The contract provided for operation of the new MCIC for the period 1 August 1971 through 31 July 1972. This report covers MCIC activities for that period, i.e., nominally for FY72.

During the reporting period, the Contracting Officer's Technical Representative (COTR) was changed from the Air Force Materials Laboratory (AFML) to the Army Materials and Mechanics Research Center (AMMRC). The transfer of assignment was officially 1 July 1972, but the transition in monitorship began in March and effectively was complete by May.

The emergence of the new MCIC in August 1971 also was marked by the announcement of a service charge program in accordance with the established policies of ODDRE. Pending resolution of the related contractual authority and of arrangements with National Technical Information Service, as discussed below, a period of transition from the former no-charge policy to the full-charge plan took place during the months of August through December 1971. The new policy was fully implemented effective 1 January 1972.

SCOPE AND PURPOSES OF MCIC

MCIC is recognized as a formal Department of Defense Information Analysis Center. As such, its objectives are to provide scientific and technical information analysis services to the Department of Defense components, contractors and grantees, US Government agencies and their contractors, and to the private sector on the following materials:⁽¹⁾

(1) For the complete MCIC contractual work statement refer to Appendix A.

Metals: Titanium and titanium-base alloys, beryllium and beryllium-base alloys, high-strength steels, high-strength aluminum alloys, high-strength alloys for elevated-temperature service (superalloys), refractory metals, composites of, or containing, these metals, and coatings to improve corrosion and oxidation resistance of these materials. Magnesium, rhenium, and other metals and alloys used in structural applications shall be covered on a limited basis as resources permit and needs for information on these materials are recognized.

Ceramics: Single crystal and polycrystalline metal oxides, sulfides, carbides, borides, nitrides, silicides, intermetallics, metalloid elements, and their refractory compounds, glasses, carbons, graphites, and coatings for these materials, and combinations and composites of these materials with themselves or with other materials.

To accomplish these purposes, the MCIC program consists of four basic functions (Figure 1).

1. Maintenance of a comprehensive, up-to-date, authoritative Technical Information Base
2. Response to requests for technical advice and assistance from Government agencies, contractors, suppliers, and the public sector
3. Issuance of a series of timely Reviews of Recent Technical Developments on a variety of subjects within the MCIC scope
4. Publication of Technical Reports, Handbooks, and related documents appraising the state of the art of metals, ceramics, and processes within the MCIC scope.

In addition, MCIC provides capabilities for special assignments, such as preparation, publication and maintenance of engineering handbooks, conduct of critical surveys, and materials technology assessments, etc.

ORGANIZATION OF THE MCIC PROGRAM

The Metals and Ceramics Information Center is assigned to the Materials Analysis Division of Battelle's Columbus Laboratories. The Chief of that Division also serves as MCIC Director (see Figure 2a). A full-time staff of approximately seventeen engineers, information specialists, and secretarial assistants is substantially supplemented

FUNCTIONS OF THE METALS AND CERAMICS INFORMATION CENTER

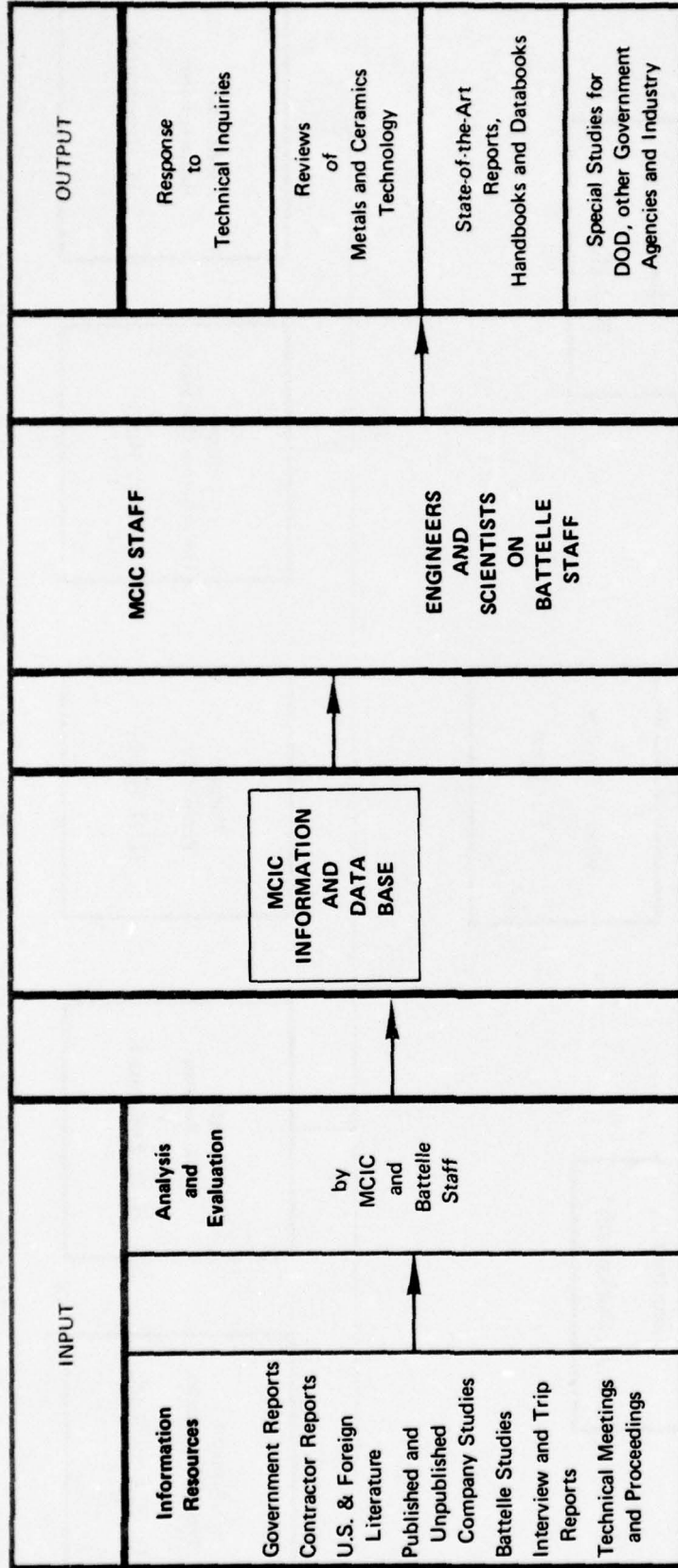


FIGURE 1. FUNCTIONS OF METALS AND CERAMICS INFORMATION CENTER (MCIC)

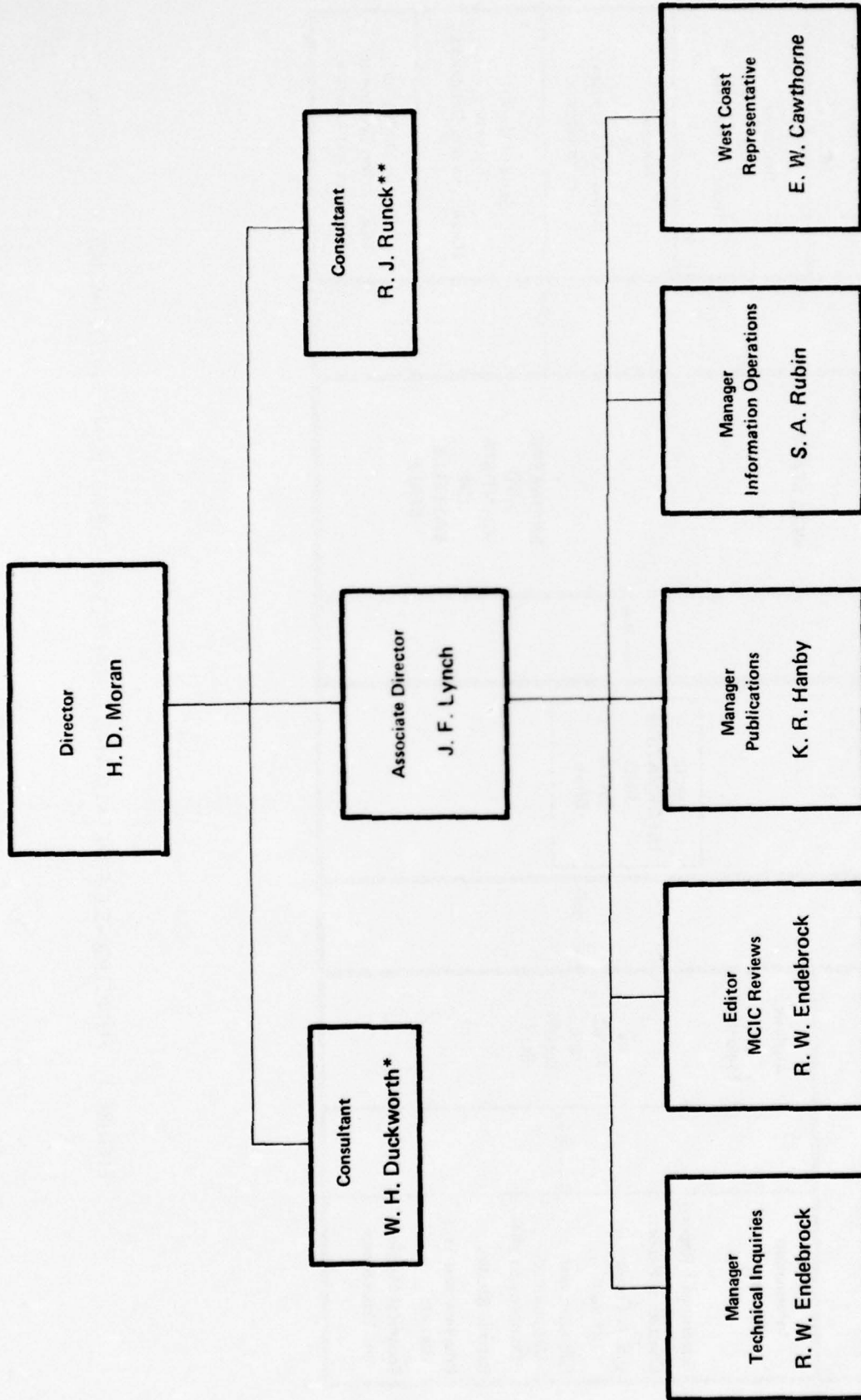
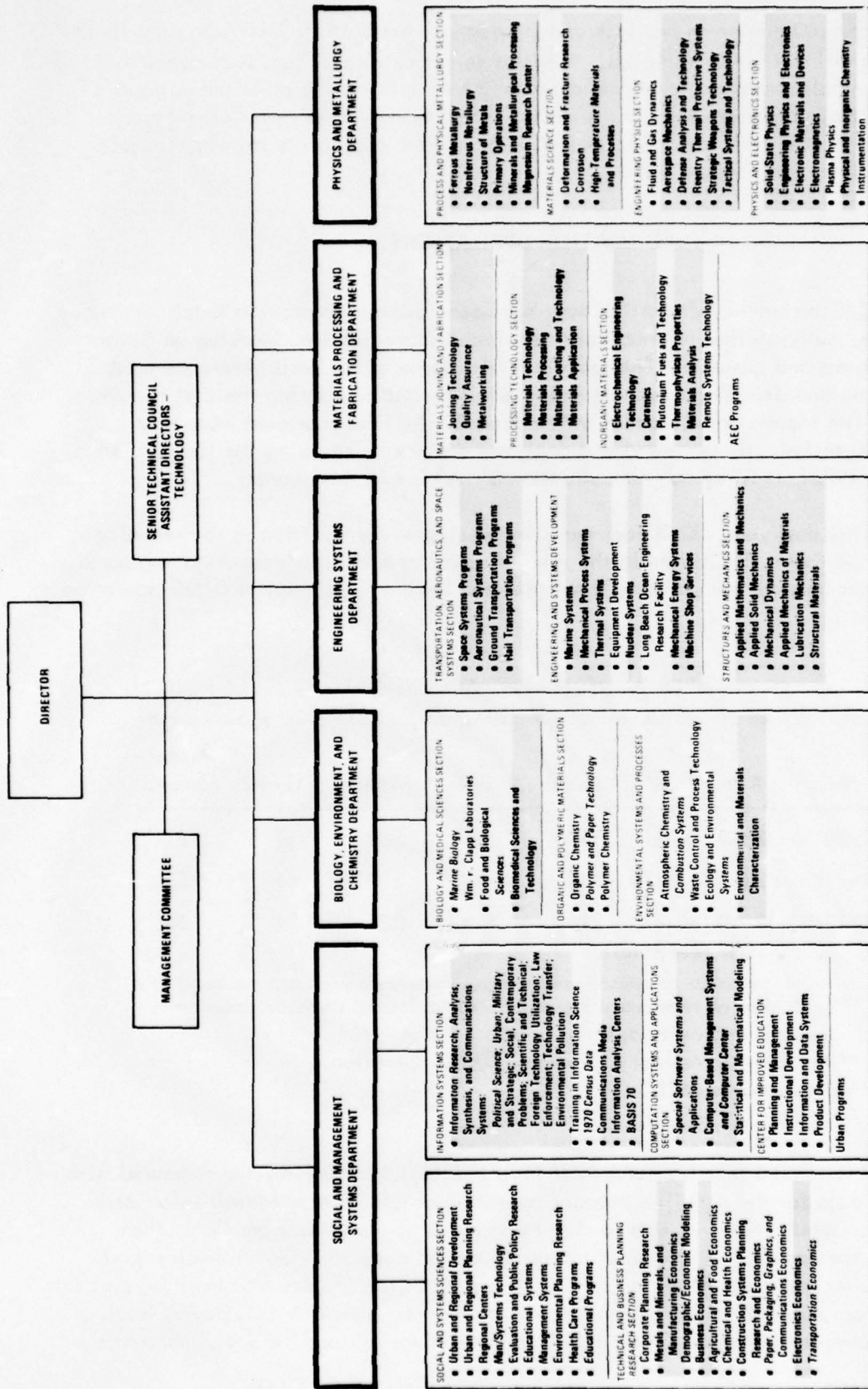


FIGURE 2a. ORGANIZATION OF MCIC WITHIN MATERIALS ANALYSIS DIVISION

*Consultant on ceramics, part time.

**Consultant on metals, part time.

TECHNICAL ORGANIZATION OF BATTELLE-COLUMBUS



November 1972

Over 100 engineers and scientists in 57 of the Battelle-Columbus Divisions provide authoritative advice and assistance to the Metals and Ceramics Information Center

FIGURE 2b. ORGANIZATION OF MCIC WITHIN BATTELLE-COLUMBUS

by nearly 100 engineers and scientists throughout the Battelle staff who contribute on a part-time basis as required. It is this select coterie of qualified authorities in the metals and ceramic technologies which constitutes the principal strength of MCIC; their experience and daily participation in *advanced materials* research provide the Center's users with expert advice and authoritative state-of-the-art publications (see Figure 2b).

INFORMATION OPERATIONS

The MCIC technical information base has been designed to provide timely, comprehensive, authoritative information to engineers and scientists, working on Center assignments and projects. The technical files serve as the basic reference tool, recording and detailing advances in materials technology during the past two decades. The Metals and Ceramics Information Center files represent more than 100,000 technically reviewed and analyzed documents covering the time period 1955 - 1972. It is the largest collection of its kind in this country.

During the past year, 3247 documents were selected for addition to the technical files. Of these, 1007 were in the area of ceramics and 2240 were metal-oriented. These numbers are compared to those reported for the final years of DMIC operation in Table 1.

TABLE 1. PERTINENT ACCESSIONS

Year	Total Accessions*	Reports	Articles	Papers	Internal	Miscellaneous
1970*	2845 (metals)	1640	914	213	57	21
1971**	2310 (metals)	1422	561	210	61	56
1972***	2240 (metals) 1007 (ceramics)	2164	765	235	27	56

*Exclusive of temporary items such as technical news releases -- journals and newspapers.

**Projected to reflect a 12-month DMIC operation.

***Operated as MCIC.

Table 2 shows the relative makeup of input. Fiscal 1972 figures are compared with similar data for the past five years of operation of the Defense Metals Information Center. While there has been a slight change in composition from 1971, the figures are exceptionally constant over the period covered. Government report literature constitutes 66.6 percent of the Center input; journal articles 23.5 percent; papers presented at technical meetings 7.2 percent; internal MCIC papers (such as trip reports and letters 1.0 percent, and other miscellaneous items 1.7 percent).

TABLE 2. PROFILE OF MCIC AND DMIC COLLECTION, percent

Category	1972	1971	1970	1969	1968	1967
Government Reports	66.6	61.5	57.6	62.6	63.4	62.8
Journal Articles	23.5	24.3	32.1	23.9	21.1	24.6
Papers from Meetings	7.2	9.1	7.5	10.0	11.1	7.8
Internal Papers	1.0	2.6	2.0	2.2	2.9	2.1
Miscellaneous	1.7	2.4	0.8	1.3	1.5	2.7

During FY72, reports were received on contracts sponsored by the following organizations:

	<u>No. of Contracts</u>	<u>% of Total</u>
Air Force	242	40
Navy	138	23
NASA	95	15
Army	95	15
AEC	35	6
Miscellaneous	2	1

The majority of government R&D programs monitored by MCIC for technical input purposes are identified through a continuing survey of Commerce Business Daily. Records are kept of all reported contract awards on subjects within the MCIC scope. This permits a regular assessment of the distribution of government investment in materials R&D and is the basis of MCIC's Contracts Data File. Such contracts awards information also is compiled, indexed, and regularly published by MCIC as a service to its users.

In each instance of new contract initiation on a subject related to the MCIC scope, form requests are sent to the government project engineer and to the contractor, requesting that MCIC be added to the primary distribution of technical reports. In about 60 percent of such cases, the request is honored, giving MCIC immediate access to the program's status and results. In those remaining instances where the MCIC request is refused (or ignored), the reports are requested through DDC. It should be noted that these procedures are time-consuming and costly; much of this effort could be saved if, as has often been suggested, DoD were to mandate automatic distribution of contract reports to the DoD Information Analysis Centers.

The current rate of new accessions for the MCIC files is about 300 per month. Each acquisition passes through a series of reviews and evaluations to determine applicability to MCIC scope, timeliness and merit of content, restrictions on use, pertinent MCIC technical specialist(s), etc. It then is indexed and marked for extracting of essential content. The bibliographic data and index terms are then entered into MCIC's files; in some instances, the extract also is prepared at this time. (In a majority of cases, however, the extract is not entered into the file until the first time it is required for output purposes.)

Figure 3 schematically depicts the flow of MCIC's information storage and retrieval.

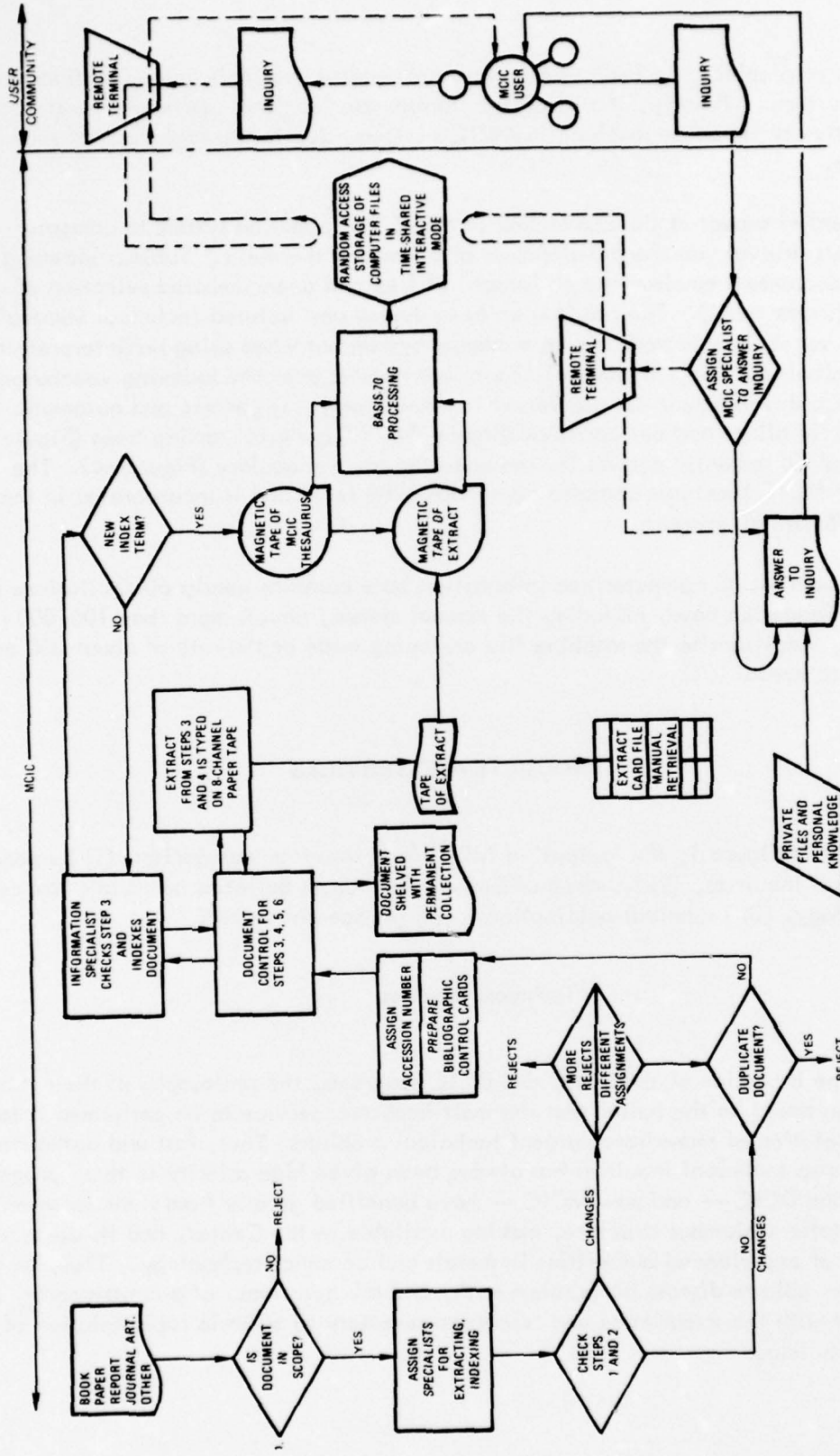
Both predecessor centers, DMIC and DCIC, used a multiple cross-filed manual card index system, including extracts or abstracts. These manual files are maintained for reference purposes but the active MCIC information base is now automated, using Battelle's BASIS 70 program.

BASIS 70 is a highly sophisticated computerized information storage and retrieval system. The system involves teletype or high-speed CRT terminals coupled to a time-shared computer housed at Battelle. Using an Intel 852 business machine, machine-readable paper tapes are processed in accordance with established formats. These paper tapes have been converted to magnetic tape and run through several computer programs designed to produce a digitized record. Index and header files have been built for the 'working-data base'. The computer files are searchable by publication data and index terms precisely in the same manner as the former manual files. The advantage of performing searches based upon Boolean statements (and/or logic) increases the speed and efficiency with which very specific information can be retrieved. In anticipation of future growth in usage, a continuing research and development program aimed at upgrading the BASIS 70 system is in progress. This will provide on-line updating, purging and editing of files, so that qualified remote users can conduct their own file maintenance.

Battelle is in the process of installing a second computer facility (Cyber '73). Immediate effects of the new computer will be the availability of several billion characters of high-speed storage and the ability to support approximately one hundred simultaneous on-line users.

MCIC is experimenting with a microfiche storage device which acts in conjunction with the computer to provide a fully automated information storage and retrieval system. The original document is microfilmed and stored off-line at the terminal site. The fiche is coded with the appropriate accessions number. While querying the computer system, the user may request a display of the microfiche. The image is projected from the storage carousel into a CRT. The image may be electronically edited and such revisions are stored in the computer processor memory. The two sources of information are integrated together in proper alignment and displayed as one composite output image on the system's monitor.

This system provides the means of handling vast data collections without the associated high costs of keypunching data conversion and computer storage. It further permits the



FLOW CHART FOR INFORMATION PROCESSING AND RETRIEVAL FUNCTIONS

storage of graphics, an important feature not readily available in conventional computer systems. Finally, it will permit storage and 'on-line' retrieval of extracts, currently not stored on machine in MCIC's system, due to the high costs of such storage.

An essential aspect of the conversion of MCIC's information system to computer storage/retrieval was the development of a working thesaurus. Subject indexing of MCIC documents employs the philosophy of free and unencumbered selection of clue words (index terms). The result is an open-ended unstructured technical vocabulary. Such a vocabulary is workable in a manual system but when using noninterpretive mechanical searching (computer), control is needed over the indexing vocabulary. Thesaurus development has progressed in three areas: (1) generic and automatic control for alloys and compositions (Figure 4a), (2) generic starting trees (Figure 4b), and (3) semantic control for the unedited raw vocabulary (Figure 4c). The current MCIC thesaurus contains more than 6700 terms and is incorporated in the MCIC/BASIS 70 program.

The current MCIC computerized information base contains nearly 6000 citations (the total information base, including the manual system, covers more than 100,000 references). Additions to the machine file are being made at the rate of about 300 accessions per month.

PRODUCTS AND SERVICES

As noted in Figure 1, the 'output' of MCIC falls into four categories: (1) Response to Technical Inquiries, (2) Issuance of Current Awareness Bulletins on metals and ceramics technology, (3) Technical publications, and (4) Special studies.

Technical Inquiries

Since the inception of the DMIC and DCIC programs, the philosophy of their management has been based on the belief that the most important service to be performed is to assist in the solution of immediate, urgent technical problems. Thus, fast and authoritative response to technical inquiries has always been given high priority in these programs. DMIC and DCIC -- and now MCIC -- have benefited greatly from their location within the Battelle-Columbus structure, making available to the Center, and its users, a large number of experienced authorities in metals and ceramics technology. Thus, an inquirer has been able to discuss his problem with, and ask questions, of a contemporary technologist with the experience and resources necessary to assist in rapid solution of the technical issue.

During the seventeen years of DMIC and DCIC services, the peak period for technical inquiries was 1967, when a total of 1761 inquiries were processed by DMIC and by DCIC. In 1971, the totals for a 10-month contract period were 942 metals inquiries and 431 ceramics inquiries.

In the 1972 12-month contract period, the total number of technical inquiries processed by MCIC dropped to 580 -- 471 for the first half of the year (August 1, 1971 to January 31, 1972), and only 109 for the second half (February 1 to July 31). Although the slowdown in the aerospace industry and other defense-oriented industries accounts for some of the recent decrease in inquiry activity, the overwhelming decrease during the second half of 1972 can be attributed directly to the introduction of charges for these services beginning in January.

Despite the decrease in technical inquiry activity in the last six months, analysis of the distribution of technical inquiry subject areas within the MCIC scope provides administrative awareness of the areas of greatest concern to present users. Table 3, showing the distribution of technical inquiries during the first half of the contract period, may be compared directly with Table 4, which shows the second half distribution. For an equitable distribution of subjects, some of the complex inquiries were subdivided into several subject categories, so that the total number of subjects of Tables 3 and 4 (827) is greater than the actual total number of inquiries (580).

Although most of the subject headings are self-explanatory, two need clarification. The column heading "Use, Market, and Source Information" refers to requests involving applications of materials, relative costs dealing with past, present, and projected markets for materials, procurement of materials, and contract identification. For the most part, the row heading "Miscellaneous" refers to materials that are of infrequent interest, that now are only marginally within the MCIC scope, or that deal with a combination of metal systems. Both tables show that titanium and properties of materials continue to be of greatest interest to MCIC users, as they have been in the past.

Analysis of MCIC technical inquiries since the inception of service charges (January 1) offers the following interesting conclusions:

Of a total of 104 organizations using the inquiry service, 38 were non-defense-oriented; altogether, the 104 organizations submitted 153 inquiries

Roughly half of the inquiries called upon the expertise of an MCIC engineer or scientist; the remainder were primarily literature searches

Most individual requests cost less than \$200 (many only the nominal minimum of \$35); all paid requests through July 31 yielded a total income of \$9,073

Only 5 organizations submitted more than 1 request (3 of these were government agencies, 1 aerospace contractor, 1 commercial firm)

Many problems, most of them predictable resulted from initiation of charges for information services. Applying a charging scale or "yardstick" to answers to inquiries "before the fact" has been particularly troublesome because a cursory effort must be expended to determine (1) whether a simple file search will suffice, or (2) whether the services of a Battelle technologist must be used, and the initial effort often may yield a correct answer, positive or negative, before authorization to proceed has been given. In any case, experience has taught the MCIC specialist that a negative answer (one that indicates that no data exist), regardless of the effort necessary to determine it, is not marketable.

Requestors must be informed of charging requirements and methods of implementing payment at the time that a request is made. Usually, while the requestor is determining whether his company (supervisors and/or business administrators) will allow charges, MCIC must evaluate the request and estimate its cost. Consequently, most requests require two or more telephone contacts, often including one with a company procurement official, and sometimes a letter explaining the type of answer to be given and the cost. If authorization is received, usually by way of a delaying purchase order, the MCIC response must always include a written reply, often with copies of the covering letter going to the requestor's business office, his supervisor, or both. The burden of "red tape" required both by MCIC and the MCIC user tends to counteract the Center's capability of instant response to urgent technical requests, causes more than half of the incoming requests to be cancelled before authorization to proceed can be obtained, and results in costly, unreimbursed efforts by both MCIC and user.

Experience to date with charges for technical inquiry services has made two facts apparent:

- (1) Defense materials, aside from common structural materials, used by all industry, are too sophisticated and too expensive for nondefense industrial use, and, therefore, information about them is only rarely of interest to the public sector.
- (2) Most government agencies and their contracting industries, particularly the aerospace industry, have no simple mechanism for paying for rapid responses to technical requests.

Recent experience also suggests that many companies and government agencies, in an effort to keep outside costs at a minimum, have lowered the "quality" of requests to the point where low-cost, key-word, computer searches for bibliographic information are substituted for answers requiring technical expertise. Although MCIC's files are capable of providing annotated, carefully evaluated bibliographies, such services do not employ the most valuable resource of the Center, its 'resident experts' in materials technology;

TABLE 3. DISTRIBUTION OF TECHNICAL INQUIRIES

August 1, 1971 to January 31, 1972

(First Half) FY 72

MATERIALS	Use, Market & Source Information	Production	Primary Fabrication	Secondary Fabrication	Powder Metallurgy	Joining	Diffusion	Mechanical and Physical Properties	Physical Metallurgy	Coatings	Environmental Effects	Quality Control	Friction & Lubrication	Sintering	Crystal Growing	General Technology	Total
LIGHT METALS																	
Aluminum	1	2		5		5		23	2	3	15	2					58
Beryllium	1					3		4	1	1						1	11
Magnesium	1			1		1		2	1		3					1	10
Titanium	31	4	1	28	1	16	2	39	10	14	25	9	1			2	183
HIGH-STRENGTH STEEL																	
Maraging				1				10		2	1					1	15
Stainless				5		3		34	4	2	9	2					59
General	2	1		4		5		27	5	5	3	2	1			1	56
REFRACTORY METALS																	
Chromium																	
Columbium	2			1		1		2									6
Molybdenum	6			1			1	1			3						12
Rhenium				1													1
Tantalum	5				1		2	4	1	1							14
Tungsten	2		1	2				3		1	2						11
General	1							1		2	2	1				1	8
SUPERALLOYS																	
Ni-Base	1	1	1	6	1	6		21	2	1	7					3	50
General	1	1		3		1		9	2		1	1				4	23
FIBER REINFORCED METALS																	
											1					2	3
MISC. METALS																	
	25			7	1	8	2	33	2	7	14	15				6	120
CERAMICS																	
	6	1		3		2		6		2	1					4	25
GRAPHITE																	
	2							1		2	1						6
GLASSES																	
						1				1							2
TOTAL	87	10	3	68	4	52	7	220	30	44	88	32	2			26	673

TABLE 4. DISTRIBUTION OF TECHNICAL INQUIRIES

February 1 to July 31, 1972

(Second Half) FY 72

MATERIALS	Use, Market & Source Information	Production	Primary Fabrication	Secondary Fabrication	Powder Metallurgy	Joining	Diffusion	Mechanical and Physical Properties	Physical Metallurgy	Coatings	Environmental Effects	Quality Control	Friction & Lubrication	Sintering	Crystal Growing	General Technology	Total
LIGHT METALS																	
Aluminum	1				1	1		8	1	1	1	1				1	16
Beryllium								1		1							2
Magnesium																	
Titanium	7	1	1	2	1	3		9		2	3	2				1	33
HIGH-STRENGTH STEEL																	
Maraging									1								1
Stainless				1		3		6			3	1	1				15
General	1							1		1							3
REFRACTORY METALS																	
Chromium																	
Columbium	1					1		3									5
Molybdenum				1		1		1			1						4
Rhenium																	
Tantalum								1									1
Tungsten																	
General	1									2	1						4
SUPERALLOYS																	
Ni-Base		1	1			1		6	1		1						11
General	2	1						3			1					1	8
FIBER REINFORCED METALS																	
	2															2	4
MISC. METALS																	
	3			1	1	3		6	3	2	4	2				4	29
CERAMICS																	
	6					1		5								3	15
GRAPHITE																	
								1		1							2
GLASSES																	
																1	1
TOTAL	24	3	2	5	3	14		51	7	10	15	6	1			13	154

rather, the responsibility for studying reference information, selecting that applicable to the immediate problem, and correctly using such information is laid back upon the user engineer -- at a potential cost, of course, far greater than would have been the MCIC service charge.

In an effort to partially ameliorate (2) above, MCIC has originated a task order contract plan which permits an agency or company to maintain an open-ended agreement through Battelle for servicing all technical inquiry needs. Under this plan, the organization designates a responsible official whose verbal approval is all that is required for MCIC to proceed with preparation of a response. Several companies and one government agency have established such task order agreements. It is hoped that this 'family' of regular users can be expanded in the coming year.

Reviews of Metals and Ceramic Technology

An important mission of the information analysis center is to alert its user audience on a timely basis to significant developments within its various fields of technology -- the so-called 'Current Awareness' Function. In 1962, the DMIC Reviews of Recent Developments covering technical topics within its scope were initiated, and in 1967, the DCIC Ceramics Awareness Bulletin was started -- each with the purpose of fulfilling this important need in the metals and ceramics technical communities, respectively. With the creation of MCIC and the introduction of publication fees, the two series were reformatted as the MCIC Reviews of Metals Technology and the MCIC Review of Ceramic Technology. Both Reviews now are available only by subscription through NTIS.

MCIC Reviews of Metals Technology

The format of the Reviews of Metals Technology is informal and the subject areas purposely kept flexible in order to accommodate changing emphasis in technology. The Reviews frequently report unpublished data and highlight important trends in materials and processing. In general, each Metals Review covers the subject area for a period of three to six months; however, most are issued quarterly. The subscription guarantees 48 issues. However, special Review issues also are provided subscribers at no extra cost.

Review authors represent the backbone of MCIC metals expertise. All are Battelle scientists who are authors or coauthors of many papers and reports, and most are well known in their respective fields. All either are directly engaged in, or supervise, research and development in their fields.

Subject areas of regular MCIC Reviews of Metals Technology are:

Advanced Composite Materials	Mechanical Properties of Metals
Aluminum and Magnesium	Metalworking
Beryllium	Metals Joining
Corrosion and Compatibility	Nickel- and Cobalt-Base Alloys
High-Temperature Oxidation-Resistant Coatings	Powder Metallurgy
Low-Temperature Properties of Metals	Refractory Metals
	Titanium and Titanium Alloys.

In addition, special Review subjects include:

High-Strength Steels
Liquid Metals.

Non-Traditional Machining

The Low-Temperature Properties of Metals Review was introduced in 1970 as the first regular cooperative publication. Costs for the preparation and distribution of this Review are shared by The Metal Properties Council. As a result, this issue is provided free of charge to all on the MCIC general distribution list regardless of whether or not they are Review subscribers.

MCIC Reviews of Ceramic Technology

The format of the Reviews of Ceramic Technology, although flexible, is somewhat more formal than the Metals Reviews. The Reviews contain digests of technical reports on ceramic technology that have become available to MCIC and on occasion feature an article of general interest. Digests and feature articles are prepared by various associates of the Ceramics Research Division of Battelle-Columbus. In addition, the Review features a section that identifies new research and development in the ceramics field. The digest contributors and the feature-article authors all are professionally experienced in advanced ceramic technology and well known in their field.

The Review of Ceramic Technology is published monthly; subject areas covered include:

ceramics	processing	characterization
selected glasses	fabrication	evaluation
glass-ceramics	applications	property determinations
carbon and graphite and related materials		fundamental studies of behavior

Subscription Availability

Subscriptions to either or both Review series are available only through the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, Virginia 22151. Subscription rates are as follows:

- (1) MCIC Review of Ceramic Technology, 12 issues, \$25 U.S., \$32 outside U.S.
- (2) MCIC Review of Metals Technology, 48 issues, \$95 U.S., \$125 outside U.S.
- (3) Combination of (1) and (2), 60 issues, \$115 U.S., \$145 outside U.S.

Examples of these Reviews are shown in Figure 5.

Review of Ceramic Technology
Metals and Ceramics Information Center
Issue No. 9
SEPTEMBER 1972
A Review of Selected Developments

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NOTICE

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Ceramics for Bone Replacement

A second annual report has issued from an ONR program for research in biomaterials at Cornell University. The current effort is directed to the use of porous ceramics for dental material (see Review of Ceramic Technology No. 2, February 1971, section 100000-143) and calcium phosphate (see section 143) and calcium phosphate were studied for their application. The report discusses reasons for changing the materials for dental prostheses, but previous work indicated that calcium phosphate ceramics became essential when they were implanted.

Materials were used for the implant and the porous ceramic materials were compared with other implantation. The porous

Review of Metals Technology
Metals and Ceramics Information Center
Advances in Metals Technology
A Review of Selected Developments
May 31, 1972

SELECTIVE REINFORCEMENT OF AEROSPACE STRUCTURES

Submersible design studies have demonstrated that significant weight savings are possible in tubular structures through the replacement of composite materials. The weight savings are not yet realized, however, because the cost of composite materials is still too high. A composite material is being used in a submersible structure in the selective use of composites to achieve optimum weight savings and cost effectiveness.

The ONR current interest in the selective reinforcement approach was evident in four reports and technical articles published in the Review of Metals Technology (see Review of Metals Technology No. 2, February 1971, section 100000-143) and calcium phosphate were studied for their application. The report discusses reasons for changing the materials for dental prostheses, but previous work indicated that calcium phosphate ceramics became essential when they were implanted.

Materials were used for the implant and the porous ceramic materials were compared with other implantation. The porous

FIGURE 1. SPACE SHUTTLE ROCKET TUBULAR STRUCTURE [2]

FIGURE 5. EXAMPLES OF REVIEWS OF METALS AND CERAMIC TECHNOLOGY

Publications

Comprising state-of-the-art reports, proceedings of current technical conferences, bibliographies, and handbooks, MCIC publications are intended to provide significant information in a form most useful to DoD components and other U.S. Government agencies and their contractors, in line with the primary objective of the Center. The choice of "significant" topics for publications, if the publication costs were 100 percent subsidized by the Government, would depend only upon the existence of a need by a Government component and the availability of MCIC resources to cover the topic. However, under the constraint of a contractual requirement to recover costs, selection of a topic for a publication must also be influenced by the estimated size of the total market for copies of that publication, including a portion which may be outside the Government-related group.

The MCIC publications policy of necessity is evolutionary, because of limitations in current knowledge of the new broader markets. The publication schedule at present is intended to be balanced and includes reports and handbooks of different types on a variety of topics within the MCIC scope, in attempts to determine the size of the market for each of them. As sales data are accumulated, it should be possible to provide more publications of the special-interest type, through pricing to provide operating funds for them, as well as continuing to publish items of broad interest.

Publications Issued During FY72

The status of the nine formal MCIC reports published during the contract period is given in Table 5. "Formal" reports include all those that were given an MCIC publication number. Three types were published: (1) state-of-the-art reports (include evaluative effort of technical specialists) -- MCIC 72-01, 02, 03, 04, 06, 07, and 08, (2) proceedings of technical conferences -- MCIC 72-05 and (3) bibliographies -- MCIC 72-09. As the table shows, 1000 copies of most of these were printed; the number sold of each as of July 31, 1972, is given in the last column.

The numbers sold should not be compared directly, since they represent sales over different periods of time. The figures are quite preliminary; the sales of 72-01 represent a period of about 8 months; others substantially shorter periods. Pricing was based on complete recovery of investment over assumed total sales of 1000 copies (800 for MCIC 72-06). Present planning is based on an assumed period of two years for complete recovery on each publication.

In addition to issuance of the formal reports listed, MCIC's publication activities during the contract period included preparation of a camera-ready manuscript for publication by ASTM, and of a series of special reports for ODDR&E on separate funds appropriated specifically by that Office (see Special Studies, below).

The ASTM manuscript was a 52-page document, "Compilation and Index of Trade Names, Specifications, and Producers of Stainless Alloys and Superalloys", completed during FY72 and scheduled for subsequent publication by ASTM under their Data Series DS-45A. MCIC's effort on preparation of this document was initiated during the previous (DMIC) contract period. Partial recovery of MCIC funds expended on preparation of the document will be effected through payment of a royalty by ASTM.

TABLE 5. STATUS OF FORMAL MCIC REPORTS PUBLISHED IN FY'72

<u>MCIC Publication No.</u>		<u>Price</u>	<u>No. Printed</u>	<u>No. Sold</u>
MCIC 71-01	Effects of Surface Condition on the Mechanical Properties of Titanium and Its Alloys, 68 pages, 88 references, 57 figures, 34 tables (August 1971). AD 732 248.	\$ 7.50	1000	508
MCIC 71-02	Shot Peening for Improved Fatigue Properties and Stress-Corrosion Resistance, 49 pages, 40 references, 39 figures, 10 tables (December 1971). AD 735 409.	\$ 7.50	1000	299
MCIC 72-03	Nontraditional Machining of Beryllium, 84 pages, 83 references, 58 figures, 19 tables (January 1972). AD 738 271.	\$ 9.00	1000	82
MCIC 72-04	Crack Behavior in D6AC Steel (An Evaluation of Fracture Mechanics Data for the F-111 Aircraft), 210 pages (includes 124 pages of data in original computer-generated format), 9 references, 55 figures, 13 tables (January 1972). AD 737 779.	\$12.50	1000	135
MCIC 72-05	Symposium on Electrodeposited Metals as Materials for Selected Applications, 125 pages, 70 references, 91 figures, 44 tables (January 1972). AD 738 272.	\$ 7.50	1000	99
MCIC 72-06	Impurity Effects in Beryllium, 67 pages, 64 references, 36 figures, 21 tables (March 1972). AD 741 896.	\$ 7.50	800	12
MCIC 72-07	Oxidation of Iron-, Nickel-, and Cobalt-Base Alloys, 55 pages, 172 references, 27 figures, 2 tables (June 1972). AD 745 473.	\$10.75*	1000	--
MCIC 72-08	Hot Corrosion in Gas Turbines, 52 pages, 52 references, 33 figures, 5 tables (June 1972). AD 745 474.	\$10.75*	1000	--
MCIC 72-09	Bibliography on Fibers and Composite Materials -- 1969-1972, 92 pages, references indexed by materials and by subject (July 1972).	\$ 8.50	1000	--

* \$18.95 combined price for MCIC 72-07 and MCIC 72-08

FY73 Publications

The subjects of current report preparation tasks for which formal reports are expected to be issued during FY73 are listed below. Official titles have not yet been chosen for these:

- (1) Proceedings of Superalloys Processing Conference (September 18-19, 1972)
- (2) Beta Titanium Alloys
- (3) Fracture Analysis by Scanning Electron Microscopy
- (4) A Decade of Advances in Welding Technology
- (5) Gas-Turbine Materials
- (6) New Developments in Nondestructive Testing
- (7) Atmospheric Corrosion of Aluminum and Aluminum Alloys
- (8) The Metallurgy of Repair Welding
- (9) Metallic Prosthetic Materials.

Tasks for preparation of three additional reports will be initiated in the near future, for a maintained formal-report publication schedule of about one report per month. Topics for the latter have not yet been chosen.

Additional activity in publication of special reports for ODDR&E, of the type described above, is anticipated during FY73.

Handbooks

In addition to its state-of-the-art reports, MCIC plans publication of several handbooks, being prepared under separate funding:

- (1) Manufacturing and Quality Assurance Manual on Fundamentals of Forging Practice (Contract No. F33615-71-C-1565).
- (2) Fracture Mechanics Engineering and Design Data Handbook (Contract No. F33615-71-C-1227).
- (3) Aircraft Designer's Handbook for Titanium and Titanium Alloys (Revised) (Contract No. F33615-71-C-1227).

In all of these cases, some MCIC funds will be invested in publication of additional copies of each of these handbooks, beyond the numbers required by each of the contracts listed. These extra copies will be sold by MCIC at a price calculated to provide full recovery of funds. Such an arrangement is mutually beneficial to the sponsors of the handbook programs and to MCIC. The handbook sponsors are able to secure their required number of copies at a lower unit cost because the larger printing volume helps to offset the large setup cost encountered for publications of this type. MCIC benefits because it is able to make this important reference information available to a large number of users at a moderate cost. Further, MCIC (and NTIS) provide a continuing facility for the updating and issuance of supplements to these handbooks.

A unique experimental 'publication', prepared during the contract period is a color film summary of one of MCIC's engineering reports. Titled "Scanning Fractures with the Electron Microscope", the movie is a brief -- but technically definitive -- introduction to the use of the scanning electron microscope in fracture analysis, the subject of the forthcoming MCIC Report 72-12. The 12-minute film is addressed to the engineer who is not familiar with recent advances in these technologies and who can make use of advanced methods for the determination of causes of material failures. A variety of uses are seen for this film, including in-house seminars, education programs, conferences, and, of course, promotion of the MCIC report. MCIC intends to make a careful evaluation of this method for presenting engineering information, and currently plans at least two more such experimental films.

Special Studies

MCIC is called upon to use its resources for a variety of special analyses and state-of-the-art reports, both for its DoD sponsor, for other government agencies, and for industry. Noteworthy among such work during the past year were the following:

1. Technology Assessments: For ODDRE, MCIC prepared four special reports and two informal studies of US versus Soviet technologies. Dubbed the 'Red/Blue' reports, topics included eleven general areas of materials and processes; re-entry materials; low-drag polymers; and two classified subjects. Several additional topics of interest in Net Technical Assessment are being considered for the coming year.
2. Analysis of US R&D Programs and surveys of high-temperature materials research for The Technical Cooperation Program (TTCP).

These studies were funded through supplements to the basic MCIC contract. Also undertaken, for the Department of Commerce, but unreimbursed, were a number of short analyses and responses to technical inquiries regarding the critical materials (embargo) lists.

MCIC believes that use of the Information Analysis Centers for special studies of this nature is one of the most valuable, but least employed, functions of the programs. We hope that, in the future, MCIC will be called upon more frequently to perform objective, authoritative evaluations of current technology, of new proposed research programs and of work in process.

PROMOTIONAL ACTIVITIES

With the introduction of charges for MCIC's information services, it became necessary to 'sell' the user audience on the value of the Center's products. Although the primary marketing function for publications is to be provided by NTIS, a general

promotional program has been considered essential. The objectives of this activity are three: to encourage the current users to continue to employ MCIC's services, to broaden the user community in the government and contractor sectors, and to introduce new audiences to the Center's benefits (particularly the public sector).

The current promotional program consists of:

1. The issuance of a monthly Newsletter to regular users; distributed free of charge, the MCIC Newsletter provides general news of interesting developments in the advanced materials, summarizes new materials procurements and sources sought, advises of technical meetings, and -- most importantly -- announces new MCIC products and services. The Newsletter is informal, intending to maintain a free dialogue between the Center and its technical community.
2. The preparation of a descriptive film on MCIC to be used in introducing the Center to visitors, to groups in the user organizations, and to conferences or exhibits. The 8-minute film, prepared partly at Battelle expense has been shown to audiences throughout the country and is frequently on loan to companies or agencies not fully aware of MCIC.
3. The distribution of special flyers and publication announcements, primarily those prepared by NTIS.
4. Participation in conference exhibits, such as the ASM annual meeting in 1971 and the ASIS national conference in 1972.

Additional marketing activities are planned for the coming year, to include the purchase of special mailing lists for publication announcement, visits to selected agencies and companies and discussions with publishers of trade journals.

NATIONAL TECHNICAL INFORMATION SERVICE (NTIS)

In order to take advantage of the established and extensive resources of NTIS, the DoD sponsor, in conjunction with the implementation of the service charge policy, offered the option of use of NTIS for the dissemination of IAC information products. Paragraph 2.3.4.4 of the MCIC work statement (Appendix A) provides for this option. Recognizing that the role of the information analysis center is to provide technical expertise rather than marketing skills, MCIC chose to accept this plan and initiated working arrangements with NTIS in May of 1971. The first publication to be consigned to NTIS for sale was report MCIC 71-01, issued in August 1971. An interim letter agreement covering arrangements for NTIS sales of this and subsequent publications was written in June 1971, following the terms of DSA/NTIS MU No. 72-DSA-1. This provides for all sales to be handled by NTIS with income subject to a handling charge of \$2.25 per report and a 10 percent marketing fee.

A total of ten MCIC reports plus the two Review subscriptions series were consigned to NTIS during the reporting period. Sales of these publications are reported in the paragraphs above; resulting income is shown in Figure 6. Although recognizing that there has been insufficient time to have obtained a reasonable estimate of the market for MCIC publications and that many factors (e.g., price sensitivity) have yet to be evaluated, it nonetheless must be observed that such sales to date are disappointing. An important reason for this must be the lack of experience in the promotion and sale of technical materials which previously were distributed free of charge. But a principal cause for the minimal sales is the lack of an organized and ongoing marketing program. Through this contract period, MCIC, except for announcements through its Newsletter, depended on NTIS for all sales promotion activities. That agency, unfortunately, has suffered understandable delays and difficulties in the implementation of its marketing efforts for the IACs. Through July 1972, NTIS announcements had been issued only on the first four of the MCIC reports; the announcement of the MCIC Review subscription service (which began in January) did not get distributed until April. In effect, then, literally all sales of MCIC publications through July resulted only from announcements in the Center's Newsletter. This fact must be taken into account when evaluating the results of the MCIC publication sales program in FY72.

However, it should also be recognized that the NTIS marketing program for the IACs became fully staffed in June and that now a very substantial effort is being put into an aggressive and dynamic promotional activity. As of this writing, a complete 'kit' of report announcements, order blanks, descriptive material, etc., has been prepared for MCIC and a widespread advertising program initiated. There is, therefore, considerable reason for encouragement and expectation that the distribution of MCIC publications through sales to the technical community will expand rapidly in coming months.

A formal continuing agreement with NTIS for sales and marketing services for MCIC is being negotiated and should be finalized by the time of issuance of this report.

MCIC SERVICE CHARGE PROGRAM

Although the DoD policy of charges for information services provided by its IACs was first stated in July 1968, a variety of technical, contractual, and legal issues delayed its broad implementation by the Centers until 1971. In the intervening period, most of the Centers, including DMIC and DCIC (and later MCIC) introduced fees for particular services and/or publications.

With the principal contractual issues resolved in mid-1971, MCIC began a phased transition to service charges beginning in August. As of that month, all new MCIC

METALS AND CERAMICS INFORMATION CENTER CONTRACT SUMMARY – FY72

Area Title	Units	Manhours		Costs	Income
		Professional	Nonprofessional		
(1) Acquisition and Input of Source Information a. Number of Accessions b. Accessions entered into file	<u>4277</u> <u>3096</u>	7720	8778	\$278,323	
(2) Technical Inquiries a. Inquiries received and processed b. Inquiry responses Paid Unpaid	<u>594</u> <u>62</u> ⁽¹⁾ <u>532</u>	3987	2196	123,981	\$4189*
(3) Nontechnical Inquiries Processed	1653	(6)	(6)	(6)	
(4) Handbooks and Databooks a. Hand/databooks issued b. Hand/databooks in preparation c. Hand/databooks supplements issued d. Hand/databooks supplements in preparation	<u>0</u> <u>3</u> <u>0</u> <u>1</u>	(7)	(7)	(7)	
(5) State-of-the-Art Reports a. Reports issued b. Reports in preparation	<u>12</u> <u>13</u>	2829	2069	107,000	10,037**(3)
(6) Current Awareness Bulletins Issued ⁽²⁾	61	3009	1118	95,508	33,882*
(7) Promotional Activities a. Newsletters issued b. Visitors c. Meetings, conferences, and other personal promotional efforts d. Other promotional activities (preparation of MCIC film)	<u>10</u> <u>57</u> <u>376</u> <u>1</u>	(6)	(6)	(6)	
(8) a. Other Direct Income ⁽⁴⁾ b. Indirect Income ⁽⁵⁾		2550 --	270 --	74,074 --	77,455 296,080
(9) Management and Support		6171	1441	134,833	
TOTALS		26266	15872	\$813,719	\$421,643

*Credited to MCIC account by NTIS.

**Includes \$4211 royalties for commercial publications; \$5826 credited to MCIC account by NTIS.

FIGURE 6.

FOOTNOTES TO FY72 CONTRACT SUMMARY

- (1) Inquiries processed after 15 December 71, when fees for technical inquiries were initiated.
- (2) MCIC's Reviews were distributed free of charge through December, 1971; distribution totaled about 4000 per issue. Placed on a subscription basis in January, 1972, total paid subscriptions through July, 1972, were 346 for Ceramics Review, 413 for Metals Review.
- (3) Income for reports includes NTIS credits for 1135 reports sold during contract period, income from sale on DCIC 69-1 Conference Proceedings, royalties from sale of DMIC 245 and royalties paid by ASTM for joint publications.
- (4) Direct income, in addition to sale of publications and inquiries, includes:

Source/Subject	Funding Basis	Amount
- Survey of U.S. vs Soviet Materials Technology for ODDRE	MIPR: Contract Mod. P00007	\$21,688
- Special Studies for TTCP/ODDRE	MIPR: Contract Mod. P00008	25,000
- Additional Surveys of U.S. vs Soviet Materials Technology for ODDRE	MIPR: Contract Mod. P00011	24,767
- Classified Study for ODDRE	MIPR: Contract Mod. P00012	6,000
		<u>\$77,455</u>

- (5) Indirect income includes:

Source/Subject	Amount
Publication of Proceedings of American Carbon Conference	\$ 5,000
Special Paper for Brooklyn Polytech Inst.	176
Publication of Joining Review for Metals Properties Council	6,000
Preparation of Fracture Mechanics Data Handbook* (Contract F33615-72-C-1227) Mod. P00001	49,500
Preparation of New Edition and Supplements to Titanium Handbook* (Contract F33615-72-C-1227)	29,957
Technical Service Agreements for Air Force, Navy and 5 Industrial Firms	2,780
Preparation of Manual on Forging Practices* (Contract F33615-71-C-1565)	106,000
Current Awareness Service on Composites (Contract W7405-ENG-92)	19,000
Technical Services Provided to Other (Government) Sponsored In-House Programs** - Ref. PAR 2.3.4.6 of Work Statement, Appendix A	71,950 (est.)
Credit for Technical Inquiry Services for Non-Paying Government Agencies - Ref. 'Interim Policy' 11 Jan 1972	<u>5,717</u>
	<u>\$296,080</u>

- (6) Man-hours and costs for non-technical inquiries and promotional activities are included in management and support totals.
- (7) Costs for handbook programs charged to separate contracts.

*To be published as MCIC Handbooks.

**Government contract numbers available on request; not included in this total is an estimated \$27,500 technical assistance provided to industrially-sponsored programs.

technical reports were consigned to National Technical Information Service (NTIS) for sale. Fees for technical inquiry services were instituted in December 1971. Beginning in January 1972, the MCIC current awareness bulletins, the Reviews of Metals and Ceramic Technology, were placed on a subscription basis, through NTIS, completing the transition.

The objectives of the service charge program are to recover part -- of all -- of the costs associated with the 'output' of the Center, thus providing an income to offset rising costs and to provide for expansion of services to the technical community. The revised contractual statement of work for MCIC adopted in November of 1971 states as a goal for the MCIC service charge program achievement of an annual rate of income equal to 50 percent of the initial contract funding by 31 December 1972.

MCIC income is treated in two categories, Direct Income from sales of publications and services, returned directly to the contract; Indirect Income, constituting separately funded studies assigned to MCIC, by both government and industrial sponsors. The latter also includes costs of services provided by MCIC to other sponsored programs in-house, in accordance with Paragraph 2.3.4.6 of the MCIC Work Statement (Appendix A). Income totals for the report period are presented in Figure 6; details on the sources of such income are given in the footnotes to that figure. It should be noted, incidentally, that although income in both categories was generated throughout the reporting period, that portion reflecting sales of publications and technical services represents only the seven months of sales effort since introduction of full-charge policy 1 January 1972.

Apart from separately sponsored MCIC studies or those funded as supplements to the MCIC contract, income at present is received through three channels. All publications, excepting the free MCIC Newsletter, are sold through NTIS; receipts from such sales are credited to DSA for addition to the MCIC contractual funding. Many charges for MCIC technical inquiry services also are billed through NTIS and similarly credited. However, a preferred arrangement in many cases is the establishment of a separate technical assistance agreement with Battelle, providing for MCIC services. At present, MCIC has six such agreements, including one for the Air Force Materials Laboratory. Income from these separate contracts is reported in the Indirect category mentioned above. A third source of income is through royalties for commercially published MCIC reports, including DMIC Report 245 (published by Bayer & Company) and joint technical publications with ASTM.

The MCIC contract establishes as a goal for the service charge program the achievement, by December 1972, of an average rate of total income equal to 50 percent of the initial contract funding. As Figure 6 reports, total income for the reporting period (essentially FY72) was \$421,643. This represents 57.8 percent of the initial contract funding for that period, \$730,000. Thus, the stated goal has been exceeded.

It must be realized, however, that Direct Income averaged 17.2 percent of contract funding for the period, while Indirect Income averaged 40.6 percent. The bulk of that Direct Income was in special studies funded as supplements to the MCIC contract. The direct return from sale of publications and inquiries must be considered as applicable only over the past seven-month period, and averaged \$6,873, or 11.3 percent of the (initial) monthly contract funding.

Because the NTIS marketing program had not been implemented until the end of the reporting period, and because the flow of publications for sale built up gradually during the initial seven months, there is good reason to anticipate that the return from sale of publications and inquiry services will steadily increase in coming months. However, it seems clear that a major increment in the 'income' to the program must continue to be the special studies and programs assigned to MCIC as supplements to the contract or as separate contracts. It also seems reasonable to conclude that, under present arrangements, the fees for technical inquiry services will return only a fraction of the cost of maintaining that service (which is, in our judgment, the most valuable service of the Center, if properly and sufficiently utilized).

FUTURE PLANNING FOR MCIC

The present MCIC program content is the result of nearly eighteen years of experience, growth and change. Yet over that period of time, the fundamental functions have remained the same -- maintenance of an up-to-date, authoritative information base, technical advice and assistance, current awareness services, technical reports and handbooks, and special studies. We believe, in fact, that these are the primary obligations of an information analysis center and propose to continue all five to the degree that resources will permit.

However, even assuming this framework of fundamental functions, there is substantial opportunity for continued improvement in MCIC service to the DoD sponsor and to the technical community. In addition to the introduction of service charges, a number of other, perhaps more subtle, changes have been made in MCIC activities in the past two or three years: the conversion of the information base to a fully computerized storage/retrieval system; the combination of the metals and ceramics scopes; the adoption of new formats for all publications, substantially increasing readability, convenience for reference use, etc.; the implementation of major handbook programs; the initiation of the MCIC Newsletter; improved reporting of new contract information; experimentation with new methods of communication (see below). Physical facilities, too, have been significantly improved, and better information handling and processing equipment introduced.

Constant attention is given by MCIC management to the planning of steady improvement in the Center's programs. Such planning addresses three basic objectives:

- (1) Assurance of maximum technical quality and professional efficiency in the Center's primary operations
- (2) Expansion of the user technical community and of the scope of MCIC services
- (3) Introduction of innovative and more effective methods of communicating contemporary information on materials technology.

With these purposes in mind, the following are some of the developments planned, or under consideration, for the near future.

Information Operations

MCIC's information base currently expands at the rate of 300 to 500 accessions per month. The system is highly mechanized and uses (as described above) computerized storage and retrieval. Three major developments are being considered for further improvement in both the utility and the cost-effectiveness of the information base.

For most of its existence, a key element of MCIC's files has been the preparation and storage of extracts of all accessed (and accepted) reference material. About two years ago, the preparation of such extracts was discontinued in most instances, as an economy move. (Extracts are prepared on any reference on the first instance when it is called up for use, but no extracts are stored in the computerized file.) Although the availability of the extracts in machine-readable form offers prospect of additional information products and speeds literature searches, the computer storage costs could not be justified. A study is being initiated to evaluate the use of a new on-line microfiche storage system, which potentially can offer the same benefits as computer storage at a fraction of the relative cost.

With the cooperation of DSA, arrangements are being made for the establishment of an on-line connection to DDC's integrated files. These consist of several data bases, access to which could substantially enhance MCIC's resources:

- (1) Program Planning (DD 1634)
- (2) Work Unit Summaries (DD 1498)
- (3) Technical Reports (DD 1473).

Under a special clause in the FY73 MCIC contract, the Center and DDC will conduct a joint evaluation of the remote access system, and of the usefulness of DDC's computerized files to the Center's mission. In the longer term, this DDC network connection

offers the prospect of reduction of information processing in-house and on-line availability of AEC and NASA information bases. The MCIC/Battelle direct DDC access installation will be the only one of its kind in a nongovernment facility. Thus, the evaluation will provide advice of value to the entire DoD IAC program, as well as to DDC and MCIC. It is anticipated that this evaluation will require 8 to 12 months to fully complete.

The third -- and longer range -- development is the prospect of eventual direct on-line access to MCIC's computerized files by user agencies and companies. The Center's machine files system has been designed from the outset to permit controlled remote access. A number of operational tests and demonstrations already have been conducted, from locations in Washington, Los Angeles, Huntsville, and Detroit. Feasibility already has been fully demonstrated. The practical questions to be resolved include the acceptance to the user engineer community, adaptability to the remote location environment, cost-effectiveness, methods of handling and controlling charges, and, of course, technical benefits to the user organization. During the coming contract period, plans will be made for at least two test on-line connections, one in a government laboratory, one in a contractor facility. MCIC will propose to share expenses in the test installations during the trial period. It is expected that the results of these evaluations will be available in 12 to 18 months.

As these evaluation programs are being conducted, and further improvements in the MCIC computerized information base are made, continued attention is being given to adaptability to the inevitable networking of the IAC systems. We foresee a probability that, within a decade, there will be on-line interchange among not only the DoD information analysis centers, but between these centers and technical information programs in several locations throughout the world. MCIC, in planning of technical improvements in its own system, will assure that it is able to continue to play a leading role in the exchange and dissemination of materials information.

Inquiry Services

As is the case with MCIC, other DoD Centers have experienced the same dramatic reduction in technical inquiries after introduction of service charges. We believe that the important effect on this particular service already is apparent; this service, which we have always considered to be the most important function of the IACs, is becoming unproductive, uneconomic, and unavailable to the technical community. Due to the costs of processing inquiries which are cancelled due to estimated price, the difficulties of charging a user for a negative response, and the excessive cost of processing the necessary paperwork for payment (both by the Center and at the user organization), the technical inquiry operations are running at a considerable loss. A substantial increase in volume could alter this picture, but does not appear likely.

We believe that the first objective of the DoD information analysis centers is to reduce duplication of effort, assist in the solution of urgent technical problems, and contribute to the more rapid development of DoD systems. And we believe that the most effective means for accomplishing this is through the provision of authoritative timely technical assistance. For these reasons, we are concerned with the current lack of utilization

of the IAC technical inquiry services, and we will urge our DoD sponsor to modify the current policy to permit the Centers to provide -- to DoD agencies and contractors -- technical inquiry services at no charge.

Although we hope for a favorable reaction to this recommendation, MCIC is continuing to explore alternatives which may assure greater availability and use of this technical service. Among these are:

- (1) Provision of all MCIC services on an annual subscription ('membership') basis
- (2) 'Packaged Service Plans' -- tailored to the needs of specific agencies or user organizations
- (3) Separate annual support by specific government agencies for inquiry services for their own laboratories and contractors.

There are both benefits and disadvantages in each concept; during the coming contract period, the feasibility of each of these -- and other possible -- approaches will be investigated. The objective, of course, will be to maximize the utilization of MCIC's technical resources.

Current Awareness Services

The MCIC Reviews of Metals and Ceramic Technology are well accepted in the materials community. It is intended to retain the current series, with particular effort being placed, both by MCIC and NTIS, on the expansion of the subscription lists. Topic coverage, within the two series, will be subject to change as the emphasis in new materials technology varies, but the framework -- and format -- will be retained.

Because we consider the current awareness activity one of the more important services of the IAC, additional series of Reviews, addressed to both additional topics and additional audiences, are being considered. Among these would be a Review series concerned with the reporting of trends in materials developments and new requirements, and a quarterly or semiannual newsletter on government contract awards and new program definition.

Subscriptions for the current Reviews are handled by NTIS; as of 31 July, there were a total of 515 subscribers. It is our opinion that the Review series is of continuing value to a much larger audience than this. NTIS' new marketing program will give particular attention to the MCIC Current Awareness Services; the goal for 1973 is a minimum of 1000 subscriptions.

Publications

MCIC's technical publications program is planned on the basis of 100 percent recovery of related costs (excepting certain administrative expenses), but it is recognized that such return from sales of reports and handbooks will extend over a period of years. Until considerable additional experience is obtained with the NTIS marketing program and a variety of publications 'on the shelf', a rational pricing policy will not be assured. Therefore, for at least the coming year, it is intended to maintain the current program, which provides for issuance of a new state-of-the-art report about monthly (see page 20). As income is credited to the MCIC contract from sales of reports by NTIS, those funds will be assigned primarily to additional publication tasks. The target, under this current plan, is to issue about 15 new engineering reports during Fiscal 73.

Three handbooks are scheduled for publication in FY73; two of these are new, the third a reissue and updating of an earlier DMIC handbook. The preparation of all three is being supported by the Air Force. In all three cases, there are plans for supplements and/or additional volumes. We view the issuance and maintenance of reliable, authoritative and up-to-date reference handbooks as one of the important functions of the IAC, and hope to add at least one new handbook or databook to MCIC's standard publications each year.

Marketing and Service Charges

As we have noted several times, insufficient experience is available to date to determine either the potential return on fees for MCIC publications and services, or the optimum format for the marketing and promotional programs. With the current implementation of the NTIS marketing effort and the several promotional resources now being tested, it is hoped that, by the end of the coming contract period, reasonably reliable data will be at hand for the definition of a positive, continuing, user community development plan.

However, it is intended that the current aggressive effort to expand both direct and indirect income sources will be maintained. As mentioned above, slightly over 11 percent of the initial funding level for the applicable period was recovered through direct sales during the first 7 months of calendar 1972. The goal for FY73 will be to increase this percentage to at least 20 percent. Similarly, particular attention will be given to the identification and development of sources for other direct (special study) funding, which, we have noted, is considered to be one of the more important uses of MCIC capabilities. The goal for this category of direct income, which totaled just over 10 percent of the initial contract funding in FY72, is 15 percent for the coming year. Due to definitional problems, it is difficult to establish a specific goal for the indirect category of income, but the objective will be to achieve at least a level of 20 percent of base contract funding.

As mentioned above, we sincerely hope that the policy regarding technical inquiry charges can be modified; since this activity is returning so little income at present, a reversion to the 'no-charge' plan (for government agencies and contractors) would have negligible effect on cost recovery goals for the program.

Technical Scope of MCIC

The technological environment in which MCIC exists is subject to continual change, both in purpose and in areas of emphasis. Similarly, MCIC must adapt to, and in instances, give leadership to changes in technological need. Such change ranges from specific technical concerns, such as the current concern with the mechanics of material fracture, to the questions of R&D investment and international technological competition.

Thus, it is intended that MCIC's scope of materials interest, and services to the DoD sponsor, as well as to the technical community, regularly be reviewed. Every effort will be made to 'sense' the needs of the audience served by MCIC and to maximize the utilization of the Center's resources.

WORK STATEMENT FOR THE
METALS AND CERAMICS INFORMATION CENTER
(Contract F33615-71-C-1067, P0006)

1. Abstract. The objective of the Metals and Ceramics Information Center is to provide information analysis services to the Department of Defense components, contractors, and grantees, U.S. Government Agencies and their contractors, and to the extent practical without impairment of services to the foregoing users, to the private sector, consistent with security and other limitations on MCIC information. Additionally, it is a goal of the Center to institute a service charge system for its products and services which, when combined with financial support for the program provided by other than DSA sources, will provide a rate of separate income by 31 December 1972 equal to at least 50 percent of the initial (FY72) funding of this contract.

2. Scope of Engineering Services and Requirements

2.1 Functions. The contractor shall operate MCIC and shall be responsible for the collection, review, analysis, appraisal, and summary of the available scientific and technical information and data on the materials as set forth in Paragraph 2.2. Additionally, the contractor shall be responsible for providing authoritative information to MCIC users on the materials within the scope of this Statement of Work.

2.2 Materials. The materials within the scope of the MCIC's competence and concern include:

2.2.1 Metals. Titanium and titanium-base alloys, beryllium and beryllium-base alloys, high-strength aluminum alloys, high-strength steels, high-strength alloys for elevated-temperature service (super-alloys), refractory metals, composites of or containing these metals, and coatings to improve corrosion and oxidation resistance of these materials. Magnesium, rhenium, vanadium, platinum-group metals and other metals and alloys used in structural applications shall be covered on a limited basis as resources permit and needs for information on these metals are recognized.

2.2.2 Non-Metals. Single crystal and polycrystalline metal oxides, sulfides, carbides, borides, nitrides, silicides, intermetallics, metalloid elements, and their refractory compounds, glasses, carbons, graphites and coatings for these materials, and combinations and composites of these materials with themselves or with other materials.

2.3 Products and Services.

2.3.1 The contractor shall provide technical information services on the materials within its scope to the users of the Center including the following:

- a. Response to Technical Inquiries
- b. Current Awareness Bulletins, newsletters, or similar technical services
- c. State-of-the-Art Reports and Memoranda
- d. Technical Handbooks and Databooks
- e. Other services within the scope of this Statement of Work, but not specifically cited subject to agreement and approval of the Contracting Officer and the Contracting Officer's Technical Representative (COTR). The AFML/LAM, WPAFB, O. 45433 is designated as the COTR.*

2.3.2 Limitations

- a. The subject of each candidate state-of-the-art report shall be approved by the COTR prior to its preparation.
- b. Changes in the nature of the above services, additions or deletions, shall be only with the approval of the COTR.
- c. Records of all services provided to users shall be maintained in a businesslike and auditable manner.

2.3.3 Services Charges -- The contractor shall establish a system of service charges including an auditable list of charges and users, applicable to all users and products that is designed to achieve the 50 percent cost objective specified in Paragraph 1 of the Statement of Work and consistent with one of, or combination of, the following provisions:

2.3.4.1 Reimbursement Procedure -- Reimbursement received for center products and services will be expended within the MCIC program in a manner that will enhance the technical quality and quantity of products provided MCIC users. Each category of products and services and income collected therefrom shall be clearly presented in the bills and management reports submitted to the Government.

2.3.4.2 MCIC may use a commercial publisher as they deem desirable and is authorized to negotiate separate agreements for publications and royalties.

2.3.4.3 Royalty received by Battelle Memorial Institute (BMI) from the sale of documents prepared during previous DCIC and DMIC contracts will be credited to the cost recovery objective.

*AMMRC/AMXMR-XP, Watertown, Massachusetts 02172, designated COTR effective 1 June 1972.

2.3.4.4 MCIC may negotiate an agreement with National Technical Information Service (NTIS) for dissemination of MCIC products and collection of service charges. The agreement will be consistent with the DSA-NTIS Memorandum of Understanding No. 72-DSA-1. A copy of the NTIS-MCIC agreement will be forwarded to the Contracting Officer.

2.3.4.5 Net reimbursement through sale of MCIC products will be added to MCIC program.

2.3.4.6 Credit toward the cost recovery objective will be allowed for services provided by MCIC to other sponsored activities provided that the cost of such service is not charged to this contract and provided further that the full cost of such service is reported in the management reports prescribed in this contract. The government contracts whose efforts are supported by this service including the nature of the service provided will be presented.

2.3.4.7 Costs for reproduction of publications for subsequent sale shall be an allowable contract expense, provided such cost is not otherwise obtained.

3. Special Requirements

3.1 Product Review Requirements. State-of-the-art reports, handbooks and special reports require review and advice of the Contracting Officer's Technical Representative (COTR) prior to formal printing, publication and/or distribution. Accordingly, four (4) draft copies of the manuscripts for such Reports shall be submitted for review purposes and return advice prior to final printing. Issues generated by this review shall be resolved between the contractor and the COTR prior to printing and distribution of the Reports. The contractor will allow 15 days for this review. Two (2) copies of such final Reports shall be furnished to the COTR for distribution in accordance with program management needs of the Government. Two (2) copies of each Report shall be forwarded to the Defense Documentation Center (DDC). Copies forwarded to DDC will be accompanied by announcement advice, including the service charge to be made therefor and source of the report. All other copies of these reports shall be subject to the service charge provisions specified by paragraph 2.3.4.

3.2 Limitations by Originators: The contractor shall comply with limitations on dissemination of information established by originators. MCIC users shall be advised of any limitations or restrictions that expressly pertain to any of the information supplied.

3.3 The Technical Information File. Technical information file of MCIC, exclusive of hardware and personnel, developed under this and previous contracts under DMIC and DCIC at the expense of the Government shall constitute a deliverable item at the direction of the Contracting Officer in the event of termination or expiration of this contract.

4. Reporting Requirement Guidance

4.1 The monthly progress reports shall contain specific information on the quantity of products and services rendered, number and kind of users served, manhours and costs, and service charges collected and/or expected.

4.2 The summary technical report shall contain specific long-range planning information.

4.3 All items published and/or furnished by MCIC will be clearly identified as products of the Metals and Ceramics Information Center.

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 Information retrieval

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 September 1972,
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 August 1, 1971, to July 31, 1972

This report reviews and discusses the continuing operations and development of the Metals and Ceramics Information Center. Activity and growth of the Center are discussed in terms of the six major work areas: Input, File Maintenance, Output, Systems Development, Management, and Marketing-Sales. Future developments of the Center are included.

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13. ABSTRACT The Department of Defense, in 1955, established the Titanium Metallurgical Laboratory at Battelle-Columbus, expanding the scope and changing the name to Defense Metals Information Center in 1958. The Defense Ceramic Information Center was assigned to Battelle in 1967. The two Centers were combined in 1971, forming the current Metals and Ceramics Information Center (MCIC). This is the first annual report on the new MCIC program, but its historical data are derived from the 17 continuous years of these DoD information service activities. In addition to merging of the two Centers, Fiscal 1972 was marked by the introduction of the full service-charge policy, which became effective for all MCIC services as of 1 January 1972. The first change was reflected in new formats and, to some degree, new services; the second has had a substantial effect on the dimensions and directions of the Center's efforts. During the contract year reported, 3247 references were added to the approximately 100,000 items in the MCIC files. 580 technical inquiries were processed (more than 80% of these before the introduction of inquiry charges). 61 issues of the Reviews of Metals and Ceramics Technology were published; the Reviews now are sold under subscription through NTIS. 9 formal state-of-the-art reports were published; and three new Handbook programs were initiated. Several special studies were conducted and the operations of MCIC were converted totally to the computerized system which was initiated in 1970. Arrangements were implemented for use of National Technical Information Service for marketing MCIC output.			

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