CLASSIFICATION

# PROJECT EVALUATION SUMMARY (PES) — PART I

Report Control Symbol U-447

| 1. PROJECT TITLE | 2. PROJECT NUMBER | 3. MISSION/AID/W OFFICE |
|---|---|---|
| APPLIED SCIENCE AND TECHNOLOGY | 263-0016 | USAID/Cairo |

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY) 84-3

☐ REGULAR EVALUATION ☐ SPECIAL EVALUATION

| 5. KEY PROJECT IMPLEMENTATION DATES | 6. ESTIMATED PROJECT FUNDING | 7. PERIOD COVERED BY EVALUATION |
|---|---|---|
| A. First PRO-AG or Equivalent FY 77 | A. Total $ | From (month/yr.) April 1980 |
| B. Final Obligation Expected FY 80 | B. U.S. $ 24.4 m | To (month/yr.) December 1983 |
| C. Final Input Delivery FY 86 | | Date of Evaluation Review January 1984 |

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

| A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.) | B. NAME OF OFFICER RESPONSIBLE FOR ACTION | C. DATE ACTION TO BE COMPLETED |
|---|---|---|
| 1. Strengthen ASRT research and development management functions by: | | |
| a) developing and implementing a plan for building a management system and staffing pattern in the ASRT and NRC; | ASRT | develop 2/29/84 implement 9/31/8 |
| b) amending NAS contract to extend their services for upto two years and to include the services of an R&D management subcontractor; | AID-NAS | 5/31/84 |
| c) preparing and submitting a reallocation plan, with rationale, for all budget items (taking into account the phasing out of all R&D and Demonstration projects by September 1985 at the latest). | ASRT | 3/1/84 |
| 2. Ensure the completion of an adequate and appropriate information system by: | | |
| a) reviewing and resolving remaining questions on the information system (specifically, signing agreements, providing a rationale for locating the nodes and establishing a governance board); | ASRT with Ga Tech | 3/31/84 |
| b) evaluating the information system to determine the technical progress and marketing feasibility to assist in deciding on the need for extension of the component. | AID | 11/30/84 |
| 3. Complete the instrumentation portion of the project by: | | |
| a) ensuring that all equipment is ordered, delivered and installed in sufficient time to | U. of Wisconsin | 1/31/85 |

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS

- ☐ Project Paper
- ☒ Implementation Plan e.g., CPI Network
- ☐ Other (Specify)
- ☒ Financial Plan
- ☒ PIO/T
- ☐ Logical Framework
- ☐ PIO/C
- ☐ Other (Specify)
- ☐ Project Agreement
- ☐ PIO/P

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT

- A. ☐ Continue Project Without Change
- B. ☐ Change Project Design and/or ☒ Change Implementation Plan
- C. ☐ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

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12. Mission/AID/W Office Director Approval

Signature

Typed Name: M.P.W. Stone, Director

Date: 1-30-84

AID 1330-15 (3-78)

BEST AVAILABLE COPY

CLASSIFICATION

# PROJECT EVALUATION SUMMARY (PES) — PART I

Report Control Symbol U-447

| 1. PROJECT TITLE | 2. PROJECT NUMBER | 3. MISSION/AID/W OFFICE |
|---|---|---|
| | | |

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY) _____

☐ REGULAR EVALUATION ☐ SPECIAL EVALUATION

| 5. KEY PROJECT IMPLEMENTATION DATES | | | 6. ESTIMATED PROJECT FUNDING | 7. PERIOD COVERED BY EVALUATION |
|---|---|---|---|---|
| A. First PRO-AG or Equivalent FY____ | B. Final Obligation Expected FY____ | C. Final Input Delivery FY____ | A. Total $ _____<br>B. U.S. $ _____ | From (month/yr.) _____<br>To (month/yr.) _____<br>Date of Evaluation Review |

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

| A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.) | B. NAME OF OFFICER RESPONSIBLE FOR ACTION | C. DATE ACTION TO BE COMPLETED |
|---|---|---|
| cont.<br><br>benefit the project;<br>b) completing the design of the integrated procurement system and implementing necessary actions. | ASRT with NIH and U. Wisc. | 5/31/84 |

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS

- ☐ Project Paper
- ☐ Financial Plan
- ☐ Logical Framework
- ☐ Project Agreement
- ☐ Implementation Plan e.g., CPI Network
- ☐ PIO/T
- ☐ PIO/C
- ☐ PIO/P
- ☐ Other (Specify) _____
- ☐ Other (Specify) _____

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT

- A. ☐ Continue Project Without Change
- B. ☐ Change Project Design and/or ☐ Change Implementation Plan
- C. ☐ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

12. Mission/AID/W Office Director Approval

Signature

Typed Name

Date

AID 1330-15 (3-76)

# PROJECT EVALUATION

## APPLIED SCIENCE AND TECHNOLOGY RESEARCH

## PROJECT 263-0016

December 1983

Cairo, Egypt

Project Evaluation 1983
Applied Science and Technology Research
Project 263-0016

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## Preface

One of the major achievements of the Applied Science and Technology Research project is that it has served as a vehicle for cooperation on the part of Egyptians and Americans to accomplish a significant improvement in Egypt's scientific and technological resources. In carrying out this sincere desire of all parties, the project has already been a success.

Major contributions to the evaluation were the knowledge, insights and practical reflections of Dr. Ibrahim Badran, President of the Academy of Scientific Research and Technology, Dr. Mohamed Kamel, Director of the National Research Center, Dr. A.S. El Nockrashy, Program Coordinator for the Applied S&T project and Dr. Sherif Arif, Project Officer of USAID. Each of them "taught" the team many lessons and added materially to the value of the study.

Although the process of development and change, on both sides, has not been an easy one, it has been accompanied by a large element of goodwill, enthusiasm, and an unusually strong sense of purpose on all sides. This goodwill and cooperation carried over into the work of the evaluation team, and the team wishes to acknowledge with deep appreciation the assistance provided by ASRT and NRC program coordinators, the many Egyptian scientists, administrators, principal investigators and other public and private sector personnel contacted during the course of the evaluation. All responded patiently and candidly to the team's questions and requests for information. The work would not have been possible without this support. Representatives of the U.S. contractors and members of the Joint Consultative Committee were similarly helpful.

The U.S. members of the team wish to express special appreciation to Dr. Ahmed Mohammed Azzam and Dr. Nayel Barakat, Egyptian team members, who gave unstintingly of their time and efforts in a most effective way and who were, in addition, fine companions in all we did together. We also wish to thank Dr. Ahmed Aziz Kamal for the time taken from his busy schedule for the benefit of the team and the evaluation.

## Executive Summary

### Background

The Applied Science and Technology Research Project began in 1977 as Phase I and continued in 1980 as Phase II. Present completion date is October 1985. Phase I emphasized the "design" of S&T activities and Phase II the "operational" aspects of that cumulative design. Total funding is $24.4 million.

The Egyptian agency responsible for the project is the Academy of Scientific Research and Technology (ASRT), the government agency mandated in 1971 to have twelve major responsibilities, including "to formulate policies . . . which serve the national development plans", "to coordinate the major research projects affecting the national economic and social plans . . ." and "to develop international relations." (For full text, see Appendix A.)

Much of the specific technical research was carried out by the National Research Center (NRC), one of eleven ASRT "institutes."

### Achievements

ASRT has established itself as a primary resource of the Egyptian S&T community. It is the predominant institution linking together some 1500 Egyptian scientists and engineers and has made substantial gains in its own internal capability to undertake and perform significant work on Egypt's development problems. ASRT will now be largely responsible for, and increasingly in a position to provide leadership for, the S&T elements of the National Five Year Plan implemented through a derived S&T five year plan initiated by the Academy. It has developed active cooperative working arrangements with both public and private sector entities and is in a position to expand those arrangements. ASRT recognizes the need to improve R&D management practices in order to respond better to the development needs of Egypt and indicates it is prepared to commit resources to that improvement. The final two years of the project offer the opportunity to strengthen the essential management functions necessary to permit ASRT to sustain a program of applied research of high quality and utility and to compete for scarce resources from sponsors of research.

### Future Direction

ASRT and NRC have already articulated most of the management functions necessary for further growth. The evaluation team summarizes these as: (1) establish priorities and program strategies, (2) expand collaboration with end-users, (3) establish more specific criteria in decision-making, (4) maintain good administrative practice and control, (5) cope with the persistent problem of maintenance and repair, (6) develop "linkage" working relationships and improve communications, (7) strengthen the indigenous training capacity, (8) improve assessment of research programs, and (9) plan for self-sufficiency through sponsor participation.

Recommendations for the Applied S&T Research Project

The evaluation team recommends a shift in strategy for the remainder of the project to emphasize the functions of management important to research and development in Egypt. The nature of these should be determined and developed by ASRT using whatever resources are available, local and international. The concept the team suggests is that ASRT expand its direct participation in cooperative applied research in Egypt and become a model for other institutions and activities. Specific recommendations are: (detailed recommendations comprise Part I, pages 6 to 9.)

1. The National Academy of Sciences (NAS), as a U.S. contractor, should consult with ASRT and, under ASRT guidance, adjust its work in terms of a shift to: (a) strengthening the management functions of ASRT, and (b) a stronger in-country training program including a training-of-trainer approach. AID, too, will need to consider its support of this change. This could result in an extension of this portion of the NAS contract to September 1986, including continuance of Joint Consultative Committee (JCC) to 1986. Within the JCC program the evaluation team recommends that "national policy" activities remain as primarily an Egyptian effort.

2. All R&D and Demonstration Project activity under this project should be concluded by September 1985 or sooner.

3. ASRT should review the budget and decide on the reallocations which it proposes.

4. The budget reallocation proposal should apply criteria compatible with the project purpose, as expressed in detailed Recommendation, Part IV.

5. Special ASRT attention should be given to the design and installation of the procurement/maintenance/repair management system of the Scientific and Technical Instrumentation Center (STI).

6. The Georgia Institute of Technology contract (information system) should be extended to Oct. 1986, but should be reevaluated in late 1984 and 1985.

7. Subject to progress in this new strategy, AID should consider favorably further future support, preferably through a matching of funds with end-user sponsors.

## Abbreviations

| | |
|---|---|
| AID | - Agency for International Development (worldwide) |
| ASRT | - Academy of Scientific Research and Technology |
| Battelle | - Battelle Memorial Institute |
| DRI | - Denver Research Institute |
| Five Year Plan | - Government of Egypt National Five Year Plan (1983-1987) |
| Georgia Tech | - Georgia Institute of Technology |
| GOE | - Government of Egypt |
| JCC | - Joint Consultative Committee |
| MIT | - Massachusetts Institute of Technology |
| NAS | - National Academy of Sciences |
| NBS | - National Bureau of Standards |
| NIH | - National Institutes of Health |
| NRC | - National Research Center |
| R&D | - Research and Development |
| S&T | - Science and Technology |
| S&T Five Year Plan | - Five Year Plan for the Specific Councils (1983-1987) |
| STI | - Scientific and Technical Instrumentation Center |
| USAID | - AID Mission to Egypt (local) |

## PART I

### Summary of Conclusions and Recommendations

#### Background

The Applied S&T Research project (263-0016) was approved in 1977; a second, three-year phase (Phase II) followed in 1980 and was subsequently extended to 1985. Total funding for both phases is $24.4 million. The purpose of the project has remained the same:

> To improve the institutional capacity of the Egytian S&T community to develop and manage research programs to solve priority development problems. (See Appendix B, Logical Framework.)

This purpose was to be achieved through outputs in several areas which, taken together, form a comprehensive strategy of improvements. These make up the six components of the project: First, policy studies and international seminars aimed at defining the elements of a science and technology policy for Egypt. Second, science and technology program management aimed at strengthening the management and control capability of the Academy of Scientific Research and Technology and its principal multidisciplinary research institute, the National Research Center. Third, several R&D and Demonstration projects (activities). These activities were aimed at establishing new linkages between the academically-oriented research institutes and end-user groups in industry and agriculture, and were seen as vehicles enabling Egyptian researchers to develop and test skills in designing and managing applied research linked to end-users. Fourth, establishment of a national S&T information system. Fifth, establishment of a training capability in maintenance and repair of scientific equipment. And sixth, development of coordinated services in standardization, measurement and quality control to support industry. Cutting across most of these components was a substantial program of equipment procurement, originally estimated at one-third of the $16.1 million for Phase II.

With the exception of the information system, the management of which required the formation of a new inter-institutional coordinating group with management responsibilities, the components of the project had already established institutional bases through which to develop the respective improvement programs.

Phase I of the project emphasized the design of specific approaches to achieving the desired improvements. Phase II has concentrated on their implementation. Five U.S. contractors assist in the implementation of specific components. The project involves 15 participating institutes and organizations in Egypt, of which four have major roles. ASRT is the counterpart institution. A Joint Consultative Committee (JCC) consisting of five Egytian and five American scientists provides overall guidance to ASRT regarding the project. None of the five U.S. contractors has overall

coordination responsibility for all six project components, with the result that the project has placed a substantial management responsibility on the ASRT and on AID with whom the contractual arrangements are signed. Coordination and overall management on the Egyptian side resides in ASRT.

The purpose of this mid-course "process" evaluation of Phase II is to assist ASRT and its institutes, the U.S. contractors, and AID to improve their performance during the final two years of Phase II so that the project outputs and purpose will be achieved as planned. The evaluation team followed a scope of work prepared by AID and agreed to by ASRT (see Appendix C).

The general methodology used by the evaluation team was to conduct open discussions with varied groups and people, especially focusing on the evaluation topics in the Evaluation-Scope of Work (Appendix C, paragraph C), over a period of two weeks, then to concentrate on specific topics. In doing this the team selected as the most profitable topics of: overall project management, role of American contractors and policy studies. The topics of research capabilities and commodities appeared to the team as sufficiently well advanced that they need not be addressed in this interim process evaluation. In carrying out the evaluation, the team identified those areas in which progress appeared to be slow compared to project expectations; interviewed Egyptians and Americans regarding their perception of the project, problems they are encountering in their research management experience and their explanations for successful or lagging performance; and attempted to reconcile differing viewpoints through larger explanatory models. Most of the explanations focused on management issues, on different expectations as to roles and responsibilities, and on the question of whether or not the project was succeeding in achieving one of its key outputs, implementation of effective management systems at ASRT and the NRC. Different perceptions were evident of what constitutes an effective R&D management system that can best ensure that a research product or technology will have a development impact, and on what had to be done to learn and apply the lessons from experience gained under the Applied S&T Research project. The team's recommendations address the problems and solutions from a composite viewpoint but are purely the responsibility of the team and its efforts.

## Significant Achievements

The evaluation team concluded that the Applied S&T Research project has strengthened a nascent ability of the ASRT and NRC to plan and monitor a program of applied research directed to industry, agriculture, health and nutrition needs. The ASRT, though still a young institution, has credibly demonstrated that the S&T community in Egypt can have a reasonable impact on development problems; can support industrial production needs; can adapt new technologies in an established period of time; and can undertake research involving several disciplines. The team found strong evidence of ASRT and NRC awareness of a need to upgrade R&D management practice necessary to build more rapidly on these accomplishments. Equally important, the ASRT and NRC have reached a point where they expect to be able to compete convincingly for sponsors and incentives on which to sustain an applied research program of high quality and utility. The final two years of the project should concentrate on strengthening selected R&D management functions to complete this initial stage of institutional development in the ASRT and NRC.

The specific research, training and infrastructure accomplishments supported by the project to date, although very important, do not in themselves constitute institutionalization of an R&D management system. Although the AID Mission states that such institutionalization was not the purpose of the Phase II project, the team believes that sufficient momentum has been generated that the next two years of the project should focus strongly on management improvement. This improvement should involve strengthening the staff of the ASRT to provide guidance, design resources and performance standards to the institutes; to recruit and train additional staff to these functions from within the institutes; and to broaden the exposure of principal investigators and researchers to basic R&D management concepts. This will require some shift in implementation strategy and some redirection of both attention and resources in the Applied S&T Research project.

The strengthening of research capability and infrastructure is being accompanied by an important indicator of institutional development--awareness of the need and attempts to attract interest and support from user organizations and the national government. The experience of working with end-users in the specific R&D and Demonstration projects, although very mixed, is being followed up by organizational provision for a "marketing" program. While a user-focused orientation is not yet fully established, both approaches could generate increasing external incentives for applied research, paid by end-users. The government's budgetary commitment to support a substantial proportion of the "Five Year Plan for the Specific Councils, 1983-1987" also represents a new stage in ASRT's growth.

Few, if any, of the elements of R&D management, or even its basic concepts, were in place in Egypt when the project began. Thus, the situation in 1983 is very different from that prevailing in 1976 (when the ASRT was barely four years old), or even as recently as 1980. Although the record of accomplishments is not without its share of technical problems and difficulties in management and coordination, there is no question but that the perception of the ASRT and NRC by user groups is changing, and that the researchers and administrators involved have themselves gained self-confidence in their management and technical abilities.

## Phase II Implementation Status and Prospects

Although the rate of expenditure under Phase II has accelerated gradually between 1980 and 1983, three-fourths of the funds for Phase II remained unspent as of September 1983. The team is satisfied that the maintenance and repair (National Institutes of Health-NIH) and the standardization (National Bureau of Standards-NBS) components will be completed as planned. Both NIH and NBS are dependent on the University of Wisconsin to complete their tasks, the former in establishing a management system for maintenance/repair/procurement, and the latter for the procurement of equipment for calibration and training. Work on these has begun or is continuing well. A major single expenditure is scheduled to be made for a food technology pilot plant, subject to decisions which may be made in the recommended budget reallocation.

The most serious delays have been those in procurement of equipment and supplies, in those activities of the National Academy of Sciences (NAS) that

provide for U.S. short-term technical advisory support, fact-finding trips, and R&D management improvement, and in establishing user "nodes" for the science and technology information system (Georgia Institute of Technology). Smaller funds for local materials, supplies and instrumentation repair also remain unexpended.

The causes for these delays are varied. They include fundamental problems in the project design; the Egyptian use of fixed budget estimates for equipment and supplies for an activity (applied research) which by its nature involves uncertainty and requires flexibility; the tendency of Egyptian counterparts (and, to a certain extent, AID) to regard elements of the project as fixed and unchangeable; the failure of some U.S. contractors to reexamine their strategies and procedures in order to respond more rapidly to fairly persistent problems, or to work actively with Egyptian counterparts in defining priorities; and less Egyptian use of U.S. consultants and technical services than planned. In the case of Georgia Tech, even if the comprehensive implementation plan were to be largely completed within the next two years, the team believes that additional time will be necessary for any reasonable test of the information system.

The evaluation team has concluded that the purpose of the project remains valid for the next two years and that the achievements to date are sufficiently strong to warrant a forward thrust in implementation strategy, both to promote the purpose of the project and remedy some current delays in implementation. This shift refocuses attention on the development of management in ASRT and NRC and on a concerted in-country training program.

## Future Direction

In the view of the evaluation team, major tasks lie ahead in consolidating and building on initial accomplishments. It will be necessary in some areas to strengthen management awareness, capacities, and administrative functions as described in the evaluation report, especially in ASRT, and to take further advantage of techniques for internalizing some activities which have depended on external donor assistance and advice. The team believes that, as improvements continue in the management and training areas, other problems will be overcome. Among these management functions, many of which the ASRT has already articulated, are those that will better ensure the following:

1. Establish more detailed, long-term priorities and program strategies in the planning of applied research. The S&T five year plan could itself be used as a vehicle for the further development of appropriate management functions.

2. Follow up the experience gained in the R&D and Demonstration projects by insisting on the consideration of end-use and "real world" economic and social factors and, perhaps more fundamentally, developing collaboration strategies with users for all applied research projects funded through the ASRT and NRC early in project selection and design. The criterion of end-use should also be applied, as appropriate, to the location of some development and testing equipment (e.g., by locating pilot plants in industrial rather than laboratory contexts. This was done in the case of the wool wax project).

3. Establish more specific criteria governing not only the design, but also modification and/or termination of research projects. In a world of scarce resources and pressing development needs, it is necessary to manage resources judiciously. Clear criteria can ease the economically or politically difficult decisions to redirect or terminate research that proves to be unproductive in an anticipated period of time. (For example, the case of the research project of Food Crops for Arid Lands.)

4. Strengthen good administrative practice and controls as research progresses. Some of the R&D and Demonstration projects can serve as excellent case studies to be incorporated in ongoing training programs at NRC.

5. Continue to seek imaginative ways of coping with the persistent problem of maintenance and repair, and provide substantial incentive payments to this area. The maintenance and repair of equipment are intimately related to the Academy's ability to attract research sponsors, especially in the mid- and long-term. Efforts under Phase II of the AID project to apply training models that can help retain both trainers and trainees will have to be carefully monitored, particularly their effectiveness in retaining a corps of electronic engineers.

6. Support joint working relationships and internal communication within the research community. The many activities assisted by this project led to added requirements for coordination and communication. The team considers that Egyptian management styles discourage information sharing and encourage individual retention of control over activities involving personal responsibility. There are, nevertheless, some straightforward and unexploited opportunities for the exchange of experience, such as meetings between principal investigators to discuss such common problems as procurement or research marketing.

7. Emphasize training in Egypt and training-of-trainers. The team concludes that a sufficient level of awareness at ASRT and NRC has been built up through the management training that has been provided in the U.S. by the project that it is now possible and necessary to move in the direction of a more concerted training program. This program can build on the ongoing training program in NRC and can design training programs at ASRT tailored to particular levels of program responsibilities and functions. Building local capacity for R&D management improvement and training should become a priority for the next two years. In facing up to the problem of loss of trained personnel, training programs can focus on training-of-trainers, on selecting candidates for training from staff members having well-established stakes in their jobs, on building a library of R&D management reference materials, and creating on linkages with sources of expertise.

8. Conduct assessment of research programs. The management function of evaluation is not yet organizationally defined, although some "evaluative" and monitoring activities are being carried out within the ASRT and NRC. The ASRT can approach this function in a combination of ways: at the institute level, at the level of the research project, and ASRT and NRC can require the wider use of self-monitoring systems already tested in some R&D projects. At the level of the ASRT staff, the ASRT can establish a central system for program assessment (including evaluation and techno-economic analysis). The ASRT can

periodically review groups of research projects, by priority and by sector, and assess their progress toward meeting national development priorities.

9. Plan for self-sufficiency. As part of a broadened "marketing" effort, the ASRT and NRC can begin to set for themselves realistic goals for incentive income, and a plan for attaining these goals, as a basis for reviewing progress in the direction of self-sufficiency. As technical and management functions are strengthened, the team believes that these organizations will attract external sponsors, both in Egypt and the donor community.

Recommendations for the Applied S&T Research Project

The following recommendations are designed to enable the ASRT, by the end of the Applied S&T Research project, to be in a strong institutional position to guide and manage a program of applied research, as both a model for and a direct participant in, applied research in Egypt. Taken together, these recommendations call for a much stronger emphasis on R&D management and in-country training, a shift in strategy that is necessary if the outputs and purpose of the project are to be achieved by 1986. The team believes that such a shift is feasible, given the improved applied research capabilities and infrastructure, and the likelihood that the related services of procurement/maintenance/repair and standardization will be established within their contracted periods.

1. The NAS should immediately review its program in terms of what is recommended as a major shift in project strategy toward strengthening selected management functions in ASRT and a stronger in-country training program in R&D management in NRC. The latter should incorporate a "training-of-trainers" approach and the experience gained under this project.

(a) Strengthened R&D management capacity and administrative functions: The NAS should approach ASRT to ascertain its interest in a comprehensive program of management-building assistance, and, if ASRT is interested, the NAS should select one or more institutions qualified to provide the R&D management assistance required to strengthen management capacity in ASRT and assist in the establishment of selected administrative functions. The NAS and ASRT should discuss with AID any additional funding requirements and any extension of the NAS contract to 1986 which may be required by such a refocused effort. For the purposes of the Applied S&T Research project, this effort should not extend beyond 1986. AID, however, should consider this effort as a desirable area for future U.S. support, and should regard a strengthened ASRT as a key element in a strategy for U.S. support for overall S&T development in Egypt. If the ASRT does not express an interest in this refocused effort by March 1984, the NAS contract should be extended only to September 1985, and should focus on the development of in-country training, and support for the activities of the Joint Consultative Committee. If ASRT does agree, it should demonstrate its commitment to this effort by assigning adequate incentive funds to the R&D management improvement effort; the method of such commitment should be an ASRT decision. [Responsibility ASRT/NAS.]

(b) In-country training: while continuing its role in supporting scientific exchange between Egypt and the U.S., the NAS should concentrate its R&D training on a modest, but important, improvement in in-country training. [Responsibility ASRT/NAS.]

(c) The JCC should continue its role until 1985, or to 1986 if the NAS contract is extended. The JCC should review its original functional statement so as to enable that body to give its fullest support to a shift in project strategy toward R&D management improvement. [Responsibility ASRT/NAS.]

(d) With regard to the policy components, in those cases in which the Egyptian scientists and policy makers involved in this endeavor wish assistance in strengthening certain technical functions indirectly related to policy processes (e.g., technology forecasting, technology transfer processes, technical and program information gathering), this assistance can be provided, for example, through the strengthened programs of R&D management and in-country training and the S&T information component. [Responsibility ASRT.]

2. The R&D and Demonstration activity component under this project should be concluded not later than September 1985, whether or not all the individual research activities have been brought to completion. This will require a terminal date early in 1984 for ordering equipment to ensure delivery and installation by September 1985. The team believes that these research and demonstration activities will have served their purpose under this project, as vehicles for gaining management experience in applied research, and for building a basis for internal and external confidence. The ASRT and NRC should now move to synthesize and disseminate the lessons learned, and to capitalize on their strengthened position. The attention given by ASRT staff to implementing these research activities should turn toward strengthening selected management functions, to identifying and building its constituency of users and markets, and to attaining a greater level of indigenous and self-sustaining support less dependent on general donor grants. [Responsibility ASRT.]

3. The ASRT should immediately review existing budget allocations and relationships between project components and activities and decide what reallocations it wishes to propose to AID (within the limits of the Project Agreement) to ensure that all contracts terminate as planned, with two exceptions discussed below. This review should take the form of a "portfolio review" of all R&D and Demonstration project budgets. It should result in a comprehensive reallocation plan and rationale. This plan should reflect ASRT consideration of the priority it desires to give to a shift in the strategy of this project to an improved R&D management system and in-country training, as well as ASRT's commitment to this strategy by reallocation of both AID and Egyptian funds. Until this review is completed, and the resulting proposals presented and discussed with AID, no budgetary actions should be taken involving new or follow-on activities. AID should also consider this shift of strategy within the purpose of the project and convey its position to ASRT. [Responsibility ASRT/AID.]

4. In developing its recommendations on budget reallocations between specific R&D and Demonstration projects, the ASRT should, in consultation with NRC, consider the following criteria, in rank order of priority (these criteria are inferred from the purpose of the Applied S&T Research project):

(a) those projects at or close to completion in terms of their originally planned purpose and outputs;

(b) those ongoing activities with active institutionalized end-user support;

(c) those ongoing or completed activities in which discussions are currently being carried out with potential institutionalized end users, or with other research institutions interested in undertaking a similar program of applied research, in which tangible evidence of user commitment to adopt research results can be demonstrated;

(d) those completed projects for which a follow-on is already part of the Five Year Plan and which can be completed by 1985 without new procurement. [Responsibility ASRT.]

5. In reviewing the relationship between project components, the ASRT should give special attention to the careful integration of the NIH and University of Wisconsin activities relating to the design and installation of an overall procurement/maintenance/repair management system in STI, to ensure that such a system is fully understood by the new director of STI. ASRT should move quickly to complete the design of the integrated procurement management system, using University of Wisconsin and NIH resources, and implement this system. [Responsibility ASRT.]

6. The Georgia Tech contract should be extended to 1986. This component of the project continues to pose major institutional problems rooted in the comprehensive design of the information system envisioned, in which major investments have already been made, the slowness with which the "user orientation" of the system is being carried out, and the complex management requirements and responsibilities involved. To activate the "user orientation" side, ASRT should review the original selection of information nodes (for example, consider the desirability of the location of one node in the Ministry of Health) to ensure that they will represent the most relevant and interested user groups, take all steps necessary to expedite the signing of required agreements, and establish a counterpart unit in the form of a governance board. AID should carefully evaluate this component at the end of 1984 and 1985. [Responsibility AID.]

7. If, during the next two to three years, the ASRT (and NRC) demonstrate sufficient continued progress in an ability to guide and manage an applied research program through renewed efforts to strengthen selected R&D management functions, and as external sponsorship and interest from end-users continues to develop, AID should consider favorably future support. The preferred model for such support should be one of matching funds for high priority research for which end-user support is clearly evident through both direct involvement in research programs and the promise of concrete resources for carrying out the research. An example of such an arrangement is the wool

wax project. In such research the U.S. would at least match the funds or resources provided by an industrial user to pay for the research. Another example could involve future efforts in the pharmaceutical chemicals project. This is elaborated further in this report. (See Part II, page 14.) [Responsibility AID.]

## PART II

### Project Management

#### Influence of Project Design on Management

The design of the Applied S&T Research project has noticeably influenced the way in which the particular groups involved in the project have managed their respective tasks. A summary of these design features provides a framework for the later discussion of project management and the role of the five principal U.S. contractors. Few of these design features are of the type that can be readily or easily changed mid-stream, as part of a normal process of problem-solving during implementation:

1. Multiple Targets: The purpose of the project aims at developing the S&T "community" in general, rather than the particular organizations in which management systems and capacity are to be improved. Some of the project outputs clearly aim toward strengthening the ASRT, its related institutes and research staffs. Other outputs had wider aims. Thus, the project never really settled on an institutional framework. The resulting confusion is evident in some latent disagreement over priorities and encouraged periodic shifts in focus. Moreover, it has hampered the coordination of the several components of the project, even though these components represent an appropriate mix of elements necessary for overall improvement in applied research. In AID jargon, what began as a "project" apppears to have taken on many characteristics of a "program".

2. Narrow Scope for Management Choice: The Phase II project design evolved from the explorations made in Phase I. The R&D portions followed the Egyptian practice of fixing specific budget amounts in detail and this was perceived by the R&D managers as limiting the flexibility of management decisions. The input services portions were fully committed to individual contracts and that was also perceived as being inflexible. An additional problem arose in that Egyptian scientists and administrators saw themselves as frustrated by AID rules and regulations and by the AID bureaucracy. While each of these perceptions is partially true none are, of course, entirely accurate yet they are the perceptions upon which actions were taken (or not taken). When this was compounded by the need to follow Egyptian constraints, difficult in themselves, both scientists and administrators were faced with a very difficult problem of learning to cope with the realities of the situation under trying and unaccustomed circumstances. As a result the project design, a joint Egyptian/U.S. effort, did not provide the scientists and managers the fullest possible opportunity to exercise R&D management funtions and to make choices involving the exercise of these functions and to use the project as a "laboratory" for testing and developing management skills. The tight structuring of the relationships between the budgets for project components and the budgets of the five contractors led the Egyptian managers to limit the possibilities for mid-course corrections requiring judgment, internal compromise, decision and action. Conversely this tight structuring certanly permitted, and possibly encouraged, the Egyptians to go to the AID Mission and the JCC to make decisions on matters which should properly have been resolved within the counterpart organizations. This ran counter to the stated purpose of the project.

3. Emphasis on the "Supply" Side of S&T: The Phase II project paper places emphasis on "the 'supply' side of S&T, i.e., on improving the skills, reputation and marketability of the research community." This emphasis may have been appropriate during Phase I of the project. During Phase II, it conflicted with the aim of orienting applied research toward the "end-user" (the "demand" side) which requires: (1) a careful consideration, at the beginning of research, of the relationships between the possible technology and end-user (e.g., industry), program strategies, the probable investment/expenditure decisions by the industry and the development agency or other organization which would eventually apply the research product or technology to a development problem; and (2) engaging researchers actively in helping industries and development agencies to redefine development problems into researchable problems, and only then organizing the necessary skills and resources to tackle the research problem. Red Sea Fisheries, for example, appears to have little or no end-user orientation.

There is very great difference between marketing a research product or technology at the end of a research process designed mainly to prove Egyptian capabilities to do applied research in selected areas, and assessing the implications for marketing the product or technology at the beginning and during the research process or involving the user or sponsor early in the project conception and design stage. The experience of the first three years of Phase II has brought this difference into sharper focus. While there was an initial effort to develop a marketing function, the team found no evidence that the Academy and the NRC were able to provide research managers and staffs with the analytical services and guidance within the project (referred to as "techno-economic" analysis) to support a change in designing research by emphasizing "end-use" at the beginning. A similar problem has affected the S&T information system. At the time of the evaluation, the information user "nodes" (the "demand side") had not yet been activated.

The above design elements have been and will probably continue to be a deterrent to improved performance, and are impediments to the achievement of the output and purpose of the project. The team has recommended some actions during the final years of the project to ease these constraints without redesigning the project (Part I).

## Overall Project Management

In order to assess the management of the project and its implications for the achievement of project outputs and purpose, the evaluation team extended the framework of its investigation and analysis (to the extent that time permitted) to the larger organizational context in which the project is being carried out. This approach also enabled the team to obtain a general impression of how the project related to overall management resources in the Academy and NRC.

The project has six major components, and involves fifteen participating Egyptian institutions (of which four have major roles) and five principal U.S. contractors. The Joint Consultative Committee of five U.S. and five Egyptian scientists provide guidance and recommendations to the President of the Academy during meetings held every six months, alternately in Egypt and the U.S.

A feature of the project, on both the Egyptian and U.S. side, is that the same individuals have played key roles (in some cases more than one role) in managing the project during the three years since Phase II started, and even during the years of Phase I. This has provided a sense of continuity and stability in management. On the other hand, it is also clear that the Academy has not succeeded in recruiting new experienced staff needed to carry out adequately several important management functions called for in Phase II. Given Egypt's public personnel system and the exclusively academic criteria for staff promotion in S&T institutions, it has turned out to be unrealistic to expect the Academy to obtain full-time managers from outside or inside the Academy and its associated institutes. Until more fundamental remedies to this problem can be designed, the most that can be expected is a more deliberate use of part-time or rotational assignment of scientists and engineers to management functions. Future management structure development and training programs should experiment with more imaginative ways of taking these constraints into account.

Management at the Executive Level

Responsibility for overall policy and management, for all project components, rests with the President of the ASRT. A program coordinator manages ongoing operations and monitors progress. The President makes major policy and program decisions (and many minor decisions as well) after consultation with the JCC and discussions with the program coordinator, directors of participating institutes, and the principal investigators or chairmen of steering committees of the respective R&D and Demonstration activities being carried out under the project.

Although a management system for the project exists and can be located in organizational form in the Academy, it does not fully represent the manner in which decisions are made and subsequently transmitted to individuals and groups. Decision-making is highly centralized, relatively little authority is delegated and individuals at various levels tend to retain firm control over their assigned responsibilities and the information pertaining to the exercise of those responsibilities. These features are by no means unique to the Academy, but are widely characterstic of Egyptian organizational and management styles. These characteristics heighten the risk that, without continuous attention, problems and trends can develop, their correction ultimately requiring a kind of crisis management.

Another observable aspect of executive management is the absence of stable and widely understood criteria (other than those of personal relationship and trust) upon which the President can rely in making decisions on performance and progress. The management burdens placed on the Academy by the project were fairly new ones, and the Academy is itself a young institution (1972). Although the Academy's mandate has always involved it in some direct management of research programs, a second, more familiar role is that of a broker, or grant institution--an intermediary between research sponsors and research institutions. Not surprisingly, the kinds of detailed internal policies and criteria useful as reference points in making decisions or establishing program guidance have not been fully developed and published. This situation stands in marked contrast to the forceful and articulate

espousal by the Academy of the general policy that sponsored research must be applied to national development needs and must eventually be marketed to development agencies.

The above conditions help explain the role into which the JCC has been cast during Phase II, as directly observed by the evaluation team and verified through a review of reports extending back into Phase I. Essentially, the JCC twice a year performs management functions which should be performed within the Academy's internal management system in a more continuous manner.

The JCC does not focus exclusively, or even primarily, on the expected functions of providing a forum for bringing to the Academy scientific and technological support, advice and broad perspectives on the project and the role of the project within the larger S&T community. Almost by default, and possibly because the JCC is not an independent body advisory to the President of the Academy but rather a body chaired by him, the JCC has come to assume a substantial role in project management, extending to such matters as budget reallocations, procurement of specific equipment, etc. The terms of the relationship between the JCC and the Academy were unclear to the evaluation team. The JCC had no firm basis for resisting the deepening of its involvement in management concerns, while at the same time it had no solid grounds for insisting that its recommendations be adopted and carried out.

Both the President and the JCC appear to be well-informed on the progress of the project, the latter within the limitations set by twice-a-year meetings. During the meetings, Egyptian participants and U.S. contractors report on their activities, and important problems are addressed or assigned, as appropriate, to task forces for the preparation of recommendations. These meetings provide very useful mutual opportunities to recapitulate progress and to reconfirm the purpose of the project.

The conditions described above have had some effect on implementation progress by encouraging a postponement of problem resolution and action until the JCC meets semi-annually. They may also have relieved the perceived necessity to institutionalize some management functions in the Academy, which in turn delays the ability of the NAS contractor to implement that portion of the contract designed to carry out an R&D management improvement program. The above conditions are less of a handicap to implementation, however, than they are to the ultimate R&D management improvement purpose of the project.

The evaluation team considers that early in the project U.S. decision-makers and Egyptian administrators were not sufficiently convinced of one central fact about R&D management. This fact is that certain basic R&D management approaches, procedures and administrative functions are imperative, especially if an R&D institution is trying to obtain solutions to development problems within tight fiscal, skill and time constraints. The most important requirement is the one that requires applied researchers to identify and have an in-depth understanding of the problem, and to design and carry out the research in close collaboration with the industry, development agency, or group which will actually have to invest in and "market" the resulting product or technology (through widespread application, production or extension). Having an improved capability to solve research problems, with some general idea of end-users or development in mind, is an important step, but it is not



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a sufficient condition. The conviction that this approach to management is important now appears to exist.

The pharmaceutical chemicals project can be used as a case example for a possible future design. Thus, following the spirit of the approached proposed in this report, future efforts would be constructed:

(a) so as to be congruent and contributory to industry strategies in a near-term perspective, e.g., assisting and supporting their efforts to identify and transfer technology for quick impact;

(b) to support longer term indigenous growth through collaborative R&D projects with and in industry. Such efforts strengthen capacity and industry motivation to adopt and sustain the production of locally developed products while providing, at the same time, the personnel and facilities environment conducive to pilot testing and scale-up production programs (this is especially important where companies are trying to build up their own technical capacity); and

(c) to provide a complementary technology feeding and service function at the laboratory level that will sustain a healthy developing industry.

The project so far has focused on laboratory based development as a strategy to push towards achieving industry support and, thereby, reduce the need for technology transfer. This was probably appropriate as a ground level start-up strategy, but the trend should now be toward a more complete and balanced approach, with ASRT/NRC playing the "corporate" laboratory role viz-a-viz the operating companies, acting as a window and a link to technology as well as a primary technology source.

If the Academy is willing to commit itself to a program of improving selected R&D management capacity during the remaining two years of the project, building on the notable accomplishments already achieved, the evaluation team believes that the Applied Science and Technology Research project will contribute substantially to enabling Egypt's S&T community to develop and manage research to solve priority development problems.

## Operational Level Management

A program coordinator manages the project directly from the Academy, assisted by four technical officers who have monitored responsibilities over assigned subproject activities (see Appendix E). The coordinator has responsibility over local project costs granted to the Academy, such as the incentive fund and the fund for local materials and supplies. Although most of the R&D and Demonstration activities being carried out under the project involve scientists and engineers in the NRC, the activities are not governed by the NRC's own management and control system. Liaison between the Academy and the NRC is maintained through a technical office in the latter institution.

To assist the implementation of subproject activities and, more important, to established a firm functional basis to assist the future selection, design

and monitoring of new research activities, the NRC was to have established four support units to carry out the management functions of programming, techno-economic analysis, contracting and marketing studies. In a parallel effort, the Academy was to have received support from short-term specialists in policy, planning, evaluation, techno-economic analysis, and technology assessment. Some of the units were made conditions precedent to Phase II. The team found that, in the NRC, two of the envisioned functions are being carried out on a part-time basis. In any event, the removal of the AID-supported R&D and Demonstration activities from the management jurisdiction of the NRC sharply reduced the program motivation and incentive funds for establishing the management units.

Corresponding units have not yet been established in the Academy. However, the nucleus of a management system, to include functions of planning, coordination, financial controls, and marketing, are being created in the Academy to support implementation of the new "Five Year Plan of the Specific Councils, 1983-1987". The units ("sectors") are not yet fully manned, and their development has not received support from short-term specialists through the project (see Appendix E).

The evaluation team believes that the functions of planning, techno-economic analysis, and evaluation will assume greater importance in the future if the Academy is to make an impact on Egypt's development needs through the Five Year Plan. Techno-economic analysis at the predesign stage of applied research is particularly important, and currently lacks institutional support.

Monitoring by the coordinator covers all components of the project, with the notable exceptions of the S&T information system and the policy studies. Reporting on progress peaks twice a year in anticipation of the JCC meetings. Although more continuous monitoring is carried out (e.g., through attendance at regular meetings of steering committees), it is limited by the fact that the monitors, like the coordinator, have other more basic responsibilities. Again, management is centralized. No meetings have been convened of all principal investigators of the R&D and Demonstration activities outside the JCC to discuss common problems or resolve issues.

The program coordinator (as the title implies) is indeed more a coordinator of established, ongoing activities than a manager responsible for directing resources efficiently toward the achievement of project objectives. These activities are linked to U.S. contracts and PASAs governed by AID regulations over which the Academy perceives (correctly) it has no direct budgetary control. Once the R&D and Demonstration activities are reviewed and approved in the JCC, they are monitored as fairly fixed activities with fixed budgets. (Not all these activities have detailed implementation plans necessary for adequate monitoring.) In the case of the fund for local materials and supplies, the coordinator's hands seem largely tied by a conflict between the regulations of AID and the laws of Egypt. The principal areas left for the exercise of managerial judgment have been the selection of candidates for training and the important function of allocating incentive funds. During the remaining two years of the project, however, the need to reallocate remaining funds will present a major challenge to the project coordination unit of the Academy.

Since operational management of the project seemed to be constrained by the design of the project itself, the evaluation team could not assess the strengths and weaknesses of the centralized management style. Once again, the degree of management centralization may be less of a problem than the absence of clear and widely understood criteria on which to make judgments and decisions regarding performance of the individual activities being monitored. Unfortunately, since they were for selection purposes only, the criteria set forth in the project paper for the initial selection of applied research activities (see Project Paper) are not fully applicable to making judgments on progress and performance during the research. (The selection criteria would be applicable if a research activity strays seriously away from its original purpose; none of the activities under the project has done so).

The apparent difficulties faced by the Academy in trying to decide whether and how to terminate the research activity on New Crops for Arid Lands were in part the result of the lack of clear internal policies and criteria governing performances and progress against reasonable time-tables. This same lack is posing similar difficulties as the Academy tries to reach a decision on reallocation of budgeted funds between contending research activities in various stages of implementation and equipment procurement.

Technical Level Management

Seven specific R&D and Demonstration activities supported by the project were at various stages of implementation and completion at the time of the evaluation: More and Better Food, Biogas, Corrosion, Wool Wax, Bentonites, Phosphates, and Pharmaceuticals. One new research activity, an evaluation of Egypt's experience in land reclamation projects to be conducted by the Academy, was being considered in place of the original New Crops for Arid Lands.

These research and demonstration activities were to play an important role in the project as vehicles, or "laboratories", for developing and demonstrating technical capacities and management skills in applied research. They were regarded by the designers of the Applied S&T research project as one crucial element in the process of institutional change helping to shape the understanding by researchers of the nature of research applied to development needs and its management requirements. The research activities funded under the project were selected because they presented opportunities to develop and demonstrate R&D management skills in several contexts--in industry, agriculture and health; to engage for the first time in multidisciplinary applied research; to forge a stronger link between research in the laboratory and research in the field or the industrial site; and to solve applied research problems within specified periods of time.

The evaluation team found that most principal investigators and research staffs understood this purpose in general terms. Naturally, their main interest centered on their research activities per se; for those whose research was completed or nearing completion, the issue was "where do we go from here?". In several instances, the problem of late equipment procurement was uppermost, especially when the next stage of the research depended on expected equipment or supplies, but generally because the new equipment was seen as contributing to an overall upgrading in their research capability.

In terms of some straightforward R&D management criteria, the R&D and Demonstration projects showed a very wide range. As to the criterion regarding linkages with end-users, particularly institutionalized end-users having resources to apply or extend the new technology, there was also a very wide range. Some principal investigators worked directly at an industrial site as well as in the lab; in the case of the More and Better Food project, there was close interaction with the farmer, but less with the Ministry having extension responsibilities; the Biogas project, while successful, was unlikely to be taken up soon by village households for social and economic reasons; Phosphate Research continued without sufficient knowledge of the very substantial investments that would be required for actual large-scale production. As to the criterion of being able to begin and/or complete the research within some specified time frame, the experience was again mixed, as was that for internal project monitoring. Some employed fairly rigorous management techniques; others had only a very general implementation plan. Whether the project was managed by a steering committee (in the case of multidisciplinary research) or by a single principal investigator did not appear to account in an appreciable way for this variation. (See Appendix F for an illustrative history of one industrial project.)

Those interviewed reported that they had learned a great deal from this experience (for many, simply working outside the laboratory in farmer's fields or industrial locations had clearly been a novel and exciting experience), and the "end-user" issue was a very active topic. The team believes that the experience gained could have been magnified if there had been a closer relationship established (outside the JCC forum) between all research staff under the Appled S&T Research project, and between them and researchers engaged in related work in other Egyptian institutions. There was relatively little contact between these projects, little between the research and demonstration projects and much less between them and other project components.

The evaluation team understood that when most of the research activities had been selected and approved in the JCC during Phase I, the issue of ultimate end-use was not as prominent as it came to be during Phase II. In Phase I, the perceived problem was one of taking available research skills, providing technical support and equipment, and getting to work on applied research problems having a more or less direct link to a development problem or a need of an industry. The research would be "successful" if it proved that Egyptian could carry out such research. The "marketing" could be left to the end, and the cost implication of eventual production or extension was not seen as a factor guiding the research or demonstration. This has caused some anguish as the researchers search for sponsors to take up or extend the research results.

It is unfortunate, therefore, that the research staff had to proceed without the support planned in Phase II in research programming, techno-economics and marketing. It is even more unfortunate that, outside the JCC, no system is operating to gather and synthesize the "lessons learned" from this initial experience in order to influence policy, to introduce the experience into training programs, and to disseminate the lessons to the larger S&T community.

There was considerable variation as well in the responsiveness of technical management to the problem of preparing specifications for equipment when it became apparent, as early as Phase I, that incomplete specifications were contributing to procurement delays. This initial problem was aggravated by the lack of priorities for equipment delivery and by changes in priorities but remains as one area in which creative adaptation might have improved the situation.

AID Management

The team learned of no AID management problems serious enough to handicap the implementation of the project. The project, however, has placed a heavy management burden on the Mission. In the absence of a contracted overall coordinator on the U.S. side to work with the counterpart institution in managing and integrating all project components, this role was played by the project manager in the Mission. All the participants interviewed agreed that this role has been played in an outstanding manner, especially given the complexity of the project, and the project design features which tended (as with the JCC) to push an unwanted decision-making role into AID. The project manager too was caught in the same rigidities in the project design and felt the day-to-day operational effects of the attempt in the project design to put into a tight framework (and one closely governed by AID regulations) an R&D activity which by its nature requires experimentation and a certain flexibility.

The AID Mission will need to come to grips with the question of when its development strategy should support an effort to institutionalize an R&D management system and related capacity in ASRT and NRC, as distinct from a program of improvements. Once a decision is made, the Mission will have to convey its position to the Academy.

The team noted two fairly significant instances of missed communication between the project manager and the counterpart institution. The first dealt with an understanding regarding one of the criteria for use of the fund for local materials and supplies. The second dealt with an apparent lack of understanding on the part of the Egyptians of AID rules and regulations governing the possibilities for moving funds and resources within and between contracts as these relate to possible reallocation between the R&D and Demonstration activity budgets. The Egyptian view of such possibilities has been much more limited than is actually the case and this misunderstanding may have added unnecessarily to a sense of being in a "straight jacket". So long as each principal investigator insisted on having "his own budget" (although these were only estimates), the problem of competition for resources took the form of a search for additional funds. As the Applied S&T Research project nears its termination date, the issue has more clearly become one of reallocation between budgets, and the team believes AID should take an active role in assisting the ASRT to understand both the opportunities for and limitations on such reallocations within the terms of the basic Project Agreement.

## PART III

### Role of American Contractors

The components of the project are implemented or assisted by five principal U.S. contractors. In two instances, responsibilities overlap. In the first such instance, the University of Wisconsin and the National Institutes of Health are each to play a role in institutionalizing an instrumentation procurement/repair/maintenance system at STI. In the second, the University of Wisconsin has the responsibility for equipment purchases relating to the activities of several of the other contractors. Three of the five contractors have an "institutionalization" responsibility--that is, providing the necessary resources to enable the counterpart organization to become self-sustaining upon expiration of the contract. This process was not yet fully underway and in the case of Georgia Tech, barely started.

The team reaffirms from the experience of all contractors the importance of having full-time contractor representatives in-country.

### National Academy of Sciences (NAS)

NAS responsibilities under the project cover a wide range of activities roughly grouped as: those relating to the JCC, the functions of the Resident Director, providing consultant teams and staff training and some general guidance and support for the technical subprojects. In general NAS has complied with the letter of the contract and much of the work has been performed in exemplary fashion.

Since the NAS contract is due to be terminated or extended in May 1984, the evaluation team has looked in detail at the current situation at the ASRT and NRC relative to NAS participation. As the project moved from Phase I to Phase II, a distinct change of method appears to have been in order. Phase I appears as a "design" phase and Phase II an "operational" phase. In this operational phase ASRT has set the limits for the interaction with NAS based on ASRT perceptions of worthwhile activities and NAS has largely accepted these limits as realistic. It is the sense of the evaluation team that the NAS performed well within the ASRT limits but that this restricted the benefits which should have been obtained.

A primary concern of the evaluation team has been a search for those areas where the capacity for R&D management has been strengthened or, conversely, not strengthened. In looking at ASRT the team saw a lack of understanding and capability in functional support areas and judged a major need to be the strengthening of the basic functions of R&D management. (See Appendix D.) The first step which has shown some progress is the developing of the understanding and appreciation of the need for such functions, and the follow-on is the assistance in carrying out the activity. NAS attempted to assist nascent development of these functions at ASRT and NRC early in the contract and the joint effort met such problems as personnel structure, salaries and professional "image". To have been within the "operational" mode of Phase II the evaluation team considers that NAS should have alerted top

ASRT management, the JCC and USAID to the importance of this effort and to its problems at that time and continued to press for further action.

The team considers it imperative that, during the time remaining, the project make available to ASRT, and ASRT utilize, the resources necessary to understand and develop these functions, in keeping with an expressed interest by the President of ASRT. This will require the services of an organization which has considerable experience in the actual management of R&D efforts and a sensitivity to the dynamic process of installing management change in this field. The team believes that NAS should make an initial approach to ASRT, but that for implementation NAS should subcontract the actual effort, working closely with ASRT on design, scope of work and controls. While this is within their present contractual scope of work it does amount to a major change in approach. It may require additional financing although present unexpended or uncommitted funds are available within the contract budget.

The team considered the following factors to be important: (1) Under an overall plan the development of various functions should include specialists to provide support services but most especially, at this time, create an operational knowledge of the management functions and of their value to working level research efforts and research workers. (2) Initially the focus should be on the ASRT's implementation of the S&T five-year plan with a gradual shift to the development of routine research and development procedures and capabilities. (3) ASRT and NRC should be encouraged to develop a training-of-trainers effort and a continuous staff training program supported by bibliographic and training materials, primarily oriented to use of Egyptian staff and minimizing U.S. input over time. (4) The emphasis on training should shift to an "Egyptian" content and to local training in Egypt, with U.S. training only to support that emphasis. (5) While every resource should be made available the thrust should be as an ASRT effort under ASRT control and direction with ASRT assuming action responsibility.

The team views the above efforts as crucial to the further development of ASRT as representing the R&D "community." Progress in this direction is seen as indicative of administrative and technical capability and would be one clear indicator of ASRT's ability to attract support from end-users, whether public or private sector or international donor.

## University of Wisconsin

The University of Wisconsin is responsible for handling the procurement of almost all the equipment and supplies provided for all components under the project. Since the beginning of the project, procurement has presented the single most frustrating problem and continues to be an issue. The contract (a "best effort" contract) was due to expire in June 1984, and there was no expectation that all planned equipment would be purchased much less installed in Egypt by that time, given change in specifications, extended delivery on custom made equipment, delays in shipment, problems in Egyptian customs, etc.

The team's examination of the causes of the delay indicated, once again, problems in project design; a root cause of the difficulties was the use of estimated budgets for equipment by the Egyptians, and the design of the

University of Wisconsin contract around those estimates. The contract provisions made no allowance for the likely need of a R&D effort for some flexibility and occasional changes in either particular pieces of equipment or in priorities as the research proceeded. When estimates prove to be invalid or priorities change or equipment requests are incomplete, there is an additional delay. A far more serious problem arises when the delay in delivery and installation of equipment (anywhere from 100 to 500 days from the time of order) holds up the research.

The team concluded that, although by the time of the evaluation a number of lessons had been learned regarding procurement problems, this "learning curve" has been very flat, and that University of Wisconsin has been slow in responding to some persistent problems in attempting to find partial solutions to others and in alerting AID to both the problems and possible remedies which would have reduced the level of frustration and assisted Egyptian scientists in learning more of the practices and pitfalls of procuring scientific equipment (at least from the United States).

In the manner of delivering contracted services, the University of Wisconsin contractor has remedied some of the serious flaws which affected the success of the procurement effort during Phase I. Other problems (e.g., the time involved in securing waivers to purchase) are simply unchangeable. However, more rapid action could have been taken to help scientists in developing their equipment specifications and to establish a system of priorities which continuously reflected the most urgent requirements from the Egyptian perspective. The Egyptian program coordinating unit could have been brought more actively into such an effort to manage the procurement process more effectively. Many such problems, as well as the difficulties involved in expediting shipments through customs, may have been overcome by the appointment of a local representative.

The team has concluded that further improvement would require a major reconstruction of both the Egyptian budgets and the University of Wisconson contract. Short of that, a strong effort should be made to incorporate the lessons learned into the structuring of the new procurement/maintenance/repair system at STI, giving special attention to the possibility of a subsystem that would facilitate rapid response to small orders for supplies or minor equipment.

National Institutes of Health

The National Institutes of Health (NIH) contractor implements a training program that supports an improved procurement/maintenance/repair system in STI (as well as several universities). This contract is to be renewed to October 1984, and the team did not identify any problems likely to delay the NIH implementation schedule.

Maintenance and repair is a continuing problem because of the difficulty in retaining qualified persons once they have received their training, and in recruiting for training, and subsequently retaining, electronics engineers in particular. Almost all those who were trained in Phase I for maintenance and repair left their project related jobs.

It was too early to judge the results of the Phase II effort, since the first course for electronics maintenance and repair had just been completed. However, a deliberate effort is being made in Phase II to select (as trainers and trainees) somewhat older engineers who have invested more time and have a stake in their positions in research institutions in Egypt. The team felt that a similar model should be extended to selecting participants from universities to participate in the program by a more vigorous search for older technicians (as distinct from engineers) with more advanced training and equivalent stakes in their university ("administrative") positions.

This program does not fully address the matter of maintenance and repair of much of the equipment purchased under the project. This issue, as well as the relative success of the training model being applied, should be evaluated a year after the contract expires.

National Bureau of Standards

The NBS has overall responsibility for providing technical assistance to the Egyptian National Institute of Standards (NIS) and the Egyptian Organization for Standardization and Quality Control (EOS) in three areas: (1) providing short term U.S. consultants and trainers; (2) participant training of Egyptians in U.S. and in-country; (3) assist in preparing specifications for procurement of essential goods and materials.

After review of documentary material from USAID files and a series of discussions with contractor and project-related personnel, the evaluation team considers this element of the project to be progressing smoothly and according to schedule with every expectation of completing its outputs on time and in a satisfactory fashion. Adaptive procedures along the way in meeting problems in standards and measurements indicate a realistic response to the development needs of NIS and EOS as they surface and suggests that no significant change in the operation of this project element is called for.

Georgia Institute of Technology

Georgia Tech is responsible to provide technical assistance to the ASRT Scientific and Technological Information Center (ASRT/STI) in strategic planning and in development of action proposals for systemwide activities and to perform certain specific tasks related to: staff training, system installation and management, data base establishment, employment of an Egyptian technical group and provision for a Project Manager.

The evaluation team has reviewed the USAID files and correspondence, has discussed this project element with U.S. and Egyptian contract personnel, ASRT and USAID officials and has observed the discussions of this element during the JCC meeting in Cairo in November. It is clear that this is a complicated and sensitive portion of the project. The team will not presume to express a major judgment of the factors involved, but instead will call attention to those of the factors within the grasp of this review and discussion: (1) the information network is highly "supply" driven with much emphasis on the comprehensiveness of the design and relatively little emphasis to date on the

real or perceived needs of actual uses in the Egyptian scientific and technical community. The team believes that the emphasis during the remaining portion of the contract should shift toward user needs; (2) the responsibilities of the contract team to coordinate with other project elements and with other projects seems clearly stated in the contract and should also receive additional emphasis as "user-elements"; and (3) it is clear that the system will not be installed and tested-in-practice by the present termination date in 1985. Therefore, the team recommends a one-year extension of this project element to 1986. The team suggests that this component should be evaluated at the end of 1984 and 1985.

One action which appears critical at this point is the establishment of the information nodes, and the team recommends a review of the original selection of their location, with the rationale, and that the required agreements with each node be expedited as a first priority.

## PART IV

### Policy Studies

The project has achieved an impressive level of success in helping launch a national technology policy process. The subject has begun to be part of the national agenda. Top GOE leaders, including those at the very highest levels, have come to a point where they appear willing to be associated with a technology policy thrust and they have expressed themselves on this matter in most supportive ways. Large numbers of people prestigious in Egypt's S&T community have become involved in technology policy deliberations and areas of focus and consensus have been identified. This positive picture is somewhat mitigated by the low involvement of some key groups and of younger members of the S&T community, but the assistance provided through the project facilitated the emergence of an activity that could eventually have impact on national thinking and priorities with respect to S&T. The development by ASRT of the S&T five year plan, while not a specific activity of the policy studies unit of this project, was clearly an associated endeavor and a noteworthy one at that. While further steps may be needed to develop the document into a fully-scoped plan and to put it into forms suitable for communication to its several audiencies (Egyptian and U.S.), this is a valuable first step and the Academy is to be congratulated.

While AID's investment in the policy studies undertaking has been significant, its substantive role has been quite modest; i.e., essentially limited to enabling meetings to take place and covering paper preparation and conference costs. This limited role resulted from a deliberate decision by Egyptian counterparts to make this exercise a purely indigenous effort. External input of any kind and from any source was largely eschewed. These inputs could have included the services of U.S. experts who were available to be brought in as an important element of the project under the planned $250,000 budget. Instead a considerable part of this budget was devoted to covering the efforts of many Egyptian participants who prepared commissioned papers on a variety of technology policy topics. While understandable, and in a primary sense justifiable, this shift had the consequence of limiting the views of technology policy designed by key Egyptian participants. These views were defined largely from a generation of UN and certain "anti-dependencia" and state directed perspectives (primarily from Indian and Brazilian models) whose currency has already begun to fade even in those circles. The possibility of a debate among perspectives that included those from the U.S. and even from some recent Indian and South-East Asian thinking was lost.

The commissioned papers were clearly useful in generating and substantiating involvement and this was certainly important in a first effort. The main substantive contribution (with the exception of the five-year plan) has been of this process nature. It is less obvious to this point that the endeavour has laid down the fundamentals of a technology policy.

Following a U.S. view of technology policy, as implied in the project paper's plans, the emphasis would have been on the examination of specific technology policy issues and mechanisms. This would have made field and practice experience a key informational input--what are the problems and

opportunities, what do we know about the positive and negative aspects of alternative solutions, what would work well for Egypt? The outcome would have been guidelines and approaches relevant to various issues, i.e., a variety of policies only loosely linked to a general political perspective. This approach was clearly not followed. It is at this point that the team sees the U.S. and Egyptian differences in perspective surface on technology policy.

An alternative model, more characteristic of countries pursuing centrally planned technology strategies (as in France and various other developed and developing countries) was adopted, however. The National Five Year Plan provided a congruent context for such an endeavour.

The deliberations and papers are not focused on the former perspective and, in total, they are still far from defining the Egyptian approach to technology policy--certainly well short of what would be viewed as a sound basis for legislation. The policy issue for AID is to decide whether it is appropriate to support further an approach to a technology policy of the genre that in fact emerged despite the original project paper design, and one that is viewed by some with misgivings as not being helpful--perhaps even counter-productive to development.

With respect to the continuing steps, it is the conclusion of the evaluation team that it would not be useful or appropriate for AID to attempt to persuade the Egyptian scientists and policy makers to follow an alternative technology policy approach for the remainder of the project. The key Egyptian personnel involved in this endeavour must develop this activity as a continuous process themselves and in their own way, nor should they become encumbered by projects or institutions with strong ties to U.S. thinking. With U.S. technology policy perspectives and approaches so different from those emerging on the Egyptian side, any other approach would serve only to generate an unproductive tension. Relatedly, the general policy perspective formulation process cannot be viewed as a step that has been completed, with attention now being transferred to implementation; rather the process should be an evolving one.

While it is recognized that AID may need to engage in further internal discussion and study of this profound and sensitive issue, the team recommends that no further general AID support be provided for this activity, nor should AID agree to support the establishment of a general technology policy institute should one be proposed. AID should, however, be responsive to requests for assistance to support the strengthening of capacity to deal with specific technology policy elements (e.g., technology transfer) or perform certain technical functions related to technology policy processes (e.g., technology forecasting, technology monitoring), or carry out projects devoted to improved data collection on program activities and resources. Insofar as such endeavors are to be supported through training or even institution building, these could be incorporated within the R&D management capacity building mission of ASRT and NAS. AID should also be responsive to requests to support investigations of the experience of other nations with technology policies. In all cases, however, support should be based on specific proposals that indicate the rationale for the policy element or study, the procedures to be followed, the information sources to be used, the output being sought and the implementation strategy, as appropriate.

Technology policy in this project was defined in national terms. There are policy implications at the institutional level (within ASRT, for example, and technology forecasting would again be an example) that should also be considered. At this level the team has no hesitation in calling for continued support, again as part of the ASRT/NAS R&D management capacity building effort.

In this context ASRT could play an important role in bridging the technology/national policy gulf to be found everywhere by providing a legitimate source of information and understanding on technology imperatives and issues. NRC's programs could be used as a pilot basis for such an effort. The public technology information and understanding development role is another appropriate one for the Academy. This topic is referred to again in Appendix D on R&D management.

## The Academy of Scientific Research and Technology

The Academy of Scientific Research and Technology was established in 1971 by the GOE as being the responsible body for science and technology in Egypt having the following functions:

1. To support scientific research directed towards solving problems of national interest or priority;

2. To encourage the application of modern technology in areas included in the national programmes of economic and social development;

3. To formulate policies that ensure strong linkages at a national level between scientific and technological organizations, within the frame of the principal trends of the scientific and technological research which serve the national development plans;

4. To coordinate the major research projects affecting the national economic and social plans that have been put forward by the various institutes or departments;

5. To participate in the study of the scientific and technological aspects of the major development projects, and when necessary to recommend the establishment of new research institutes;

6. To encourage basic research as a means of building up human research resources and to support research schools working in modern fields of science;

7. To disseminate information concerning the potentialities of international modern technologies;

8. To participate in the development of science curricula;

9. To organize incentives for scientific workers;

10. To organize scientific publishing and the popularization of science;

11. To support scientific societies and to encourage and participate in convening of scientific conferences; and

12. To develop international relations.

# APPENDIX B

## LOGICAL FRAMEWORK (LOGFRAME)

Project Title and Number: Applied Science & Technology (263-0016) Phase II

From FY 1980 to FY 1983
Total U.S. Funding $16.3 million
Date Prepared: July 5, 1980

| NARRATIVE SUMMARY | OBJECTIVELY VERIFIABLE INDICATORS | MEANS OF VERIFICATION | IMPORTANT ASSUMPTIONS |
|---|---|---|---|
| Program or Sector Goal: The broader objective to which this project contributes: (A-1) | Measures of Goal Achievement: (A-2) | (A-3) | Assumptions for achieving goal targets: (A-4) |
| • To reorient the scientific and technical research community toward those types of research which are of priority importance and are applicable to solving national development problems. | • Private and public sector organizations working with research community on solution of development problems. | • Examination of number of research activities requested by end-users. | • That GOE will remain committed to reorienting its scientific and technical research community to development concerns. |
| | • Involvement of S&T leaders in the provision of technological inputs to the decision-making process. | • Participation of S&T leaders in decision-making bodies. | |
| | • Increase in Applied R&D being performed at NRC. | • Examination of technical reports. | |

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PROJECT DESIGN SUMMARY - LOGICAL FRAMEWORK

Project Title and Number: Applied Science & Technology (263-0016) Phase II

From FY 1980 to FY 1983
Total U.S. Funding $16.3 million
Date Prepared: July 5, 1980

| NARRATIVE SUMMARY | OBJECTIVELY VERIFIABLE INDICATORS | MEANS OF VERIFICATION | IMPORTANT ASSUMPTIONS |
|---|---|---|---|
| Project Purposes: (B-1) | Conditions that will indicate purpose has been achieved: End-of-Project Status. (B-2) | (B-3) | Assumptions for achieving purpose (B-4) |
| • To improve the institutional capability of the Egyptian S&T community to develop and manage research programs to solve priority development problems. | • Institutionalization of National Policy Measures through which Egyptian S&T research would be linked to national development plans. | • Establishment of a mechanism to develop and implement national S&T policy measures. | • Legislation of national science policy measures will be passed. |
| | • Implementation of effective management systems at ASRT and NRC. | • Site visits to determine establishment of well-staffed management support offices at NRC including marketing, programming, techoeconomics, project coordination, evaluation and implementation. | • Sufficient technically-trained people under th project will remain in NRC to permit purpose achievement through incentive or other means of inducement. |
| | • Establishment of capability to utilize, maintain and repair S&T core equipment necessary to solution of national R&D problems. | • On-site inspection of institutions receiving core equipment and interviews with personnel trained in M&R. | |
| | • Establishment of information network to supply information resources for researchers and policy-makers to make informed decisions concerning all aspects of S&T research. | • Examination of records for degree of utilization of newly acquired information resources in national STI network. | |
| | • Successful R&D and Demo. projects developed, tested and functioning at demonstration site or in end-user facility. | • Site visits; examination of reports; interviews with end-users. | |
| | • Strengthened metrological services and standardized infrastructure to support industrial sectors. | • Site visits; examination of reports; interviews with end-users. | |



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Project Design Summary — Logical Framework

Project Title and Number: Applied Research & Technology (263-0016) Phase II

From FY 1980 to FY 1983

Total U.S. Funding $16.3 million

Date Prepared: July 5, 1980

| NARRATIVE SUMMARY | OBJECTIVELY VERIFIABLE INDICATORS | MEANS OF VERIFICATION | IMPORTANT ASSUMPTIONS |
|---|---|---|---|
| Project Outputs: (C-1) | Magnitude of Outputs: (C-2) | (C-3) | Assumptions for achieving ou (C-4) |
| • National Policy Measures for S&T<br>-S&T policy studies completed<br>-S&T policy measures developed, instituted.<br>-Establishment of effective management systems at ASRT and NRC. | • National Policy Measures for S&T<br>-5 S&T policy studies completed<br>-6 site visits to U.S. by Egyptians.<br>-Development of S&T legislation<br>-Marketing, programming, project implementation and evaluation and technoeconomics division established at NRC<br>-4 to 5 persons trained in S&T management. | • Review of studies; inspection of sites, reports; % increase in number of contracts with end-users.<br>• Enactment of S&T legislation. | • Sufficient GOE staff will be made availabl to support policy studies. |
| • Demonstration Projects<br>-Tested and functioning in the field. | • Demonstration Projects<br>-Field implementation of projects; transfer to the field; information integrated at village level.<br>-3 experimental sites for new crops.<br>-2 biogas demo villages.<br>-5 sites for More & Better Food. | • Site inspections; discussions at village level to establish extent to which demo. projects have been transferred; evaluations. | |
| • R&D Projects<br>-Targeted at critical national development needs completed and results being utilized.<br>-Installation of pilot plants at NRC. | • R&D Projects<br>-6 to 7 completed and results being utilized by end-users in respective industries including<br>-2 pilot plants for food technology.<br>-1 pilot plant-phosphate ore.<br>-1 lab & 1 pilot plant - wool scouring.<br>-1 corrosion lab.<br>-Economic and feasibility studies for Red Sea Fisheries completed. | • R&D project reports; end-user interviews; surveys of adoption of R&D results in respective sectors. | • Demand for R&D subjec reports exists.<br>• Marketing activities are successful enough to attract and inform potential end-users. |



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PROJECT DESIGN SUMMARY: LOGAL FRAMEWORK

Project Title and Number: Applied Science & Technology (263-0016) Phase II

From FY 1980 to FY 1983
Total U.S. Funding $16.3 million
Date Prepared: July 5, 1980

| NARRATIVE SUMMARY | OBJECTIVELY VERIFIABLE INDICATORS | MEANS OF VERIFICATION | IMPORTANT ASSUMPTIONS |
|---|---|---|---|
| Project Outputs: (C-1) | Magnitude of Outputs: (C-2) | (C-3) | Assumptions for achieving outp (C-4) |
| • STI Services<br>-National Info. Network established.<br>-Institutionalization of Info. services.<br>-Courses in STI developed, taught in Egypt.<br>-Improved STI basic collection.<br>-Policy on National Information developed. | • STI Services<br>-Central Info. Service operating in NIDOC.<br>-20 nodes in the STI national network established and operating.<br>-Institutionalization of STI training courses in Egypt.<br>-Marketing service established.<br>-User orientation courses established.<br>-Data base software developed and in place.<br>-Data base searches being performed.<br>-Subscriptions to at least 500 journals available and being utilized.<br>-Cadre of 20 trained specialists working in various information service areas. | • Project files;<br>Records of 20 nodes;<br>Collection inspection;<br>Policy on national information officially enacted by GOE;<br>Evaluation. | |
| • Instrumentation Technology<br>-Core equipment laboratory established at NRC.<br>-Maintenance and repair facilities established at NRC and various sites throughout the country. | • Instrumentation Technology<br>-Establishment of instrumentation laboratory at NRC and M&R facilities at NRC and 3-4 other sites.<br>-Cadre of personnel trained in M&R to staff 3-4 M&R facilities. | • Site visits;<br>Training evaluations;<br>Project reports. | • -Qualified candidates can be found to enter M&R field.<br>-Scientific & Medical Fund instituted at NRC. |
| • Standardization & Measurement<br>-Development of coordinated services in standardization, measurement and quality control to support industrial sectors. | • Strengthen metrological, standardization and quality control infrastructure through upgraded equipment at NIS and EOS.<br>Core of people trained to operate and coordinate NIS and EOS activities. | • Site visits;<br>Training evaluations;<br>Project reports;<br>End-user interviews. | |



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PROJECT DESIGN SUMMARY - LOGICAL FRAMEWORK

Project Title and Number: Applied Science & Technology (263-0016) Phase II

Life of Project: From FY 1980 to FY 1983
Total U.S. Funding $16.3 million
Date Prepared July 5, 1980

| NARRATIVE SUMMARY | OBJECTIVELY VERIFIABLE INDICATORS | MEANS OF VERIFICATION | IMPORTANT ASSUMPTIONS |
|---|---|---|---|
| Project Inputs: (D-1) | Implementation Target (Type and Quantity) (D-2) | (D-3) | Assumptions for providing inputs: (D-4) |
| • Program Planning Management & Control<br>-Equipment<br>-Consultants<br>-Management Services<br>-Training. | • Program Planning Management & Control<br>-Equipment - $57,000<br>-187 pm's of technical assistance in science policy, program planning, management services, R&D marketing,<br>-12 pm's training in program planning & management fields. | • Examination of technical reports.<br>-On-site inspections.<br>-Regular project monitoring and evaluations.<br>(This applies to all inputs) | • GOE will be able to supply incentive payments for LOP so that best qualified candidates can be trained. |
| • Demonstration Projects<br>-Equipment<br>-Consultants.<br>-Training. | • Demonstration Projects<br>-Equipment - $1,580,000<br>-Consultants - 29 pm's<br>-Training - 74 pm's in substantive areas of 3 demo. projects. | | |
| • R&D Projects<br>-Equipment<br>-Consultants<br>-Training. | • R&D Projects<br>-$1,858,000 for 5 ongoing R&D projects and 1-2 new projects<br>-28 pm's technical assistance for same.<br>-73 pm's training for same. | | |
| • STI<br>-Equipment<br>-Consultants<br>-Training. | • STI<br>-$938,000<br>-15 pm's technical assistance<br>-73 pm's training in U.S.<br>-10 courses in Egypt (institutionalization of local capability, including teaching lab)<br>-2 py's visiting faculty from U.S. | | |

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PROJECT DESIGN SUMMARY - LOGICAL FRAMEWORK

Project Title and Number: Applied Science & Technology (263-0016) Phase II

Date of Project: From FY 1980 to FY 1983
Total U.S. Funding $16.3 million
Date Prepared July 5, 1980

| NARRATIVE SUMMARY | OBJECTIVELY VERIFIABLE INDICATORS | MEANS OF VERIFICATION | IMPORTANT ASSUMPTIONS |
|---|---|---|---|
| Project Inputs: (D-1) | Implementation Target (Type and Quantity) (D-2) | (D-3) | Assumptions for providing inputs (D-4) |
| • Instrumentation Technology<br>-Equipment<br>-Consultants<br>-Training. | • Instrumentation Technology<br>-$441,000<br>-32 pm's technical assistance<br>-63 pm's training at various U.S. institutions. | | |
| • Standardization & Measurement<br>-Equipment<br>-Consultants<br>-Training. | • Standardization & Measurement<br>-$750,000<br>-52 pm's technical assistance<br>-147 pm's training in U.S. in standards, measurement, quality control. | | |



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Applied S&T Research Project 263-0016
Evaluation - Scope of Work

A. BACKGROUND

Approved in 1977 and initiated in 1978, the Applied Science and Technology Research Project has pursued the following goal and purpose in two separate phases:

Goal: To reorient the scientific and technical research community toward those types of research which are of priority importance and are applicable to solving national development problems.

Purpose: To improve the institutional capability of the Egyptian S&T community to develop and manage research programs to solve priority development problems.

Phase I of this supply-side S&T project included six basic elements:

1. Policy planning and management of research and development;
2. Demonstration projects, multidisciplinary in scope, directed to high priority areas of economic and social development;
3. R&D projects, directed toward priority problems faced by end-users in agriculture or industry;
4. Scientific and technical information systems;
5. Procurement of scientific instruments and equipment, including improvement of maintenance and repair capabilities; and
6. Planning for Phase II.

In order to help design Phase II of the project, an evaluation of Phase I was conducted in 1980. Its recommendations were built into Phase II, the object of the present evaluation. Phase II was intended to run for three years, with a Project Assistance Completion Date (PACD) of September 30, 1983. In 1982 the PACD was extended an additional two years with no cost or basic design changes, although there was a re-orientation of several elements.

Phase II has the same basic inputs as Phase I:

1. Technical advisory services.
2. Training programs in Egypt and the United States.
3. Commodities.
4. Basic information package.

The two phases differ in their outputs. Most of Phase I activities dealt with start-up tasks, such as subproject design, training and basic equipment procurement. Phase II builds on the accomplishments of Phase I in order to produce the following outputs:

- National Policy Measures for S&T
  - Science and technology policy studies completed
  - S&T policy measures instituted
  - Establishment of effective management systems at ASRT and NRC

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- Demonstration Projects
  - Tested and functioning in the field

- R&D Projects
  - Targeted at critical national development needs completed and being utilized
  - Installation of pilot plants at NRC

- STI Services
  - National Information Network established
  - Institutionalization of information services
  - Courses in STI developed, taught in Egypt
  - Improved STI basic collection
  - Policy on National Information developed

- Instrumentation Technology
  - Core equipment laboratory established at NRC with maintenance and repair facilities established there and at various sites throughout the country.

- Standardization and Measurement
  - Development of coordinated services in standardization, measurement and quality control to support industrial sectors.

There are five U.S. contractors directly responsible to AID for assisting the Egyptian implementing agencies for Phase II:

1. The National Academy of Sciences provides assistance in policy, management, demonstration and R&D activities.

2. The National Institutes of Health provide training assistance in instrumentation technology.

3. The University of Wisconsin, Madison, assists in the management and procurement of scientific equipment and materials.

4. The National Bureau of Standards has responsibility for work on standards and related quality control.

5. Georgia Institute of Technology assists in the establishment of a national scientific and technical information service.

These contractors and the project components are managed by the Mission's Office of Science and Technology (HRDC/ST). Applied S&T is one of a number of both supply and demand-oriented S&T projects supported by USAID. A sector assessment separate from the present evaluation is scheduled for the fall/winter of 1983.

B. PURPOSE OF THIS PROJECT EVALUATION

This evaluation is intended to assist the Academy of Scientific Research and Technology (ASRT) and its institutes, the American contractors, and

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USAID to improve their performance during the final two years of the project in order to ensure achievement of the project outputs and purpose. The evaluation is intended to be a management tool. It will assess performance, identify impediments to improved performance, and recommend action plans to help ensure project success.

This present scope of services does not mandate a specific methodology that the evaluation team should adopt to achieve these tasks. The actual field work will take no more than one week in the U.S. and three in Egypt. (The evaluation team will be assisted by the participating Egyptian agencies, the American contractors, and USAID in providing materials and other background information).

C. SPECIFIC EVALUATION TOPICS

Within the above general requirements, the evaluation team shall give specific attention to the following overlapping topics:

1. Overall project management.
2. Role of American Contractors.
3. Research Capabilities.
4. Policy Studies.
5. Commodities procurement.
6 TRAINING

The evaluation will survey all of these topics during the first half of the field work in light of their contribution to the overall project purpose then the evaluation team will focus in greater depth on those elements considered most amenable to enhancement and improvement of eventual achievements of the project purpose. The bases used in this screening and focusing will be indicated, along with briefer assessments of the topics not identified for more detailed examination.

1. Overall Project Management:

Applied S&T is a multifaceted project involving 11 separate components, 15 participating institutes and 5 U.S. contractors to assist in implementing this project. The project is placed under the overall guidance of the Joint Consultative Committee (JCC) consisting of 5 Egyptian and 5 U.S. senior scientists who provide guidance every six months to the ASRT President on policy planning and overall project management.

The evaluation team is to review the overall management structure and organization at four different levels:

A. Executive level: At this level, the ASRT President makes all the policy decisions after consultation with the JCC members, the overall project manager of the Applied S&T project, the chairman of the different subprojects committees, and the director of the participaing institutions.

The evaluation committee is to assess how decisions are made in this project. By whom? What criteria are used to decide upon project performance and progress? Is the JCC role effective in the decision

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making process? What are channels by which decisions are communicated to the operational and technical level? Who assumes the coordinating role between the different components and elements of this project? How effective is this role? How well informed are the JCC and the ASRT President on the performance and progress of this project?

B. Operational level: The project is centrally managed by the technical office at the ASRT, which is headed by the overall project manager and assisted by four technical officers who have monitoring responsibilities over the research subproject elements, and financial responsibility over all the local project costs granted to ASRT such as the local materials and supplies and the incentive fund. In parallel with this central technical office, there is another technical office at the National Research Center (NRC) which maintain liaison between ASRT and the NRC activities.

The evaluation committee will assess the structure and organization of the overall management of this project, how decisions are made at this level. By whom? Who participates in those decisions and in the performance of day-to-day management of this project? What are the strengths and deficiencies of this centralized management approach adopted by ASRT for this project? What are the lines of coordination and authority of the operational level management with the executive and technical levels?

C. Technical level: Each of the subproject elements is managed by a committee chaired either by the principal investigators or a senior scientist, or the ASRT President. Committees for R&D and demonstration projects are responsible for the day-to-day technical and financial operation of their own subprojects. The committees for policy studies, instrumentation technology and STI are supported and chaired by ASRT President and have a wide range of operational and sometimes executive functions.

The evaluation committee is to assess the role of those committees, their relation to the operational and executive management. What are the strengths and deficiencies in this system and what impact it has had in the implementation of the subprojects? Is there a better approach to restructure the technical management level in such a way that it can play a more effective role in project implementation?

Furthermore, the objective of this project is to develop an indigeneous capability for researchers to be able to manage their own projects and improve their overall management skills through management training programs in the U.S. and Egypt. Also, funds are available on a shared basis for establishing four management support offices, programming, technoeconomics, contracting and marketing.

The evaluation team is to assess the impact of these training programs in strengthening the management structure at ASRT/NRC and evaluate the role of these four offices and their impact on organization, implementation and management of the R&D projects.

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1. Project monitoring level: Project monitoring is conducted by USAID/S&T office in cooperation with NE/TECH/HRST office in AID/W. The evaluation team is to assess the monitoring role and the performance of those two offices in assisting in the implementation of this project.

2. Role of American Contractors: The five Contractors' contributions to project performance are to be assessed. This should include consideration of their implementation plans, how they structure the delivery of their services (particularly with regard to the travel and training of Egyptian participants), problems they have encountered, what exact outputs they have the responsibility to deliver, and the adequacy of their U.S. backstopping, their general administrative, financial, and technical performance.

3. Research Capabilities:

Project 263-0016 consists of 9 subproject research elements, mainly three demonstration projects, 1) More and Better Food, 2) Biogas Technology, 3) New Crops for Arid and Semi Arid Zones and 7 R&D Projects, mainly: 1) Phosphate Ore Utilization, 2) Wool Scouring, 3) Corrosion in petroleum refinery, 4) Development of Red Sea Fisheries, 5) Preparation of selected pharmaceuticals chemicals, 6) Evaluation and investigation of Egyptian bentonites, 7) Food Technology Pilot Plant (this subproject is still pending on the construction of the pilot plant).

These research projects were selected by the JCC in accordance with criteria established in Phase I and stated in Phase II PP on page 37.

The Evaluation will assess: a) The extent at which these subprojects are still relevant to Egyptian national development priorities in Agriculture and Industry; b) The technoeconomic feasibility of these subprojects as well as their user benefits and user applications; c) The impact that these subprojects have on the institutional capability of ASRT and its participating institutes; d) The ability of ASRT/NRC to carry out the subprojects beyond Phase II and without AID financial assistance.

Also, Phase II of this project includes three support systems designed to strengthen the indigenous capability of the Academy and its supporting institutes relating to: a) Instrumentation Maintenance and Repair, b) Scientific and Technical Information Services, c) Standards and Measurements.

The evaluation team is to review the progress made under these three elements, assess the feasibility of completing their activities in the next two years, and the steps taken by ASRT toward institutionalizing and continuing these activities beyond Phase II.

4. Policy Studies:

During Phase II, ASRT has taken the lead in carrying out several policy studies that will deepen understanding of technology policy issues. This activity was to be implemented in close collaboration with U.S. experts who would be commissioned to cooperate on studies of relevant policy issues. Contrary to what was designed, ASRT chose to implement this

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project internally involving U.S. expertise on an as needed basis.

The evaluation team is to assess the progress made by ASRT in defining elements of the technology policy. The team will recommend on what capacity U.S. experts can play a role in this process.

5. Procurement of Commodities: Approximately 60% of the project grant funds are for procurement of commodities (scientific equipment and local materials and supplies). The evaluation is to assess the process by which commodity needs are identified, assessed with respect to project objective, procured, delivered, installed, used, and maintained. Criteria of appropriateness must be developed, along with measures of usage, the effects of usage, and maintenance conditions.

D. REPORTS

Prior to departure from Egypt, the evaluation team will deliver to the Office of S&T a draft report in English that includes, among other features:

1. Executive Summary.

2. Introduction
   -- Purpose of Evaluation
   -- Methodology (any lengthy discussion of methods and techniques should appear as annexes).

3. Findings and Recommendations addressing the five overlapping topics outlined in Section C above. To the extent possible, the recommendations should be assigned priorities according to overall importance and the timing for action to be taken on them. Responsibility for implementing the recommendations also should be noted.

The evaluation team will meet weekly--or more often, as required--with HRDC/ST project officer regarding project methodology and especially the results of the initial screening that is designed to identify topics for more in-depth examination.

E. COMPOSITION OF EVALUATION TEAM, LEVEL OF EFFORT, AND IMPLEMENTATION STRATEGY

The evaluation team will consist of a minimum of four members:

1. Team leader responsible for overall management of the evaluation, preparation of different reports, and liaison with the Mission, participating Egyptian agencies, and contractors. This person will be broadly knowledgeable in the general areas covered by the evaluation, evaluation itself, and management/implementation of AID-funded development projects. Although desirable, it is not necessary for this person to be a scientist or an engineer.

2. Scientist/engineer with more detailed expertise in the technical S&T research areas being developed under this project.

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## R&D Management

The successful planning and management of scientific and technological activities in any environment require that:

(1) a critical mass of informational, fiscal, human and material resources be available;

(2) healthy and creative institutions be built up and maintained;

(3) proper strategies be set and timely decisions and plans be made, accepted and implemented;

(4) necessary R&D activities be effectively conducted, controlled and evaluated; and,

(5) vital linkages within, and transitions to and from practice and other critical external linkages, be developed and maintained.

Further, it must be recognized that these generic management and operational functions must be performed with a continuity and flexibility that reflects R&D's inherent uncertainty, fragility, complex temporal and resource characteristics and its critical dependence on an information rich environment. Vital also are the achievement and sustaining of the highest levels of professional commitment.

The generic requirements and functions must be distinguished from the contextual environment. This refers to the cultural political and economic and developmental conditions that determine how such functions should and could be carried out in the most appropriate, effective and sustaining manner. The central point to be made is that there is a culture of technology and R&D management; i.e., an approach and a practice that is fundamental to successful R&D performance. These generic characteristics will be manifested differently across nations and institutions that vary in their cultures, states of development and fields of endeavor but they apply in every environment.

It was one of the implicit objectives of this project that the ASRT and the NRC be assisted in strengthening their awareness and understanding of the need to build up this R&D management culture. The implementation required that they put in place the functions, processes and practices necessary to permit R&D to be managed effectively in Egypt, both within these institutions and as a model for others. It was even a Condition Precedent for Phase II (see Section 4.5 of the Grant Agreement, August 31, 1980) that "evidence of the establishment of management support offices at the National Research Center and at the ASRT . . ." be furnished to AID. ASRT's letter of July 26, 1981 to AID describes three offices at the Academy (Program Planning and Management, Contracting and Accounting, R&D) and reports on the establishment of four new offices (S&T Marketing, Extension to Production and Services Sector, Management of Foreign Programs, Evaluating of Applied Research). In

addition three NRC research and management offices were mentioned as being in operation (Technical, Programming and Marketing). The NAS was responsible for performing the roles needed to help attain these objectives within ASRT and NRC, for its management personnel level in general and with respect to specific R&D administrative support office functions.

It was the conclusion of the evaluation team that while some progress had been made, relative to the obviously great level of initial need, the improvement has been modest and much remains to be done. The intensity and quality of experience gained by the several score of ASRT and NRC personnel going to the short courses at DRI, MIT and Battelle and the training given at an Egyptian seminar have achieved little more than the creation of some awareness of the need and possibilities of better R&D management approaches and practice. Nor was the selection of personnel to attend the U.S. courses facilitative of the needed build-up of capacity; e.g., the absence of most of the principal investigators from the R&D management training is notable. Even so, the heightening of awareness achieved, especially on the part of a few key persons, together with the ongoing pressures for better procedures and answers that came from the JCC and AID did succeed in generating an encouraging movement over the project period toward better practice and more end-use (marketing) concern. This has created a base upon which building can continue. Based on a standard of reasonable and usual practice, especially compared to other examples of Third World technology development institutions, ASRT and NRC have started to achieve "respectability". This is especially notable given the low state of initial capability.

It is the team's strong assessment that very significant R&D management weaknesses remain to a degree sufficiently serious to threaten the prospects of the ASRT and NRC being able to attain their desired goal of supporting national development through science and technology. Efforts for improvement in the coming period must be far more vigorous and built on an indigenous and contextually relevant foundation. The weaknesses are particularly evident with respect to several of the most vital of the central R&D management functions. Specifically, this refers to the following ten aspects which, while not spelled out in formal project design documentation, must be seen as implicit in any definition of good R&D management practice:

(1) The process of identifying those needs and implementable opportunities for R&D that can be expected to result in developmental impact within acceptable time frames and cost constraints.

(2) The carrying out of techno-economic analyses that consider the full range and timing of requirements, costs and benefits across <u>all</u> stages of R&D; i.e., on to investment practice, implementation, maintenance and improvement.

(3) The maintaining of linkage to intermediate and ultimate users, as appropriate. This is a linkage that goes far beyond the concept of post-development marketing which has been accepted by ASRT and NRC. Rather, it is one that:

- generates "up-front" sponsorship from users;
- involves users in project selection and gives them an opportunity to provide design input;
- builds both user capacity and motivation to adopt, manage and maintain developments in practice;
- can contribute to a self-sustaining user process of adaptation and improvement.

Of all the areas of R&D management shortcoming observed by the evaluation team, these three and most especially the last were seen to be the most pervasive and potentially the most crucial targets for enhancing the indigenous capability of Egyptian applied science and technology. Their lack was manifest in the initiation of virtually every project examined, but some more than others. That there is an issue here has been recognized by the Egyptian managers, but the depth of their response is less clear.

(4) The development of plans and priorities that consider necessary fiscal, skill, support and time resource availabilities, trade-offs, portfolio balances, risk profiles and implementation requirements.

(5) The operational programming, monitoring and control of R&D projects.

(6) Ensuring the proper linkage between those R&D institutions and departments and across those disciplines that should collaborate on projects. Relatedly, the management of both disciplinary and interdisciplinary teams and networks for performing large-scale applied R&D projects must be ensured.

(7) The recognition of the need for and the ability to conduct process, product and ultimate impact evaluations.

(8) The establishment of processes and systems for identifying sources of and obtaining needed technical and environmental information.

(9) The creation of procedures for identifying, scheduling and procuring required technical, material and service resources whether by contract or otherwise; and for working with and managing such contractors and other resource providers.

(10) The creation of a capacity to contribute to national technology policy development processes. This must be achieved by providing policy makers with informed insight on the reality, potential, process characteristics and limitations, requirements and alternatives with respect to R&D strategies and activities. It must also provide them with a proper evaluation of existing technology policy models and experience. Attention must also be given to winning proper support from both policy makers and other influential members of the society. Finally, there must be a harnessing of the sustained commitment of the R&D community.

The above list of ten functions and states is not intended to be exhaustive. It represents only those aspects of R&D management at ASRT and NRC of which the evaluation team became aware and which also seemed in need of substantial strengthening. It is to be reiterated that this is not an unrealistic call for some ideal level of practice but a caution regarding a low level in those functions which could endanger the whole project.

The level of R&D management capacity and of user commitment should be a consideration in future AID decisions to support specific project and program proposals. More pointedly for this project, however, they define a priority for the final project period, most especially for NAS. A much more substantial and creative effort than heretofore is needed to help ASRT and NRC to locate and build up the necessary administrative support functions for R&D management, to assist ASRT and NRC to develop internal policies, criteria, guidelines and procedures that can establish the closest possible linkage between S&T research and the end-user and to provide the management improvement assistance and training that is essential at all levels of these institutions. This must be matched by a much greater responsiveness from the Egyptian side to build this capacity, to tailor the approaches and practices to the local context and to operate to the best level of appropriate practice.

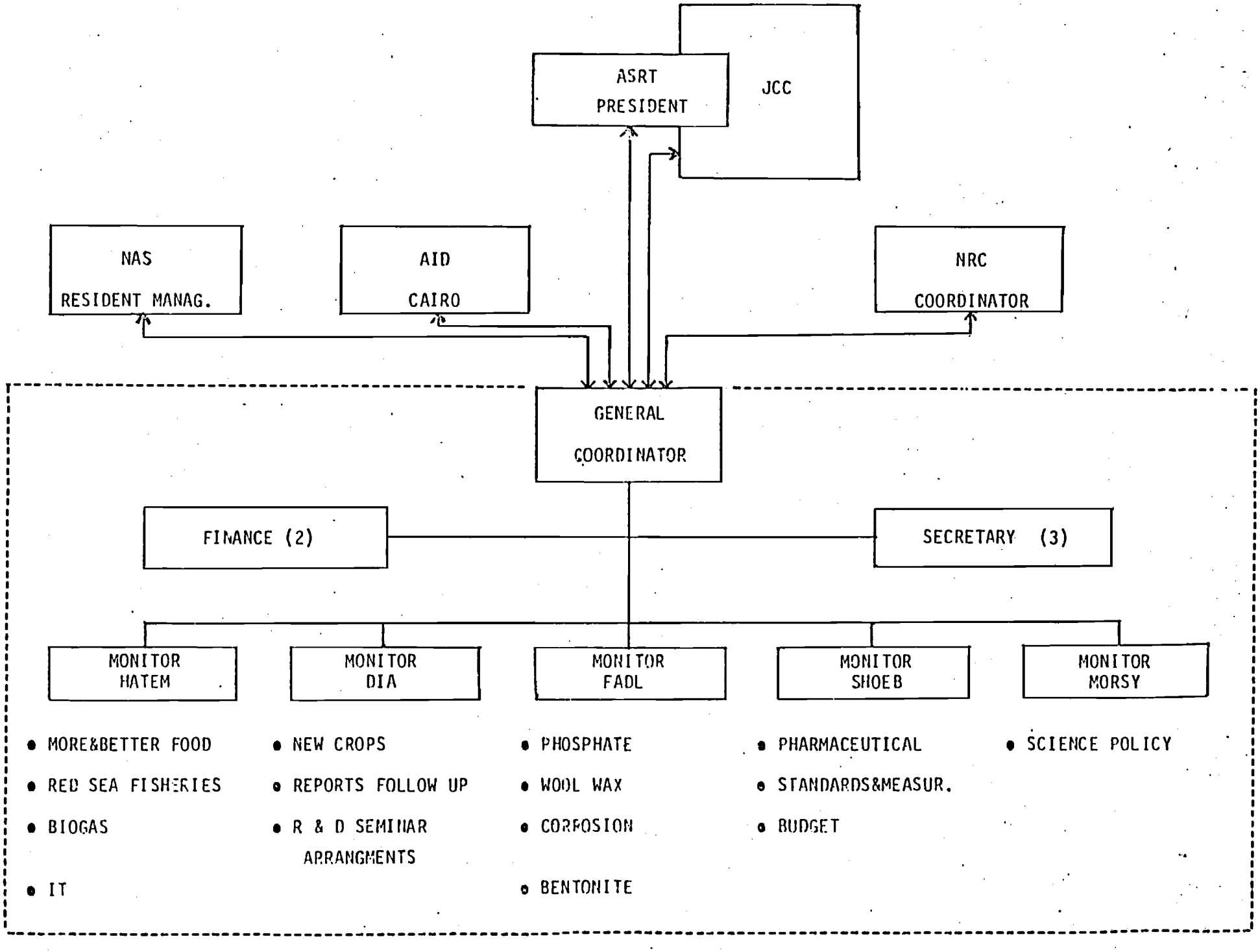
The plan submitted by Blackledge (21 June, 1982; see References) could provide at least a useful starting point for program design. It is encouraging that this plan is being seriously considered by key ASRT and NRC personnel. Even though it is somewhat deficient in the attention paid to R&D external relations, it could be used as a base to build upon. The major challenge will be to find ways to implement some such program taking into account the embedded resistance and constraints.

With respect to a strategy for such R&D management strengthening it is to be emphasized that the focus should be in personnel and relationship development, the generation, implementation and follow-up and enforcement of improved R&D management pocedures at every level, rather than on the creation of the administrative support staff offices. These offices have their place but their creation should be viewed as a complementary step. In fact, it is the team's firm view that the above mentioned Condition Predent was inappropriately designed. To push for the creation of the offices in an R&D management vacuum was to push for what would have been a primarily cosmetic, costly and bureaucratic response to a fundamental need.

Instead, the recommended strategy for the next two or three years is to begin with parallel programs: (1) to generate the need for better management practice by ASRT and NRC leaders and the AID project manager, insisting on applications and proposals that provide evidence of adequate analysis, linkage, control procedures and other critical characteristics (and refusing to consider those that do not); and (2) to provide the training, consulting, reference materials, evaluation criteria and simple procedures needed and appropriate to allow R&D managers to respond to such demands. Initial efforts should concentrate on very simple procedures of analysis and control. Very small (1-2 persons, full time equivalent) staffs of trainers/consultants in ASRT and NRC would be sufficient. These resources could be made up of Egyptians who have already had some training and who have shown some interest in the R&D management field, aided by U.S. or other consultants, and by

further training through an NAS subcontractor(s). As the new R&D management culture begins to take root (e.g., within 1-2 years), consideration of establishing the several administrative offices is appropriate.

The above reference to an NAS subcontract(s) recognizes that NAS may need to obtain such assistance to develop and implement the type of vigorous, close hands-on assistance and locally centered R&D management development effort implied in this discussion.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• WOOL WAX
• CORROSION
• BENTONITE
• PHARMACEUTICAL
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• BUDGET
• SCIENCE POLICY

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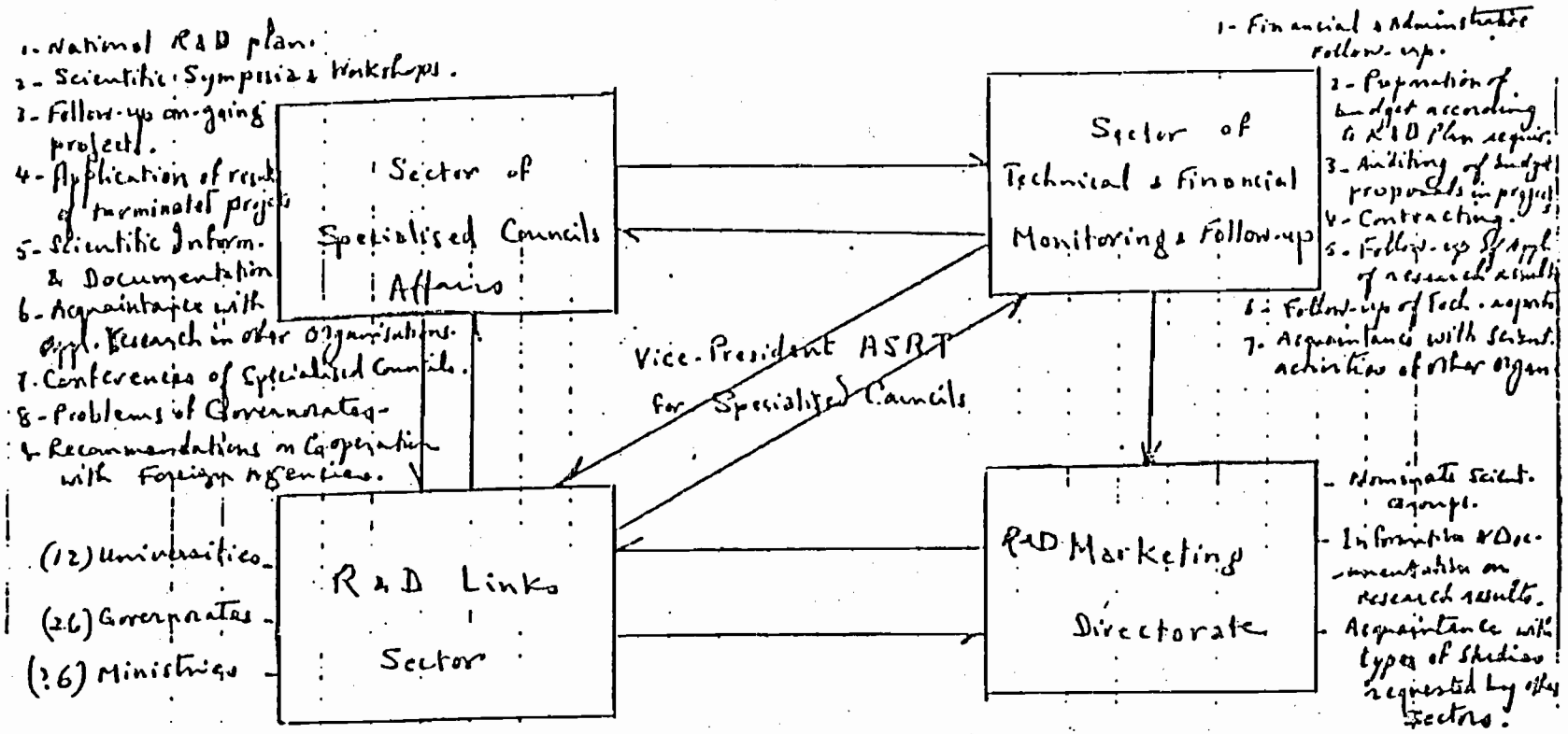
## The Vice-President of ASRT for Specialised Councils

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APPENDIX F

Applied Science and Technology Project
(263-0016)
Case History
Phosphate Ores

I. Description

A. This R&D project was designed to:

1. Evaluate, in the laboratory, the technological beneficiation problems of a variety of phosphate ores from the Nile Valley and the Eastern and Western Deserts of Egypt.

2. Conduct Pilot Plant studies of the beneficiation of the ores based upon the laboratory results.

3. Perform laboratory and technical studies of the chemical processing of beneficiated ores to produce end products suitable for fertilizer production.

B. Under the broader purpose of the Applied Science and Technology Research project, this project element aimed to improve the institutional capability of a portion of the Egyptian S&T community to develop and manage research programs directed to priority development problems.

C. Physically this R&D project consists of laboratory scale chemical processing of phosphate ore samples using the batch equipment of the NRC in Cairo and pilot plant testing of ores at the El Tebbin facilities of the Central Metalurgical Research and Development Institute (CMRDI), a companion institute of the NRC within the Academy of Scientific Research and Technology. This facility has a capacity of one ton per hour on a continuous three shift basis. This output has been reached on a one shift basis as of November 1983.

D. Institutionally the project is under the control of the Director, Dr. Abdel Azim, and of the Principal Investigator, Dr. Tawfik Boulos, both staff members of the CMRDI/NRC. It is conducted partly under contract to the Executive Organization for the Industrial and Mining Complexes (IMG), an Egyptian government agency, and the Misr Phosphate Company and the El Nasr Phosphate Company. Operational staff consists of 50 engineering researchers, 25 technical staff and 15 support workers. 9 Egyptian scientists/engineers have participated in training courses at the International Fertilizer Development Center (IFCD) and Tennessee Valley Authority (TVA) and 7 are still employed on the project.

II. Project life

A. The conception of this project developed as part of the continuing relationship of NRC researchers and the Phosphate Fertilizer Company,



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a government entity. This relationship dates back to the beginning of NRC in the mid-1950's and the participation of staff members in studies of phosphate research. During the 50's and 60's, NRC concentrated on building research and study capabilities within NRC, and in assisting masters and doctoral candidates to complete their theses and dissertations. When the Abu Tartur phosphate deposit in Egypt's western desert (estimated at one billion tons) was discovered in the late 60's, three key NRC staff members became part of an international consortium "committee" to both evaluate the deposit and to oversee the consulting work of a French company on its development. In the early 70's primary interest centered around the Egyptian portion of the "World Phosphate Belt" which loops from Morocco through Algeria, Egypt, Saudi Arabia, Jordan and Israel. The AID project element evolved from that interest. The first significant user-oriented contract was with the Hamrawein Phosphate Company about 1974, and this was followed by the other two company contacts. There was, in addition, a series of conference discussions with the university community. The essential project element of the Applied Science and Technology Project was defined in 1977. A preliminary design was presented to the JCC in May 1978 and a final design approved by the JCC in November 1978. During the ensuing six months, discussions continued with the companies and in April 1979 a panel of three U.S. scientists and engineers met with seven Egyptian counterparts for discussions and for a visit to the production facilities of the Phosphate Fertilizer Company. This visit emphasized the industrial aspects of phosphate fertilizer planning, manufacturing and marketing. Additional meetings of the joint panel group during the following year resulted in a report to the JCC placing specific focus on (1) progress, (2) beneficiation equipment and facilities, (3) pilot plant, (4) chemical processing, (5) economic assessment needs, (6) multidisciplinary approach, and (7) a long-term program of novel technologies. It should be noted that what was designed was a limited research effort and not a complete research design, including physical facilities, production cost estimates, etc., a level of sophistication still not evident in 1983.

The "beneficiation," in this case upgrading the ore to international standards, has two major components, mineral beneficiation or ore preparation and chemical beneficiation or chemicals preparation (i.e., phosphoric acid). Initial emphasis was on the first, ore preparation, and on a continuous process in preference to "batch" preparation.

B. As a preliminary to implementation, the research group wrote a work plan to include evaluation of the deposits and beneficiation, chemical processing and techno-economic studies. In their early work, the three NRC staff members, who were working with the international consortium and the French consultant company, had suggested a wet processing method and that had been adopted by the consortium. At the request of U.S. panel members, early in the implementation period, the design was modified to include a "dry beneficiation" program, acidulation of phosphate matrix and for an agronomy study of two Egyptian crops. Results of the wet-vs-dry beneficiation testing and evaluation again proved the superiority of the wet process and that process was upscaled to pilot plant level by mid-1982. The industrial end-users began by supplying

NRC/CMRDI with 10 to 24 ton samples for processing. The one ton per hour plant at El Tebbin is the first and largest mineral beneficiation pilot plant in the Middle East. An analysis of phosphate ore potential indicated that approximately a four-fold increase (1.2 million tons per year to 4.5 million) could be utilized if production was economically feasible. During both the early laboratory and pilot plant stages monthly staff conferences were held in the two sections of the study, mineral and chemical beneficiation. This practice has continued throughout the project work and has contributed greatly to the steady progress of the project element. A Phase II Program Plan was prepared including a scheduling bar type chart (see Annex A) of all project activities. As of November 1983 the project is substantially on time.

C. The dissemination and marketing of the plans, progress and results of this activity have been essentially continuous from the beginning with constant interaction between CMRDI and the fertilizer industry both in Egypt and abroad. Visits to Egypt were made by the Chairman of the International Fertilizer Development Corporation, and by IFC's Chief Chemist, and key staff members participated in international conferences and these contacts helped place the Egyptian situation in context. Generally speaking the supply of high grade ore is decreasing rapidly and this factor encouraged studies of the medium grade ore generally found in Egypt. More recently a depressed world market for fertilizer chemicals has put in doubt the development of medium grade ores worldwide.

D. The R&D project is scheduled to end by December 1984 and will meet that schedule. With the decrease in world market prices for fertilizer chemicals, the economy of developing a substantial industry in phosphate ore processing seems doubtful for the present. However these studies have developed additional possible activities in the search for alternative local uses of phosphates; e.g., in animal feeds and in super phosphates for cleaning. Work is going forward on establishment of a Company phosphoric acid production plant using the Abu Zabal site ores and the two company engineers responsible for that plant have been trained "on-the-job" at the CMRDI pilot plant in El Tebbin.

E. A series of periodic reviews have kept this R&D project up-to-date as it progressed. Changes were made in the design, implementation and, potentially, in the results which will be accomplished. The drop in fertilizer chemical prices world-wide has raised serious economic questions and the techno-economic studies necessary to place production in perspective have been programmed. In any case the value of this project element to the Applied Science and Technology Research Project does not rest solely on the technical research in that improvement of institutional capability is a basic concern. While the technical elements of the project have served a valuable purpose in decision making, a major gain has been in the capabilities and performance of the research and design tasks by CMRDI/NRC personnel. This time period has seen a change of style in which applied research and directed effort have altered the basic CMRDI approach toward that of "results". From a basic science and academically isolated work environment to an applied research and user-oriented sensitivity, the CMRDI has changed focus and added these new dimensions to its ongoing relationships with industry and commerce. Part of that change is due to the Phosphate Ores project.

APPENDIX G

## Evaluation Team Members

Team Leader: Ms. Nena Vreeland, Office of Evaluation, AID/Washington.

Prof. Ahmed Mohammed Azzam, Former Vice Rector, Faculty of Science, Ein Shams University and Former Scientific Counselor in Washington.

Prof. Nayel Barakat, Former Dean, Faculty of Sciences, Ein Shams University and Former Scientific Counselor in Bonn and presently Professor of Physics, Ein Shams University.

Mr. David Carr, Program Economist, USAID/Cairo.

Mr. Richard Fraenkel, Agricultural Economist and Sociologist, USAID/Cairo.

Prof. Ahmed Aziz Kamal, Dean, Faculty of Engineering, Cairo University.

Prof. Michael Radnor, Director, Institute of Science and Technology, Northwestern University.

Mr. Ross Thomas, President, Management Associates International, Retired AID Science and Technology Officer.

Mr. Richard Williams, Industrial Engineering Officer, USAID/Cairo.

Institutional Coordinators:

ASRT - Prof. Hatem Mohamed Aly, Program Monitor

NRC - Prof. Nabil Saleh, Program Monitor

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