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# ENHANCING LEAA'S UTILIZATION OF RESEARCH AND DEVELOPMENT IN SCIENCE AND TECHNOLOGY

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IN SCIENCE AND TECHNOLOGY

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## ABSTRACT

The purpose of this study was to determine the best alternative for LEAA in order to bring to bear appropriate knowledge in science and technology on the accomplishment of the Agency's missions. Three alternatives were analyzed:

1. An LEAA/NILECJ-managed R&D program, performed by multiple contractors and grantees.

2. A prime-contractor-managed R&D program.

3. A multidisciplinary R&D laboratory, owned and operated by LEAA.

The first alternative is recommended for LEAA's consideration and implementation. Analyses are presented indicating why this alternative is to be preferred at this time, and how it would meet LEAA's needs and help overcome issues and problems that have surfaced during recent years in LEAA's science and technology programs.

Specific organizational, staffing, operational, and budget recommendations are made to assist in the implementation of the recommended alternative.

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## EXECUTIVE SUMMARY

In this study of LEAA's Research and Development activities in the natural sciences and technology, we have examined three alternatives for carrying out such work:

1. An LEAA/NILECJ-managed R&D Program, performed by multiple contractors and grantees.

2. A prime-Contractor-managed R&D Program.

3. A multidisciplinary R&D laboratory, owned and operated by LEAA.

We recommend that LEAA adopt the first alternative. The principal advantages of this mode of operation are:

- LEAA maintains direction and control of its R&D program, through an enhanced internal capability for systems analysis and program planning.
- The research and technology development agenda is defined in relation to user needs, and is performed by the best talent available through competitive awards of contracts and grants.
- Maximum flexibility is retained, particularly important given the current uncertainty about the contribution of technology to law enforcement and criminal justice.
- The R&D program is performed more cost-effectively than under either of the other two alternatives, particularly so for engineering development projects which will likely be a major portion of that program.

In order to effectively pursue this recommended course of action, NILECJ will need to upgrade its Advanced Technology Division into an Office of Research and Engineering Development, reporting directly to the Director of NILECJ, and staffed by a highly qualified group of about 15 professionals. These persons need to be skilled in program and project management, have strong technical experience, and understanding of the functions of one or more of the principal elements of the criminal justice system: police, courts, and corrections.

Such a NILECJ-managed R&D effort will most effectively, speedily, and convincingly demonstrate (both within LEAA as well as within the criminal justice community) whether, where, how, and by whom science and technology can be used to improve the criminal justice system and to reduce crime.

Alternative II is not recommended because it runs the danger of NILECJ losing direction and control of its R&D efforts. This danger is inherent whenever a sponsor of R&D turns over the management of the bulk of its R&D program to a prime contractor, however well qualified and intentioned such a contractor may be. This danger is all the more present in this instance where LEAA/NILECJ is still uncertain about its R&D goals and objectives. It must strive to build the capabilities in-house for systems analysis, project selection, project monitoring, and for interaction with potential users of science and technology.
It must also be in a position to retain as much flexibility as possible to reach the best qualified talent (under contracts and grants) to perform the R&D work.





Alternative III is not recommended because a multidisciplinary in-house laboratory would need to be relatively large in order to cover the wide spectrum of science and technology efforts, and it would thus be motivated to undertake not only research but also engineering development, which is likely to be the bulk of NILECJ's R&D effort for the foreseeable future. Such development is done more cost-effectively under contracts with industry. If the multidisciplinary lab were to be restricted solely to research, which is correspondingly a much smaller portion of NILECJ's R&D program, it would not achieve critical size to undertake any but those projects for which its staff may by happenstance be better qualified than outside grantees. A single-purpose smaller lab, e.g., for forensic science research, would be duplicative of efforts underway elsewhere in federal and state agencies.

## I. INTRODUCTION

In March 1976, the Law Enforcement Assistance Administration asked Arthur D. Little, Inc. to undertake a study of the need for a federal law enforcement physical and natural sciences laboratory. The focus of the study was to determine the best alternative for LEAA to pursue in order to bring to bear appropriate knowledge in science and technology on the accomplishment of the agency's missions.

The study was to:

- review the history of LEAA's science and technology R&D program including its objectives, activities, and funding levels;
- identify major alternative means of implementing a science and technology program for LEAA;
- analyze and weigh the merits of each alternative;
- recommend the preferred alternative, and define the organizational and functional requirements, the cost, and any special physical facilities required;
- consider other federal agency experience in making similar determinations, and examine the relationship of an improved R&D capability in LEAA with technology development efforts in other parts of the Department of Justice.

Our work tasks included review of LEAA program plans, reports, and other documents related to R&D; interviews with selected participants in the LEAA R&D effort and expert observers thereof; development of draft working papers for internal ADL analysis; review of major issues and alternatives by a panel of ADL staff in disciplines relevant to the LEAA R&D agenda; and preparation of a final report.





Some definitional issues should be clarified here. Where we refer to R&D or research, we mean within the law enforcement and criminal justice arena. Further, unless we say otherwise, we mean by R&D, research and development in science and technology (and particularly in the physical and natural sciences. Within those activities we include (unless otherwise specifically identified) three kinds of activities: engineering development, practice-oriented research, and fundamental research.

Thus, most of the LEAA-supported R&D with which we are concerned is under the aegis of the Advanced Technology Division, Office of Research Programs, in the National Institute of Law Enforcement and Criminal Justice. Some, notably environmental design, is the concern of the Community Crime Prevention Division.

As we conducted the study, we came upon several related efforts, such as the National Academy of Sciences review of the entire LEAA (or NILECJ) research program, the RAND Corporation work as staff to the R&D Task Force of the National Advisory Committee on Criminal Justice Standards and Goals, and the relatively new role being played by the International Association of Chiefs of Police (IACP) in determining law enforcement agencies' needs for new equipment and technology. We talked with representatives of these organizations, in addition to interviewing present and former LEAA staff, staff of other DOJ agencies (FBI, DEA, INS), representatives of Aerospace Corp., the National Bureau of Standards, MITRE Corp., eminent practitioners in police and criminal justice, and a variety of other federal agency representatives such as ATF/Treasury.* Our purpose in these interviews was to become aware of critical issues, of the magnitude and range and success of

*Those interviewed are listed in Appendix A.

past and present R&D efforts, of management difficulties, and of the larger context of law enforcement and criminal justice research beyond the physical sciences.



## II. ISSUES AND PROBLEMS

In this chapter, we briefly review the principal issues and problems that have surfaced in NILECJ's research and development efforts in the natural sciences and technology, from their beginnings in FY '69 through FY '76.* We realize that much of this is known to present senior management of LEAA/ NILECJ and their staff. Most of these observations have been previously made and documented.** Nonetheless, we believe it important to record them here in order to illustrate the context in which this study was undertaken.

### A. Objectives and Budget

NILECJ's objectives have undergone frequent changes in emphasis and direction:

- FY '69 : Riot or demonstration control (collective violence)
- FY '70 : As for FY '69, with addition of drug-related activities, stranger-to-stranger crimes, and burglary.
- FY '71 : Same as FY '70, covering wide gamut of research activities.
- FY '72 : Specific program emphasis on large projects, with special attention to engineering development (beginning of Equipment Systems Improvement Program (ESIP) under single prime-contractor management).

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* For fuller details, see Appendix B: "History and Status".

** Michael Radnor, "Study and Action Program of the Law Enforcement Equipment R&D System; ESIP", January 31, 1975 (Northwestern University); and General Accounting Office, "The Program to Develop Improved Law Enforcement Equipment Needs to be Better Managed", January 1976.

- FY '73 : Corrections (rehabilitation, recidivism, and causes of crime); opportunity-reduction through citizen-involved crime-prevention programs; ESIP continuing.
- FY '74 : Crime prevention; juvenile delinquency; ESIP continuing.
- FY '75 : Efficiency, fairness, reducing cost of crime -- applied to the full range of criminal justice activities; ESIP continuing (becoming Advanced Technology Program - ATD).
- FY '76 : Crime prevention and control of habitual offenders; special police operations; white-collar crime and official corruption; ATD continuing.

In short, while the broad objectives of the Institute changed, its science and technology program (ESIP, ATD) essentially continued on its course originally set in FY '72, and bore only a tenuous relationship to the Institute's objectives. The objectives themselves varied with respect to specificity, and some were so broad as to be not susceptible to measuring success (or failure) of their attainment. These characteristics made it all the more difficult to mount a meaningful and related science and technology program.

The budget for ESIP/ATD grew from about $1 million in FY '69 to about $9 million in FY '75. Its share of total NILECJ funds ranged between 23% and 37% during those years, stabilizing in FY '74 and FY '75 at about 26% of the total NILECJ budget.





B. Systems Analysis

No systematic and sustained efforts have been undertaken to analyze the criminal justice system (police, courts, corrections) in order to determine where and how science and technology might effectively improve that system and/or reduce crime. To this day, eminent practitioners in the criminal justice system hold widely divergent views about the value of science and technology. This divergence is reflected within LEAA/NILECJ.

C. Program and Project Planning; User Requirement Analysis

Science and technology programs were typically selected with inadequate understanding of potential user needs. Efforts by the Mitre Corporation* in 1972-1974 to identify problem areas susceptible to technical solutions, and the National Bureau of Standards' extensive police equipment survey of 1972 were requested too late by NILECJ to affect the program and project choices that had already been made at that time, and pursued since then by the development contractor, the Aerospace Corp. Those choices reflected instinctive and experiential judgment of top NILECJ staff in 1972, rather than a systematic screening of target areas of opportunity for successful and rapid introduction of science and technology.

Throughout the years 1971-1976, ATD funded increasing amounts of R&D work, the bulk of it through its prime contractor but some also through separate contracts and grants. These activities were not co-

* The MITRE Corporation, "Compedium of Criminal Justice Problems Identified under the Equipment Systems Improvement Program FY74", March 11, 1974; and ibid., "Analysis of Criminal Justice Problems, MITRE Technical Report No. 6358," March 19, 1973, as referenced in The Aerospace Corporation, "Equipment Systems Improvement Program-Development", March 30, 1973.

ordinated with other R&D programs undertaken by NILECJ in non-technical areas, nor with other related technical research by organizations (public and private) outside LEAA/NILECJ.

The most critical shortcoming throughout the years was the lack of user input to program and project planning.

D. Project Definition and Project Execution

The six to nine major R&D programs which Aerospace Corporation has managed for NILECJ since 1971 have generally progressed slowly due to initially insufficiently precise definitions of performance requirements. NILECJ's monitoring of these R&D programs was superficial and the status reports, progress plans, and work statements provided by the prime contractor frequently contained insufficient detail for NILECJ/ATD staff to make informed judgments. Even when NILECJ program managers made decisions on the substance of the prime contractor's work they often had little or long-delayed effect. In saying this -- as others have said before us -- we do not criticize the professional capability of Aerospace Corporation nor of individual NILECJ/ATD staff members. Rather, managing the relationship with a prime contractor, who is responsible for the bulk of the work, can easily lead to uncertainty of who is in charge. This is an inherently sensitive problem in most "prime contractor situations", but in this case is aggravated by the apparent uncertainty of NILECJ management about its R&D goals and project selection. The result here has been a distortion of authority and control with adverse effects on the conduct of the program.



E. Access to Technical Expertise

The prime contractor, Aerospace Corporation, had responsibility for selecting subcontractors on its various projects for as much as half the project funds it received annually. There is no clear evidence that Aerospace always reached far enough to select those best qualified, and some of the delays in completing on-going projects are ascribed to this limitation.

NILECJ/ATD was not always wiser in its own choice of technical talent or special projects not under the control of its prime contractor. For instance, the miniature police transceiver development was unsuccessful largely because a better-experienced private firm produced a better product with its own resources than the contractor chosen by NILECJ for this engineering development.

On the other hand, NILECJ/ATD made good choices when it used NBS on problems of tire blow-outs of police patrol cars, and when it turned to Edgewood Arsenal and Natick Laboratories (of the U.S. Army) for the development of body armor.

F. User Assistance and Dissemination

The National Bureau of Standards' Law Enforcement Standards Laboratory (LESL) is under contract to NILECJ for the preparation of standards on criminal justice-related technical products and systems. One purpose is to help the user make wiser buying decisions. A problem recog-

nized by LESL but only now beginning to be tackled is the need to translate an often highly technical standards document (needed in that format for verification of product performance offered by vendors) into a document written in language understood by the lay-user (both the general public as well as practitioners in the criminal justice system). LESL has been, for too long, too remote from the user community, a situation apparently not of its own making but, rather, one which NILECJ/ATD did not resolve on behalf of its contractor, LESL.

G. Summary

The science and technology effort of NILECJ has suffered since its inception from:

1. Lack of systematic analysis to identify promising targets and opportunities for early application of science and technology;
2. Lack of user input for program and project selection;
3. Inadequate management of NILECJ's relations with its prime contractor;
4. Superficial monitoring of project progress;
5. Inadequate reach for technical expertise;
6. Insufficient efforts to disseminate to users the results of technical work done (whether successful or not, for in both cases the potential user's reaction is a necessary ingredient to decisions on what efforts to continue, whether and how to redirect, and which to abandon).



It is in this context that we undertook this study to examine alternative ways to improve this situation.

## III. OBJECTIVES AND CRITERIA

### A. Legislative Goals and Initial Response

The officially stated objectives for LEAA or for an LEAA research function offer scant guidance for molding an R&D program. The Omnibus Crime Control and Safe Streets Act of 1968, in section 401, cites the purpose of Title IV as:

> to provide for and encourage training, education, research, and development for the purpose of improving law enforcement and criminal justice, and developing new methods for the prevention and reduction of crime, and the detection and apprehension of criminals.

Later in the same legislation, research is intended "to develop new or improved approaches, techniques, systems, equipment, and devices to improve and strengthen law enforcement and criminal justice."

According to the act, then, research has three objectives: to improve law enforcement and criminal justice; to find new methods for prevention and reduction of crime; and to enhance the detection and apprehension functions. The National Institute for Law Enforcement and Criminal Justice is established to carry out the research and further is authorized "to establish a research center to carry out the programs described in this section".

As shown by a review of NILECJ funding, relating to research and development in science and technology, a variety of projects have been initiated for equipment improvement (e.g. to improve communications within the law enforcement and criminal justice system), and to develop crime prevention devices. Appendix B of this report reviews that agenda of projects conducted to date. The R&D program choices that have been made illustrate the gamut of NILECJ objectives



thought to be susceptible to scientific and technological contributions, in response to the legislative mandate.

Factors guiding funding choices, albeit sporadically, over the seven year history of the program included the following:

- research and development (of equipment) was to be based on a national needs survey (a first cut at which was done in 1972 by LESL/NBS for police equipment);*
- large projects were to be preferred to small;
- in "research", practice-oriented, rather than fundamental, research was emphasized.
- in "development", emphasis was on engineering development to improve equipment for police departments;
- some attempt was made at crime-specific research;
- reduction of crime was attempted through "target hardening", opportunity reduction, and increasing the risk of detection and apprehension;
- efficiency and fairness in the criminal justice system and reducing the cost of crime (1975 Annual Report) were seen as overall goals;
- the share of NILECJ's research budget devoted to science and technology has averaged 30.3%, from FY1969-75.

These characteristics of the history of NILECJ research, especially technology-related research and development, might reasonably be expected to continue into the future in the absence of some motivation to re-examine their utility.

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* "LEAA Police Equipment Survey of 1972", LESL/NBS Ref. No. LESP-RPT-0001.00 July 1975 (printed).

Since the purpose of this study is to consider alternatives to the present means of investing R&D time and dollars, it is reasonable that we examine NILECJ's R&D objectives and make some judgements about criteria for:

- choosing R&D programs and individual projects, and
- improving the management and performance of such programs and projects.

B. Objectives

The goals cited above are too broad to permit choice of specific R&D programs and individual projects within each program element. It is therefore necessary to define more specific objectives. This is important to allow orderly and rational resource allocation, and to consider and apply priorities, both among objectives, and within R&D programs to achieve a single objective. The set below is suggested by the program history, but has not been an explicit guide in program management.

1. With respect to the broad goal of improving law enforcement and criminal justice, the following specific objectives might be considered:

a. Achieving technological improvement in the analysis of physical evidence.

Included here are:

- better methods of analysis, for purposes of individualizing physical evidence such as hair, blood, mud, paint, drugs, fingerprints, and



- standardizing the best techniques already available or yet to be developed.

These objectives would call for increased forensic science research, as well as for assuring quality application of valid and competent techniques (in effect, quality control through application of standards).

b. Improving the detection of evidence on the person of a suspect or victim.

Included here is the ability to find the presence of and determine the specific nature, type, or amount of evidence. Examples would include drugs or alcohol in body fluid and gunshot residue.

c. Improving the speed and accuracy of communication for law enforcement.

This would aid in faster reporting of crimes, quicker and more efficient response by police to such reports, confirmation of illegal situations (such as stolen cars or the fugitive nature of a suspect), earlier consultation between arresting officers and prosecutors on charging decisions, enhanced notice to or consultation with medical facilities on emergency first aid or alert to incoming medical emergencies, and better command and control in response to emergency conditions (whether natural disasters, traffic accidents and jams, or civil disorders).

d. Improving effectiveness of the basic patrol/investigation/response police functions.

Here the patrol car and its occupants are the most obvious target, with technological improvements ranging from safety and fuel economy to better design of the vehicle for surveillance or prisoner transport; and to enhanced data and voice transmission, receipt, and analysis capability within the vehicle.

e. Improving equipment used by the police officer beyond or exclusive of the patrol car package.

Improvements here might relate to clothing, communications, weapons, information access, transportation, or specific techniques to be learned. Some might be passive improvements, such as body armor or more comfortable clothing. Some might be active, such as communications or non-lethal weapons. Areas of improvement would include effectiveness, safety, efficiency, and comfort of basic police functions.

(Also within this systems improvement goal, we suggest an objective different from those above, in that it would facilitate all of them, both in selection of projects and in imprlmentation of results. That objective is:)

f. Improving understanding of the operational context in which specific technological changes might be desirable.

The difficulty here is that products a process developed without consideration of the real world in which they work may be irrelevant, over-engineered, or otherwise ineffective. Spending lost of money on forensic analysis methods when only 2% of cases turn on the physical evidence may be one example. So might the development of a "citizen alarm" without careful attention to the false alarm problem.



Here, we would anticipate that operations analyses would be carried out to determine the potential gains to be expected from putting specific technology improvements into operational use, e.g. the problems and effects of widespread use of protective clothing (by both police officers and/or criminals), use of non-lethal weapons, or improved physical evidence examination techniques. Such analyses would help determine cost/benefit trade-offs and thus aid in understanding potential pay-off of technology improvements and in designing appropriate R&D programs. Additionally, after proto-type engineering development, field tests and experiments would be done to empirically confirm the operational/behavioral improvements and constraints. If modifications rather than confirmation are found, further refinement of the R&D program will be required.

2. With respect to the broad goal of <u>crime reduction</u>, more specific objectives could include:

a. Crime-specific identification of preventive action strategies, or cost reduction strategies.

This is an analytic task to examine which types of crimes might be preventable, under what conditions, and what possible combination of behavior and technology would help. Possible applications of technology could then be specified for development, with both users and beneficiaries better defined, and opportunities and problems of implementation would be more clearly understood by both potential users and NILECJ,

thus improving choice of R&D programs and selection of specific projects with greater likelihood of early use of technology in practice.

b. Identification of specific hardware or equipment developments with high probable payoff in reduction of crime, and development of such.

The most obvious examples are such target-hardening devices as better window and door locks, more effective automobile anti-theft devices, improved burglar alarm systems, and the "defensible space" concepts of environmental design. Other possible deterrents might include "citizen alarms", personal protection weapons, smoke detectors or automatic fire suppression systems, explosive and metal detectors.

3. With respect to the broad goal of detection and apprehension, more specific objectives have already been covered in 1(a) above, since detection and apprehension are parts of the law enforcement goal. That is, technology could be developed to improve finding and analyzing evidence, to identifying specific persons from such evidence, to shorten the time between occurrence of crime, reporting, and response.

4. Other. Most attention so far has been to law enforcement improvement, but there are possibilities for the application of science- and technology-related R&D in other criminal justice areas as well. Within the courts area, improved scheduling to handle case flow and reduce undesirable delays has been a continuing area of experimentation. Improved information systems, computerized trial transcripts, and videotaping to preserve testimony have all achieved some success. Analysis of the area might well turn up other potential areas of technology-susceptible improvements in the court systems.



Similar opportunities might exist in corrections, with respect to institutional security, prevention of crimes within correctional facilities, and technology to be utilized in learning, job training, and rehabilitative programs.

Most of what has been funded in the past has related specifically to law enforcement, to improving police equipment or enhancing the effectiveness of police functions. Another portion has related to crime prevention. Because the agenda has been relatively limited and relatively constant (as shown in the brief review of the program in Appendix B), and resources have not permitted initiating many new projects, there is only limited awareness of other needs. Therefore, we suggest that particular attention be given to identifing areas susceptible to science and technology R&D throughout the criminal justice system, rather than primarily within law enforcement.

C. Criteria: Deciding What to do.

The single most important requirement -- the prime objective -- for improving law enforcement R&D in science and technology is in deciding what to do. There has been no rational and sufficiently comprehensive decision process to identify principal R&D program elements and specific projects within each. A case can be made for the worthiness of any of the technological developments now being pursued. With almost equal ease, each such project can also be criticized as peripheral, narrow, of low potential impact, or simply unneeded.

Part of the problem is -- of course -- that there is no clear and unified understanding of an optimal law enforcment and criminal justice system, with specified roles for each component, and all interacting in pursuit of a clear and common goal. Indeed, public expectations of the system are frequently contradictory. Expectations of the criminal justice professional are likely to be bounded by his area of concern, rather than the optimal functioning of the larger system.

A consequent problem is that there has been no systematic way to decide what to do in R&D. With a fragmented, balkanized set of institutions responding to the needs for crime reduction, law enforcement, and criminal justice, it is all the more important that the means for deciding where and for what to invest research dollars and the criteria for such decisions (and their priorities) reflect these various interests. For sound funding of R&D in the physical and natural sciences, a rational and systematic decision mechanism is important for additional reasons:

- first, our present limited understanding of crime and what to do about it has not yet shown frequent evidence that technological improvements are central, either to crime reduction or to an improved law enforcement and criminal justice system.

- second, absent a more thorough understanding of crime and what to do about it, both the problems and potential solutions must be approached systematically and pragmatically from a strictly operational viewpoint. User needs for technological aids must not be defined naively (i.e. as a "wish list" that merely reflects the users' frustrations, or as a desire for "silver bullet" cures).



- third, virtually any technological improvement will be embedded in a context of human and institutional behavior that must be understood to fully utilize and benefit from the new technology.

- fourth, the "experts" in law enforcement-related technology are likely to be committed to their relatively narrow view of where improvement can be achieved, with no self-regulating ability to either see the larger system or to terminate R&D projects of questionable value.

We must, therefore, define two kinds of criteria:

- One set for selecting the most effective mechanism for managing and performing the R&D;
- Another set for selecting the most promising projects for R&D.

Since on the one hand, the potential of science and technology applications to law enforcement and criminal justice is still uncertain, while, on the other, urgency for visible beneficial results from R&D is high, relatively simple and achievable objectives must first be pursued. No present set of projects can be seen as a complete agenda. The "learning function" implied by the R&D program, both for LEAA/NILECJ and the various user communities, must be clearly recognized and pursued. This calls for flexibility in responding to the variety of potential user needs and considerable skill in setting priorities for R&D, having projects executed on time and budget, and stimulating utilization of results in operational practices. These requirements must govern the mechanism for managing and performing

the R&D programs and projects. Success will engender credibility for technology and LEAA/NILECJ's sponsorship thereof and thus facilitate the continuing finding and screening of new and more complex problems and potential solutions.

Therefore, our criteria, below, stress several aspects of activity that better inform and sharpen that critical function of deciding what to do in R&D.

- R&D Organization and Management

  The R&D organization concerned with finding and applying technology to law enforcement and criminal justice problems must have the following capabilities:

  1. System analysis capability, where the management, analysis, project selection, and evaluation is all within a conceptually broad view of a criminal justice system, and explicit note is made of system impacts. Crime specific and quantitative estimates of the potential impact of science and technology would be made.

  2. Program planning capability, with any given agenda of programs related to LEAA priorities and other NILECJ research.

  3. User requirements analysis, including identification of probable users of some new technology or projects, their requirements and constraints, acceptable costs, implementation problems (e.g. training) and what impact must be demonstrated. Continuing linkage is needed to all parts of the criminal justice system for problem identification.



4. Program and project selection mechanism, with defined criteria, specific performance, time and cost specification of each project, focussed on efforts to come to the market in the near term (e.g. three years), and with quick project start-up capability.

5. Access to technical expertise, both to identify and bring to bear the appropriate technical skills and expertise, from industry, research institutions, universities, federal and state (or federally supported) labs, as well as from the NILECJ R&D management staff.

6. Flexibility, to change direction and emphasis as problems require.

7. Dissemination of research results through means that are prompt, reach widely into the user communities, written to be understandable to a non-technical reader (as well as in technical language for prospective manufacturers or vendors).

8. Minimize costs of a given program of R&D, both through close and effective management and through staying away from unnecessarily long term or fixed commitments.

The above criteria stress sound program choices, system-wide perspective, tight management, and demonstratable impact. The organization chosen or formed to meet these criteria may also perform some or all of the actual R&D. But the management, decision making, user needs identifications, and implementation

capability analysis, are critical functions for the central organization.

- R&D Project Selection

  Whatever the organizational form of the R&D management, one key criterion is to have a sound project selection mechanism. Thus, project selection criteria should be specified, and these should include:

  1. User acceptance estimate (based on close user linkage, clearly perceived need, estimate of cost and ease of implementation).
  2. Cost determined to be reasonable (in terms of the problem addressed and applicability of solution).
  3. Marketable within the near term (say, three years).
  4. Specifically related to law enforcement and criminal justice system improvement, and/or to reduction of specific type of crime.
  5. Not presently being done (either being manufactured or being researched or developed) by others.
  6. High probability of successful technology; or
  7. Basic, tough, very prevalent and intrinsic problem.
  8. Normally, total yearly cost of each project not to exceed 20% of relevant R&D program budget.



After we have outlined the types of R&D activities which may be necessary, we shall describe three major alternatives, and then examine them against the management and organizational criteria.

## IV. R&D ACTIVITIES RELEVANT TO LEAA

### A. Types of R&D

In addition to objectives and criteria, choices must be made as to type of R&D activity. Below we briefly describe the various types of technical activities that fall within such R&D programs, and identify a specific set of activities that must exist in any effective alternative.

For NILECJ's purposes, it is necessary to distinguish between three types of R&D activities: fundamental research; practice-oriented research; and engineering development.

1. Fundamental research is undertaken to add to the store of knowledge about basic processes in the natural and social sciences. The objective of this activity -- in LEAA's context -- is to build a body of knowledge about the criminal justice system and means of reducing crime that advances the frontiers of understanding basic parameters. Such understanding, of the nature of human behavior and motivation, and of institutional behavior, as well as of related natural sciences, may in the longer run (5-10 years) become the foundation for practice-oriented R&D and engineering development.

This study is focussed on the natural sciences and related technology (hardware) where only isolated instances are likely to be found in which fundamental research would be needed for NILECJ's purposes. One such might be the biochemical/psychological area, e.g. chromosome aberrations constituting a possible factor in criminal behavior. This is natural science



fundamental research, though its results may or may not lead to practice-oriented research and engineering development.

The principal management problems related to fundamental research are:

- recognizing that the interests of highly qualified researchers (principally in universities) may not reflect the objectives and priorities of LEAA/NILECJ for expanding its knowledge base.
- intervening (e.g., through grants to such researchers) to reduce this mismatch of interests without disrupting, or even destroying, the initiatives of that rare breed who qualify as fundamental researchers.

2. Practice-Oriented Research is an activity undertaken to solve problems in the criminal justice system, and in reducing crime, with objectives of providing a useful policy, process, or product. Generally, there will be several different ways of solving such problems, but one way will be judged better than the others, reflecting the objectives and criteria discussed in Chapter III. Practice-oriented research differs from fundamental research in that NILECJ criteria are highly relevant (for choice of practice-oriented research projects). Indeed, explicit managerial attention must be paid to direct such research to

the most important practice-related problems.

In order to select promising practice-oriented research programs for LEAA/NILECJ sponsorship, user needs for which no present technology is adequate must be identified. This requires NILECJ to have an understanding of advances in fundamental research in the natural sciences (through access to leading authorities in physics, chemistry, biology, electronics, etc.), as well as in the social sciences. This understanding can be institutionalized through several means:

- A network of such authorities, with individuals generally located in universities and leading research institutions (public and private), is accessible. Their guidance is needed to suggest those practice-oriented research directions that are most likely to lead to proof-of-concept of a new technology (e.g., bloodstain analysis techniques).
- Before embarking on any specific practice-oriented research project, a review of the proposed direction and level of effort, and of the qualifications of the principal investigator should be made, including comment by a peer group selected for each program.
- This review group should assist LEAA/NILECJ in project selection, regular project monitoring, and in decisions to terminate, continue, or redirect the project.



The Institute presently uses such methods in various of its R&D efforts.

3. "Engineering Development" is an activity that generally adapts, extends, or combines existing technologies (resulting from practice-oriented research, whether LEAA-sponsored or not) to produce equipment or systems designed to meet specific user needs.

Engineering development projects involve at least three kinds of activities:

a. finding out what prospective users of new equipment and systems need; how they will productively use such if made available to them; and how much benefit accrues from such use, relative to the cost of engineering, producing, and marketing the equipment and systems and training their end-use operators.

b. finding out what technologies are available that lend themselves to meeting user needs, after suitable engineering development; whether the equipment and systems so produced and deployed are sufficiently flexible to allow further refinement (to increase utility) as the state-of-the-art of technology develops.

c. undertaking the engineering development projects to meet precisely specified performance goals within a set budget and time frame (1-3 years).

The greatest portion of LEAA-sponsored R&D in technology (up to 85%) is likely to be devoted to engineering development.

4. Mix of R&D Activities

Broadly speaking, we believe that LEAA/NILECJ objectives will call for a preponderance of engineering development projects, i.e., for developments that can make significant operational improvements in the agency's mission and the practices of its "constituencies" within a 1-3-year time period. A certain amount of practice-oriented research will also need to be supported, but very little fundamental research (in the natural and physical sciences) is likely to be justified at this stage in the agency's development. LEAA (and NILECJ) must first and foremost seek to serve its constituencies, i.e., the user communities (police, courts, and corrections systems) in upgrading their existing capabilities to use existing technologies (both hard and soft). We recognize, at the same time, that there is as yet little "proof" that "technological solutions" alone will significantly improve the functioning of the law enforcement system, of the criminal justice system, or reduce crime. For that reason, a certain amount of practice-oriented research (to develop new technologies more directly relevant to crime-related problems) is also needed.

B. Making Development Usable

In order to assure that engineering development projects will lead to equipment and systems that can be usefully deployed, certain additional work must be done. Without these ancillary activities, new technology



simply will not be adopted efficiently.

1. Before embarking on engineering development projects, relatively precise understanding is needed of perceived user needs. We say "relatively" because clarity of this understanding is an iterative and combined effort between prospective user and sponsor/performer of the engineering development. The former may first state his need, with the latter suggesting technical means of meeting it. Or the reverse may happen: the latter may suggest new technical options to help the user better perform specific functions, where the user is not even aware of such possibilities and thus has not identified a need for technical means to assist him.

2. When consensus between user and sponsor/performer is reached on desirable operational performance characteristics of new equipment and/or systems, the latter need to translate these into technical performance requirements. In other words, a change of language is needed to translate user needs into technical language so as to make unambiguous -- in technical terms -- the objectives to be fulfilled by the engineering development work to be undertaken. This calls for feasibility assessment of alternative ways of meeting the desired performance requirements, and for trade-offs on cost/benefit considerations, before the objectives of the proposed engineering development project can be spelled out in detail.

3. Every engineering development project needs to be regularly and frequently monitored by qualified personnel from the sponsoring organiza-

tion, so that problems encountered can be evaluated by the sponsor together with the performer on the one hand, and with the prospective user on the other. This may lead to termination of the project, or to modification of performance requirements. Similarly, new and better-than-expected results from the engineering development effort need to be likewise evaluated and decisions made on whether to pursue them, particularly if costs and benefits are changed.

4. When the engineering development project has reached the stage of producing a prototype of the desired equipment or system, a market study should be undertaken to determine user acceptability and the size and characteristics of the market, given the performance characteristics of the prototype and projected costs when produced and marketed in quantity.

5. If the market study shows that a market exists sufficient to attract industry to invest resources, a pre-production run of the equipment or system should be undertaken to provide a sufficient volume for field testing and evaluation.

6. After test and evaluation are successfully completed (and this may call for further engineering modifications), standards for the equipment or system can be written. Consultations with prospective users and manufacturers/vendors are needed to make these standards reflect the interests of all involved. The standard itself must not act as an obstacle to further engineering development as the state-of-the-art of technology advances, and it should insure reliability of the equipment and/or systems in the hands of the user.



7. Technical assistance needs to be given to prospective users in the form of guidebooks on how best to deploy the equipment or system (including field seminars with live demonstrations). It is also necessary to test the products offered by competitive manufacturers/vendors periodically to determine which ones meet the standards and which do not. Publication of such tests -- without necessarily endorsing or recommending any one manufacturer/vendor vs. another -- helps the user make wise buying decisions.

Next we will examine several alternative means to organize and pursue R&D in such a way that both the research or development, and such "use facilitating" activities, are done well.

## V. ALTERNATIVES FOR R&D MANAGEMENT AND PERFORMANCE

We examined three alternatives for the effective pursuit of an R&D program in science and technology to support federal law enforcement objectives. The three are:

- LEAA-managed R&D Program
- Contractor-managed R&D Program
- Multidisciplinary R&D Laboratory.

Each of these alternatives is described first in terms of the capabilities identified earlier as necessary for such an activity. These become the criteria by which comparisons among alternatives are made. Those capabilities are:

- Systems analysis capability,
- Program planning capability,
- User requirements analysis,
- Program and project selection mechanism,
- Access to technical expertise,
- Flexibility,
- Dissemination of research results,
- Minimize costs.

After the descriptions, comparative analyses of the alternatives are presented

### Alternative I. LEAA-MANAGED R&D

The primary differentiating characteristic of this alternative is that LEAA staff manage the R&D program directly. Performance of the research or development tasks is carried out by a variety of separate grantees and contractors who



report to program monitors in LEAA. This same staff is the primary R&D planning and priority setting group.

Under this alternative, a staff of about 20 persons would be required with a cadre of eight senior research managers, technical support staff, and administrative staff, in addition to a director. Primary emphasis would be on capability of their staff to carry out systems analysis and program planning and project selection/monitoring (with performance of the R&D by a wide variety of external resources). Use would be made of visiting fellows and other temporary staff members both to augment staff capabilities and to provide a steady input of new perspective and particular technical knowledge. The professional staff would have the primary responsibility for identifying user needs, as well as monitoring a small number of R&D projects each.

#### A. Systems Analysis Capability

The systems analysis capability would reside within the LEAA unit responsible for R&D, with at least two persons having expert knolwedge in this discipline. They would analyze the agenda of proposed research against a very broad horizon of law enforcement and criminal justice activities, and related to both the broad mandate to reduce crime and improve the system, as well as specific objectives to be attained.

Their task would be to define the most plausible target areas for useful intervention by science and technology development, as well as to examine and comment on all research (both soft and hard sciences) in terms of probable impact. While their counsel would be purely advisory in the social science areas, the technology R&D would be critically shaped by such analysis. For each project instituted, a statement of probable impact and implications would be prepared, covering:

- estimated impact of successful development of science and technology for a given purpose, (what problems would be affected, quantification of impact, specific crimes affected, immediate functions improved)

- requirements for implementation, that is, training necessary or changes in operational procedures (how the context must be adapted to maximize effectiveness)

- implications for other research, both technology and social sciences (what else should be started or modified to meet implementation requirements or to assess the impact of probable changes).

In effect, they would prepare a "technology impact statement."

B. Program Planning Capability

This would also be part of the NILECJ staff responsibility, and is the natural corollary of the systems analyses task. The key program planning responsibility would be specification of objectives to guide program development, identification of program areas with greatest potential, analysis of the likely costs and likely impacts of program areas, choosing of priorities among them, and determination of the kinds of projects to be considered. In short, the staff -- primarily the director and senior research staff -- would define annually an R&D strategy. In part, this would entail an examination of projects in progress to determine whether to continue or terminate, and if the former, the level of funding. In part, it would require a continuing analysis of the current



state of the art of technology against LEAA priorities.

Specific structure of such an effort might be defined in a variety of ways. Issue papers, followed by candidate program nominations could be used. A combination of internal and externally solicited concept papers could be used. The effort could link to the MBO process. The critical requirement is to carefully and explicitly examine and decide on objectives, programs, priorities, timing, funding, and implementation actions. Having done this, the decisions and strategies thus reached must be recorded, and appropriate follow-up actions determined.

Key input would of course be from the user needs, discussed next.

Another requirement might be to take the larger LEAA research agenda and program development activity as input to defining an appropriate R&D program. Thus, where social science research efforts would be aided by technology development, appropriate projects would be defined and considered. Likewise, other LEAA programs to be developed for funding and implementation could be reviewed to determine where specific technical products or processes might be of use.

Similarly, regular communication should also be set up with other Department of Justice agencies that have technology development interests, such as the FBI and the DEA.

C. User Requirements Analysis

LEAA would bear the immediate responsibility of identifying needs of the potential users, whether law enforcement agencies, citizens, courts or corrections officials, or other federal agencies. Surveys, as of

police equipment needs, are one source of information. Exchange of ideas and problems that need solving through conferences, in-house meetings, technology assessment seminars, and other forums are also useful. But more must be done to assure continual and considered user input from the criminal justice community. In a system where the potential contribution of technology is not yet well defined, and where daily operational problems are frequently overwhelming, it is too easy to do simplistic and naive identification of needs.

In order to make the R&D program respond to real problems as perceived by the user communities, systematic communication and mutual problem definition must take place. An enlarged and technically sophisticated staff within LEAA should define these mechanisms, which might include:

- an operational law enforcement technology advisory group, made up of chiefs, patrol division heads, investigation division heads, planning and analysis officers, and communications officers from major police departments;
- a federal enforcement officers technology advisory group, with representatives from FBI, DEA, INS, ATF, Secret Service, and elsewhere;
- similar operational groups drawn from courts administrators and judges, and from corrections officials, also for technology advice;
- semi-annual technology assessment seminars, to focus alternately on unsolved problems and on new equipment or techniques;



- manufacturers briefing sessions on current research results;
- LEAA staff as "circuit riders," through the university research community, the professional association meetings (of both scientific and criminal justice practitioners), the federal labs, key manufacturers, and law enforcement agencies.

D. Program and Project Selection Mechanism

Well managed activity in the above three areas will yield enough ideas to fill out an ample candidate project list. There should be, within LEAA, a clearly defined means of arriving at programs to implement, and to define projects to fund within each program. Probably a multi-year (3-5 years seems reasonable) program plan, with annual updates should be prepared. After preparation of each annual update, specific project funding decisions will be made.

Research or development program areas as an example might include: (These broad choices will have been made in using the strategy referred to above.):

- Deterrence and Crime Prevention
- Investigation and Apprehension
- Communications and Reporting
- Personal Protection and Safety
- Institutional Security and Surveillance
- Information and Recording Support in Courts

Alternatively, the traditional areas of police, courts, and corrections

might be used. These are offered as examples to illustrate the types of program areas to be considered here. In any event, within each area one person would be assigned responsibility for developing a program plan (which would be a specification of the broad strategies outlined under program planning capability) to include problems and needs assessment and possible technology contributions, identification of the extent and source of the needs, and potential projects. Project proposals would then be solicited from a selective source list, formal project reviews done by each program area, and decisions made on which to fund.

An illustrative schedule might be:

| | |
|---|---|
| User Requirements Research | Sept. 15-Dec. 31 |
| Program Plan Written | January 30 |
| Program Plan Review and Approval | Feb. 28 |
| Project Proposals Solicited | March 30 |
| Proposals due in | May 15 |
| Proposal Review | May 15-June 30 |
| (staggered, by program area) | |
| Project Decisions | July 15 |
| Grants and Contracts Let | Aug. 15 |
| Project Implementation Start-Up | Aug. 15-Sept. 15 |

This would allow almost equal time devoted to finding out from the criminal justice community what is needed and monitoring on-going projects, and to the task of deciding what to do in program and project selection.



E. Access to Technical Expertise

The staff would have the widest possible access to technical competence in identifying centers of knowledge and soliciting proposals from them to do the development or the research.

It would also, through the user requirements definition processes, (see the mechanisms suggested there) have expert practitioner advice.

Finally, as elaborated in Chapter VI (B & C), this staff (of about 20 persons) would be heavily weighted to technical competence, and would undertake a variety of activities to maintain fresh and current expertise.

F. Flexibility, Ability to Change Directions

Since the performance of the R&D is done in a variety of places, under grant or contract, there is considerable ability to change course. Both the strategy development and the annual program and project review and selection cycle requires such considerations in a formal way. Since the staff will spend half their time in touch with users and with the projects as monitors, responsiveness to needed changes and recognition of those changes will also be assured.

G. Dissemination of Research Results

We would maintain the NBS role in standards development, as one major means of dissemination. It should be modified to allow for the standards to include a less technical section, so that practioners can understand their import and thus be guided in wise buying and use decisions.

The previously mentioned semi-annual technology assessment seminars would also serve as a dissemination forum, as might a number of less formal user contacts.

The program plan might well be published each year, or (since NILECJ already publishes an overall program plan) a "technology progress report" could be put out, summarizing current status of projects. Also, a brief version of the final report on high-priority projects could be prepared for distribution to the appropriate user community.

H. Minimize Cost

The estimated cost of this alternative is $630,000 for NILECJ staff (using an estimate of $30,000 per person year as average to include all indirect costs), with an anticipated program of grant and contract research of $7.67 million (assuming maintenance of present total level of ATD/R&D funding).

Under Alternative I, all additional costs are in the form of increased permanent staff within NILECJ. (Incremental cost is less than $630,000, but for purposes of comparing alternatives it is easier to deal with totals.) This alternative is the least costly of the three, since it eliminates the higher overhead costs and fee which would be paid to a prime contractor, and does not entail the large (staff and operating) costs associated with a laboratory. While Alternative I requires a larger permanent staff complement within NILECJ than a contractor managed program and larger than the present ATD staff, this does not approach the staff costs of Alternative III.



ALTERNATIVE II. PRIME-CONTRACTOR-MANAGED R&D PROGRAM

A number of federal agencies have employed prime-contractors to manage specific R&D projects -- oftentime these are referred to as systems managers. Rarely, however, are contractors employed to manage diversified R&D programs. LEAA could hire a contractor to exercise its R&D management functions, as well as perform some R&D. This alternative is, in some respects, an idealized version of the present situation. Such an ideal is inherently difficult to achieve given the professional involvement effort, and learning gained by contractor staff rather than LEAA staff.

Using a contractor as program manager will not relieve LEAA staff of an R&D management role. LEAA will have to provide program direction and guidance to the contractor, identify user needs, and if grantees or federal agencies perform R&D, LEAA will have to directly supervise those activities. We estimate that a professional staff of about 10 would be required in LEAA to provide adequate control of the R&D program under this alternative.

The prime-contractor would propose activities for a program plan, but LEAA staff would set overall priorities, approve the plan, and oversee the implementation of the plan. Prime-contractor personnel would determine what R&D to do with their resources (if any) and what to contract out, would identify sources of expertise, let sub-contracts, monitor projects, determine the adequacy of products. They would also need to be aware of user needs, at least to assure that the work statements they write for projects and the criteria by which adequacy is judged, are consonant with user requirements.

A. Systems Analysis Capability

This capability must be in LEAA, either in the staff supervising the contractor or at the level of the director of NILECJ. It is as described in Alternative I. The contractor needs to have staff to communicate with such an interactive view of the criminal justice system,

and to design projects to reflect the needs identified.

B. Program Planning Capability

The contractor plans in a narrower and more constrained arena than does LEAA staff, even where he manages the program. He responds to overall strategy and priorities as defined by LEAA, although because he is managing almost the entire R&D effort, significant program planning must be based on awareness and information that does not exist in detail elsewhere. Therefore, there must be contractor input on what objectives are appropriate and possible, on technical feasibility of projects, on timing and level of spending, on probable pay-off, and on consonance with user requirements.

However, LEAA must set the priorities, approve a plan after critical review of contractor inputs, and assure that user requirements are being met. LEAA also will continue to monitor and plan for work done by grantees or by other government agencies. It must retain primary program planning responsibility. In order to do so, the staff must also be in close touch with prime-contractor activities and project results. Therefore, the program planning activities must be a joint effort, with LEAA staff and contractor personnel able to share information, each make judgements as to probable high impact areas, determine whether to adopt new priorities, and define a program strategy.

Such cooperative planning is difficult to achieve within the same agency, much less between a small, monitoring staff and a heavily involved and larger contractor group. As the contractor grows in knowledge of the program area, it becomes still more difficult for the monitoring agency to assert a differ-



ing agenda. Since a prime contractor relationship requires a relatively long term to mature in effectiveness, such a shift in control becomes still more probable.

In fact, such long term relationships have been useful in situation where the sponsoring agency had a well defined set of technical goals and objectives, and could thereby retain control of the priorities agenda. Such situations pertained in DOD and NASA, but do not at this time pertain in LEAA.

C. User Requirement Analysis

Identifying user needs would be done either by the contractor or by LEAA, in this option. While there are arguments to be made on either side, our feeling is that it is best done by LEAA for two reasons:

- First, even contracted out, it is an LEAA research and development program, intended to serve LEAA's constituents.
- Second, leaving the user needs analysis with LEAA staff makes it more likely that active monitoring of the contractor can occur. The staff has some knowledge critical to the contractor, and that information is in the nature of criteria that determine the relevance and responsiveness of R&D being performed.

However, the same caveats, cited at the end of the previous section, apply here also and are likely to weaken LEAA's role, particularly when both LEAA and the prime contractor start at a similar level of uncertainly about user needs, which is the present situation.

D. Program and Project Selection Mechanism

Here a contractor would perform a series of tasks not dissimilar to those described under Alternative I, in terms of writing a program plan and soliciting project proposals. However, this task would require heavy involvement of an LEAA staff, for their knowledge of user requirements, for LEAA priorities, and for approval. It is an awkward partnership, since the contractor has the more detailed knowledge of past efforts and technical feasibility, while the LEAA staff has both approval power and must link in priorities and user requirements. This is so, again, because of the previously stated caveats.



E. Access to Technical Expertise

There is no inherent reason why a contractor should have less access to technical expertise than could be reached in either Alternative I or II. Indeed, the same access should accrue to either the LEAA- or contractor-managed effort, without the fixed staff constraint of the multi-disciplinary in-house laboratory. The contractor will need to maintain current knowledge of user needs through LEAA, and will have to get through its LEAA monitors some information about utilization and capabilities of other government laboratories and grantees. A potential problem is that the prime contractor will tend to consider his own expertise sufficient. Such difficulties can be mitigated -- but with difficulty -- by the kind of careful attention to project review and to communicating user needs that is incumbent on the program monitor. To the extent that a contractor assumes responsibility for the performance of the R&D, he risks a narrowing of view of the technical requirements of the projects. Since one clear potential advantage held by a contractor is the freedom to go where the expertise is, and a key requirement of the management contractor is to seek out the appropriate resource, it may be wise to consider severely restricting his own R&D performance.

F. Flexibility

Flexibility of a contractor-managed program is quite high, allowing change in direction with relative ease, through the new sub-contractors or modifying existing sub-contractual arrangements. Further, LEAA has a clear option to re-direct the prime-contractor at the end of each contract period. However, as a practical matter, if the program builds momentum and

projects are on-going, there will be great reluctance to turn it off. Since the contractor is managing the program, he is in the best position to report on and assess the future probability of success. Certainly, without close and sensitive LEAA monitoring, the flexibility is mostly with the contractor. With tight LEAA oversight, the agency's flexibility can be retained, albeit with difficulty.

G. Dissemination

Essentially the situation here is the same as in Alternative I, with the contractor putting out some progress reports, but LEAA staff seeing to the rest.

H. Minimize Cost

The estimated cost of this alternative is $8.3 million, with $300,000 LEAA salaries, $950,000 the estimated planning, management and administrative costs and fee for a prime contractor, and $7.05 million available for grant and contract research and development.

The costs associated with using a prime contractor to manage the R&D program are similar to those in the existing arrangement, whereby Aerospace receives almost $1 million for its planning, management, and administrative services and fee. However, to better accomplish the analyses, program planning, user needs identification and monitoring tasks mentioned earlier, should this alternative be adopted, we would urge that LEAA staff be expanded by increasing the number of ATD staff to a minimum of 10 professionals. This would add 5 salaries to the cost of this alternative.



The alternative would entail fewer continuing costs, and lower overall costs than the multi-disciplinary in-house laboratory (Alternative III), since the contractor can be terminated at any time, and the costs of building and equipping a permanent laboratory are eliminated. Yet, many of the functions which LEAA is presently handling for other offices, such as contracting, procurement, personnel, finance and budgetting, would have to be undertaken by the prime contractor, thus duplicating services to some extent. Additionally, a clear incremental cost of this alternative is the higher overhead cost of both profit-making and non-profit organizations compared to the government's "apparent" overhead (which does not always take into a single account all the factors that a private organization does, but distributes them among different accounts).

ALTERNATIVE III. MULTIDISCIPLINARY R&D LABORATORY

One alternative to pursue a law enforcement related R&D program in the physical and natural sciences is a multi-disciplinary lab. It would be within NILECJ and heavily focussed on in-house practice oriented research and engineering development. In order to accomodate the range of disciplines required, as evidenced by the scope of work for this study as well as by a review of the projects undertaken in R&D already sponsored, staff would probably grow to as many as 100 professional scientist and engineers with additional technical support, management and housekeeping. Further, if the intent is to perform the majority of R&D in-house, a new and costly physical facility would be required. (The remainder of NILECJ might occupy the same space, but for purposes of keeping comparison of alternatives uncluttered, we describe this technical facility as a separate entity.)

A. Systems Analysis Capability

In this option, the systems analysis capability would probably exist external to the lab, as a staff function within NILECJ. The require-

ments are the same as in Alternative I, to provide a sufficiently broad view of problems that potential impacts, system-wide, can be assessed for project selection and implementation. While some systems analysis capability should exist within the laboratory, the tendency to sub-optimize such analyses to the individual projects undertaken must be avoided as well as the temptation to focus on the immediate effect and impact of utilizing new technology. Ideally both laboratory staff and others in NILECJ would have such systems analysis capability, so that mutual project relevance and appropriate links to other (non-technology) R&D can be assessed.

B. Program Planning Capability

A program planning function would exist in the laboratory, probably both as staff to the director and as a role for his senior research department heads. Their focus would be on devising a cohesive and rational program plan for R&D and application of technology. Adherance to overall LEAA priorities would be necessary, and a planning staff within LEAA should assure this. Given the past relative isolation of the Institute's research program from other LEAA programs, a major new R&D entity such as an in-house laboratory might lean to similar independence. Careful drawing of their mandate and careful selection of top staff could minimize such potential problems.

Indeed, however, one potential virtue of such a facility is its independent ability to forge a program of development activities, to push forward in a number of technological areas. As a free-standing center of technology development with a prestigious and capable



scientific staff, new technology might well be developed, equipment taken to prototype and test, and advances made in a variety of useable products. But the relationship to LEAA priorities must be explicit and is, by its nature, a continuing need.

C. User Requirements Definition

As the center of law enforcement technology, the laboratory would take responsibility for assessing user needs to define the R&D. This might be done through conferences, periodic technology needs seminars with different user groups, advisory panels, etc. (See Alternative I for a more complete range of possibilities.) It seems unlikely that senior research staff would do a significant amount of direct, circuit-riding contact with practioners, i.e. police departments, court administrators, etc. That task must be accomplished in other ways, perhaps by using a special staff for this purpose.

A special staff within the laboratory (or an LEAA adjunct liaison group) would maintain continuing user contact and would aid in clear assessment of operational constraints in user agencies, and counter any tendency of the scientific laboratory personnel to focus on R&D performance, per se. The disadvantage of a separate staff of non-scientists defining user requirements is that the laboratory director and his key scientific staff might be inclined to ignore their advice. Continuing attention to such user needs will be required here, no less than with the other alternatives.

D. Program and Project Selection Mechanism

Essentially the laboratory would define its own work program and research agenda, based on technical feasibility, on user needs inputs, and on advice from other offices of LEAA as to research needs (a special form of user needs identification). The form this would take might be a program plan, spelling out by division (based on problem areas) of the laboratory what overall focus the program was to take, in response to what problems, and what set of proposed projects were to be undertaken.

Arriving at an overall budget for the laboratory would involve calculating the salary costs of a permanent staff (both scientific and administrative), adding support activities, maintenance, equipment costs, and subcontract estimates. With advantage, even a large laboratory will find it cost-effective to contract out some development tasks, especially for engineering development. Because the laboratory personnel would be assigned to department or divisions (e.g. forensics, communications, electronics, materials, information systems, etc.), the level of expenditure on each such program area would (in the short run) be a function of the staff available and a share of the subcontract budget. Therefore, the number of projects in any one program area and the intensity of effort on each project is also a function of staff size and expertise.

To some extent, then, the program plan and project selection is constrained by the specific characteristics of existing staff. Obviously staff additions can be made; there will be attrition; sometimes temporary help may be feasible; and subcontracting can be done. Nonetheless,



there will be a tendency to plan to do what can be done well, with existing staff, and as that staff becomes more expert, the tendency will grow stronger to do science for science sake.

Presumably the internal program planning would go through a review, revision, and integration before submission for approval to LEAA. At this size, the review of a laboratory program plan and its approval might well be between the lab director, the director of NILECJ, and perhaps the Administrator of LEAA. The details of the program plan would largely be left to the laboratoru, with NILECJ review focussing on emphasis, priorities and anticipated products.

E. Access to Technical Expertise

The clear first source of expertise is the lab scientific staff, comprising a multi-disciplinary group of up to 100, with technical support staff of about the same number. Clearly this is a major resource, ranging through the biosciences, chemistry, physics, mathematics, engineering, materials, environmental design, and the behavioral sciences. Additionally, as such a staff acquires experience in criminal justice related projects, it will become still more valuable.

The staff cannot, however, comprise the entire range of expertise that will be needed. Specialists will be hired within each major discipline, related to reasonable estimates as to longer run needs. Since these needs are yet unknown, the continued relevance of the staff cannot be any more certain. Maximum utilization of visiting fellows as such specialists might help insure such continuing relevances. For this reason, in part, the contracting-out capability will also provide additional access to technical expertise.

Staff size and range of disciplines anticipated is predicated on several factors, reviewed by an internal ADL panel of scientists from an appropriate range of disciplines and knowledge of R&D management and performance.

- first, provision for a relatively full range of disciplines from the physical and natural sciences;
- second, to satisfy the foregoing, such an in-house capability would need to be doing both practice-oriented research and a substantial amount of engineering development;
- third, allowing for multi-disciplinary teams of varying size, but assuming a minimum set of 15-20 significant concurrent projects, each requiring (on the average) a team of 5-6 professional scientists or engineers, with additional technical support;
- fourth, the requirement that the lab also provide management of the entire R&D technology program, including some amount of contracting out for engineering development, and careful and continued attention to user needs;
- fifth, observation of the size of other government labs with a similar support mission, as well as the size of the effort (in terms of budget) being supported. (Examples are: Transportation System Center, Naval Ordnance Lab, NIH, National Bureau of Standards.)



F. Flexibility

The ability to change direction with this alternative is a mixed picture. One the one hand, there is a diversity of skills readily at hand which can undertake a variety of projects, and probably with relatively quick start-up. On the other hand, once set in motion, it will be difficult and impractical to try to redirect the program in major ways, since particular staff will have been selected and assigned to maximize results. Change is much more feasible on next year's program or the year after that, than it is now.

G. Dissemination

A laboratory would maintain the present LESL/NBS standards setting and dissemination activities, by continuing the present arrangement of contracting out to NBS.

Another possibility is for the laboratory to institute a technical publications program, aimed at several sets of users. Thus, one periodic report on progress might go to criminal justice practitioners, while more detailed and more technical individual reports are sent to a scientific mailing list, and requests are answered on an ad hoc basis from the general public. Such a publications and distribution program might be more adaptable to the laboratory than the other alternatives, although it could be instituted there as well.

H. Minimize Cost

The estimated cost of this alternative, as detailed below is $13 million/year operating costs, plus $11 million initial capital costs.

TABLE 1

COSTS AND STAFFING OF AN IN-HOUSE LABORATORY

| | | | |
|---|---|---|---|
| Staff | | | |
| 100 | Senior Research Personnel | | |
| 100 | Technical Support Staff | | |
| 100 | Administrative Support Staff | | |
| 300 | @ $30,000 per man-year | = | $ 9.0 million |
| Operating Equipment | 10% of personnel costs | = | 0.9 million |
| Subcontracting Costs | 1/3 of personnel costs | = | 3.0 million |
| Total Annual Operating Costs | | | $12.9 million |

Capital costs must be added as a one-time expense. These reflect an estimate of 200 sq. ft. for each senior researcher and technician, and 150 sq. ft. for each member of the administrative staff, with approximately 25 percent of the total space used for non-personnel space (stairwells, halls, storage, etc.). Construction costs cited below are only an order of magnitude, and if available space could be renovated, the cost might be reduced by 30-80%.





Capital Costs

| | | | |
|---|---|---|---|
| Building Costs - | 55,000 sq.ft. (personnel space) @ $100/sq.ft. | = | 5.5 million |
| | - 18,000 sq.ft. (misc. space) @ $100/sq.ft. | = | 1.8 million |
| | 73,000 sq.ft. (total space) @ $100/sq.ft. | = | 7.3 million |
| Equipment Costs - | @ $ 50/sq.ft. | = | 3.7 million |
| Total Capital Costs | | | $11.0 million |

## VI. COMPARISON OF ALTERNATIVES

### A. Overall Cost Comparison

The comparative costs of the three alternatives are shown in the following table.

TABLE 2

COST COMPARISON OF THE THREE ALTERNATIVES ($ million)

| | One-time Laboratory Construction Costs | Contractor & Laboratory Staffing & Equipment Costs | LEAA Direct Management Costs | Contracting Funds | TOTAL |
|---|---|---|---|---|---|
| In-house Lab. | $ 11.0 | $ 9.9 | $ 0.15 | $ 3.00 | $24.05 million |
| Prime Contractor | 0 | 0.95 | 0.30 | 7.05* | 8.30 million* |
| LEAA-managed | 0 | 0 | 0.63 | 7.67* | 8.30 million* |

The costs of each of the three Alternatives must be viewed against the costs of the present system. As far as we are able to determine, NILECJ, through its Advanced Technology Division (ATD) is committing 5 man-years of staff time and $8.3 million to the science and technology field. Of this, Aerospace Corporation receives approximately $4.9 million, of which approximately $0.95 million is allocated for its planning, management and administration services plus fee.

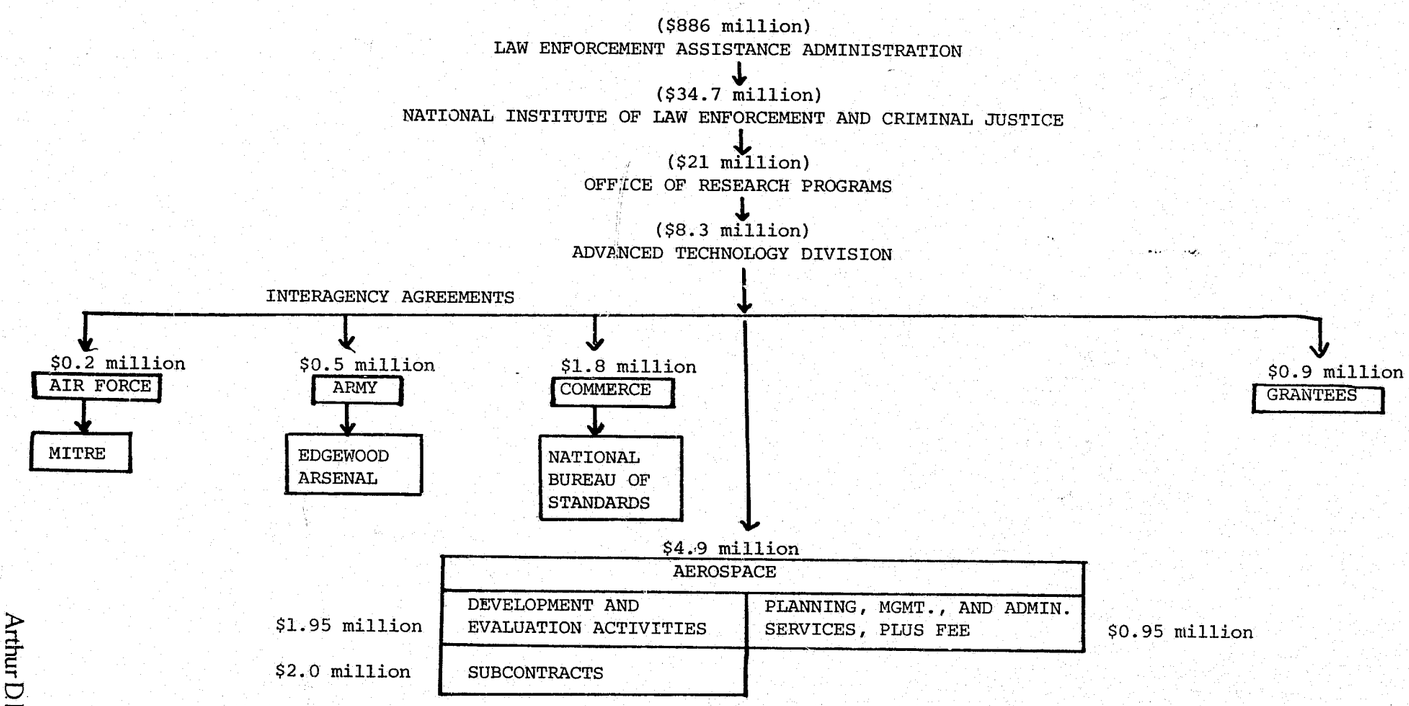
The remaining $3.4 million is distributed among other contractors and grantees, the largest recipient being the National Bureau of Standards within the Department of Commerce ($1.8 million). Table 3 illustrates this flow of LEAA funds.

* These figurges are chosen so as to make the total equal the present budget.

TABLE 3

LEAA FUNDING FOR SCIENCE AND TECHNOLOGY DEVELOPMENT

FY 75 APPROXIMATE FUNDING FLOW



B. Qualitative Comparison

1. Introduction

Here we need to examine how the alternatives compare to each other. We shall do that in two ways.

a. The most dramatic comparison is between an in-house laboratory and an R&D activity which relies for the major performance of R&D on outside contractors and grantees. Therefore, the first analysis is an examination of the in-house vs. out-house dichotomy.

b. We also compare the alternatives in terms of the eight criteria or capabilities under which we described each.

The ratings we display here are judgements of how each of these choices is likely to perform within the LEAA environment.





and given the current state of consensus on criminal justice system research needs.

2. In-house laboratory vs. out-house contracted research.

a. Big laboratory inappropriate at this time.

Having examined the characteristics and costs of a major in-house laboratory facility we conclude that this alternative is an inappropriate means of improving LEAA's science and technology efforts at the present time. Although there are many arguments supporting this conclusion, we find two to be particulary powerful:

1. Given the uncertainty concerning the role and potential impact of technological research and development in the field of law enforcement and criminal justice, a major and permanent commitment of resources to one strategy is both risky and premature. Until LEAA knows more about what to do in the science and technology area, and what the likelihood of success is, it would be potentially wasteful to invest resources in a major permanent technical institutions. Without a carefully explored research agenda the achievements of an LEAA laboratory are not likely to have substantially greater impact than past products. Such a research agenda does not yet exist.

2. Even if such an agenda existed today, the laboratory approach would not be the recommended alternative because of the nature of the tasks involved. As discussed earlier, most of

the previous R&D work supported by LEAA, and the kind of research which will best meet LEAA's R&D objectives in the foreseeable future (the application of existing technology to criminal justice problems) is engineering development rather than practice-oriented or fundamental research. The experience of numerous federal research laboratories is that engineering development is carried out more cost-effectively by outside contractors (mainly in industry) than by in-house laboratories.*

Thus, both the uncertainty of the agenda and the apparent current balance toward engineering development militates against the laboratory. While we find the above arguments convincing there are still other reasons why a laboratory would be ill-advised at present. Given the rapidly changing priorities and emphases in criminal justice over the past ten years, LEAA's R&D program should be able to respond quickly to possible new opportunities, ideas, and approaches. A laboratory, with its permanent staff and equipment limitations, would not offer the flexibility of other approaches. Should priorities shift from year to year, one discipline within the lab may become overburdened, while others would not be fully utilized. The problem of matching relatively fixed staff resources to changing problem areas without wasting manpower is far greater in a laboratory than in the contractual arrangements in Alternatives I and II.

There is also the danger that a laboratory would become, over time, a relatively independent author of its agenda, with little regard to

* viz. "The DOD Laboratory Utilization Study", John L. Allen, et al. April 1976, NTIS AD/A-012 660.





other input. The consequences of such "ivory tower" independence, in terms of losing contact with both LEAA's priorities and user needs, are so great as to require substantial potential benefits to offset them.

In addition to the above arguments, the costs of an in-house laboratory clearly exceed those of the other alternatives in both the short and long run. Further these costs will inevitably grow due to political, internal and constituency pressure. Also, as we have mentioned earlier, this increased expense does not necessarily purchase short-term responsiveness given the fixed staff capabilities.

Finally, in considering the alternative of a major laboratory facility at the national level, we examined the possibility of an organizational base for such a laboratory within the Department of Justice, rather than LEAA. An argument could be made that such a laboratory should serve all federal agencies involved in law enforcement and not merely LEAA.

We conclude that a broader organizational base would not significantly increase the utility of such a laboratory to either federal or local law enforcement agencies. Should such a laboratory be established within LEAA, its research and technological developments would be available to, and benefit, all law enforcement agencies, of which local agencies greatly outnumber federal agencies. Furthermore, only LEAA has a mandate sufficiently broad to include such a major research facility serving all levels of law enforcement agencies.

Both federal and local law enforcement agencies are in the role of consumers and users of the central laboratory's products. As such, it is relatively unimportant that the laboratory be based closer to one element of its user constituency, i.e., other DOJ agencies. Indeed, it may be desirable that a lab retain a measure of independence from federal law enforcement agencies so as not to have its research directed or unduly influenced by those agencies to the detriment of local agency needs.

While our judgement is that a major laboratory is presently inappropriate, it may not always be so. When, through analysis and determination of a systematically conceived research agenda, and through utilization of outside resources to achieve early results, NILECJ has achieved the visible, productive role that its "user constituencies" expect of it, a new context will exist. At that time, with demonstrated usefulness of R&D activities in science and technology as leading to "marketable" technologies that help fulfill LEAA's mission, then it may once again be useful to re-examine the viability of an in-house laboratory. But that is likely to be some 5+ years hence. It is premature now, given all the circumstances and issues discussed in this report.

b. What about a smaller laboratory?

Having found substantial, and convincing, arguments against the establishment of a major multi-disciplinary in-house laboratory, we examined the possibility of a smaller laboratory staff, conducting practice-oriented



research in only one or two areas of criminal justice activity. We reasoned that the costs of such a facility would be manageable, and if areas could be found which gave promise of a high level of continuing research activity over a long period of time, then the fixed and continuing costs of a laboratory facility and staff might be justified.

However, as we have mentioned above, NILECJ's goals in R&D over the foreseeable future, will best be met by devoting most of its R&D funds to engineering development (perhaps as much as 85 percent of them). Thus, the creation of a smaller in-house laboratory to undertake only 15 percent of practice-oriented research would provide an annual operating budget of about $1.0 million which, in turn, would allow for a total staff of about 30, of which only about 10-12 would be highly qualified researchers.

With such a limited staff, research activities would be limited to only one or two areas. Such a small number of researchers would not provide the "critical mass" of multi-disciplinary teams necessary to undertake all projects, but only those for which the staff may, by happenstance, be most qualified.

This point is particularly important. Neither NILECJ (nor anyone else) is yet in a position to define, with any degree of accuracy or conviction, what menu of practice-oriented research <u>should</u> be pursued over the next 5 years. It will thus be very difficult to make appropriate staff selection for the small in-house laboratory which NILECJ could afford and, by the same token, to attract high-caliber staff for such an as yet "unplanned" work program.

Further, in examining the areas of past and potential R&D activity, we discovered only one area for which there would likely be a continued need for a high level of research activity -- forensics research. No other area appeared to promise sufficient research activity over a sustained period to warrant the establishment of an in-house laboratory facility.

In researching the forensics field, we examined the possibility of a "National Forensics Research Laboratory" for the purpose of advancing the state of forensics research. We discussed this concept with leading federal, state, and local criminalistics researchers and contacted other federal agencies which might benefit from or be affected by such a facility (FBI, DEA, ATF). We also examined present research capabilities and co-operative arrangements at the different governmental levels.

Our conclusion, based on this analysis, is that there is no need for a smaller single-purpose laboratory for forensics research beyond the capabilities which either already exist or are being planned. This conclusion stems from the following findings:

- The forensics research community sees no real need for a central laboratory facility and possible negative consequences of such a lab. The overwhelming belief was that, until existing forensics research techniques become generally available through the provision of training and equipment, there was little need for newer, more sophisticated analytic techniques which would be the primary focus of a national forensics lab.



Crime Lab Directors were particularly concerned that (1) the establishment of a central lab to do pure or fundamental research might limit their own work to routine evidence analysis for case work, removing the more interesting and stimulating aspects of their laboratories' work; and (2) a central laboratory focused on pure research would quickly lose touch with the practical applications of that research and become an "ivory tower" divorced from real-world needs.

- There is no strong reason to believe that the development of more refined evidence analysis capabilities would lead to a reduction in crime or an improvement in the criminal justice system. Many knowledgeable practitioners indicate that existing evidence analysis techniques are not used to anywhere near their fullest extent because of poor evidence collection practices, prosecutorial indifference to evidence, and judicial resistance. There is no reason to believe that, under these circumstances, better forensics research techniques would have much impact soon.

- LEAA is not the best sponsor of a forensics research lab. There was near unanimity in the criminalistics research community in their opinion that LEAA had neither the credibility, understanding, nor expertise in the forensics field which would justify the establishment of an LEAA laboratory in forensics.

- The FBI would be a more appropriate agency to sponsor such a laboratory and is, in fact, planning a small forensics training and research facility at Quantico, Va. Almost all interviewees indicated that the FBI represented the most appropriate agency

to sponsor a forensics laboratory, and the State Crime Laboratory Directors have endorsed FBI plans to build a limited training and research facility at Quantico. This kind of facility was seen by criminalistics researchers as far more helpful to them than a laboratory involved in developing sophisticated new analytic techniques in forensics.

Given these considerations, we conclude that an LEAA laboratory in the forensics area would be duplicative of other efforts without adding substantially to the impact of forensics research in criminal justice.

As an alternative to a laboratory, we suggest the following LEAA actions in the forensics field:

- closer cooperation and increased support for applied research in existing crime laboratories, by identifying and supporting a select number of leading laboratories in each area of forensics;
- investigate the possibility of supporting FBI training and research efforts in forensics techniques;
- initiate and support cooperative relationships among federal, state, and local crime laboratories to generate the exchange of information and ideas;
- support Visiting Fellows in forensics research to develop, test, or apply new techniques at selected forensics laboratories around the country.

We feel that the above activities represent a practical and useful role for LEAA in the forensics field.



If a laboratory of any size is not appropriate or feasible at this time, for the reasons above, what represents the best approach for LEAA to take in science and technology? That analysis is presented next.

3. LEAA-managed vs. prime contractor-managed R&D

If an in-house laboratory has its risks and its severe disadvantages, so does delegating to a contractor the critical R&D management functions. In Chapter III, we suggested a set of criteria for choosing an R&D management alternative. In Chapter V, we described three alternatives with appropriate commentary on each of the eight suggested criteria.

In Table 4, we array these criteria and rate the estimated performance of each alternative against them. The ratings are "high" (H), "medium" (M), and "low" (L), used to describe the relative probability among

these alternatives of satisfying the criteria as they are explained in Chapter III. Thus, where a "high" rating is assigned, it is judged that this alternative is probably superior to the others on that criterion. Similarly, "low" indicates inferior performance, while "medium" indicates either equal performance with one or both of the others, or that one of the others is better and one worse.

TABLE 4

RATING OF OPERATIONAL CRITERIA

| | LEAA Managed | Contractor Managed | Lab** |
|---|---|---|---|
| System Analysis Capability * | H | H | H |
| Program Planning Capability | H | L | M |
| User Requirements Analysis | H | M | L |
| Program and Project Selection Mechanism | H | L | M |
| Access to Technical Expertise | H | M | H |
| Flexibility, Ability to Change Direction | H | M | L |
| Dissemination of Research Results | M | M | M |
| Minimize Costs | H | M | L |

*H for all three alternatives because it must be carried out, and done well, within LEAA.

** Laboratory alternative included for completeness' sake; though the comparative ratings of the other two alternatives are the issue in this table.



These scores are based on professional judgments derived by us from extensive discussions with LEAA/NILECJ staff, selected user community representatives (practitioners of the law enforcement and criminal justice system), related federal agencies, managers of other federal research programs, and/or research laboratories (with missions not unlike those of LEAA/NILECJ in the broadest sense, e.g., ATF/Treasury; NHTSA/DOT; and TSC/DOT).

The composite judgment reflected in the scoring shown in Table 4 indicates most strongly that Alternative I has the most to offer.

C. Summary Comparison of Alternatives

We have suggested earlier the eight capabilities which an R&D management activity must possess, and suggested that these might reasonably be the criteria for making a choice among alternatives. Above, it is clear that the "LEAA-Managed R&D Program", (Alternative I), in our judgement performs best against these criteria. Further, there are a number of reasons that rule out a laboratory at this time -- most importantly the uncertainty of a continuing science and technology R&D agenda, the present emphasis on engineering development (better done in private industry), and the reduced flexibility which accompanies such a choice.

Here we set forth the most important reasons for an "LEAA-Managed R&D Program" both as the preferred choice among these alternatives and as a program development effort of significant importance to LEAA.

1. There is continuing interest in the broad application of technology

to the problems of criminal justice. This is evidenced by media coverage of esoteric new law enforcement hardware, by Congressional inquiry, by the GAO report on ESIP, by the existence and work of an R&D Task Force of the National Committee on Criminal Justice Standards and Goals, and by the interest and response of the constituent agencies. At the same time, there is a general uncertainty whether most of the pervasive problems do in fact lend themselves to technology solutions.

Therefore, a sharply focussed, thoroughly analyzed, actionable agenda for technology R&D is necessary. It must reflect user needs, relate to important problems, and lead to results.

2. LEAA management must retain control of program planning, setting priorities, initiating major R&D efforts, and monitoring their progress. At this stage of what is known about applying technology in law enforcement and criminal justice, the need to reach decisions using LEAA staff, to build a better understanding of the criminal justice system as a system, and to internalize such understanding and the resulting R&D priorities, is paramount. Only a program directly managed by LEAA has these possibilities.

3. Building, internally, a cadre of well-qualified and sophisticated research managers is the most straight-forward way to improve the relevance, timeliness, and early results of the R&D program. Such a group, directing what initially is an engineering development program, in close and continuing touch with user communities, will enhance the ability of LEAA to undertake more practice-oriented



reserach, to sharpen the research agenda still further and to assure quality performance by contractors and grantees.

4. An LEAA-Managed R&D Program will also be most likely to lead to utilization of the technology developed. As we have mentioned earlier, the actual performance of R&D or the development of a particular product or technology, will not alone insure success. Not only must user needs be recognized in defining technology development needs, but also in getting the product manufactured, distributed, and into use. LEAA staff, coordinating with users, manufacturers, NBS as a testing and standards facility, other testing groups, and other parts of LEAA, are best informed about the multiple issues that may arise here. Among the tasks to be performed might be: publication of research results, news of standards in development, assessment of new products or products under private development, communications of field test data.

5. Finally, an enhanced LEAA technology and research monitoring staff provides the greatest future flexibility. At such time as the shape of an on-going R&D agenda can be defined with confidence it may be such as to require different organizational arrangements. If, at that time, a program of practice-oriented research exists in sufficient breadth to make a laboratory feasible, the option should be re-examined. The best means for getting to such an agenda, (and for being positioned to implement a heavier program of practice-oriented research) is through the building of a highly-qualified staff of technology research managers.

The next chapter sets out the organizational and implementation actions for this preferred alternative.





## VII. CONCLUSIONS AND RECOMMENDATIONS

### A. Preferred Alternative: LEAA-Managed R&D Program

We recommend that LEAA implement an enhanced LEAA-managed R&D program (which was described in Chapter V as Alternative I), for the reasons set out above. The remainder of this chapter is devoted to describing the organizational structure, the functions, staffing, implementation schedule, and other considerations to make this alternative work well.

### B. Organization and Implementation

#### 1. Organizational Structure

From the preceding discussion, it is clear that Alternative I entails a considerable expansion of internal effort and a modified approach for NILECJ in the area of technological research and development. It is our belief that this alternative could best be implemented through the establishment of a new Office within NILECJ, incorporating and replacing the present Advanced Technology Division.

Establishing a separate Office aids LEAA's technology development effort in several ways:

- it increases the credibility of LEAA's activities in the area by elevating the importance of the function organizationally;
- it gives greater visibility to LEAA's technology development program by designating an Institute Office to have prime responsibility in the area;

- the elevation of the function to the Office level makes it easier to attract and compensate highly-qualified staff.

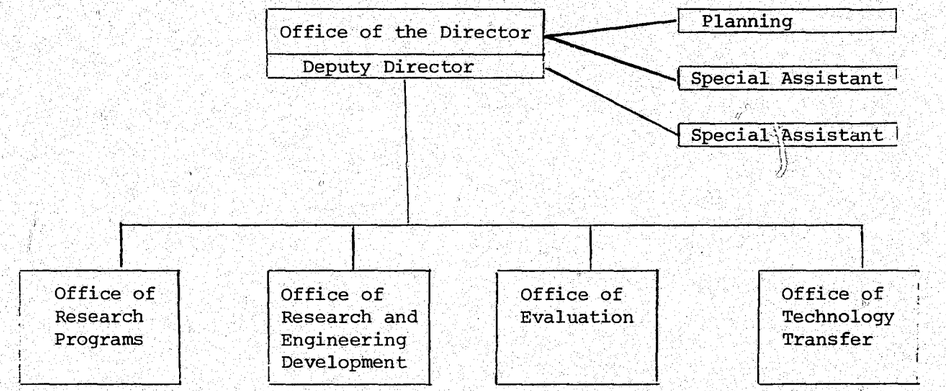
An examination of the total annual budget for technological research and development activities (approximately $9 million of the $36 million Institute budget) compared with budgets of other Institute Offices suggests that a separate Office is warranted. Similarly, the recommended staffing level for Alternative I, as outlined below, would seem to dictate an organizational home separate from the Office of Research Programs (ORP). Finally, although some overlap exists between the activities of other ORP divisions and ATD, the area of science research and engineering development is sufficiently discrete to warrant a separate organizational base.

Therefore, we suggest that the Office of Research and Engineering Development (ORED) be established as a fourth Office within NILECJ with equal standing with ORP, OE, and OTT. The organizational structure would appear as in Figure 1.



FIGURE 1

PROPOSED NILECJ STRUCTURE




2. Reporting Relationships and Functional Linkages

As the head of an Institute Office, the Director of ORED would be an Assistant Director of NILECJ and report directly to the Institute Director. Within ORED, the staff should be organized on a project team basis with a Senior Research Manager responsible to the Director for each major project (or group of related projects within a program area).

Because of the previously discussed importance of maintaining close relationships with the relevant research and user communities, it is essential that ORED develop and maintain strong linkages with organizations representing technology consumers (International Association of Chiefs of Police, State Crime Laboratory Directors, criminal justice practitioners, National District Attorneys Association, etc.), those delivering

technology (SPA's, industry, government purchasing agencies, etc.), and those carrying out related scientific and technological research (universities, industry, other governmental agencies).

Within LEAA, the new Office will necessarily interact with established LEAA offices responsible for agency activities such as personnel, grants and contracts management, and overall LEAA planning. Since some of these administrative responsibilities have been handled by a prime contractor, they represent an additional administrative burden on LEAA's internal offices, which could be considerable, particularly in the area of contract procurement, and which should not be overlooked in setting up the new Office.

ORED must also develop working relationships with OE, OTT, and NCJRS to insure adequate evaluation and dissemination of its research and an effective information and publications program. Assistance from and cooperation with these offices would reduce costs and duplication of effort in carrying out important functions related to science and technology research.

3. Staffing Considerations

A consequence of rejecting the alternative of having a prime contractor manage the LEAA research program in favor of a NILECJ staff-managed research program is a transfer of functions from the contractor to the NILECJ staff. The activities outlined in Chapter V (continuing communication with users to identify needs, defining and translating performance characteristics, conducting feasibility assessments and



market studies, monitoring project performance, organizing and overseeing field tests and evaluations, and setting standards and providing technical assistance) become the responsibility of the staff of ORED with assistance as needed from contractors and grantees (such as assistance in setting standards from NBS).

Such an expanded role implies not only a substantial increase in the number of staff members but new kinds of skills required as well.

The numbers and suggested classifications of ORED staff are outlined in Table 5 below.

TABLE 5

STAFFING OF ALTERNATIVE I

OFFICE OF RESEARCH AND ENGINEERING DEVELOPMENT

| Number | Title | Suggested GS Level |
|---|---|---|
| 1 | Director | 16 |
| 2 | Management Support Staff | 9-12 |
| 8 | Senior Research Managers | 13-15 |
| 4 | Technical Support Staff | 9-12 |
| 6 | Administrative Support Staff | 4-9 |

This staff would represent an approximate tripling of the present ATD staff. We feel that a staff of about this size, with the professional mix listed above and described in detail below, is both necessary and sufficient to exercise strong program guidance and control while undertaking the ancillary, but essential, tasks related to a successful

science and technology effort. A significantly smaller staff risks losing the breadth of technical competence required and neglecting the research-related tasks described in Chapters III and IV. A significantly larger staff, while providing greater expertise and control, would be difficult to justify, given (1) the staffing levels and manpower needs of other LEAA and NILECJ offices, and (2) the as yet ill-defined and unproven potential which technological research and engineering development presently has in fulfilling LEAA's overall objectives of reducing crime and improving the criminal justice system.

(NOTE: The staff requirements outlined here are based on a dollar commitment to R&D of between $8 and $12 million. Obviously, a substantially greater or lesser commitment would alter the staffing requirements. Following the staffing distribution we suggest, additional funding would require staffing increments of one additional senior research manager, one-half person-year of management and technical support, and one-half person-year of administrative support for each additional $1 million of contracts and grants.)

4. Qualifications, Functions, and Responsibilities

Each of the tasks outlined in Chapter IV must be carried out by the ORED staff. In organizing the staff, as indicated above, the following staff expertise and functional responsibilities are suggested:

- Director: The Director of ORED must be a nationally recognized researcher or research manager with a strong background in the practical application of research to criminal justice



problems. He must have strong ties to the user communities and the research community. While he need not excel technically in any one research area, he must have credibility in the research community and possess experience and skill in managing research programs.

He will be responsible for the overall direction of the ORED program, recommending research objectives and priorities, fashioning a coherent research strategy and action program, and overseeing research progress, completion, and implementation. He should maintain constant contact with relevant user groups and the research community, taking an active role in establishing ORED as a visible and credible source of ideas, information, and assistance to criminal justice practitioners.

We recognize the problems in attracting such a person, particularly on Civil Service salaries. However, to provide the kind of national visibility and credibility which the R&D effort requires, and has lacked, this kind of person must be recruited. Given the potential of the new Office as a focus for national law enforcement related technological research, we feel it is possible to attract such a Director.

- Management Support Staff: The two management support staff would assist the Director and the eight Senior Research Managers in the related research tasks outlined in Chapter IV. Specifically, they would:

1. handle all formal relationships with user and research communities, arrange conferences, seminars, Advisory Board activities (described later), and contacts with the public at large;

2. participate in the identification of user needs (in conjunction with Senior Research Managers) through studies, field research and interviews, identification of problems, discussions with professional associations and practitioners, etc.;

3. take primary responsibility for the dissemination and implementation of research products, information, and knowledge generated by ORED activities; conduct or coordinate market studies, establish an information clearinghouse capability in areas of ORED interest, handle information and publications distribution, coordinate technical assistance efforts related to ORED activities and products;

4. organize and coordinate a Visiting Fellows Program and Staff Exchange Program.

The two management support staff should collectively have experience in public relations, marketing, survey research, and administration, with an understanding of criminal justice research.

- Senior Research Managers: The eight Senior Research Managers form the backbone of ORED and provide the office with a breadth of competence covering the basic disciplines involved in research and technological development in criminal justice. These disciplines include:

  - Electronics/Communications
  - Analytical Chemistry
  - Physics
  - Bio-Medical
  - Explosives/Ballistics
  - Engineering Design and Development
  - Operations Research, Statistics, and Mathematics
  - Forensics

Perhaps the most important single characteristic of these managers is their emphasis on applied or practice-oriented research and engineering development as contrasted with fundamental research, an important distinction described in Chapter IV. We believe that most of LEAA's present and future R&D needs are practice-oriented and/or geared to specific engineering development problems, rather than fundamental research with the broad goal of expanding knowledge.

Therefore, the Senior Research Managers should be recruited from among criminal justice research practitioners who are familiar with both the problems and needs of potential users of science and technology, as well as the application of research techniques to meet those needs. While some fundamental research will undoubtedly be sponsored by LEAA, it will remain a small percentage of effort and dollars, and be focused on filling specific gaps in basic knowledge that are needed for practice-oriented research and engineering development projects to aid law enforcement and criminal justice.

CONTINUED

1 OF 2

As in the case of the Director, the credibility of the Senior Research Managers must be high in both the research and user communities. Thus, they must have had first-hand research experience in the criminal justice field, yet they must also be willing and able to manage research efforts to be performed by others. The importance and means of maintaining some "hands-on" research experience while exercising a managerial function is described later in this chapter.

The eight Senior Research Managers will operate on a project team basis, organizing themselves around particular research objectives with support from the management and technical support staffs. Their specific tasks will be as follows:

- to undertake, on a continuing basis, the identification of problems in criminal justice and law enforcement which might be susceptible to technological solutions through applications of existing technology or practice-oriented research to develop new solutions. This will require extensive field interaction with all parts of the potential user community, i.e., police, courts, and corrections.
- to participate in the annual updating of a research and development strategy and programs, recommending new areas for study, approaches to be investigated, and follow-up on continuing and completed research and engineering development efforts. Their key responsibility in this area will be to recommend research priorities based on a thorough examination of the needs and problems of law enforcement and criminal justice and an assessment of the probable impact of research and technology on those needs.
- determine the most feasible approach to research problems and appropriate contractors or grantees; develop research work plans and RFP's, and negotiate with performers of R&D concerning research tasks and costs.
- maintain control of the contractor or grantee through close monitoring and joint review of each task.
- assess research results against predetermined performance specifications and objectives.
- arrange for appropriate field tests and evaluation of technological developments.
- participate in disseminating and marketing successful research ideas and products.

The above tasks represent a very active role for Senior Research Managers with very close involvement in research projects for which they are responsible. Thus, we suggest that no research manager be responsible for managing more than two major R&D efforts ($500,000 - $1,000,000) at any one time.

In thinking of ways of organizing ORED staff activity, we considered assigning a small ORED group to be responsible for each major research related task (identifying needs and planning research, monitoring and evaluating results, dissemination of results, etc.). We rejected this for three reasons: (1) the interest and expertise of the Senior Research Managers could not, and should not, be limited to only one portion of the research effort; (2) the size of the staff does not allow the separation of functions, nor is it clear that such separation would produce more successful research; and (3) the assistance of other Institute Offices, such as the Office of Evaluation and the Office of Technology Transfer, makes it less important that ORED divide its staff according to these functions.

Alternatively, we suggest that ORED use project teams to be responsible for all tasks related to each research project, i.e., carry it through to completion. This has been proven in industry to be most effective in motivating the team and making its efforts successful. The teams would be assembled on the basis of expertise and skills, and would consist of one or more Senior Research Managers and management and technical support staff as needed. Within each team, it is appropriate and desirable that specific tasks be allocated among team members. The teams, advised by a Project Review Committee and headed by a Senior Research Manager, would be collectively responsible for the management of the research project, and would disband after the research project terminates and the results are disseminated and implemented. ORED staff would work on several projects simultaneously under this arrangement. We feel that this approach is more appropriate for the foreseeable R&D program and would be attractive to ORED candidate staff.





- Technical Support Staff: The four technical support staff should be technically qualified staff providing back-up for the eight Senior Research Managers. They should participate heavily in the field work associated with communicating with users, monitoring ongoing research efforts, and providing technical assistance to users with respect to ORED research products. This staff could be supplemented by graduate school interns if long-term (one year) internships could be arranged to the benefit of ORED and participating universities.

- Administrative Support Staff: A total six clerical and secretarial staff would be sufficient to provide administrative support to the ORED staff. However, this assumes that existing LEAA offices will provide support in the areas of contracts and grants management, personnel, etc.

5. Advisory Bodies

Because of the importance of maintaining strong linkages with external groups in the research and user communities, we strongly suggest that two kinds of advisory bodies be established. One would be a permanent Oversight Committee for ORED which would meet regularly to review ORED plans and progress, lend advice on specific research problems and proposed solutions, and suggest future

research directions. Members of this ORED Oversight Committee should be outstanding researchers and criminal justice practitioners with long experience and high credibility in the criminal justice area. Such a group would provide invaluable advice and assistance to the Director and the Senior Research Managers and would also help give ORED the necessary visibility and status to attract talented staff and the interest of researchers and research users.

The second form of advisory group would be ad-hoc Project Review Committees, established for each major research project undertaken by ORED. These Committees would be quite active, working closely with the Senior Research Managers to insure that user input guided research and development direction, and that the best technical talent is utilized by ORED on each project.

The Project Review Committees would consist of representatives from the user and research communities with the most knowledge of the specific problem area. Representation of knowledgeable professional interest groups and criminal justice agency representatives could also be valuable in building user acceptance for the research or development product.

The Project Review Committees would be established at the time a project was first conceived, or a problem first identified, and would participate in all subsequent consideration of strategies, approaches, and research and development tasks.

The tasks of the Project Review Committees would be to assist the



Senior Research Managers in:

- clarifying and translating user-identified needs;
- identifying potential R&D solutions to specific needs or problems;
- defining R&D tasks and specifications;
- identifying and selecting contractors;
- monitoring and evaluating R&D activities and contractor performance;
- developing product & system standards & certification requirements;
- marketing and disseminating research results.

To be an effective working group, the PRC's should be limited in size to 5-7 directly interested and qualified people, meeting 6-12 times per year to aid the ORED staff in these tasks. The activities of these PRC's should be supported and planned for within the ORED budget.

With these advisory bodies functioning actively, the ORED staff would be able to regularly draw upon expert advice to guide contractor and grantee activities in the most fruitful directions. They would also serve as an excellent way for ORED staff to maintain knowledge of new developments in their areas of expertise through continued contact with leading researchers.

6. Steps to Implementation

The transition from the present situation of a contractor-managed R&D program to the establishment of a new Institute Office to

manage the program cannot be achieved overnight. It should, however, be started immediately. It will require considerable planning and preparation to build the internal capacity and external linkages necessary for success. We estimate that the time required from deciding to adopt Alternative I to having an Office fully staffed and operating smoothly is from two to three years. The time required depends largely on two factors: (1) the rapidity with which the Institute is able to budget for, attract, and hire through Civil Service procedures, highly-qualified staff; and (2) the time required to complete present research commitments and plan and initiate a long-term research strategy using the freed-up resources.

Should the recommended Alternative be adopted, we strongly recommend that the Institute undertake a rapid and thorough review of their existing research and development commitments and, based on this review, enter a transition period of no new project funding for science and technology efforts, and only selective continuation of existing projects. This period of decreased funding activity is important to allow the reflection and conceptualization necessary to develop a sound research strategy for ORED and plan and prioritize its future activities. While temporarily delays in start-up of new projects may involve some political risks in terms of the difficulty in regaining lost funds, we feel these risks are justified to achieve a sound science and technology program.

The following represents a tentative scheduling of steps to implement the new science and technology program within the Institute:



0 - 6 months

- Form an LEAA Working Committee to organize the new Office (recruit staff, develop budget, establish organizational linkages and general structure, determine rate of freed-up resources, identify advisory groups candidates, etc.);
- Initiate a review and assessment of present R&D commitments;
- Begin transition period of no new funding commitments;
- Begin talent search concentrating upon the Director and Senior Research Managers;
- Modify existing budgets to provide for the new Office, formally requesting positions and resources;
- Undertake study of research and technology needs in preparation for developing an overall ORED research strategy.

6 - 12 months

- Hire ORED Director and initial Senior Research Managers (disband Working Committee);
- Organize and recruit the ORED Oversight Committee;
- Intensify working relationships with user communities & R&D resources;
- Develop overall ORED research strategy and approaches, areas of concentration, next FY research program plan, etc. (with Oversight Committee);

- Identify potential R&D performers;
- Announce the establishment of the Office.

12 - 24 months

- Complete staff hiring and Office organization;
- End transition period and begin new funding commitments based on ORED research strategy and annual research plan;
- Organize Project Review Committees as new projects are planned or problems are identified;
- Formalize links with research and user communities by establishing the Visiting Fellows Program, the Staff Exchange Program, internship activities, and regular conferences and seminars;
- Establish procedures for monitoring, evaluating, and marketing research results.

24 - 36 months

- Initiate first full year of Office operations; build to full funding level of ORED;
- Begin providing technical assistance to user and research communities;
- Develop information clearinghouse capability in criminal justice R&D (in conjunction with NCJRS).



We see no major obstacles to implementing this Alternative, given agreement by LEAA, Justice Department, and OMB officials as to the general approach and resources involved.

C. Maintaining Technical Competence

A frequently identified problem in staffing any management organization with scientific and technically proficient personnel is to both attract and retain high-quality staff, and to structure the responsibilities to allow retention of scientific and technical expertise. The requirement is sufficiently important that ORED should undertake specific actions to address it. Since most of these actions are complementary to user needs identification requirements, implementation serves two purposes:

1. Circuit Riding

Considering the functions of the ORED staff, close-working liaison, specifically to include frequent field visits, would be needed with a variety of organizations. Some of this circuit riding activity has been mentioned earlier. It should include visits to:

- Prospective user communities to identify their needs;
- Prospective contractors/grantees community to become aware of engineering development options and/or practice-oriented (and fundamental) research opportunities;
- Other federal laboratories (e.g., FBI; ATF (Treasury); NBS; Army (e.g., Aberdeen and Natick); etc.) to obtain technical expertise judgments;

- Advisory groups of scientists, engineers, and other professional specialists to help guide ORED priority decisions on R&D programs and projects. While these are mentioned above, some meetings might be held on a "host" campus.

These and other continuing close-working relationships should help to keep ORED staff technically "on the mark".

2. Visiting Fellows Program and Staff Exchange

In addition, "visiting fellows" from the user communities, universities, other federal labs, could be invited to serve on the ORED staff for one- or two-year stints, and thus help direct, monitor, evaluate ongoing programs or projects. Some of these visiting fellows would then return to their home base and might become grantees for practice-oriented research on subjects that they became familiar with while at ORED.

Conversely, ORED staff could be "visiting fellows" to any of the aforementioned organizations, utilizing their familiarity with user requirements to become a vital participant in a contract/grant program being carried out at that institution. Such an effort could be carried out along the lines of the existing NILECJ visiting fellows program, and might be coordinated in part through Intergovernmental Personnel Act programs.



3. Technical Seminars Program

Seminars for prospective users and prospective (or current) contractors and grantees should be held at reasonably frequent intervals on programs and projects of current or near-term interest. Similarly, seminars -- less frequently -- should assemble "fundamental researchers" from a multiplicity of disciplines to provide guidance on the longer-range prospects of suitable, synergistic interaction between the soft and hard sciences in pursuit of LEAA's mission.

4. Involvement with User Assistance

ORED staff should be available to the user communities for direct technical assistance (backed up where necessary by contractors or grantees such as NBS). This assistance may take the form of exploring the practicality of introducing some new product or system, or help on evaluating existing products or systems and related procurement practices for both kinds of goods.

5. General Professional Involvement

ORED staff should be encouraged to be active in professional societies, to publish articles, and to participate in one or more user or constituency organizations. In short, ORED should become highly visible to the user community as a group of professionals who can provide some practical help immediately, and who will respond to their needs by appropriate selection of practice-oriented research programs or engineering developments for outside contracting or grant awards.

Through all of these means, we believe, there will be real-life opportunities to maintain technical competence of the ORED staff and gain credibility and respect on the part of both the prospective users and the prospective contractors and grantees. We would also anticipate that high-quality staff would carry with it a propensity to regular staff turnover, as staff members left for further professional growth and opportunity. This is clearly a healthy organizational characteristic and should not be discouraged by attempting to recruit a "permanent" staff. Obviously, care should be taken to insure a long enough tenure for staff and program continuity. Also, the need for close links with users, contractors, grantees, and other researchers must be met with appropriate attention to avoiding conflict-of-interest problems.

D. Conclusion

We have recommended that LEAA choose the direction of strengthening their internal management of technology R&D by establishing ORED with a highly-qualified staff that interacts closely with the users and performers of R&D. Our suggestions would require addition of approximately 14 people, phasing out and elimination of a prime development contractor, organization of a more visible science and technology R&D effort in NILECJ, and significantly greater attention to the identification and analysis of user needs and careful program planning. It is not likely to be an easy course. It will not yield instant solutions. It offers the opportunity to address the critical problem of law enforcement related technology development: deciding what to do. It offers the outline of a systematic approach to



making those choices, linked to user needs, and developing a responsive and useful technology program.

APPENDIX A

LIST OF INDIVIDUALS (AND ORGANIZATIONS)
INTERVIEWED IN THE CONDUCT OF THIS STUDY

U.S. Department of Justice

Paul Wormeli, Assistant Administrator, LEAA

Gerald Caplan, Director, NILECJ
Geoffry Alperin, ORP/NILECJ

Joseph Kochanski, Chief, Advanced Technology Division (ATD), NILECJ

George Shollenberger, Program Manager for Standards, ATD

Lester Shubin, Program Manager for Development, ATD

John Sullivan, Manager Forensic Sciences Program, ATD

Fred Heinzelmann, NILECJ, Community Crime Prevention Division

Martin Danzinger, Former Director, NILECJ

Henry Ruth, Former Director, NILECJ

Jay Cochran, Assistant Director, FBI

Tom Kelleher, Deputy Assistant Director, FBI

Dr. William McGee, Former FBI Lab official

John Gunn, Director, Office of Science and Technology, Drug Enforcement Administration (DEA)

Donald Sheldon, Chief, Advanced Technology Division, DEA

Richard Frank, Acting Chief, Forensic Sciences Division, DEA

Gilbert Leight, Department of Justice, Office of Assistant Attorney General for Administration





Police

| | |
|---|---|
| Jerry Wilson | Former D.C. Chief of Police;<br>Member, National Advisory Committee on Criminal Justice Standards and Goals |
| Patrick Murphy | Police Foundation |

Concurrent and Related Studies

| | |
|---|---|
| Robert Yin | Rand Corporation<br>Staff Director,<br>Task Force on Criminal Justice R&D Standards and Goals |
| A. Atley Peterson | Member of Task Force on Criminal Justice R&D Standards and Goals<br>Assistant Director,<br>Office of Technical and Scientific Services<br>Bureau of Alcohol, Tobacco, and Firearms (ATF)<br>U.S. Treasury Department |
| Frank J. Kreysa | Chief, Scientific Services Division, ATF, U.S. Treasury Department |
| Ms. Susan White | National Academy of Sciences |
| Ms. Ricky Kramer | National Academy of Sciences |
| Richard Fox | Chairman, American Society of Crime Laboratory Directors |

NILECJ Contractors

| | |
|---|---|
| John Eylor | Aerospace Corporation |
| Robert Merkle | Aerospace Corporation |
| Robert Kennel | Aerospace Corporation |
| Warner Elliot | MITRE |
| Jacob J. Diamond | Chief, Law Enforcement Standards Laboratory, National Bureau of Standards |

ADL Resource Staff (assisting the Principal Research Team identified on the title page)

| | |
|---|---|
| David Boodman | (Operations Research) |
| Alan Burg | (Biology, Toxicology, Forensics) |
| Donald Lindsay | (Physics, Chemistry) |
| Tom Lloyd | (Environmental Design) |
| Roger Long | (Electronics, Communications) |
| Anton Morton | (Behavioral/Social Sciences) |
| Gordon Raisbeck | (R&D Management, Systems Analysis) |
| Derek Till | (New Product Development, Standards, R&D Management) |





Miscellaneous

| | |
|---|---|
| Arnold Sagalyn | Staff Member of President's Crime Commission |
| Joseph Coates | Office of Technology Assessment, U.S. Congress |
| James Elms | Former Director, Transportation Systems Center/DOT |
| Robert Whitford | Deputy Director, TSC/DOT |
| Lewis Roberts | Director of Engineering TSC/DOT |
| Alford Blumstein | Carnegie Mellon formerly President's Crime Commission, S&T Staff Director |
| James Wykoff | Executive Secretary Committee on Federal Laboratories, Federal Council of Science and Technology |
| Hugh Witt | Assistant Director, OMB |
| Frederick Dietrich | " " " |
| William Russell | " " " |

(re Circular A 76)

APPENDIX B

## HISTORY AND STATUS AND PROBLEMS

### A. Objectives and Priorities

The history of any organization can be traced (in part) through an analysis of the changes in its goals and objectives. NILECJ is certainly no exception. NILECJ's (FY69-76) goals and objectives are arrayed in Chart

The Institute's objectives in FY69 clearly emphasize R&D efforts in the area of riot or demonstration control (collective violence) and urban crime. Organized crime was (to a lesser extent) a priority area also. FY70 stressed these same areas with the addition of drug related activities, stranger to stranger crimes and burglary. A shift in grant strategy is also suggested in that large projects are to be preferred over small ones. But, again, the primary focus of FY70 objectives was on "collective violence" as three priority program areas were pursued:

- social conflict in educational institutions,
- review and evaluation of the role of criminal justice in collective violence, and
- law enforcement control problems related to crowds and demonstrations.

FY71 goals described the identical crime targets noted in '70 as the focus of R&D efforts. The areas of research identified cover the gamut of potential research activities. FY72 objectives, on the other hand, suggested both grant strategy and specific program emphasis. Here large projects were stressed (as in '70), increased in-house research, and a preference toward applied over basic research. The R&D efforts for FY72 were concentrated in the following areas:



- High Impact Anti-Crime Program
- Evaluation
- Criminal justice procedures and systems
- Technology transfer (demonstration projects, etc.)
- ESIP (Equipment Systems Improvement Program)
- Research into criminal behavior.

FY73 marked the second consecutive year in which corrections (rehabilitation) and the ESIP were areas of major interest, as two of the goals dealt with recidivism and the causes of crime, while the other dealt with technical innovation. The new area of focus was the concept of opportunity reduction through citizen involved crime prevention programs.

FY74 objectives cover a range of potential R&D efforts but appear to focus on evaluation and crime prevention, just by the sheer number of sub-objectives listed in these categories. The only new concern is that of juvenile delinquency (prevention and diversion).

The FY75 goals (or more appropriately the major areas of focus) were quite different from those of previous years. Past goals generally referred to specific program areas or project types for which problems had been identified. The '75 objectives apply to the full range of criminal justice activities as they stress:

- Efficiency
- Fairness
- Reduction of the cost of crime.

NILECJ's FY76 plan clearly outlines five priority research areas, two of which (Crime Prevention and Control of Habitual Offenders) reflect

the FY74 emphasis in these two categories. The new areas of focus are:

- Special Police Operations (police referral systems, crisis intervention, policing of prostitution, etc.).
- White Collar Crime and Official Corruption (consumer fraud, corruption in licensing and regulatory agencies).
- Technology Development and Standardization (develop standards, improve testing procedures, field test body armor cargo security systems, explosives and gunshot residue detection).

One major difference in the FY76 (and to a lesser extent the '75) objectives is the fact that they do not emphasize problem areas which suggest the development of hardware or equipment systems.

General observation can be made about the FY69-76 goals and objectives:

- they vary with respect to specificity.
- priorities shifted significantly from year to year.
- some goals were difficult (if not impossible) to measure success towards.
- the format was never the same for any two consecutive years.

B. Budget

Paralleling the change in scope of NILECJ's goals and priorities was the growth in the R&D budget. Chart II presents R&D funding by program area from FY 69-75, the source documents being the LEAA/NILECJ Annual reports. The category ATD varies in definition such that activities described in a particular year may be included under another

CHART II

DISTRIBUTION OF INSTITUTE FUNDS BY PROGRAM AREA

| | FY69 | | FY70 | | FY71 | | FY72 (1) | | FY73 | | FY74 | | FY75 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | # | % of budget | # | % of budget | # | % of budget | # | % of budget | # | % of budget | # | % of budget | # | % of budget |
| Crime Prevention | 435,794 | 15.00 | 1,201,894 | 16.09 | 1,801,846 | 26.27 | 1,178,756 | 4.50 | 742,840 | 2.71 | 3,483,160 | 10.70 | 1,666,316 | 4.8 |
| Juvenile Delinquency | | | | | | | 1,112,059 | 4.00 | | | 1,707,768 | 5.20 | | |
| Police | 232,423 | 8.00 | 675,663 | 9.05 | Included in Advanced Technology | | 132,212 | 0.50 | 2,177,172 | 7.96 | 1,914,815 | 5.80 | 2,016,955 | 5.8 |
| Courts | 319,582 | 11.00 | 1,494,934 | 20.01 | 918,716 | 13.06 | 753,391 | 3.00 | 1,550,065 | 5.66 | 2,061,266 | 6.30 | 3,103,166 | 9.0 |
| Corrections | 435,794 | 15.00 | 490,652 | 6.57 | 1,201,131 | 17.07 | 1,320,377 | 5.00 | 2,029,539 | 7.42 | 2,547,019 | 7.20 | 3,198,951 | 9.2 |
| Advanced Technology | 1,074,959 | 37.00 | 2,593,537 | 34.70 | 1,656,130 | 23.54 | 7,491,317 | 30.00 | 9,264,100 | 33.85 | 8,621,084 | 26.50 | 9,417,516 | 27.1 |
| Education and Manpower | | | | | | | | | | | 1,274,550 | 3.90 | 1,634,490 | 4.7 |
| Evaluation | | | | | 109,050 | 1.55 | 2,545,303 | 10.00 | | | 4,414,005 | 13.90 | (6,572,028) | (18.9) |
| Visiting Fellows | | | | | | | 226,580 | 1.00 | | | 262,850 | 0.80 | 192,970 | 0.6 |
| Technology Transfer | | | | | 774,191 | 11.00 | 1,010,892 | 3.00 | 553,683 | 2.02 | 6,355,884 | 19.50 | 4,502,849 | 13.0 |
| Other | 406,741 (2) | .14 | 1,012,768 (3) | 13.56 | 528,061 (4) | 4.28 | 10,100,000 (5) | 39.00 | 11,012,333 (6) | 40.38 | | | 2,392,830 (7) | 6.9 |
| TOTAL | 2,905,296 | 100.00 | 7,469,449 | 100.00 | 6,989,126 | 100.00 | 25,870,887 | 100.00 | 27,369,732 | 100.00 | 32,642,401 | 100.00 | 34,698,116 | 100.0 |

(1) Figures were not categorized for FY72. Extracted from grant and contract abstracts. Total expenditure exceeds FY72 stated level of 21 million.

(2) Civil Disorders and General Law Enforcement

(3) National Service Functions of the Institute

(4) Collective Violence and Organized Crime

(5) Impact Cities and Pilot Cities

(6) Impact Cities, Pilot Cities, Office of Science and Technology, Office of Drug Abuse Law Enforcement, Graduate Fellowships.

(7) Research Agreements.

program in the next (and vice versa). Despite this inconsistency, the ATD funding showed a marked increase between FY 69 and 75 as it rose from $1,074,959 to $9,417,516. On the other hand, ATD's share of NILECJ's R&D funds ranged between 23% and 37%. In FY 74 and 75 advanced technology funds amounted to 26% and 27% respectively, as these funds maintained a relatively constant portion of all program funding. Chart I depicts Institute funding by program area.

C. Problems

Discussed in this section are various problem areas which exist with respect to the operation and management of R&D. The specific areas addressed are as follows:

- process and systemization,
- project results,
- operating style, and
- utilization of science and technology in law enforcement.

Many of these same problems have been described in other studies such as the Northwestern University Report and GAO's assessment of the ESIP.* But their significance here is the fact that they represent issues which must be addressed by any R&D alternatives if LEAA's research objectives are to be met with maximum efficiency and effectiveness. Certainly the recommended alternative would address some of these problems by its very nature (e.g., increased staff would provide increased capability to monitor, manage and perform research). They would also incorporate appropriate systems and processes in their

*Northwestern University Radnor Report, "The Program to Develop Improved Law Enforcement Equipment, Needs to be Better Managed", General Accounting Office, January, 1976.

CHART I

OBJECTIVES (GOALS) NATIONAL INSTITUTE OF LAW ENFORCEMENT AND CRIMINAL JUSTICE (FY69-75)

| FY69 | FY70 | FY71 | FY72 | FY73 | FY74 | FY75 | FY76 |
|---|---|---|---|---|---|---|---|
| • Perform R&D in a wide range of criminal justice areas, based on needs identified in a national survey.<br>• Identified problem areas were:<br>- improved communications for foot patrolmen<br>- methods and devices to combat urban crime and civil disorders<br>- understanding of causes of violent crime and riots<br>- assessment of organized crime's infiltration of organized business. | • Fund primarily large comprehensive projects rather than small ones.<br>• Perform R&D in criminal justice areas which will enhance law enforcement in controlling the following types of crimes:<br>- stranger-to-stranger street crimes (robbery, assault, vandalism)<br>- burglary (esp. home and small business)<br>- narcotic trafficking and addict crimes<br>- violent disorder hindering orderly functioning of communities<br>- organized crime.<br>• Priority programs<br>- collective violence<br>- social conflict in educational inst.<br>- review and evaluation of CJ role in collective violence<br>- law enforcement command and control program related to crowds and demonstrations. | • R&D efforts focused on the following types of crime:<br>- stranger-to-stranger<br>- burglary<br>- drug related and traffic<br>- collective violence<br>- organized crime<br>• Program and project plan developed to deal with R&D efforts in these areas:<br>- crime prevention and deterrence<br>- police operations<br>- prosecution and courts<br>- corrections<br>- collective violence<br>- organized crime<br>- white-collar crime<br>- evaluation program<br>- demonstration and dissemination<br>- encouragement of criminal justice research. | • Concentrate on large-scale projects.<br>• Sponsor both in-house and outside research.<br>• Focus on applied rather than basic research.<br>• Increase knowledge of extent and impact of crime, criminal justice operations, effectiveness of prevention and control strategies.<br>• Design and develop improved criminal justice procedures, policies, and systems<br>• Assist in the design, implementation, and evaluation of national demonstration programs.<br>• Increase adoption and utilization of new avenues to crime reduction by criminal justice system and the community.<br>• R&D priorities<br>- High Impact Anti-Crime Program<br>- criminal behavior and solution for<br>- Equipment System Improvement Program | • Alleviate social, economic and behavioral conditions causing crime.<br>• Reduce recidivism.<br>• Opportunity reduction through preventative means.<br>• Increase risk of crime through improved detection, identification, apprehension capabilities of law enforcement and improvement of the adjudication process. | • Community crime and prevention.<br>- reduce crime opportunities<br>- encourage community activities<br>- promote citizen participation in CJ<br>- assist victims and clients of the criminal justice system<br>• Juvenile delinquency<br>- delinquency prevention<br>- diversion<br>• Police<br>• Courts<br>- reducing courtroom delay<br>• Corrections<br>- assessment of new alternative rehab. programs.<br>• Evaluation<br>- determine costs and effectiveness of various approaches to criminal justice problems<br>- enhance management and performance of LEAA programs<br>- assist state and local evaluation efforts<br>- advance the state of the arts.<br>• Technology transfer. | • Increase the efficiency of criminal justice activities.<br>• Improve the fairness with which justice is administered (development of standards and goals)<br>• Reduce the cost of crime. | • Crime prevention and citizen involvement (environmental design, victimization studies).<br>• Special Police Operations (police referral systems, crisis intervention, police services for the aged and handicapped, policing of prostitution, narcotics control).<br>• Control of habitual offenders.<br>• White-collar crime and official corruption (consumer fraud, technology abuse, computer enforcement, corruption in licensing and regulatory agencies).<br>• Technology development and standardization<br>- develop standards for equipment and testing procedures<br>- field test (body armor, burglar alarm sensors, cargo security system, techniques for identifying explosives and gunshot residue). |

operational plan. But planners of the current R&D program also went through a cycle of describing the operational activities prior to the development of the existing agenda. Problems will not be eliminated simply through mandating a system.

In addition, some of the problems cited go beyond the boundaries of ATD and even NILECJ. These problem areas are both a description of current R&D deficiencies as well as a set of potential problems likely to face any R&D program.

1. Limited Use of an Effective Planning and Monitoring Process

Probably the planning function most affected by the lack of process is problem definition.

The agency (MITRE) previously responsible for this activity ceased operations in FY74. Their product, a catalogue of various criminal justice needs was never used.

The reasons for its non-use are basically two:

- no mechanism for incorporating problems into the development process; and
- no funds available for any new projects that might address new problem areas.

With respect to the second point GAO points to an early management decision to simultaneously fund (initially) the analysis (problem definition) and development groups as the undoing of the analysis function. The assumption made at the outset was that a substantial



increase in funds would be available after year one, for both on-going projects and new ones resulting from new problems identified. These additional funds were only sufficient to fund primarily existing projects and a few small ones. Thus the MITRE group was disbanded in FY74.

Consequently, the current planning activity also suffers from its lack of user input in the overall process. Thus the goals and objectives that have evolved from the existing process might be considered suspect (by users at least). Additionally, these goals and objectives were rarely translated into operational goals (projects) and milestones, and associated with specific timetables and end products. There is in fact no annual plan for ATD (overall) of this nature. The current plan is made up of essentially two documents:

- Aerospace's annual operation plan (primarily on-going projects) and
- Law Enforcement Standards Lab FY project plans.

These documents speak to activities surrounding specific ATD projects which they currently are working on or propose to pursue. There is no overall ATD program to which these and other contractor/grantee projects relate.

Another area in which the absence of process presents a major problem is that of Project Monitoring. There are means by which project progress is measured (such as):

- status reports,
- final products (reports, hardware),
- budget, and
- work programs and timetables for completion.

But a review of such documents reveals essentially two things:

- in many instances not enough data is contained in them to make critical project decisions (i.e. temporary delay, change in direction, or termination; and
- even when a monitor makes such a decision often times has little effect on the actions of the contractor.

In reference to the first point GAO states the following:

> "...The Institute has not requested the development group to determine how long it would take to develop the various projects at various funding levels within its funding limitation. Without such information, the Institute cannot ascertain whether individual projects could be completed faster if higher funding were authorized. Institute management should have this information to evaluate the wisdom of stopping some ongoing projects or deferring the start of new projects to permit an earlier completion of vital projects."

With respect to the second point, we enoountered several instances in which the monitor did not approve the contractor's work plan, but work continued (for several months) and payments were made prior to the plans acceptance.





But there is no guidance as to how these are to be applied with respect to the temporary delay, change in direction or termination of a particular project. We encountered many instances in which the monitor did not approve the sub-contractors workplan but work continued (for several months) and payment was made even though the workplan remained unacceptable.

2. Project Results

A comment often heard concerning ATD's major projects is that they never change and they never seem to get finished. Enumerated below are the major research projects for FY76:

- Cost Effective Burglary Alarm System
- Citizen Alarm System Development (field test and evaluation)
- Speaker Identification
- Cargo Security System
- Bloodstain Analysis
- Control of Illegal use of Explosives
- Improved Police Patrol Car System
- Detection of Gunshot Residue
- Body Armor Field Evaluation

With respect to the first comment concerning projects never changing, all, except detection of gunshot residue, were listed as LEAA projects in FY72. Activities like the improved patrol car, speaker identification, bloodstain analysis and the control of illegal explosive use were initiated even before FY72.

Probably the more glaring criticism is that these projects never get finished. In fact, only two of the projects have reached the point where they are ready for field testing and evaluation. While there is no evidence to support management's emphasis on short-term results at the outset, they now clearly expect more products that currently exist from on-going projects. Further emphasizing the "never seems to get finished" concept are two other projects which began in FY69 but disappeared from the ATD project listing with little apparent success. They are the non-lethal weapons project (or police weapons system program) and the miniature transceiver for patrolmen. The non-lethal weapons project was still cited as a viable LEAA research activity as late as FY74. The miniature transceiver project ended during FY73. A prototype transceiver was developed but not field tested because it was felt that the final product was inferior to a similar device developed in the private sector.

3. Operating Style

The transceiver case is symptomatic (at least in part) of the disjointed and often ineffective R&D process in ATD. Here is a project that more than likely could have been done more effectively by private companies in the business of developing transceivers for commercial use. But given ATD's poor coordination and lack of execution with respect to R&D process activities, decisions like this are often overlooked or inaccurately made. These and other problems can be tied directly to ATD's existing operating style. That is, they:

- contract out all development;
- have no formal problem identification function;



- isolated the standards function; and
- never really developed user needs assessment.

As cited earlier, the problem definition activities of MITRE ended in FY74 with no action taken on their recommendations, and no designations of another problem definition group. But even if such a group were in existence, there are no procedures outlined for translating these problems into solution sets and specific projects. In addition, there are no available funds for any projects identified by such a problem definition or analysis group. All projects are then contracted out (or the subject of grants) to various entities who are generally one step removed from the user population and likely to be insufficiently enlightened by the problem definition activity. In fact, a major source of actual problem definition activity is the development contractor suggestions of activities (primarily related to on-going projects) for the coming year. These suggestions (at least in the case of Aerospace) are often accepted by ATD.

Aerospace, of course, has come primary responsibility for the completion of all the major projects cited above. The plan, direct, manage, monitor and perform the vast majority (over 70% in R&D dollars) of ATD's development function. While this mode of operation may take on the characteristics of "putting all your eggs in one basket", it is an operating style which is not unfamiliar to the field of R&D. We, in fact, heard several positive comments about the excellent capabilities of Aerospace. But on the other hand, the one prime development contractor mode, can and has contributed to various

probelms related to project control, (i.e., improper suboptimal subcontractor selection, isolation of development and standards functions, ineffective utilization of user input).

The standards function performed by LESL was characterized by project monitors and contractors as an isolated activity. LESL spends a great deal of time developing what most people characterize as technically sound standards. But often these standards are not stated in a fashion understood by the user community.

In addition to this, LESL has often engaged in similar research activities being performed by contractors and grantees, with little apparent coordination of effort. Here again as with problem definition, there is no formal procedure or plan for interrelating the standards function with the development and problem definition activities.

Finally, as the GAO and NWU studies point out, ATD has never effectively assessed user needs, an activity which is relevant to all phases of the R&D process. Ideally, a user needs assessment would yield the following for each functional area:

- identification of specific problems in the field and a basis for prioritizing them;
- criteria to measure appropriateness and effectiveness of solution through various stages of the development process; and
- operational performance test against which the success of the final product is measured. A basis for determining the scope and specificity necessary in developing and translating technical standards for the user community.



Critical to any R&D effort designed to utilize technology in the improvement of the criminal justice system, is a thorough understanding of the problems of the various agencies, departments, etc. that are a part of that system. At present ATD has no formal mechanism for identifying that need and incorporating it into the overall R&D process as cited above. It is important to note, though, that IACP has been recently retained to interface with the user community and may appropriately satisfy this deficiency.

4. Utilization of Science and Technology in Law Enforcement

Most evident from our interviews (and the GAO and NWU reports) is the fact that many people are not satisfied with the way in which science and technology is being applied to develop new methods, devices or techniques to meet law enforcement needs. The comments heard ranged from disagreement with the overall objectives to reservations concerning the capabilities of contractors and grantees. Examples of these assessments are as follows:

- R&D in the soft sciences is likely to produce greater benefits in the law enforcement area than will the hard sciences,
- "We've been in the R&D business since '69 and what have we produced?"
- The current operation can't work because ATD has no real control over contractors.

While there clearly are stronly held opinions within NILECJ and the criminal justice community about the relevance and objectives of scientific and technological research in law enforcement, there is little knowledge. The potential impact of science and technology in the improvement of criminal justice appears limited relative to other types of research. This is simultaneously the reason for this study, the basis for our premise that improvement is clearly possible and necessary, and an agenda of concerns to be addressed in any modified R&D program.



APPENDIX C

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