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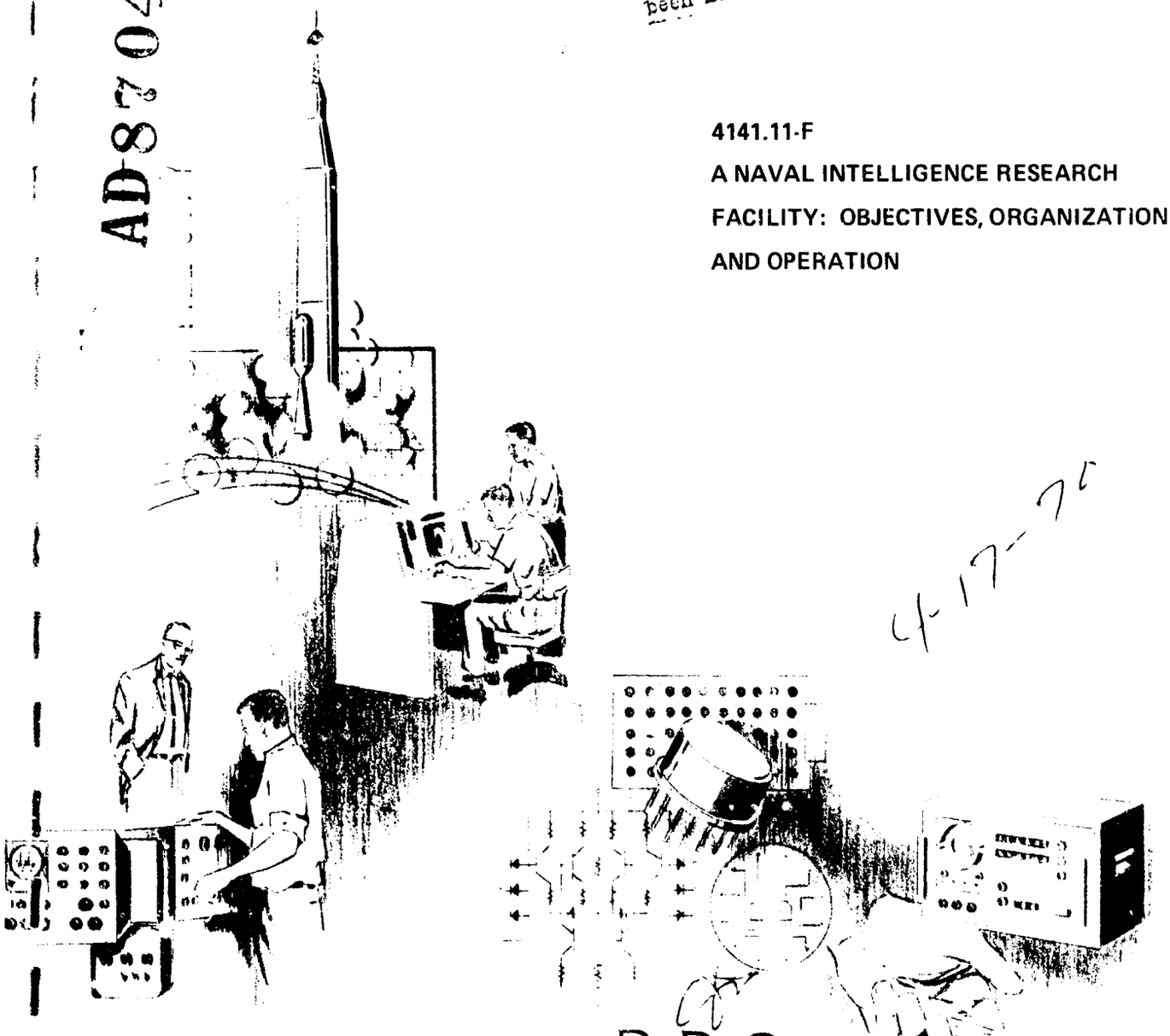
A NAVAL INTELLIGENCE RESEARCH FACILITY: OBJECTIVES, ORGANIZATION AND OPERATION



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A NAVAL INTELLIGENCE RESEARCH FACILITY: OBJECTIVES, ORGANIZATION, AND OPERATION

ONR Contract No. N00014-67-C-0355

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ABSTRACT

The findings of this report reaffirm the major recommendations made by HRB-Singer, Inc., in an earlier effort, viz., that a Naval Intelligence Research Facility (NIRF) be established and that the Naval Intelligence Research Advisory Group (NIRAG) be reorganized. Within the context of these two recommendations, this report describes the objectives of these two activities and presents an organizational and operational configuration which appears most feasible in light of existing objectives and constraints.

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LIST OF ABBREVIATIONS AND ACRONYMS

ACNO	Assistant Chief of Naval Operations
ADO	Advanced Development Objective
CNM	Chief of Naval Material
CNO	Chief of Naval Operations
CNR	Chief of Naval Research
CODAS	Current Operations Data System
DCNM	Deputy Chief of Naval Material
DCNO	Deputy Chief of Naval Operations
DCNO(D)	Deputy Chief of Naval Operations--Development (OP-07)
GOR	General Operational Requirement
IOIC	Integrated Operational Intelligence System
MORS	Military Operations Research Society
NARDIC	Naval Research and Development Information Center
NAVELEX	Naval Electronic Systems Command
NFOIO	Navy Field Operational Intelligence Office
NIC	Naval Intelligence Command
NIC-2	Naval Intelligence Command--Intelligence Systems Requirements and Support
NIPS	Naval Intelligence Processing System
NIPSSA	Naval Intelligence Processing System Support Activity
NIRAG	Naval Intelligence Research Advisory Group
NIRF	Naval Intelligence Research Facility
NMC	Naval Material Command
NMSE	Naval Material Support Establishment
NOSIC	Naval Ocean Surveillance Information Center
NRL	Naval Research Laboratory

LIST OF ABBREVIATIONS AND ACRONYMS (Cont'd)

NRTSC	Naval Reconnaissance and Technical Support Center
NTDS	Naval Tactical Data System
OASIS	Ocean All-Source Surveillance Information System
ONR	Office of Naval Research
OP-07	Deputy Chief of Naval Operations--Development
OP-07D	Special Assistant for Intelligence to DCNO(D)
OP-07T	Technical Analysis and Advisory Group to DCNO(D)
OP-92	Assistant Chief of Naval Operations (Intelligence)
OSIC	Ocean Surveillance Intelligence Center
OSIS	Ocean Surveillance Information System
REWSON	Reconnaissance, Electronic Warfare, Special Operations, and Naval Intelligence Processing Systems
SOR	Specific Operational Requirement
TSOR	Tentative Specific Operational Requirement

EXECUTIVE SUMMARY

Naval Intelligence, like all intelligence groups, is confronted with a growing problem of producing responsive, timely, evaluated intelligence from an expanding volume of collected data. Advances in computer and information processing technology offer the intelligence analysts a potential means for coping with this processing problem. To date, however, the anticipated potential has not been realized.

There exist two main difficulties which underlie the evident failure in achieving a sound man-machine partnership within the intelligence processing and reporting system. First, within the area of information handling, information scientists and engineers identify that "software" (processing algorithms, heuristic techniques, processing languages) seriously lag behind hardware capabilities. Thus, the operations of most computer-based processing systems are probably below expectations. Secondly, within the intelligence community, there exists concern that the processing needs of the analysts are not sufficiently understood to levy system development requirements. Significant advances against either of these two problems will require increased R&D activities.

Although the Navy now operates an extensive RDT&E program (through in-house laboratory activities and contracted efforts), there are some areas where improvement can be made with respect to intelligence processing research and development. First, unlike special purpose hardware systems, general purpose computer-based information systems can be significantly improved through software development. Innovations in software need not be tied to the major system development cycle, but may be efficiently advanced within DOD funding categories -- 6.1 (Research) and 6.2 (Exploratory Development), if pertinent R&D activities within these two categories are complementary and have appropriate problem orientation.

The second area where improvement can be made lies within the interrelating R&D activities necessary to the transfer of useful processing innovations into intelligence operations. Widespread applications of electronic data handling technology have created numerous lines of software R&D (e.g., medical diagnosis, fact retrieval of clinical information, selective dissemination of technical data, etc.). Much of these efforts, undoubtedly, have some pertinency to intelligence data handling. Unfortunately, however, security restrictions within the

intelligence community hinder outside researchers gaining awareness of intelligence processing problems; thus, they cannot evaluate their work with respect to this application. Moreover, within Navy intelligence, there has been no concentrated effort to continuously sift promising efforts emerging from other fields and transform, test and evaluate them against intelligence data handling problems.

Thus, there is considerable merit in having close communications among ONR (a prime link to the Nation's scientific community), CNM (major system developers), and ACNO (Intelligence). The recommendation is made to re-establish the Naval Intelligence Research Advisory Group (NIRAG) to effect this coordination function and to improve communications among the responsible Navy organizations involved in advancing intelligence processing systems.

It is recommended that NIRAG be augmented with an experimentation and exploratory development group which would (1) transform pertinent research results into demonstratable techniques for user test and evaluation, and (2) translate sensitive problem areas into less sensitive or unclassified research objectives which could be communicated to a wider range of the Nation's scientific and technical community. It is further recommended that this R&D group be established as an expansion of an existing branch within the Naval Research Laboratory and that they work in close coordination with the existing Naval support activities (e.g., NIPSSA, NRTSC, STIC, and the planned NOSIC -- scheduled to be implemented in FY-71).

I. INTRODUCTION

During the past year, under Office of Naval Research Contract N00014-67-C-0355, HRB-Singer, Inc., staff personnel have examined the interrelationships among the Naval Intelligence Command (NIC) and segments of the Naval scientific and technical community pertinent to improvement of NIC's capabilities to process, produce, and disseminate intelligence information. This final report summarizes this effort and presents the background of the study.[1] Essentially, this report reinforces the major recommendations made at the conclusion of the first year's effort (i.e., that a Naval Intelligence Research Facility (NIRF) be established and that the Naval Intelligence Research Advisory Group (NIRAG) be reorganized); describes NIRF's objectives; and suggests an organizational and operational configuration which appears most feasible in light of these objectives and existing constraints.

A. BACKGROUND OF INVESTIGATION AND RECOMMENDATIONS FROM PHASE I

Despite considerable improvement in intelligence collection capabilities, commensurate improvement in intelligence processing capabilities has not been achieved. The intelligence analyst is still confronted with problems of diminishing lead times, increasing response requirements, and ever increasing volumes of unevaluated or partially evaluated data. In effect, a collection/processing imbalance is evident.

Advances in computer and information processing technology offer the intelligence analysts a potential means for coping with this processing problem. To date, however, this potential has not been realized. The net effect is a widening gap between raw input and pertinent, finished output.

---

[1] The contract involved approximately four man-years effort spread over a two-year period. Highlights of the findings and recommendations from the first year's study are presented within Section I. See also HRB-Singer, Inc., report 4141.11-R-1, A Discussion of Needs and Guidelines for the Establishment of a Naval Intelligence Research Facility, August, 1968 (Secret).

As a result of the first year's study (Phase I), HRB-Singer made two major recommendations for ameliorating the critical lag between intelligence processing technology and intelligence collection technology. These were:

1. The Naval Intelligence Research Advisory Group (NIRAG) should be reorganized.
2. The Navy should establish a Naval Intelligence Research Facility (NIRF) having as its prime objective the development and testing of useful processing innovations pertinent to the Naval Intelligence Community.

These two recommendations are discussed briefly in the following sections.

1. Reorganization of NIRAG

In 1961, the Naval Intelligence Research Advisory Group (NIRAG) was formed. This group, composed of representatives from the Office of Naval Intelligence (now the Naval Intelligence Command), the Office of the Chief of Naval Operations, the Naval Security Group Activity, and the Office of Naval Research, had two prime functions. One function of NIRAG was to provide guidance to researchers working on efforts which had potential applications to Naval intelligence problems. A second function was to aid intelligence management in keeping abreast of research activities. The operation of NIRAG was purposely kept informal to provide flexibility.

Unfortunately, four factors have hindered NIRAG's effectiveness.[1] First, since NIRAG was an informal group, representatives of the various Naval groups often attended on an "availability" or "convenience" basis rather than by need, competence or interest. Second, the meetings often involved a mismatch between the R&D representatives and the operational intelligence personnel. Research presentations were sometimes considered to be so theoretical that possible applications of their findings were often obscured by the presentation.

[1] These factors were brought out in discussions with personnel who had been associated with NIRAG.

Third, NIRAG meetings essentially provided only "one-way" communications; i.e., contractors described their research efforts to Naval representatives, but there was no discussion of current or anticipated problems in Naval intelligence. Finally, and most importantly, the retirement or transfer of the original NIRAG members, coupled with the factors above rendered NIRAG ineffectual for all practical purposes. The last meeting of this group occurred in 1966.

Nonetheless, the NIRAG concept has considerable merit, and could provide a valuable means of effectively increasing the interface between the Naval intelligence community and the research and development community. Thus, it was suggested that NIRAG be reestablished. However, an attempt must be made to avoid the drawbacks associated with the original NIRAG.

2. Establishment of a Naval Intelligence Research Facility

Although NIRAG could improve the interface between research capabilities and intelligence problems, HRB-Singer concluded that there is also a need for a Naval Intelligence Research Facility which would focus the research and exploratory development required to transform basic research results into Naval intelligence processing capabilities. As envisioned, such a facility would have as its emphasis the study of information processing techniques potentially useful in Naval intelligence management and problem-solving efforts. General guidelines for the implementation and acceptance of NIRF were discussed in HRB-Singer Report No. 4141.11-R-1. In addition, five alternative NIRF configurations (and the associated advantages and disadvantages) were briefly described.

B. EMPHASIS AND FINDINGS OF CURRENT EFFORT

1. Emphasis

The objectives of the current year's effort have been to:

a. Determine the most feasible NIRF configuration for enhancing the planning, direction, and conduct of applied research and exploratory development for Naval intelligence information processing.

b. Determine the optimal composition and responsibilities of NIRAG.

c. "Fit" the NIRF and NIRAG concepts within the existing Navy organizational structure.

d. Identify specific problem areas within Naval intelligence which NIRF might address.

In order to meet these objectives, the organizational structures of Naval and other groups (e.g., Army, DIA, CIA) likely to directly or indirectly interface with a NIRF were analyzed. Discussions were held with key personnel in these groups to elicit reactions to the NIRF concept and to identify the organizations' potential role within the concept in light of their missions and objectives.[1] Current and proposed Naval intelligence systems (e.g., IOIC, NIPS, NTDS, CODAS, OSIS) were reviewed by examining available literature and through discussions with Naval personnel in order to determine what role NIRF might play in supporting these systems from a research and development standpoint.

The findings based on these analyses and discussions are presented below. These findings, when coupled with those of the first year's effort, gave rise to the recommendations listed in Section I-C.

2. Findings

Discussions with senior personnel within the Naval Intelligence Command and segments of the Naval R&D community have resulted in the following observations:

- Personnel in most of the Naval field elements and organizations visited were favorably disposed towards the aims and objectives of a Naval Intelligence Research Facility. Their enthusiasm was dampened, somewhat by an awareness of the constraints and limitations under which such a facility would have to evolve and operate. (These constraints are discussed in Section III.)

[1] Organizations contacted are listed in the acknowledgments of this report.

- In some form or another, many aspects of the proposed NIRF and NIRAG concepts now exist as uncoordinated activities in various areas of the Naval intelligence and research organizations.[1]

- There seems to be little awareness among members of the various elements of the Naval Intelligence Community as to the nature and extent of the data processing research being performed.[2]

- Presently, there is a growing reluctance on the part of universities to engage in Department of Defense sponsored research. Moreover, security restrictions hinder the awareness of basic and applied researchers (outside the intelligence community) on the kinds of Naval intelligence processing problems that must be addressed now or in the future.

---

[1] For example, the recently established Information Systems Branch, Mathematics and Information Sciences Division of NRL, encompasses the following intelligence R&D areas: operating systems development, intelligence analysis, intelligence analysts' interfaces, data base validation, information systems for ocean surveillance and other intelligence activity, etc.

These R&D areas are most relevant to advancing Naval intelligence processing capabilities and represent the kinds of activities that would be performed in the Naval Intelligence Research Facility. There are, however, no formal ties between these activities and the basic intelligence research efforts sponsored by the Information Systems Program of ONR.

[2] Of the 14 contacted, only two members of the Naval Intelligence Command were aware that the Office of Naval Research sponsored research projects in intelligence.

- All members of the Naval R&D community contacted (DCNO(D) and CNR) expressed a willingness to support NIC, but stated that the Naval Intelligence Command has not expressed an R&D requirement to improve processing. The formal channel for NIC's R&D requirements (e.g., the GOR, TSOR, ADO, etc.) does not necessarily reflect day-to-day problems of processing and production.

- Collection capabilities are still outstripping analysis capabilities.[1] The project investigators saw no indications that the gap between collection and analysis capabilities was closing.

- There does not seem to exist a mechanism to take methods and techniques, created under ONR sponsorship, smoothly into exploratory development, test, and evaluation.[2]

C. RECOMMENDATIONS FROM CURRENT EFFORT

HRB-Singer reaffirms the two major recommendations resulting from the first year's study; and in light of the findings, the need, and the real and anticipated constraints, recommends the following courses of action:

1. A Naval Intelligence Research Advisory Group (NIRAG) should be organized. (See Section II for a description of the proposed NIRAG.)

---

[1] This collection/processing imbalance was reaffirmed by NIC-2 personnel on 29 April 1969 in a presentation of the NIPS (Naval Intelligence Processing System). They stated that "...collection systems have advanced to such an extent that it has far outstripped our availability to process and analyze the collected information by manual methods."

Similarly, Assistant Chief of Staff for Intelligence (Department of the Army) memorandum dated 13 September 1967 to Commanding General U.S. Army Combat Developments Command states that "Several reconnaissance and surveillance studies have identified a major problem of Army combat intelligence as the inability to handle on a timely basis the mass of information generated by current collection means."

[2] The observation has been made by staff personnel within NIC that research results coming from ONR are too far removed from their operations to be judged for possible applications.

2. Core membership of NIRAG should be selected from OP-92, NIC, OP-07T, DCNM-Development, ONR, and NRL.

3. Based on a review of its mission and functions, OP-07D (Special Assistant for Intelligence to DCNO-Development) should serve as the focal point (chairman) for NIRAG.

4. A Naval Intelligence Research Facility (NIRF) should be established. (See Section III for a description of the proposed NIRF.)

5. In light of current constraints, NIRF should be implemented as an integral but distinct activity within an existing facility, viz., the Information Systems Branch of NRL.[1]

6. NIRF should have a full-time nucleus staff of appropriately cleared personnel to maintain close contacts with both intelligence problems and R&D advances.

7. NIRAG should be tasked with the implementation and subsequent evolution of NIRF into a major focusing point for the testing, evaluating, and transfer of innovations in Naval intelligence processing.

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[1] See Section IV for a discussion of other operational configurations which were considered during this study.

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II. NAVAL INTELLIGENCE RESEARCH ADVISORY GROUP

Improvement of Naval intelligence processing efforts occur in essentially two ways. Advancing technology and methodology provide increased capabilities that can be applied to intelligence. Mission oriented RDT&E efforts reduce recognized deficiencies that hinder existing and evolving operations. Critical to both paths of improvement are effective communications between the Naval Intelligence Community and the R&D Community.

Within the Naval establishment there exists a formal mechanism for the Chief of Naval Operations (CNO) to provide guidance to the technical community (e.g., Naval Material Support Establishment -- NMSE) in planning the Navy research, development, test, and evaluation program.[1] Long range study documents describe the future roles and missions of the Navy and provide broad guidance for Navy R&D programs. Additionally, the Chief of Naval Operations is responsible for the preparation of General Operational Requirements (GOR) which focus on the Navy's most pressing needs within each functional warfare and support area. Figure 1 is reproduced from OPNAV INST 3900.8C and provides an overview of the formalized exchange between the user (CNO) and the producer (NMSE or other cognizant developing activity) of research and development. This dialogue normally exists in the Navy R&D planning and procurement cycle for major systems (e.g., those that require RDT&E financing in excess of 25 million dollars or have an estimated production investment in excess of 100 million dollars).

Implicit within the formal communication channels is the requirement for the managers of the Navy's basic research programs (e.g., the Office of Naval Research -- ONR) to be cognizant of the future needs within the Navy and to plan, encourage, and support research efforts which may advance fundamental knowledge pertinent to the Navy's projected operations. Similarly, there is the implicit requirement for the technical community to be knowledgable of research results stemming from scientific endeavors that are relevant to the formulation, planning, and execution of mission oriented RDT&E programs.

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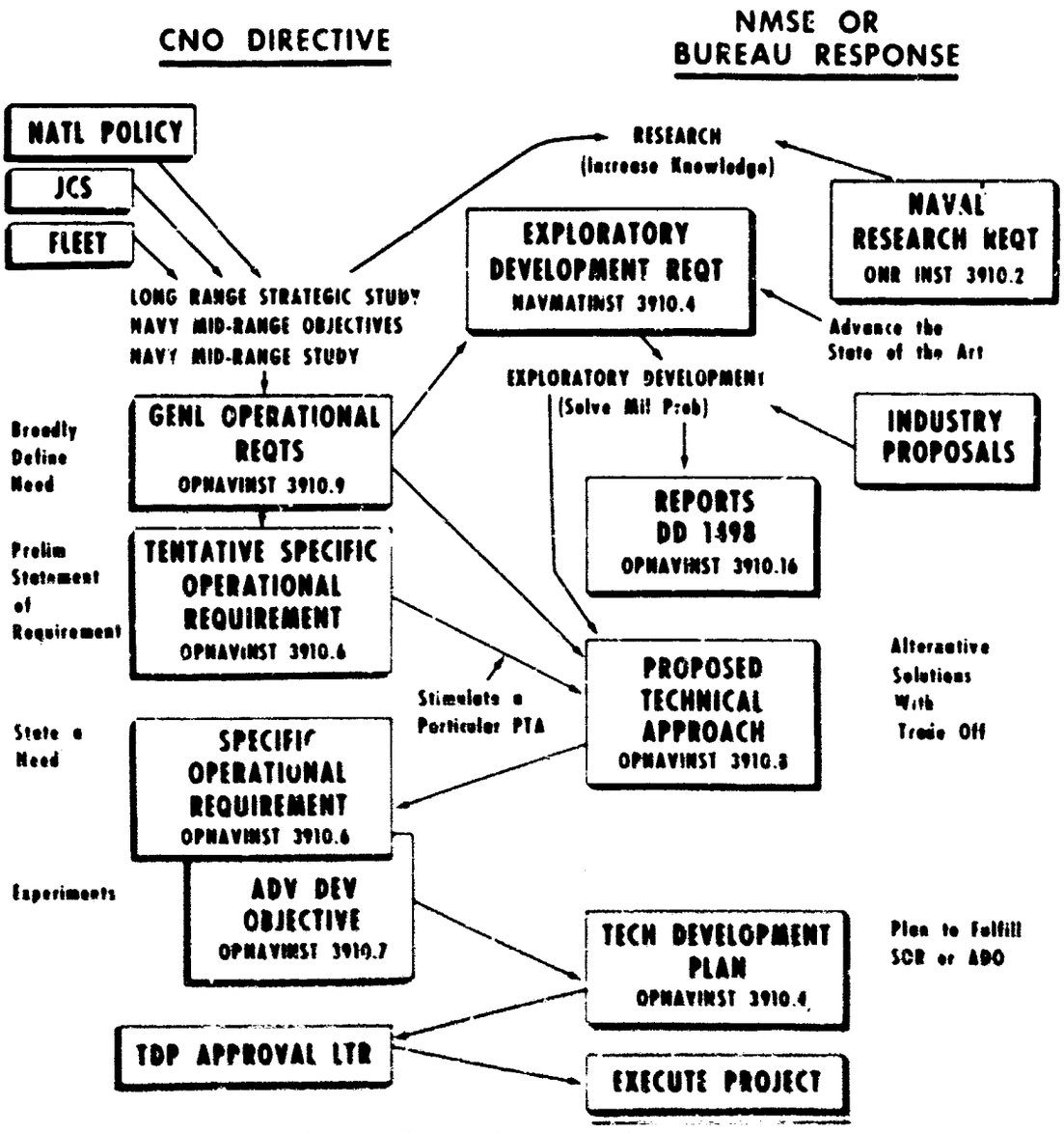
[1] Navy RDT&E planning procedures are described in OPNAV INST 3900.8C (17 January 1966).

DOCUMENTATION OF REQUIREMENTS FOR DEVELOPMENT EFFORT

OPNAV INST 3900.8*



*All instruction numbers are shown without revision letters. Latest revisions apply.

FIG. 1 OVERVIEW OF REQUIREMENTS FOR DEVELOPMENT EFFORT

AP9254

There are several observations that have led to the conclusion that the establishment of a Naval Intelligence Research Advisory Group can enhance the effectiveness and efficiency of this formal linkage between processing problems of Naval intelligence and the potential for solutions within R&D.

1. There is a need for closer participation by ONR in this communication chain. Major improvements in Naval intelligence processing will require further advances in intelligence analysis and synthesis methods. ONR's Contract Research Program provides the Navy with a significant link to the Nation's scientific community, a fundamental source for the development of processing methods.

2. There is a need for a mechanism to expedite computer software improvements in intelligence processing, outside the normal cycle provided by the RDT&E program. For example, the development of algorithms for intelligence processing need not be tied to large, expensive system efforts, but could proceed within the domain of 6.1 (Research) and 6.2 (Exploratory Development) categories.

In essence, a major role of NIRAG is envisioned as expediting communications among pertinent scientific capabilities, problem oriented exploratory development efforts, and the processing support activities within Naval intelligence. The following sections describe the mission and functions, organization, and envisioned mode of operation for NIRAG.

A. MISSION AND FUNCTIONS

The basic mission of NIRAG would be to serve in an advisory and coordinating capacity for exchanging information relating to intelligence needs and research capabilities. In short, the mission of NIRAG would be to "help close the communication gap" between the intelligence and the research communities. Specifically, NIRAG would perform the following functions:

1. Identify critical current and anticipated Naval operational intelligence problems.
2. Identify research currently underway (or planned) that may relate to current and anticipated intelligence needs.

3. Identify existing research facilities or capabilities that could be marshalled against a critical intelligence research requirement.

4. Report on progress being made on intelligence research problems identified previously.

5. Establish priorities of problems to be solved and coordinate the use of facilities which could be made available for attacking the problem.

6. Advise where and how basic research efforts could assist in (or will be required for) solving exploratory development problems.

7. Expedite the demonstration and evaluation of promising approaches and techniques to the Naval Intelligence Community.

8. Resolve problems of funding and allocation of resources.

Figure 2 summarizes the role of NIRAG in the flow of communications and introduces the basic transformation functions of NIRF. Under the auspices of NIRAG, the Naval Intelligence Research Facility transforms pertinent R&D results into processing capabilities that can be demonstrated to Naval Intelligence. NIRF, interacting with system development support personnel within NRTSC, NIPSSA, etc., transforms processing problem areas into research objectives which flow back to NIRAG for further action.

B. ORGANIZATION

The Naval Intelligence Research Advisory Group (NIRAG) would be composed on one or more spokesmen from the following organizations: OP-07, OP-92, ONR, NIC, NMC, and NRL. A representative from NIRF, the Naval Intelligence Research Facility, would also be a member of NIRAG, although he would probably also wear an NRL "hat" as well. One NIRF representative would serve as secretary for NIRAG. For coordination and administration purposes, the group

NIRAG-NIRF

A - MAINTAIN AWARENESS OF WORKS IN THE SCIENCES PERTINENT TO INTELLIGENCE PROCESSING.

B - STIMULATE BASIC RESEARCH IN AREAS WHERE FUNDAMENTAL KNOWLEDGE IS REQUIRED.

C - EXPEDITE APPLIED RESEARCH AND EXPLORATORY DEVELOPMENT ON PROBLEMS CONFRONTING NAVAL INTELLIGENCE PROCESSING.

D - COMMUNICATE AND DEMONSTRATE ADVANCED TECHNIQUES AND TECHNOLOGY TO THE NAVAL INTELLIGENCE COMMUNITY.

E - IDENTIFY NAVAL INTELLIGENCE PROCESSING PROBLEMS.

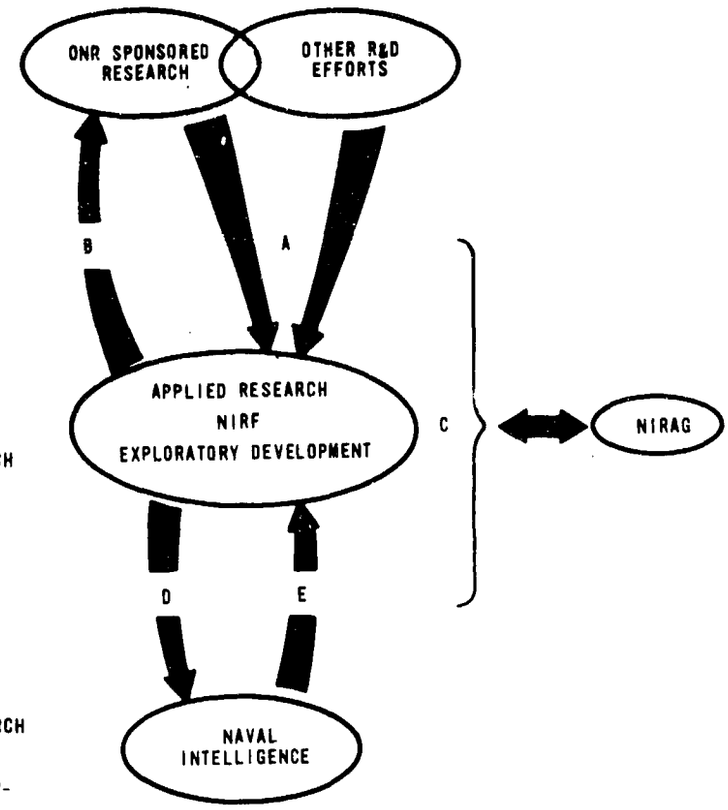


FIG. 2 FLOW OF COMMUNICATIONS IN PROPOSED ENVIRONMENT

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should be chaired by a representative from OP-07D.[1] The proposed organizational structure is in Figure 3. The actual number of representatives from each organization would probably vary as needs changed.

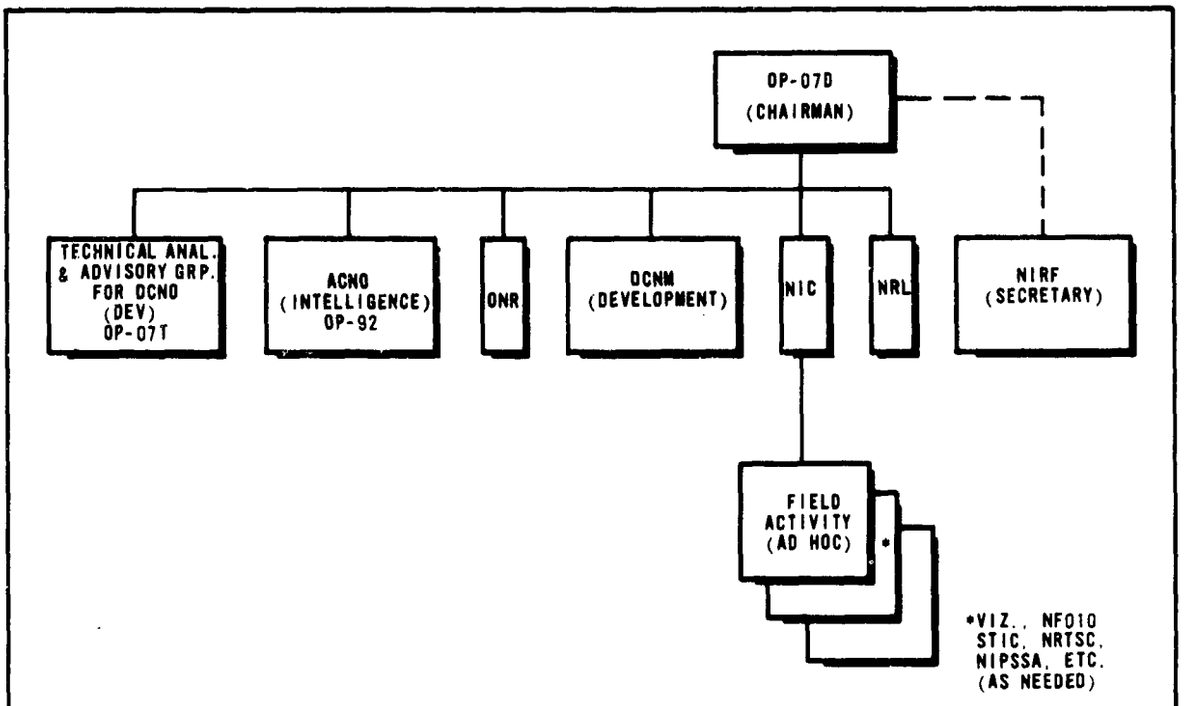

FIG. 3 PROPOSED ORGANIZATION MEMBERSHIP WITHIN NIRAG

AP9261

[1] OP-07D currently acts as the principal advisor, coordinator, control and liaison point for the DCNO (Development) in matters pertaining to intelligence. Staff assistance is provided by OP-07T. However, unlike OP-07D's current mode of operation, the proposed NIRAG concept would (a) have membership from various Naval intelligence and R&D groups; (b) concern itself solely with Naval intelligence processing problems (large and small); and (c) orient itself to the transition from basic research to development. Chairmanship of NIRAG would reside in OP-07D. Thus, NIRAG as proposed, would enhance OP-07D's role (specifically in intelligence processing) and improve the communications between Naval intelligence, research and development activities.

This proposed structure of NIRAG brings together the basic responsible elements required in support of Naval intelligence research and development, e.g.,

Element	Responsibilities
OP-92, NIC	Sponsors requirements for research, development, test and evaluation of new and improved equipment and techniques -- collaborates on actions to fill these requirements.
ONR, NRL, CNM	Identifies and supports relevant lines of research and development pertinent to the Navy's needs.
OP-07	Assists the Assistant Secretary of the Navy (R&D) with respect to coordination, integration, and direction of the Navy Research, Development, Test and Evaluation.
OP-07D	Acts as the principal advisor, coordinator, control and liaison point for the DCNO (Development) on matters pertaining to intelligence.

Within NIRAG, OP-92 and NIC are responsible for defining problem areas; ONR, NRL, and CNM are responsible for identifying relevant lines of research and development; CNM is responsible for determining which Naval laboratories can augment NIRF's activities with respect to critical problems; and ONR and CNM are responsible for the financial support of NIRF and all related R&D efforts. The chairman (OP-07D) of NIRAG is responsible for coordination and, through the assistance of the Technical Analysis and Advisory Group (OP-07T), aids in the promulgation of necessary GOR's, etc.

C. MODE OF OPERATION

A suggested mode of operation would include a minimum of four meetings a year. The meetings would be structured by an agenda which would include, at a minimum, critical problems to be attacked, progress made in addressing problems identified in previous sessions, current research underway or planned that would be pertinent to the Naval intelligence community.[1]

These items constitute the basic agenda of any NIRAG meeting. Ad hoc participants could also be summoned to report on specific aspects or developments under their cognizance which relate to the issues under discussion.

If both NIRAG and NIRF are implemented, NIRAG would, in addition to the above functions, discuss problems that have arisen or can be expected to arise in the pursuance of NIRF's activity. At each meeting, NIRAG should also undertake to evaluate NIRF's progress to date, as reported by the NIRF spokesman, and recommend appropriate action to be taken in the future. As a matter of course, all NIRF's activities should be evaluated on at least a quarterly basis.

It is suggested, as one means for better acquainting NIRAG members with the capabilities and facilities of the various research and intelligence organizations, that the formal meetings of the group be held on a rotating basis at the facilities of the different members constituting the group.

All formal meetings of the group would be supplemented by special ad hoc meetings as the need arose. Thus, should a critical need be identified by the NIC member of NIRAG, a special meeting could be called specifically for this purpose.

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[1] It should be noted that R&D activities of DIA, CIA, and NSA are important sources for advancing Naval intelligence processing; thus, NIRAG should interface with these activities in fulfilling its communications and coordinating responsibilities.

III. NAVAL INTELLIGENCE RESEARCH FACILITY

Discussion of the Naval Intelligence Research Facility (NIRF) within this chapter is separated into two distinct sections. The first section presents the underlying rationale of the NIRF concept. The second section presents the recommended form for NIRF; its mission and functions, organizational fit within the Navy, mode of operation, and resource requirements.

A. RATIONALE

Information science, although a newly emerging field, is most pertinent to the improvement of the art and science of intelligence processing.[1] The unique problems of intelligence, however, limit the direct transfer of innovations being developed within this rapidly expanding field. Moreover, the accelerating pace of scientific discovery is creating a gap between the practicing engineer and the researcher.[2] There exists a need to fill this gap with dedicated professionals who force the pace of technological change by intelligently sifting the vast flow of new concepts and techniques, testing their applicability within an area of specialization, and expediting the translation and transfer of useful information between the research community and the world of practice.[3]

The Naval Intelligence Research Advisory Group, as outlined in Chapter II, will play a vital role in bridging the gap between the Nation's R&D capabilities and the processing problems of Naval Intelligence. As a coordinating and communications node in the Naval Intelligence R&D network, NIRAG will undoubtedly expedite the flow of useful information among developers and users of processing methods and technologies. There are, however, two fundamental reasons why the

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[1] Several years ago, the President's Foreign Intelligence Advisory Board (PFIAB) recognized the problem of an imbalance between intelligence collection and processing capabilities and concluded that "...an appropriate combination of improved machine and human techniques for the processing of intelligence was called for. Specifically, the PFIAB turned to information science...". See Appendix B of this report for further extracts from the paper "An Information Science Center for the Intelligence Community."

[2] Ford Park, "Tomorrow's Engineer," Science and Technology, December 1967.

[3] Robert R. Mackie, et al., Translation and Application of Psychological Research, January 1967.

NIRAG concept alone is insufficient to fully expedite the development and application of processing innovations in Naval Intelligence. These reasons, in brief, are

1. Security requirements prohibit direct communications of intelligence processing problems to the Nation's scientific and technical community. There exists a need to transform these problem areas into unclassified (or less sensitive) research objectives and, unfortunately, this transformation function is extremely difficult. A long history of unsuccessful systems has shown that it cannot be accomplished by casual observation of the processing efforts or through periodic discussions with intelligence personnel.

2. An awareness of innovations is only the first step in the process leading to the application and adoption of novel methods and techniques. Communication lines must be augmented with the means for potential users to try, test, and evaluate R&D results. Moreover, feedback from these test efforts are vital to furthering system development.

Within the context of this study, one can identify technical personnel within organizations such as NIPSSA, NRTSC, STIC, etc., as "practicing engineers," dedicated to the support of various Naval intelligence processing functions. There exists a need to support these engineers with a research and experimentation team that would be conversant in the field of information science and whose talents are focused towards the processing problems of naval intelligence. The envisioned Naval Intelligence Research Facility is a necessary augmentation of the NIRAG concept and provides the environment and resources necessary to this transformation and transfer function. The following discussion examines the two reasons given above as rationale for the Navy's implementation of NIRF.

1. <u>Need for Better Problem Definitions</u>

The intelligence analyst is the hub of the processing effort. His experience and subject knowledge are vital to the intellectual processes required in data interpretation, evaluation, analysis, and syntheses. Like all involved professionals, he has little time to diagnose his problems and, in fact, probably could not if the time were made available.

The intellectual activities of the intelligence analyst have a reasonable counterpart in the creative activities of scientists and technologists. "Researchers in the field of information needs and uses gave up the approach of asking scientists and technologists for their opinions at least ten years ago, after it had been shown to produce poor and often entirely misleading results."[1]

Because the analysts' activities are often intellectual, direct observation of his efforts reveal little about how these processes can be aided or improved. Thus, one cannot expect to gain extensive valuable insights into the design of new and better intelligence processing systems by asking the analyst what he needs or by observing him in operation.[2]

In general, there are three courses of action that can provide better problem definition to orient intelligence processing R&D. These are

a. Implement an educational program to cross-train intelligence analysts in the tools of the information sciences. This approach has been recently adopted, and the Information Science Center at the Defense Intelligence School will begin its first program of instruction in early 1970.

b. Implement a program to involve qualified information scientists and engineers with real intelligence processing problems. Such a program could provide selected individuals with the opportunity to gain background information at the intelligence training centers and on-the-job participation in intelligence processing activities.

c. Implement an experimentation program involving participating analysts where sufficient control can be exercised to insure that changes in performance can be traced back to variations in the variables of interest -- e.g., innovations in processing methods.

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[1] Annual Review of Information Science and Technology, Volume 4, 1969 Encyclopedia Britannica, Inc., Chicago, Illinois (p. 21).

[2] It should be noted, however, that some "mechanical" aspects of processing (e.g., file maintenance, report writing and editing, etc.) may be examined through typical time-motion analysis of data flowing through a processing facility.

The first two courses of action operate under the premise that personnel, who know both the problems and the range of potential capabilities, can make better judgments about appropriate R&D direction than those who know (at most) one side of the coin. The third course of action considers that even enlightened opinion is fallible and that significant improvement can only occur after there exists an objective means for measuring differences among alternatives.

Experience in other fields is beginning to indicate that all three courses of action should be followed simultaneously. M.I.T.'s project INTREX (Information Transfer Experiments) is one example. In this program, the problems of the library and information transfer are being attacked with the ever improving capabilities of data processing, storage, retrieval, communications, and display technologies. Librarians are beginning to learn about computers, and computer entrepreneurs are beginning to appreciate the problems associated with the care and feeding of large library complexes.[1]

2. Need for Expediting the Adoption of Useful Processing Innovations

Improvement in intelligence processing will be accomplished by increasing both the mechanical and creative aspects of information handling within this community. The continuing development of computers, microform and imaging systems, communication networks, etc., will undoubtedly remain major technologies for managing and exploiting intelligence information. These same technologies are, of course, dominant in all fields where information is a significant resource to be used and reused in support of man's decision processes. Because the need is so wide spread, there is little doubt that by the year 2000, information processing technology will have etched its mark on history like the industrial revolution and the nuclear era.[2]

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[1] An important point in this interaction is that problem discussions and research results flow through both communities (i.e., the library and computer fields), stimulating further activities beyond the level of support provided INTREX.

[2] The year 2000, A Framework for Speculation on the Next Thirty-Three Years, Kahn, H. and Weiner, A. J., 1967, The MacMillan Company, New York (p. 87).

As the United States advanced technology and active markets encourage data handling innovations, a spectrum of processing concepts continues to emerge which may be applicable to Naval Intelligence. One sizeable problem in this environment is the difficulty of selecting and integrating appropriate innovations into evolving intelligence systems.[1] NIRAG will increase the Naval Intelligence Community's awareness of important processing advances by improving communications among the researchers, system developers, and system users. There are, however, three other places where improvement could expedite the application of useful processing innovations.

Once an individual is aware of a novel concept, there are usually three additional stages that precede his decision to adopt the innovation.[2] These are the interest, trial, and evaluation stages of the adoption process. This process can be accelerated by augmenting the activities within each stage and by reducing the lag time between stages.[3] In this respect, meaningful demonstrations are an order of magnitude more useful than technical reports for arousing user interest in a technique or technology. Moreover, once interest has been stimulated, convenient user participation is important throughout the trial and evaluation stages. It is envisioned that NIRF, the proposed vehicle for a continuing experimentation and exploratory development program, could provide the necessary functions to (1) transform potentially useful R&D results into demonstratable techniques against (real or realistic) intelligence problems, (2) assist in applying processing innovations and aiding in their evaluation, and (3) guide further research and system development efforts through knowledge gained in these RDT&E activities.

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[1] In general, an "appropriate" innovation is one which provides a desired capability at an acceptable cost.

[2] See, for example, Diffusion of Innovations, Everett M. Rogers, 1967, New York: The Free Press.

[3] Other important factors influencing the adoption process include: the nature of the exposure of the innovation, role of opinion leaders (individuals who influence the diffusion of new ideas--e.g., management), activities of change agents (professionals who influence the adoption decision--e.g., R&D leaders, vendors, etc.), and the extent of personal communications among involved individuals.

B. BASIC CONCEPT

The essential concept of NIRF is to provide a core capability necessary in transforming (1) vague problem areas into specific research objectives and (2) general research results into demonstratable capabilities. This concept encompasses a need to perform (1) experiments to determine what influences system improvement and (2) exploratory development efforts to integrate and test new concepts against problems of intelligence. To be effective, NIRF personnel must have sensitive awareness of existing and planned Naval Intelligence systems and must be able to communicate with both the scientists and engineers within the R&D community and the analysts, interpreters, operators, etc., who have the task of producing intelligence from the collected data.

1. Mission and Functions

The basic mission of NIRF would be to provide the Navy with the means for advancing, testing, and evaluating data processing innovations relevant to improving Naval Intelligence capabilities. To carry out this mission, the NIRF would perform the following functions.

a. Develop and maintain a continuous in-house exploratory development program to test, evaluate and demonstrate emerging methods and technologies in the information and computer sciences for Naval Intelligence applications.

Promising approaches and techniques should be tested and evaluated on genuine data and, where tests show positive results, NIRF personnel would demonstrate technical feasibility to selected members of the Naval Intelligence Community.[1]

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[1] NIRF should maintain a library of tapes, source reports, etc., (representing the various input data being processed by Naval Intelligence personnel) for analysis and testing purposes.

b. Assist NIRAG in supporting DCNO (Development) and ACNO (Intelligence by identifying and assessing important trends in science and technology pertinent to intelligence processing and production.

In performing this function, the NIRF staff should evaluate current research underway for possible application to current or anticipated problems of intelligence processing. The NIRF staff would also identify areas for which additional developmental or basic research is required. This information would be of particular interest to ONR and CNM since it would provide guidance for committing funds and manpower on future efforts.

c. Support NIRAG in maintaining communications between Naval Intelligence offices and the scientific community on problems and developments of mutual interest.

Because intelligence R&D studies are often excluded from normal communication channels, NIRF can provide a major service to Naval Intelligence by filtering and channeling information between the two communities. In this function, NIRF can support NIRAG by maintaining a file of classified studies, R&D reports, etc., that can be used in support of qualified research efforts. Additionally, NIRF should participate in existing avenues for exchanging information (e.g., attending conferences such as MORS, visiting research sites such as the Army's Behavior and Systems Science Research Laboratory, maintaining contact with groups examining similar problems such as the Information Science Center at DIS and the planned Experimentation Facility of DIA).

d. Provide support to specific R&D contract efforts sponsored by ONR and CNM as directed by NIRAG.

The facilities, professional staff, and data bases available at NIRF can significantly aid R&D efforts by expediting the contractor's acquiring problem awareness, background of previous R&D thrusts, representative data, etc.[1]

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[1] Conversely, it is envisioned that NIRF may seek contractor assistance with in-house projects which may necessarily exceed the scope of available resources.

2. Organizational Fit Within the Navy

In addition to recommending the establishment of a Naval Intelligence Research Facility (NIRF), it is recommended that NIRF be located within the Naval Research Laboratory.[1] The description of NRL states that "In its investigations of broad scientific areas, in considering its findings for potential military applications, and in furnishing to the Naval Systems Commands and Secretariat expert consultative services related to science and military systems, NRL functions as the corporate laboratory of the Navy."[2] This description further states that, "The mission of the Naval Research Laboratory is to conduct scientific research and development in the physical sciences and related fields directed toward new and improved materials, equipment, techniques, and systems for the Navy."[3]

The combination of the preceding description of NRL and the findings presented in this report identifies NRL as a most appropriate parent organization for NIRF. Specifically, the Information Systems Branch of NRL appears to be a logical setting for NIRF. This branch is currently charged with information systems research in areas of surveillance and intelligence, computer sciences, information system development, to name a few.[4] Therefore, it now performs (at least partially) the role envisioned for NIRF. Although this branch is not exclusively oriented to intelligence-related research, the Information Systems Branch does have most of the essential "ingredients" for performing the NIRF mission. Some of these "ingredients" include: (a) a technical staff, (b) physical facilities, (c) computer (forthcoming), (d) security clearances, (e) access to a wide range of expertise pertinent to naval intelligence processing problems, and (f) a location in close proximity to major staff elements and field activities within naval intelligence.

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[1] This recommendation is based, in part, on the findings presented in Section I-B.

[2] Extracted from the document titled Naval Research Laboratory, dated 15 April 1969.

[3] IBID.

[4] It should be noted that the Information Systems Branch is currently supporting NAVELEX in formulating the concept for the OASIS program.

Within the area of intelligence processing (NIRF's prime areas of consideration), extensive coordination will be required between the NIRF staff and other processing groups, e.g., NRTSC (image processing), STIC and the EW Division of NRL (signal processing), etc. Groups such as these would provide valuable assistance, within their processing specialties, to NIRF's activities. NIRF then, would not attempt to duplicate the efforts of groups such as these, but instead would augment this existing expertise in its own efforts. Figure 4 illustrates the recommended organizational setting of NIRF within the Navy structure and the interaction between NIRF and other groups.

3. Mode of Operation

Two types of intelligence-related R&D should take place under the NIRF configuration as presently envisioned.

a. Problem-Oriented R&D -- Priorities for this type of activity would be assigned by NIRAG. It is anticipated that most of NIRF's effort and monies would be utilized in this orientation.

b. Capability/Technology-Oriented R&D -- In this type of activity, the NIRF staff would have the freedom to pursue items of interest which, in general, may hold promise for intelligence processing. This type of activity, although goal-oriented in the sense that it is a means of relating current technology to intelligence processing, is essentially "undirected." It permits an element of flexibility in NIRF's operations in that promising, relevant research can be examined and tested as part of the continuous R&D program without recommendations from NIRAG.

The following steps illustrate NIRF's involvement in problem-oriented activity (see also Figure 5):

a. R&D program priorities are assigned by NIRAG.[1] These research problems may be generated by OP-92, NIRF staff members, NIC field activities, etc. Figure 5 illustrates the basic steps against an "approved" example problem area formulated by NIPSSA.

[1] The program for NIRF should be outlined annually to facilitate planning. However, in order to review and update NIRF's efforts, quarterly sessions should be held, with additional sessions as required.

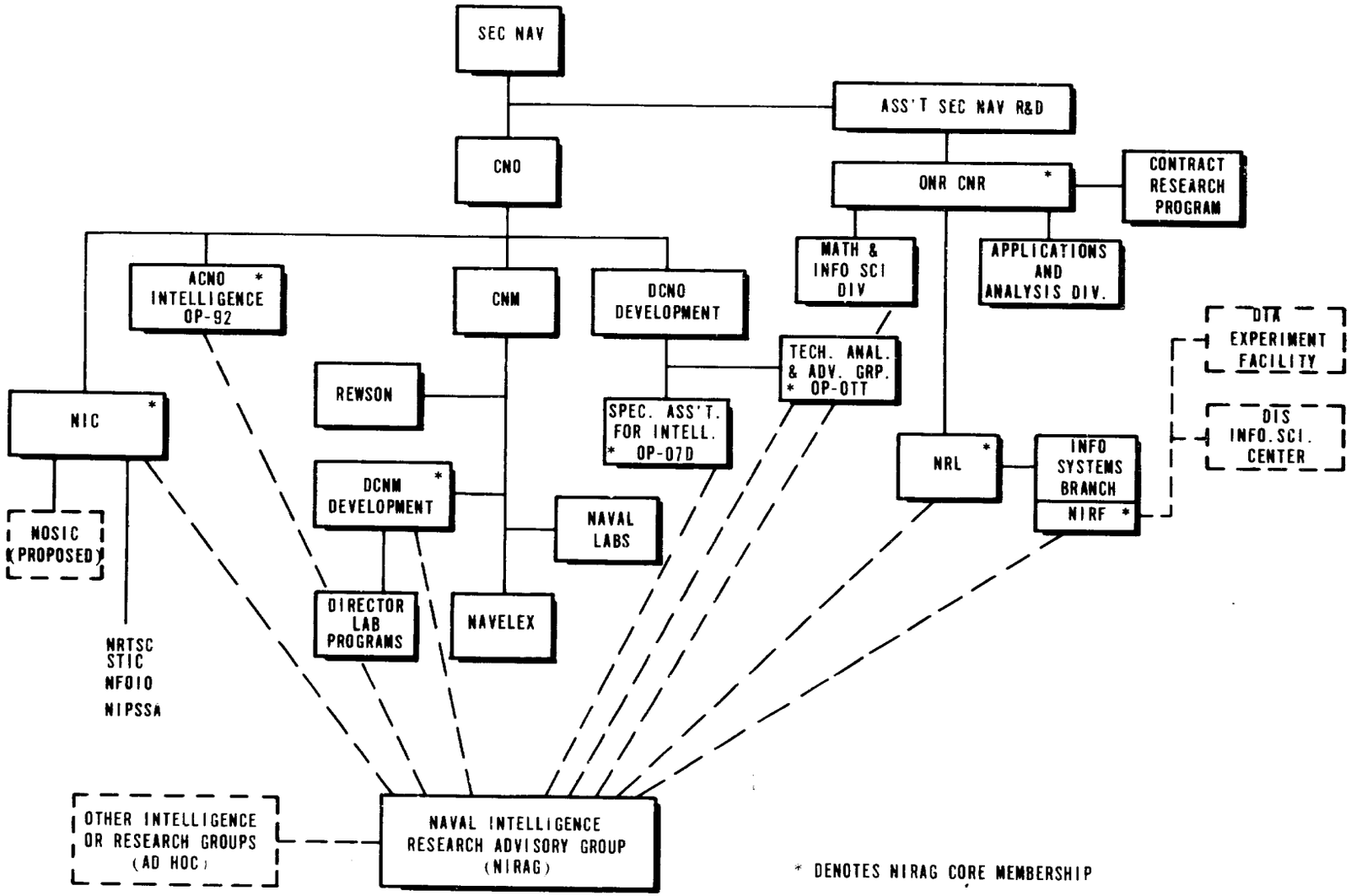

FIG 4 ORGANIZATIONAL FIT OF NIRF AND NIRAG INTERFACE

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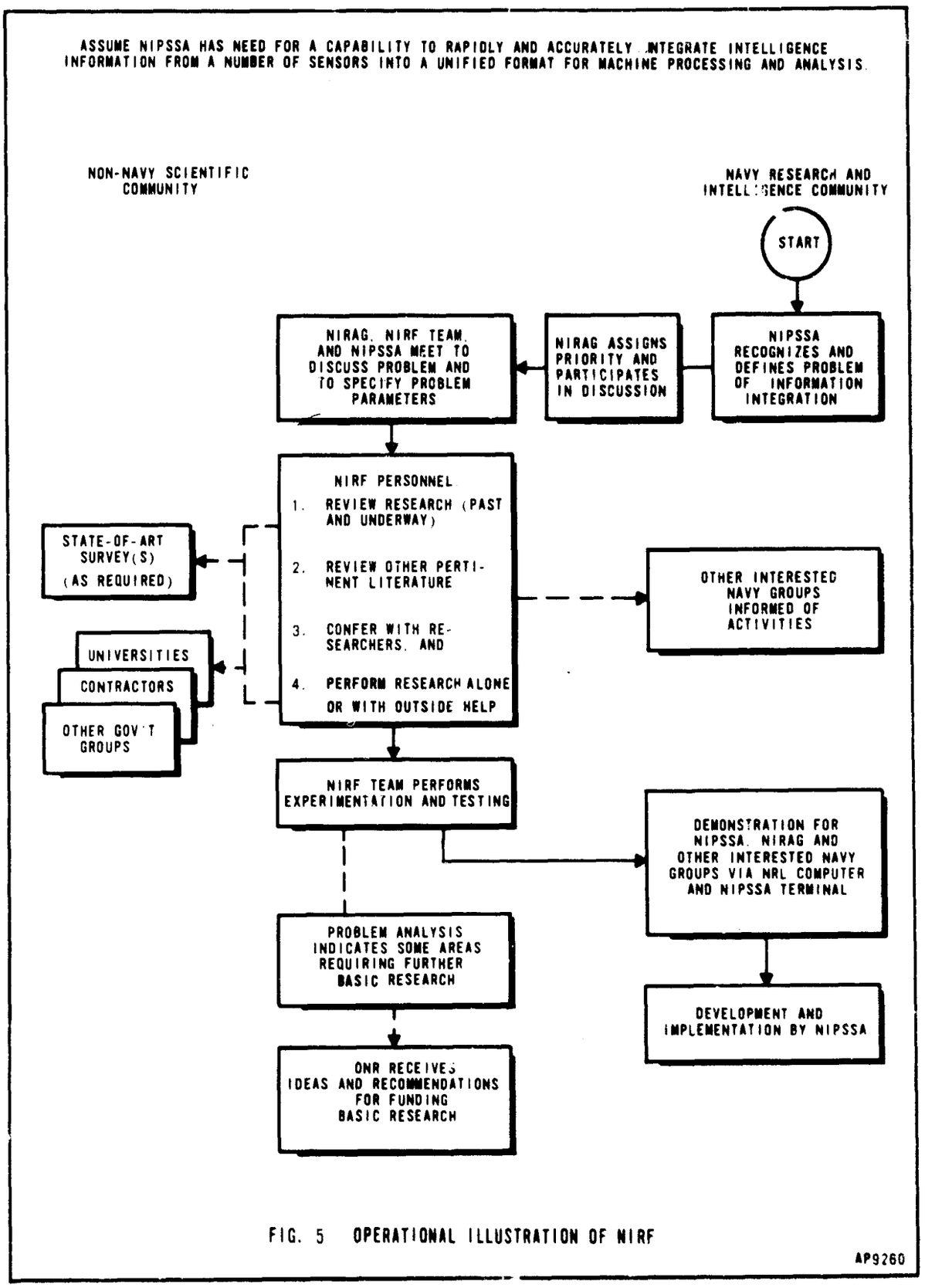

FIG. 5 OPERATIONAL ILLUSTRATION OF NIRF

b. NIRF identifies scope of problem; nature and source of program team; facilities, data bases, equipments beyond those available in NIRF and presents plans to NIRAG for coordination.

c. A program team is established and R&D effort begun. The sequence of events within this step would be dictated by the nature of the problem.

In those cases where a demonstratable "solution" is not required in NIRF's efforts (e.g., a study), the mode of operation would be simply to conduct the study and publish findings. Depending upon the nature of the research, dissemination may be limited only to that organization in which the specific problem arose. On the other hand, findings that might have a more universal application could be disseminated throughout the intelligence (and research) community by means of special reports or a periodic newsletter.

In the event that a "solution" to a problem required the development of a particular technique or a procedure, additional steps in the cycle would be necessary. These steps would include evaluating the procedure against a variety of problems to which it would be addressed, demonstrating the procedure to the intended uses and other potential users in the intelligence community, and training new users how to apply the technique to their own problems. The demonstration phase is an important step since NIRF's efforts (in the problem-oriented mode) are geared toward practical (not theoretical) solutions.

The capability/technology-oriented mode of operation would involve ongoing development, literature reviews, site visits, etc. Collectively, this mode would comprise those functions described in Section III-B.1. The value of these "undirected" activities is that they provide a means for making available to the program team latest research findings, maintain the staff's awareness and familiarization with the current state-of-the-art, and hence, increase their capabilities to address quickly new problems as they arise.

4. Resource Requirements

The general resources necessary to the NIRF concept can be readily stated. That is, successful translation and transfer of useful processing innovations occur only when there is a proper conjunction of

a. recognized need,

b. competent personnel with relevant scientific or technological ideas,

c. financial support, and

d. user involvement.

Given that NIRF may exist within the Naval Research Laboratory and would operate under the direction of the proposed Naval Intelligence Research Advisory Group, the following are assumed:

a. recognized need will stem from problem priorities formulated by OP92 and through internally generated research questions (suggested by R&D experimentation approved by NIRAG).

b. competent personnel with relevant ideas are available to NIRF through ONR's contract Research Program, CNM's in-house laboratories, NIC's field activities (e.g., STIC, NRTSC, NIPSSA) through coordination provided by NIRAG and by direct contract with R&D organizations and agencies.

c. financial support beyond that suggested in the above coordination activities can be made available through ONR's budget to NRL and through OP-92/NIC sponsorship of exploratory development programs within CNM.

d. user involvement, an important and most difficult resource requirement, can be made available under appropriate circumstances by OP-92/NIC through NIRAG coordination.

This section examines the fundamental considerations that influence resource planning for NIRF and summarizes base line resources requirements for implementing the NIRF concept as outlined in this chapter.

a. Fundamental Considerations

There are three fundamental considerations that influence the resource planning for NIRF. In brief these are

(1) Scope of NIRF's activities -- depth of involvement in the different phases of the RDT&E spectrum for the various processing areas (e.g., signal, imaging, text).

(2) Level of activity -- number of problems simultaneously addressed by NIRF and response requirements placed on these efforts.

(3) Extent of other pertinent resources available to NIRF -- degree that existing R&D results, personnel, equipment, etc., can be effectively utilized in NIRF's programs.

Additionally, there are two overriding criteria that pervade these considerations of NIRF's resources, i.e., (1) today's limited R&D budgets underscore the need for minimal cost expenditures, and (2) success of the concept is dependent upon obtaining a sufficient critical mass to insure that output results are visably effective.

(1) Scope of Activity

It is reasonable to suspect that the rapid pace of information systems technology will continue to produce innovations which, while not developed specifically for Naval Intelligence, will have important applications to the processing efforts in this field.[1] Therefore, fortuitous advances can be made in a planned program to selectively integrate and test available and emerging techniques and technologies.

There is a growing belief in the field of information science that "software" (programming techniques, algorithms, heuristics, etc.) significantly lags behind hardware technology, and that system improvement will be

[1] For example -- full text processing (library), diagnostic techniques (medicine), exception analysis (management), computer graphic techniques (engineering), large screen displays (command and control), etc.

more influenced by advances in processing methods than by further strides in hardware sophistication.[1] Therefore, it is recommended that NIRF focus its attention on the software information engineering aspects of Naval Intelligence processing systems.

In general, there are two facets to information engineering. One aspect is concerned with maintaining and improving existing systems; the other aspect forces the pace of technological change by designing, developing, and critically analyzing experimental systems. Engineering specialists now exist within the field activities of the Naval Intelligence Command who understand the structure, function, and day-to-day operation of the existing processing support systems.[2] NIRF's activities should interface with the needs of these engineers to improve processing operations. Additionally, personnel within NIRF must be capable of designing, developing, and critically analyzing experimental systems configured with state-of-the-art hardware and emerging software techniques; they must be able to identify the merits of various R&D activities with respect to Naval Intelligence Processing problems. Thus, NIRF's essential operations should lie predominately in the area of explioratory development (DOD category 6.2) and the staff's background must encompass the fundamental facets of information engineering (e.g., mathematics, statistics, logic) with emphasis in the following subjects:

(a) experimental analysis of subject matter;

(b) programming languages;

(c) the design of experiments;

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[1] "Computers are coming to represent an increasingly small part of an information system. ... In other terms, the most important segment of the industry is software." Nicolas Jequier, "Computer Industry Gaps," Science and Technology, September 1969, No. 93, (p. 39).

[2] That is, NRTSC (imaging systems), STIC (signal and acoustic processing), and NIPSSA (computer manipulation of textual information).

(d) language data processing;

(e) operations research;

(f) human factors relevant to the man-system interface.[1]

(2) Level of Activity

There are two major factors which should influence the level of R&D activity within NIRF. First, the activity level should be directly related to the Navy's needs and desires to gain improved intelligence systems. Second, requirements on NIRF's operations should be inversely related to the availability of good definitive system development specifications. The interplay between these two points is evident in the present efforts to further develop the Navy's ocean surveillance information system. The existing need for improved all-source data processing and dissemination has created an intensive effort to define an Ocean Surveillance Information System. Hardware and software specifications for this system have been hampered, however, by the lack of definitive data concerning the analyst's processing needs, command requirements for output data, and an objective assessment of the present state-of-the-art in processing techniques and technologies. Without these critical inputs, design personnel are often tempted to develop system concepts based on the upper bounds of the state-of-the-art This, of course, can frequently lead to excessive system costs.

Because NIRF's operations will develop and maintain a continuing assessment of processing innovations with respect to their applicability to Naval Intelligence, NIRF will eventually significantly improve the system design process. For example, the trade-off factors among volatile displays and paper generating devices in operational intelligence data processing are important in considering the analyst's interfaces within NOSIC. These factors would, no doubt, be well investigated by now if NIRF had been operational over the past several years. Furthermore, through a continuing program of experimentation, important understanding may be gained concerning the effects of

[1] "Toward an Education Base for the Information Sciences and Information Engineering," Robert S. Taylor, Proceedings of the Symposium on Education for the Information Science, Spartan Books, Washington, D.C., 1965 (p. 79).

various processing techniques on system performance, e.g., does all collected data have to be processed into computer storage or could less expensive microform storage be effectively utilized?

It is reasonable to expect that system development requirements will fluctuate as intelligence requirements change in support of command planning. Moreover the availability of definitive system specifications is most likely problem dependent.[1] Thus, the required activity imposed on a NIRF-type operation can be expected to vary considerably over time. This anticipated activity fluctuation dictates that NIRF be designed with a fair amount of flexibility to accommodate changes in both the types and amount of R&D undertaken within in any given fiscal period.

(3) Available Resources External to NIRF

The energy required to translate and transfer processing innovations into Naval Intelligence operations is, of course, dependent upon the degree of translation required. A major contention of this report is that the translation effort must eventually demonstrate and test the innovation so that its possible advantage can be readily perceived by potential users and Navy management. Given this perspective of the translation function, there are, in general, three aspects of emerging R&D results that influence the transformation process. These are

(a) the degree that the concept addresses recognized problems of Naval Intelligence,

(b) the extent that the concept is compatible with existing systems within Naval processing centers, and

(c) the amount of "real world" involvement (e.g., analyst participation) required in the development and test efforts.

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[1] That is, the amount of directed activity required from NIRF is probably dependent upon the type of system being considered. For example, display requirements for text presentation are presently better understood than those for real-time, in-flight, image presentation. In one case, the available literature may suffice in support of system specifications; in the other; however, experimentation may be required to develop reasonable development guidelines.

Thus, it is evident, for example, that improved communications between ONR's Contract Research Program and Naval Intelligence could expedite the application of R&D results to intelligence processing efforts. As research managers within ONR identify research efforts which may offer new capabilities to intelligence, NIRF personnel could be made aware of the R&D activities. Direct communications between the principal investigator and NIRF engineers could, in some instances, suffice in determining if further activity were warranted. If continuing investigations were called for, direct coupling of the innovator and the problem oriented engineer would significantly reduce exploratory development time and effort. Similar potential R&D improvement exists between NIRF and projects sponsored by CNM. Information handling techniques developed for command and control, for example, will often have spin-off impact on intelligence processing and dissemination R&D activities.

There are two new major activities outside the Department of the Navy which may have impact on NIRF's operations. These are

(a) The Information Science Center, a community-wide facility located at the Defense Intelligence School.

(b) The proposed Experimentation Facility now being studied by the R&D Subcommittee of USIB's Intelligence Handling Committee.

Conceivably, the Information Science Center may emerge as a major focus point in the testing of basic analytical techniques. In its somewhat unique position of having intelligence analysts (removed from operational pressure) involved in investigating techniques of the information sciences, the ISC can examine the nature of the analysts' interfaces within processing system. Because large numbers of different kinds of analysts are expected in this training program, the effects of different methods on different problem types (e.g., basic intelligence, operation intelligence, etc.) can be investigated.

The status of the Experimentation Facility (EF) is not settled as of the date of this report. The concept essentially parallels that of the NIRF except that the focus is on the entire intelligence community as opposed to concentrating on any one facet such as Naval Intelligence. There are at least two divergent paths that EF may follow, i.e.,

(a) Centralized concept -- one major program encompassing a wide range of R&D activities for the several agencies and services within the intelligence community. If such a program effectively included Naval interests, then the requirements for NIRF would be greatly reduced, if not eliminated.

(b) Decentralized concept - one smaller program, concentrating on broad fundamental questions effecting all groups and interfacing with the problem oriented R&D activities of the various agencies and services. In this instance, the requirements for a NIRE-type activity exists, albeit the scope of its operations could be somewhat reduced because of EF's activities.

In any event, the Navy, through its R&D subcommittee membership, should continue to monitor the statue of EF and fit the evolving concept against that of NIRF.

b. Base Line Resources

Because there are many variables which influence NIRF's resource requirements that lie beyond the scope of this investigation, this report cannot delineate specific resources required in implementing NIRF. The following discussion will, however, review briefly the guidelines set forth in the previous report and examine plausible base line resources required in each category (i.e., personnel, security clearances, information center, processing system, general facilities, location, and operating funds).

(1) Personnel

People will be the most important resource of NIRF. The staff must be able to communicate with both the scientific and intelligence communities and their work must advance understanding and operation of intelligence processing systems.

Because NIRF's functions include critical monitoring and analyzing progress in the information sciences, the staff requirements of federally supported information analysis centers were reviewed to determine personnel requirements in what were considered to be analogous operations.[1] The following table illustrates the staffing of five selected centers.

	FULL TIME	PART TIME	PROF.	SUPPORT
BATTELLE DEFENDER INFORMATION ANALYSIS CENTER	7	0	2	5
DEFENSE ATOMIC SUPPORT AGENCY INFORMATION ANALYSIS CENTER	10	6	*	*
ERIC CLEARINGHOUSE ON LIBRARY AND INFORMATION SCIENCES	5	1	3.5	2.5
INFRARED ANALYSIS CENTER	*	*	4.5	5
APPLIED SCIENCE DATA GROUP	*	*	9	3
*DATA NOT AVAILABLE				AP9258

In considering the emerging COSATI data base of federally sponsored R&D efforts in the information and computer sciences and the existing avenues for channeling data pertinent to the trends in these fields,[2] a full-time staff of three professionals within NIRF seems adequate to support the information transfer function.[3]

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[1] Directory of Federally Supported Information Analysis Centers, April 1968, Committee on Scientific and Technical Information (COSATI).

[2] For example, published literature such as The Annual Review of Information Science and Technology, Computing Reviews, Scientific Information Notes; and annual meetings such as Congress on the Information System Sciences, American Society Information Science, Association for Computing Machinery, National Microfilm Association, etc.

[3] It should be noted that this also represents a minimum concept for NIRF, i.e., a small staff of professional "Honest Brokers" of emerging processing concepts within the R&D environment.

Additionally, the NIRF concepts includes exploratory development, experimentation, test, and evaluation of processing concepts. It is anticipated that NIRF would have a small resident staff and would augment its personnel with program team members drawn from appropriate Naval Field Activities, in-house Naval laboratories, and outside consultants and contractors. While the R&D staff requirement is strongly influenced by the facility's activities, a minimal requirement would be to have one researcher per unique processing area. Thus, for example, text processing, image processing, and signal processing could require at least three full-time software engineers. Efficient utilization of the time of these professionals requires at least one engineer's assistant for three research engineers and one clerk/typist for each group of ten professionals.

Research engineers must maintain close contact with the literature in their field. Similarly, subject specialists who review literature are probably more perceptive of R&D trends if they maintain "hands on" contact with their field. Thus, the two functions of NIRF can probably be best performed by the same individuals. An estimate of NIRF's minimum basic personnel requirements would be as follows:

6	Professionals
2	Engineer's Assistants
1	Clerk/Typist
9	Full-Time Personnel

(2) Security Clearances

Security must not limit the dialogue between Naval Intelligence and NIRF. Facility and communications security must be adequate to permit realistic experimentation and demonstration.

A survey of 61 intelligence R&D programs within HRB-Singer revealed that key project personnel must have full access to intelligence analysts, reports, etc., pertinent to understanding of the problem. Major working areas may often be Secret, with conference areas, storage facilities and some working areas limited to Special Access Clearances.

(3) Information Center

Source of basic reference works of the information sciences and formal documentation within Naval Intelligence (e.g., GORs, SORs, PTAs, etc.). Because there presently exists a number of significant technical information centers, clearinghouses, etc.,[1] NIRF can utilize these resources and need concentrate only on problems in the flow of data between intelligence problems areas and qualified R&D personnel. Thus, the Information Center associated with NIRF should maintain a collection of R&D reports, studies, staff papers, etc., disseminated by the various intelligence agencies and services pertinent to processing activities.[2] Additionally, NIRF should have available to its staff, consultants, and contractors appropriate intelligence material reflecting the data bases being processed and maintained within Naval Intelligence. Items within this collection should be catalogued, indexed, and periodically announced in a selective dissemination program supporting qualified R&D activities (e.g., specified ONR contract research programs, projects under the direction of NIRAG, etc.).

(4) Processing System

The processing system supporting NIRF's activities must (a) be suitable for interactive man-machine experimentation against basic Naval Intelligence inputs and products (e.g., text, images, and signals and (b) must be suitable for demonstrating and testing advanced processing methods. A likely configuration of basic equipment would include

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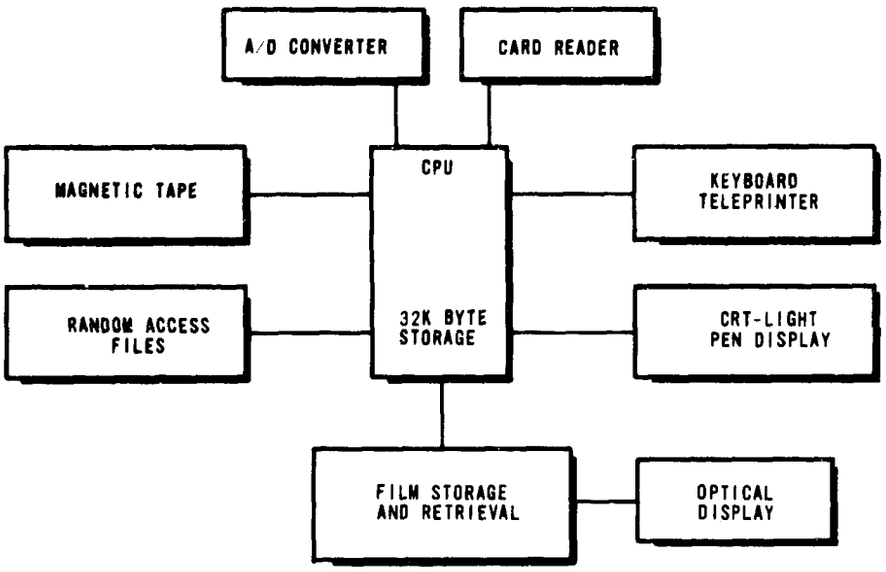
[1] For example, the Defense Documentation Center, the Clearinghouse for Federal Scientific and Technical Information, The Defense Information Analysis Centers, the Navy Automated Research and Development Information System, Science Information Exchange, The National Referral Center for Science and Technology.

[2] In addition to the PTA's, for example, all referenced studies (such as the numerous efforts to define the Sea Surveillance program) should be maintained.



There are two reasons why the R&D processing system should be compatible with operational systems utilized within Naval Intelligence. First -- meaningful experimentation may often require emulation of an operational processing effort. The R&D activities could take advantage of existing software capabilities within operational intelligence systems if the equipment configurations are compatible. Second -- R&D created processing routines could be transferred from the laboratory to the operational environment for "real world" testing (without extensive software redevelopment) if compatibility existed between the two systems. Naval Intelligence now utilizes a variety of different processing configurations,[1] thus compatibility of an R&D system with all existing operating systems is not practical. Planning is underway, however, to develop a Naval Intelligence Data Center, supporting the Naval Ocean Surveillance Information Center, the Naval Reconnaissance and Technical Support Center, and the Navy Scientific and Technical intelligence Center. These plans call for the installation of a large third generation processing system. NIRF's R&D processing system should be compatible with this system and, in fact, consideration should be given to eventual linkage of the two systems.

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[1] Operating systems now include: IBM 7090/360-30/1401 complex now supporting OSIS; IBM 1410 utilized within the Fleet Intelligence Centers; CDC-160A used within the OPCON Centers; and the AN/USQ20 used in support of the IOIS.

Major advantages of linking the R&D system with such a large-scale intelligence system include the following:

(a) availability of more processing capability for periodic R&D requirements, and

(b) provide R&D programs with direct access to operational data bases and processing software.

Some disadvantages in directly connecting an R&D system with an operational intelligence system are the following:

(a) unpredictable fluctuations in operational requirements may hinder the scheduling and conduct of R&D experiments. This, in turn, may effect both the time and costs of these programs.

(b) security aspects of the operational system may severely limit the range in R&D personnel who would be granted access to NRF's terminals.

(5) General Facilities

In addition to the obvious requirements for adequate space for the desks, files, and processing equipment, careful attention should be given to the layout of experimentation and demonstration areas. The testing and demonstrating of processing innovations (to encourage management and analyst adoption) will frequently require gaming-type activities, employing many participants over several days. Such activities may require display of ocean areas on full wall charts; leaving classified information posted overnight between sessions; and keeping working areas of participating teams separated from each other, but open to the view of exercise judges. R&D requirements will fluctuate, often dictating segregation of in-house programs to expedite control of noise, security, or experimental variables. Taken collectively, these considerations indicate a need for one or more "hard" areas which can be secured as well as some flexible working space which can be rearranged with partitions.

(6) Location

In order to be able to interact effectively with members of the intelligence and the Naval research communities, NIRF should be located in the Washington, D.C., area. This location would permit ready access to NIC, DIA, CIA, NSA, CNM, NRL, ONR as well as to NIC field activities (STIC, NRTSC, NIPSSA, and NFOIO), elements of NMC (e.g., REWSON, NAVELEX, etc.) and other offices subordinate to CNO, e.g., OP-07 and OP-92.

(7) Operating Funds

The budget of NIRF should provide for its own operations and for obtaining outside assistance. Although NIRF is not intended as a primary funding source for intelligence R&D efforts, allowances should be made in NIRF's budget for NIRF to augment its activities with consultant and contract support. These funds being administered by appropriate Navy procurement offices within ONR and CNM.

The following table provides a cost approximation of a baseline Naval Intelligence Research Facility.[1]

		NO.	AVG. COST PER UNIT	TOTAL COST
PERSONNEL	TEAM LEADER (AT LEAST GS-15)	1	24,469	24,469
	INTELLIGENCE AND RESEARCH PROFESSIONALS GS-14 GS-13	3 2	21,003 17,920	63,009 35,840
	ENGINEER'S ASSISTANTS GS-10	2	11,620	23,240
	CLERK/TYPIST GS-4	1	6,258	6 258
	SUBTOTAL	9		152,816
PROCESSING SYSTEM	BASIC SYSTEM (LEASED)	1	60,000	60,000
	INTERFACING MICROFORM SYSTEM	1	9,000	9,000
	A D CONVERTER SUBSYSTEM	1	2,000	2,000
	SUBTOTAL			71,000
	TRAVEL CONSULTANT CONTRACTS			2,000 1,500- 10,000 30,000-120,000
	SUBTOTAL			33,500-132,000
	TOTAL			$257,316-$355,816

[1] Salary figures are based on the July 1969 salary chart for Government Employees. Rate 5 was used for all GS levels.

These costs do not reflect such items as: acquisition and handling of reports, intelligence materials, etc.; desks, files, etc.; physical plant modifications, e.g., secure processing facility, vault storage, etc.; convention fees and other miscellaneous costs associated with an R&D organization.

It should be noted, however, that much of the base-line NIRF now exists within the Information Systems Branch of the Naval Research Laboratory. The next section of this report examines alternatives to satisfying the objectives of NIRF and compares the recommended alternative -- establishing NIRF within an existing facility -- with competitive approaches.

IV. DISCUSSION OF ALTERNATIVE CONCEPTS

In its investigation of feasible concepts for a Naval Intelligence Research Facility, HRB-Singer, Inc., examined a spectrum of possible alternatives. At one end of this spectrum is a NIRF alternative known as the Honest Broker concept; at the other end of the spectrum is a NIRF alternative labeled the Full-Scale Activity concept.

Each of these two end-point concepts is discussed in the following sections. Section C presents a comparison of these and other alternatives and examines each with respect to the basic alternative of maintaining the status quo.

A. HONEST BROKER CONCEPT

The Honest Broker concept essentially augments NIRAG by providing a full-time staff serving a "middleman" function between the research and Naval intelligence communities; however, no research or experimentation would be conducted under this concept. A full-time group of three professionals (e.g., one Navy and two civilians) is considered adequate initial staffing, with these personnel collectively representing a substantial background in Naval intelligence and the information sciences.

The principal mission of the Honest Broker would be to improve communications and maintain liaison between the research community and the Naval intelligence community. Specifically, the Honest Broker staff would:

1. Maintain a close relationship with the research community by reviewing reports, articles, etc., and establishing individual contacts with leaders in pertinent research areas.
2. Interface with the Naval intelligence community by on-site visits to Naval intelligence activities to review programs in progress and discuss problem areas.
3. Improve and maintain communications between Naval intelligence and the various research activities by assisting in the sponsorship (e.g., with NIRAG and ONR) of symposia to bring together members of both communities -- Naval intelligence and research -- to discuss problems and trends in the state-of-the-art in relevant areas.

This concept is the least expensive augmentation of NIRAG and represents the starting point in considering a Naval Intelligence Research Facility.

B. FULL-SCALE ACTIVITY CONCEPT

The establishment of a full-scale Naval Intelligence Research Facility would provide an environment free from operational pressures and conducive to research and development in man-machine techniques dedicated to problems of Naval Intelligence. Since previous experience has indicated that conventional off-line computer processing is extremely limited in the support it can provide operational intelligence problem-solving efforts, this NIRF concept would be built around an on-line system. In fact, NIRF would be a Project MAC microcosm for intelligence processing, i.e., a facility to investigate the ways on-line processing could be used to aid intelligence analysts in their tasks. Unlike MIT's Project MAC, however, NIRF would not primarily seek to further knowledge about multiple access computers, machine-aided heuristic processes, etc. but instead would be dedicated to determining how these capabilities could enhance intelligence processing efforts.

As visualized, NIRF as a full-scale activity would consist of 16-20 professionals in the areas of information processing, computer science, and intelligence.

NIRF's primary function would be to adapt general research results to specific problems of Naval intelligence and to develop these results into operational concepts. In addition, the NIRF staff would attempt to improve the coordination between the research and Naval intelligence communities. This second function would be performed by carrying out the activities mentioned in connection with the Honest Broker (e.g., reviewing research reports, on-site visits to Naval installations, publishing a monthly newsletter, etc.).

However, the bulk of NIRF's activities would be involved directly with applied research and applied experimentation on the utilization of computer and information processing technology in aiding Naval intelligence analysts in the analysis and production of intelligence information. These activities would be problem-oriented, having the goal of tailoring existing research findings to applications in specific problem areas.

C. COMPARISON AMONG ALTERNATIVES

The "Honest Broker" concept represents a beginning step beyond the status quo in a spectrum of alternatives which logically culminate at an upper bound solution with the creation of a new Naval research activity. Some alternative midpoints within this spectrum of possibilities include the following:

1. expand the scope of some existing Naval Intelligence organization (e.g., NIPSSA, NRTSC, etc.) to encompass the NIRF concept.
2. expand the scope of some existing R&D organization (e.g., NRL, NELC, etc.).
3. increase the responsibilities and involvement of several groups (e.g., OP-07T, NIC-3 (plans and programs), ONR, etc.) such that they collectively satisfy NIRF's objectives.

This section examines briefly the five alternatives (the Honest Broker, Full-Scale activity, and the three midpoint possibilities) and compares these with the basic alternative of maintaining the status quo.

1. Criteria in Evaluating Alternatives

The most important criterion for NIRF is that the selected concept have a high potential for increasing the development and transfer of useful processing innovations into the Naval Intelligence Community. Previous discussions have presented guidelines pertinent to successful operation of a Naval Intelligence Research Facility. These guidelines are summarized below and represent specific criteria for selecting an R&D augmentation of NIRAG.

a. Efforts should lead to actual development and testing of R&D concepts (as opposed to "paper studies").

b. Potential system users should be involved in system development, test, and evaluation efforts, thus, convenient location is important to NIRF's implementation.

c. R&D personnel must be able to effectively communicate with both the intelligence and the R&D community.

d. NIRF's operations must not get submerged under day-to-day operational problems of Naval Intelligence. Moreover, NIRF's personnel must have some flexibility to bridge organizational or functional gaps in pursuit of advanced system development.

Additionally, today's problems of restricted budgets gives special emphasis to the following criterion:

e. Costs of NIRF's implementation must be acceptable to the Navy and the funding level must be within the scope of budget ranges for processing R&D within Naval Intelligence.

This latter point essentially raises the issue that an R&D investment for processing improvement must be better spent in NIRF than elsewhere within the R&D environment if NIRF is a viable alternative.

2. General Analysis

The status quo within today's Naval Intelligence R&D efforts can generally be characterized as being system oriented. That is, the requirements for new/improved intelligence capabilities give rise to basic system concepts such as the NIPS, IOIS, OASIS (OSIS), etc. These concepts frequently stimulate development of short-range R&D programs. The Navy's in-house laboratories, industry, and other R&D organizations respond to stated requirements by formulating appropriate R&D programs of experimentation, study, exploratory development, etc. The major advantage of this form of R&D activity is that research efforts are tied to specific needs; hence, expenditures of funds are made only after specific requirements for R&D efforts are well formulated. The major disadvantages in this form of R&D activity include the following:

a. Evolution improvement in system software or processing methodology proceeds under O&M budgeting. This does not have the flexibility to encompass more fundamental research efforts which are often required in the advancement of processing techniques.

[illegible] exist [illegible]

and exploit processing advances made in other [illegible] medical diagnosis, library storage and retrieval, etc.).

c. R&D continuity does not readily exist, thus, industry may often rediscover basic problems in incorporating advanced processing techniques into operational systems.

d. There does not exist a realistic environment for testing novel processing concepts. The operational environment is too complex and time constrained to permit elaborate experimentation; ad hoc emulations of the processing problems often suffer from lack of sufficient realism to determine if the techniques are feasible.

e. There does not exist an efficient means for taking promising basic efforts conducted under ONR sponsorship forward for meaningful testing and user trial.

Although the establishment of a Naval Intelligence Research Advisory Group will improve communications among the intelligence and R&D sectors of the Navy the existence of NIRAG will not eliminate the problems noted above.

(1) Honest Broker

The establishment of a three-man full-time professional staff to support NIRAG can expedite Naval Intelligence gaining early awareness of significant research results, processing trends, etc. This concept may also help consolidate important classified studies, reports, etc., thereby increasing outside awareness of problem areas. Beyond these improvements, however, this concept offers little over the status quo.

(2) Expand Scope of NIC Field Activity

Given the appropriate resources, NIPSSA, NRTSC, or STIC could provide "hands-on" experimentation and exploratory efforts necessary for the development and test of processing innovations. Unlike the "Honest Broker" concept, this alternative involves utilization of secure spaces for R&D activities, development of computer routines, investigation and testing of input/output techniques, etc. The primary disadvantages of this alternative are

[illegible] R[illegible]

[illegible] of the [illegible] activity

[illegible] that the R&D community may be somewhat constrained because of the affiliation with a "closed" organization.

(3) Expand Scope of Existing R&D Organization

Theoretically, this concept differs from the above alternative only in the nature of its fit between the intelligence and R&D communities. Resource requirements, support to NIRAG, types of R&D projects, etc., are identical. Being a subgroup of an R&D organization, however, insures that the work environment is relatively free from the day-to-day pressures involved in system operations. This freedom and the type of flexibility found within R&D groups is important and should exist within NIRF.

(4) Increase Scope of Several Existing Organizations

This concept suffers from a potential diffusion of responsibilities among several groups, requiring more coordination than any of the above alternatives. Because of the spread in responsibilities, achievement of R&D continuity, systematic review and evaluation of processing innovations, etc., may be considerably more difficult than if the responsibilities were vested in a single organization.

(5) Implementation of a New, Full-Scale R&D Activity

The development of a new facility with full R&D and administrative staff has been included for completeness and is not considered to be a practical alternative. There presently exist organizations sufficiently close to the NIRF concept such that their expansion costs would be well below that for developing a new facility. The main value in examining the Full Scale activity concept is that it provides a standard for comparing expansion costs of candidate organizations.

Investigation of NRL as the Parent Organization for NIRS

> The Naval Research Laboratory is one of the principle in-house research and development institutions of the U.S. Government. It was established in 1923 to ensure that advancements in science and engineering could be readily applied to the Navy's needs.[1]

In December 1967, NRL, recognizing the important role of the information sciences in the Navy, established the Information System Branch within the Mathematics and Information Sciences Division of NRL. The mission of this branch (as stated in NRLINST 5400.14D) is

> To perform research and development in those aspects of the information sciences which are relevant to Navy needs; to participate in the planning of those research and development projects conducted by the Laboratory which require a substantial amount of information handling; to develop the information handling portions of systems being developed by other Laboratory components, when it is determined that such division of responsibility is in the best interest of the Laboratory and its sponsors; to provide consultantive services in the information sciences; and to develop or procure and operate information processing facilities for the use of the Division and the Laboratory.

The Information Systems Branch is located at NRL's main complex outside Washington, D.C., and is presently staffed with 20 professionals. Under NRL policy, approximately one-half of this staff is made available in support of sponsored programs (e.g., in logistics, intelligence, etc.). Long range plans include obtaining an ADP system to be compatible with the third generation configuration selected in support of the Ocean Surveillance Intelligence System (OSIS). Floor space of some 3000 square feet have, in fact, been set aside for the processing facility. As part of the Mathematics and Information Sciences Division of NRL, the Information Systems Branch works in close proximity with approximately 60 other professionals.[2] Figure 6 illustrates the organization of the Mathematics and Information Sciences Division of NRL.

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[1] Naval Research Laboratory, April 15, 1969 (p 1-9)

[2] In FY-69, the Division was involved in R&D activities totaling approximately $1.2 million.

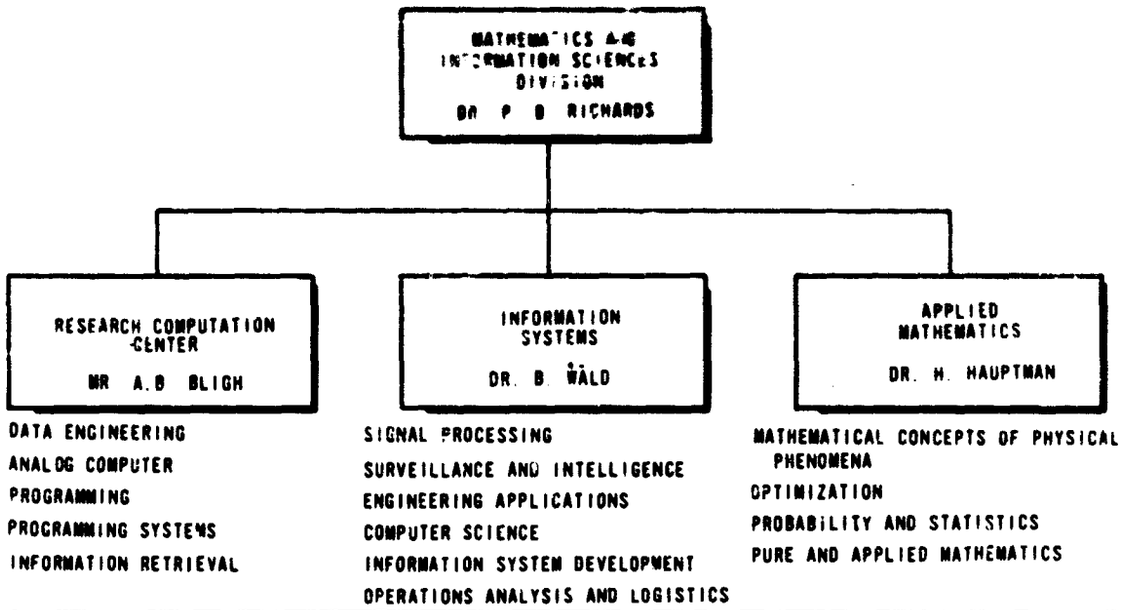

FIG. 6 MATHEMATICS AND INFORMATION SCIENCES DIVISION OF NRL

In addition to its professional staff and worldwide reputation in both the Navy and the research community, NRL has an important resource in its library. NRL's technical library is fairly extensive. A Survey of Special Libraries serving the Federal Government[1] in fiscal year 1965, reported that NRL's holdings included

100,000 bound volumes

1,400 scientific and technical serials

6,000 maps and charts

600 reels microfilm

300,000 unpublished (mostly classified) R&D reports

[1] U.S. Department of Health, Education, and Welfare Office of Education Report OE-15067, 1968.

The library employed a staff of 27 per[illegible] approximately 5[illegible] for library materials during the fiscal [illegible] compares quite favorably with all Department of Defense libra[illegible] [illegible]

73, 320 bound volumes

472 serials

54, 732 R&D reports

with an average staff of 7.3 persons and a library material expenditure of $24, 326 during this fiscal period.

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IMPLEMENTATION CONSIDERATIONS

Preceding sections discussed the need for and recommended operational modes of a Naval Intelligence Research Advisory Group (NIRAG) and a Naval Intelligence Research Facility (NIRF). Actual details of implementing these concepts, however, depend on many factors. The following pages discuss the fundamental considerations which must be examined if these concepts are to be transformed into recognizable entities. Figure 7 presents these considerations in flow diagram form.

As a preliminary step, it is suggested that the report be examined by pertinent Naval intelligence and research organizations for one month. The first NIRAG meeting should be held to consider the recommendations made in the report.

Additional comments on the implementation of NIRAG and NIRF follow Figure 7. The numbers in this section refer to specific blocks in the flow diagram.

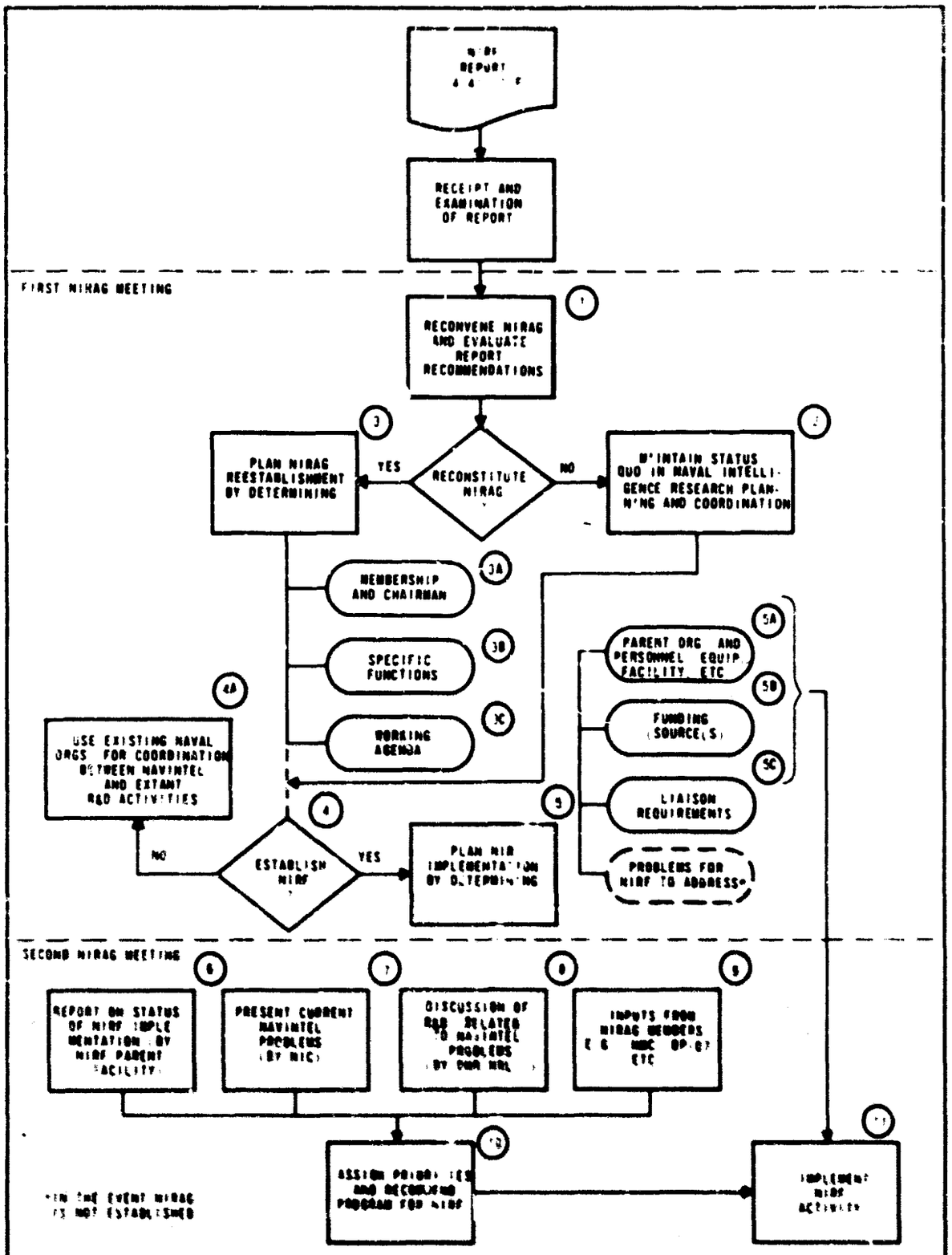

FIG. 7 IMPLEMENTATION FLOW DIAGRAM FOR NIRAG NIRF

1. It is recommended that the COTR for this study, Mr. Marvin Denicoff, Information Systems Program Director -- ONR, initiate the establishment of NIRAG and serve as chairman for the first meeting. The purpose of this meeting should be to evaluate the findings and recommendations in this report. Attendees at this meeting should represent at least ONR, NRL, NIC, and OP-07. The first order of business should be to consider the establishment of NIRAG as a permanent and active Naval entity.

2. If this first meeting should result in a decision not to reconstitute NIRAG, the planning and coordinating functions would be carried on as they are now. Although NIRAG, as a recognizable entity, is envisioned as an important coordinating and advisory arm of NIRF, it is conceivable that NIRF could still be implemented without a NIRAG (hence, the connecting line on Figure 1 between blocks 2 and 4).

3. If this first meeting should result in a decision to reestablish NIRAG, then several "next steps" should be undertaken.

   3a. Agreement should be reached on representatives to NIRAG, their number and organizational affiliation. In addition, the permanent NIRAG chairmanship should be appointed.

   3b. Although the suggested mission and functions of NIRAG are discussed in Section III of this report, the members of this first NIRAG gathering should decide the range and limits of the functions to be performed by the (permanent) NIRAG.

   3c. Having established the membership and functions of NIRAG, a working agenda should be drawn up specifying the frequency and location of meetings, topics for presentation and discussion, and other information necessary for the orderly conduct of business.

4. The second portion of the meeting should be devoted to the issues regarding NIRF's implementation.

4a. If the decision is not to implement NIRF, it is assumed that the objectives anticipated for NIRF would be pursued by current operating elements of the Navy. NIRAG could still function as a useful mechanism even if the NIRF concept is not implemented.

5. If the first NIRAG group agrees with the findings and recommendations of this report and decides in favor of a NIRF, then implementation plans and procedures should begin as soon as possible.

5a. Although many of the details of implementing NIRF would be carried out by the parent organization of NIRF, members of the first NIRAG meeting should resolve several factors, e.g., the Navy organization in which NIRF would reside, including the specific division, branch or program area thereof. NIRAG should also further define the personnel, equipment and facility requirements for NIRF. Collectively, NIRAG's recommendations would serve as guidelines for the actual establishment of NIRF.

5b. One of the most important items requiring resolution by NIRAG is the question of funding for NIRF. The recommendation for joint funding, contained in this report, should be evaluated. If this recommendation is considered sound, the actual funding sources and the estimated allocations from each source should be established.

5c. The third item of business for NIRF's implementation should be a determination of liaison requirements. NIRF would require substantial "cross talk" and coordination between various Navy (and non-Navy) intelligence and research activities. NIRAG should therefore review the liaison needs of NIRF and plan for the availability of selected personnel within the Navy to carry out this liaison function.

NOTE: During the interim between the first and second NIRAG meetings, a time interval of perhaps three months, the following activities should be undertaken.

a. Parent Organization of NIRF -- should formalize NIRF within its own structure and procure staffing, equipment, and other resources required for its operation.

b. Naval Intelligence Command (NIC) -- should present current and anticipated problems and/or requirements in Naval intelligence activities (emphasizing processing and analysis).

c. CNO (OP-07D) -- should review the missions and objectives envisioned for NIRAG and NIRF and evaluate them in light of their mission and functions. At the second NIRAG meeting, the OP-07D representative should define their potential role in future NIRAG/NIRF activities.

d. Office of Naval Research (ONR) -- specifically the Information Systems Program, should review research efforts funded by this office to determine selected programs which appear to have potential benefit to Naval intelligence. Initially, GOR-36 dated May 1969 and research areas outlined in this report may be used as a guide in determining which past, present, and proposed research programs funded or monitored by their office might be applicable to problems of Naval intelligence.

SECOND NIRAG MEETING

6. The status of NIRF's implementation, including any difficulties encountered, e.g., resources needed but not available, should be reported during this meeting.

7. NIC representatives on NIRAG should present current Naval Intelligence problems emphasizing processing and analysis difficulties encountered. Existing requirements documents should be referenced in conjunction with NIC's presentation.

8. The research arm of the Navy should present selected research areas which are pertinent to the problems cited by NIC. This activity is shown within a broken line on the diagram since the Navy research representatives (ONR/NRL) could not be expected to match (on a one-for-one basis) all research pertinent to a given problem cited by NIC, during the course of this meeting.

9. Other members of NIRAG would add inputs to this meeting as required. OP-07, for example, should state its coordinating and advisory role vis-a-vis NIRAG. Naval Material Command representatives should define their role, for example, in funding, or monitoring.

10. The net effect of items 6 through 9 above, would be to match Naval intelligence problems against available resources for coping with them. As such, NIRF, working from a priority listing, could begin operations as an active entity.

11. This item assumes that NIRF has been established with adequate resources and has received from NIRAG recommendations for areas of concentration. From this point on, the success of NIRAG and NIRF will depend, in large measure, to cooperation and active interaction among all Naval elements cited in this report.

Through its periodic, scheduling meetings, NIRAG should continue to monitor the programs of NIRF and seek new program areas -- hence, the cycle continues.

VI. NAVAL INTELLIGENCE PROCESSING RESEARCH PROGRAM

This chapter (1) describes briefly several problem-oriented R&D areas and (2) outlines broad research themes which are pertinent to improving naval intelligence processing capabilities. They constitute logical areas for NIRF and NIRAG to address.

A. PROBLEM ORIENTED R&D AREAS

1. Techniques Oriented Toward Time Constrained Processing Efforts

One fundamental approach in alleviating processing problems is to reduce the amount of data that an analyst must examine without eliminating potentially useful information. Data reduction can be accomplished in several ways. These ways are described below.

a. Sensor Integration -- Events, target, etc., offer different characteristics profiles to different sensor systems. Multisensor platforms increase acquisition probabilities, but also increase collected data. Development of characteristics profiles and autocorrelation techniques with in-platform processing can provide for automatic target recognition, thus, reduce the amount of data presented to the preprocessing or interpretation efforts.

b. Computer aided analysis (Problem Solving) -- Once a problem has been formulated, the analyst seeks information that supports or denies postulated hypotheses. An ability to engage in a dialogue with the available pertinent subset of the data base without examining nonrelevant material greatly reduces the problem solving effort. Implicit in this approach are the requirements for (a) automatic input so that all available pertinent information is within the data base during the search effort, (b) natural language query capability to expedite communications with the machine system, (c) recognition of equivalent forms so that "like" objects, events, etc., can be drawn together for analysis, and (d) associative processing so that all plausible avenues can be rapidly explored.

c. Computer aided analysis (Problem Seeking) -- One major role of operational intelligence is to monitor activities pertinent to the Navy's interests. This surveillance and intelligence effort examines daily the steady flow of data

in an attempt to update the "current" situation, and to detect deviations from expected activities. Utilization of computer technology to preprocess these data can expedite the analyst's examination of input material. This can be accomplished by automatically collating the material by intelligence interest, correlating new inputs with existing file items and determining if the new data are consistent among themselves and with the established file.

d. Information Display -- Time required for analysis can be reduced by development of appropriate data representation forms and display techniques for the analyst.

e. Automatic Abstracting -- Automatic abstracting techniques geared to the specific interests of the different analysts, could produce reduced, tailored texts for selective dissemination throughout the intelligence community. Remote retrieval and display capabilities can provide rapid access to the complete version on file.

2. Techniques To Help Cope With Uncertainty Within the Input Data

Intelligence analysis and synthesis is a process of plausible reasoning. Because the analysts frequently seek to discern the unique and infrequent (as opposed to the recurring) events by utilizing data of uncertain truth, the classical techniques of logical deduction and statistics cannot always be directly applied. There is a reason to believe, however, that "probabilistic" techniques can be utilized in the processing efforts.[1] Some potential lines of research include the following:

a. Heuristic applications in inductive inference -- Proper assembly of the various bits and pieces of intelligence with appropriate inference to fill gaps in the picture are fundamental to intelligence synthesis. Associative processing techniques can provide networks connecting items within the data base with hypotheses postulated by the analysts. Use of Bayesian techniques, "N-valued" logic, etc., can show impact of new items on existing networks and may, in fact, suggest new hypotheses.

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[1] C. R. Blunt, et al., "The Role of Plausible Reasoning Within Military Intelligence," HRB-Singer, Inc., Report 4015.11-R-2, May 1967.

b. Use of truth tables to determine redundancy and inconsistency among data -- Truth tables can be utilized in formal systems to determine if two statements are logically equivalent. There exists the possibility that such a logical filter could be used to (1) screen input material to determine if they are redundant, and (2) compare logical derivations to determine if they are inconsistent with existing propositions.

c. Identification of target state through computer simulation -- The output of collection systems are the results of three interacting systems, i.e., the sensor system, the environment, and the target. There are excellent possibilities that the state of the sensor system and the environment can be eventually specified for each mission, thus, there exists the possibility that the target and the target state can be determined automatically. A target characteristic matrix coupled with simulation programs that can replicate the collection-environment-target interactions, could provide the analysts with ranked possibilities based on the output data.

3. Techniques That Expedite the Flow of Intelligence

Despite the large amounts of collected data, there are often significant gaps in the information needed by analysts. These gaps are caused because no awareness of the analysts' requirements existed or because the data was delivered too late for integration. Approaches for solving these problems include the following:

a. Selective request for intelligence -- The preparation of dynamic intelligence profiles that reflect current processing requirements would screen intelligence flow and route data through communications network based on need (and constraints of security).

b. Connecting processing systems -- Within each processing system, interpreters and analysts create their best estimate of the intelligence yield of input data. These results are usually disseminated in reports. Directly linking processing centers could provide these estimates as they are formulated without the time-consuming report preparation efforts.

c. Automatic input of source data -- Raw intelligence data takes on many forms and formats. Transformation into common language for higher

level integration takes time and introduces the possibility for errors. Advances in digital techniques coupled with pattern recognition techniques offer promise for producing rapid, interpreted transforms of sensor output data. Preprocessing analysts, using on-line computers with rapid access to reference data and interpretation aids, can annotate, edit, and compose reports summarizing the collection results. The composed report could then be automatically compressed, coded, and routed for automatic input into subsequent processing efforts.

B. BASIC RESEARCH AREAS PERTINENT TO INTELLIGENCE

This section (1) discusses three extant areas of research which continue to offer significant promise to intelligence and (2) briefly discusses limitations in knowledge about the analyst, an area which must be further explored if man-machine systems are to be developed for intelligence processing.

1. Pertinent Extant Research Activities

In July 1964, HRB-Singer produced a report (352-R-11) under ONR Contract Nonr 3818(00) titled "Trends in the Information Sciences Relative to Naval Intelligence Needs." Figure 8 is reproduced from that study document. The following material updates this report with respect to three processing research areas. It should be noted that these research areas overlap somewhat, thus a breakthrough in any one area may have broad implications elsewhere. The research areas discussed are Pattern Recognition; Artificial Intelligence; and Language Analysis, Linguistics and Machine Translation.

a. Pattern Recognition

Pattern Recognition, in both its conventional and in its broader connotations, is of special importance to intelligence interests. Conventional aspects of optical pattern recognition have direct applicability to the automatic reading of various types of fonts and of cursive script as a means of improving the low efficiency of present modes of computer data input techniques. Under the conventional connotation, pattern recognition techniques are applicable to the following:

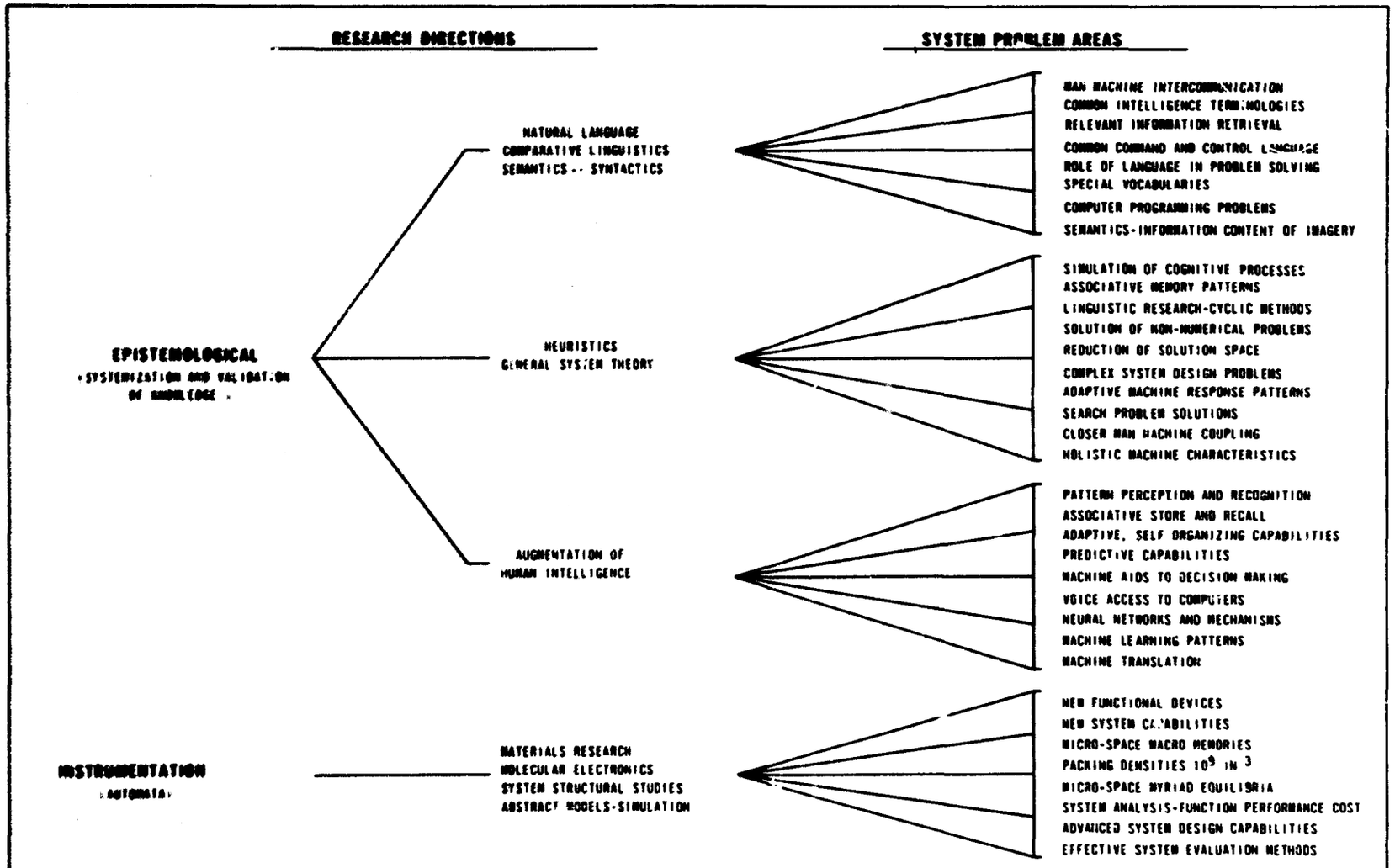

FIG. 8 - RESEARCH AREAS OF SIGNIFICANCE TO INFORMATION SYSTEM PROBLEMS

(1) Processing of various types of signal waveforms (including those related to target recognition problems, speaker identification, graph interpretation).

(2) Classification of geometrical configurations.

(3) Pictorial image recognition and interpretation.

(4) Compression of photographic images for transmission and computer storage.

(5) Applications in the broad research fields of artificial intelligence.

An area of special interest might be multisignature discrimination techniques. This research area would involve automatic classification of patterns by the computer.

b. Artificial Intelligence

Mechanization of some of the problem-solving efforts of intelligence processing offers possibilities for improving the quality of the efforts while reducing the stresses on the analysts. Some of the pertinent research activities include:

(1) Pattern recognition (e.g., activity and events as opposed to visual patterns), change detection, etc.

(2) Heuristic programs for tracking, activity analysis, etc.

(3) Automatic recognition of associations among data.

(4) Postulation of inductive inferences by machines.

(5) Automatic classification of input data.

If an area of special interest were to be chosen, it would be in the area of associative storage and retrieval of information based upon associative strings of related information rather than pre-established categories used in machine addressing.

c. Linguistics, Language Analysis, Translation

Linguistic research and language analysis (unit structuring) have direct significance to the interests and needs of intelligence activities. Important areas include language content and meaning; text compression; content sensitive storage and retrieval; and machine translation of languages.

Problem areas involve the categories of pure linguistic analysis, automatic analysis applied to structure, language statistics and their application to information retrieval, and linguistic analysis in terms of phonetic, morphological, syntactic and semantic analysis. Research in these problem areas is a requisite in support of advanced information storage, retrieval, and analysis systems, man-machine communications and effective machine translation systems.

2. Data Processing Habits of the Intelligence Analysts

A major facet in all information processing system developments is to satisfy the users' requirements. Unfortunately, the stated information requirements of potential system users do not always lend themselves to establishment of system specifications. Moreover these expressed requirements may not adequately reflect the complete set of real needs. Nevertheless, the developed system must satisfy the user or it will fail in support of the users' operations.

Although the information needs and uses of scientists and engineers have been (and continue to be) studied in detail, there is, regrettfully, a paucity of information about the intelligence analysts' data processing needs. This lack of information is particularly severe because, unlike the researcher, the intelligence analyst can only use the processing systems within his domain and he must produce the required products within fairly tight time frames.

Development of improved processing support systems will require more sensitive awareness of intelligence analysts information needs. It is reasonable to suspect that such awareness can be obtained through two interrelated efforts. First -- studies should be conducted to gain a broad outline of how the analysts transform information into intelligence. Second -- experiments should be conducted to narrow this outline into specific processing profiles for each basic processing area. These two efforts would serve to guide subsequent experimentation and development efforts leading to new processing capabilities.

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APPENDIX A

DIA'S PLANNED RESEARCH AND EXPERIMENTATION DIVISION

The Research and Experimentation Division (ERF[1]) planned by the Defense Intelligence Agency, together with an Advanced Development Division, and a Research and Development Projects Division, will comprise the Intelligence Experimentation Center within the DIA Directorate for Intelligence System Development, which is scheduled to be activated in the near future. As planned, ERF is to serve as an applied research laboratory, dedicated to the study of methods and techniques for improving the performance of DOD general intelligence production and processing functions. This mission implies somewhat of an overlap with the proposed operational concept of NIRF, an implication confirmed by an examination of ERF's planned operation, which is summarized in the following paragraphs.

In general, the goal of ERF will be the development of methodologies which may be used to facilitate or improve solutions to problems in intelligence processing and production. These methodologies will be developed in a problem-oriented mode using replicated real world problems within ERF. To assure that the problems are truly replicated, no limitations on data classification are proposed. While operational intelligence analysts work on replicated intelligence problems within the laboratory, they and the research staff of ERF will suggest new or different techniques and procedures which may prove useful in providing solutions. These techniques will be tried by the analysts, with the most promising techniques contributing to an evolving methodology.

At some point in time, the methodology will have reached a stage where future refinement is not considered useful. The improvement in problem solving as a result of the evolved methodology will be evaluated to determine whether controlled testing should be performed. If the evaluation should indicate that such a test would be valuable, arrangements will be made to subject the methodology to extensive testing, based on experimental designs selected to

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[1] DIA's planned laboratory postdates the NIRF concept and was originally referred to as The Experimentation and Research Facility, which resulted in the acronym ERF. Although the present designation is The Research and Experimentation Division, the laboratory is often referred to as ERF.

(hopefully) eliminate extraneous factors and effects. Experiments will then be conducted, data collected, results analyzed, and benefits of implementation of the methodology (or portions of it) evaluated and demonstrated.

Eventually, it is planned that ERF will have ongoing efforts on three problems concurrently. The actual problems which will be chosen for examination in the laboratory will be those which are "critical," i.e., those in which the need for improvement is greatest.

Although procedures for selecting problems to be considered by ERF have not been fully developed, it is planned that representatives of the three services will be invited to view the initial problem effort, and to suggest areas or problems for future consideration by ERF. In addition to this planned interaction with the services at a problem-oriented level through ERF, DIA is also interested in working closely with the research offices of the services (Office of Naval Research, Army Research Office, Air Force Office of Scientific Research) through the Research and Development Projects Division of the Intelligence Experimentation Center. Of a special interest to the research community is a DIS proposal that a clearinghouse for intelligence related reports and documents be established within the Directorate for Intelligence Systems Development. Such a clearinghouse could, in addition to serving as a respository for documentation, provide for the dissemination of reports and representative "real world" data bases to researchers with need-to-know.

By comparing the preceding discussion with the specific mission and functions of NIRF, listed in Section III-A, it appears that there would be an "apparent" duplication of effort between NIRF and the components of DIA's planned Experimentation Center. Of course, the Experimentation Center would be concerned with national and military intelligence, in general, as opposed to Naval intelligence problems in particular, and priorities might or might not accord with Navy needs. Therefore, it seems conceivable that a NIRF may indeed be required (perhaps as a satellite of or counterpart to ERF) in order to assure that those intelligence areas (e.g., ocean surveillance, ASW) which are for the most part the domain of the Navy obtain commensurate priority of attention and expertise that a problem common to all three services might receive. One must bear in mind, for example, that the existence of the Defense Intelligence Agency has not eliminated the need for the Naval Intelligence Command.

APPENDIX B

DIS'S INFORMATION SCIENCE CENTER

The following paragraphs were extracted from the paper titled "An Information Science Center for the Intelligence Community" by Capt. C. E. Cantlon, USN; Mr. Henry F. DeFrancesco; and Col. Robert E. Duvall, USAF.

> "An Information Science Center has been established at the Defense Intelligence School to develop and present courses for students from throughout the national intelligence community in the application of information science to intelligence problems. The objective of the courses is to improve the capabilities of intelligence personnel through education in information science which will include those elements of the methodology of science and modern information handling techniques that contribute to more efficient and effective use of information in forming the intelligence product."

Introduction

"The current fields of intelligence and information science have much in common; both are new modes of ancient practice, both are multidisciplinary, and neither is well-known outside its craft. Both are as much art as science and are equally difficult to define. Progress in each derives principally from experience, and the concentration required for expertise in either area has hindered the acquisition of more than a marginal capability in the other for all but a very few."

"An increased "knowledge of the fundamentals of information" and an improved "ability to use information" can both contribute to solutions of the greatest problem that faces the intelligence community. This problem is the imbalance between our dynamic and growing capability to collect intelligence data and our growing but lagging capability to store, retrieve, analyze, and process mountains of data into intelligence information -- our final product. Collection techniques of the late 20th century funnel a continuous and increasing output into a machine and human processing system that has not kept abreast of the growth in the collection capability."

"In recognition of this present and future problem, the President's Foreign Intelligence Advisory Board (PFIAB) several years ago concluded that an

appropriate combination of improved machine and human techniques for the processing of intelligence was called for. Specifically, the PFIAB turned to information science and recommended that selected personnel from the U.S. intelligence community be sent to graduate study at universities "where systems thinking and systems skills are understood and imparted." (This is the background for the DIA-sponsored year of graduate training in information science that is available to DIA civilians -- a very attractive arrangement.)"

"The United States Intelligence Board (USIG) directed the implementation of the graudate study program and also recommended two other educational programs in information sciences. First, community intelligence schools were to increase the attention given to intelligence data handling systems (IDHS) and to automatic data processing (ADP). Second, the community should develop and present specialized courses in the application of information science to specific intelligence problems. DIA agreed to accept the latter responsibility and on 26 December 1967, the Information Science Center (ISC) was formally established as a new major element of the Defense Intelligence School to undertake this task for the intelligence community."

The Information Science Center Program

"The USIB in 1968 established the Intelligence Information Handling Committee (IHC), headed by retired MGEN Robert Taylor, formerly DIAAP, to promote and coordinate the accomplishment of the USIB objective of ensuring "the continuous improvement and integration of the intelligence information handling systems of the USIB member agencies..." Within this tasking, the IHC was to see that education and training programs in information science were established."

"Early in 1969, the IHC, which is made up of representatives from all the departments and agencies of the USIB, endorsed the development of two courses at the Information Science Center:

Information Science in Support of Estimates and Warning
Information Science in Support of Intelligence Functions

In addition, the ISC was requested to develop a short Survey of Information Systems currently in use in the community. Initial "pilot" presentations of the

two primary courses would be about eight weeks long, final development could be up to 13 weeks depending on the number of intelligence-oriented games that can be adapted."

"The Director of the ISC has interpreted this guidance and has mapped out the objectives to be accomplished through the courses. The courses in Estimates and Warning and in Intelligence Functions are being designed to increase, through education, the proficiency of the intelligence analyst in performing his principal job functions. The analyst's job functions normally include performing task assignments such as long-range functional research, current literature review, analysis of specific information within a time frame, preparing summaries, etc. In performing his task assignments, the analyst utilizes specific skills in the areas of analysis, exercise of judgment, decision making, and communication. Additionally, he makes use of knowledge of the functioning of the intelligence environment in terms of his role, relation and contribution to the intelligence product. Finally, but not least, the intelligence analyst applies his capabilities with the highest level of professionalism, which includes his technical or area proficiency, morale, ethical philosophies, attitudes and sense of duty."

"Our general objectives in presenting the two courses in information science are simple and explicit. First, we want the intelligence analyst to learn to apply the scientific method in his field. Second, the intelligence analyst must learn how information science and technology can help him to improve his performance."

"If both of these objectives are achieved, then a side benefit will be drived. We can expect that education in information science will serve to increase job standards and hence introduce a greater degree of professionalism within the intelligence community."

The ISC -- Intelligence Community Relationship

"As the courses of the Information Science Center are to serve the needs and interests of the intelligence community, the ISC must rely on each member of the intelligence community to keep it informed of their requirements for education and training in the information sciences. Also, the ISC must turn to the community for recommendations in technique and system cases to be included

in the ISC curricula. Once these cases are developed, the ISC must again turn to the intelligence community for updating, guest lecturer support, and for access to existing intelligence files via secure terminals."

"Establishment of the Information Science Center at the Defense Intelligence School has added an important new dimension to intelligence educational programs and is a major step forward in modernization. The introduction of information science and technology into the formation of the intelligence product will provide to the intelligence analyst powerful new tools already proven through application to other intelligence-related areas of our national life. The sought after synergism is not going to happen all by itself. The new Center is not yet off the ground. To be effective the ISC needs all the support which it can acquire from the intelligence community in order that the ISC may better serve the community toward achieving higher levels of professionalism through the use of information science in fulfilling ever increasing requirements for high-quality intelligence."

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13. ABSTRACT

The findings of this report reaffirm the major recommendations made ~~by~~ HRB-Singer, Inc., in an earlier effort, viz., that a Naval Intelligence Research Facility (NIRF) be established and that the Naval Intelligence Research Advisory Group (NIRAG) be reorganized. Within the context of these two recommendations, this report describes the objectives of these two activities and presents an organizational and operational configuration which appears most feasible in light of existing objectives and constraints.

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