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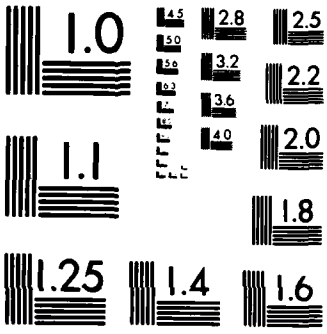

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IDA MEMORANDUM REPORT M-83

REPORT OF THE AD HOC COMMITTEE TO REVIEW THE PROGRAM OF THE SDI DIRECTORATE ON INNOVATIVE SCIENCE AND TECHNOLOGY (IST)

Bohdan Balko, *Project Coordinator*

April 1985

Prepared for
Strategic Defense Initiative Organization

INSTITUTE FOR DEFENSE ANALYSES
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Deliberations and conclusions are summarized of an ad hoc Committee to review the Innovative Science and Technology (IST) Directorate. Areas for programmatic emphasis, proposal selection, funding for individuals and consortia, and desirable budgetary levels are discussed.

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Task T-5-316

PREFACE

At the request of the Director of Innovative Science and Technology (IST), the Institute for Defense Analyses was asked to form an ad hoc committee to comment on the general direction and long-term emphasis of the IST program.

Committee participants are listed on page iv. Comments on this Memorandum Report were solicited from members of the committee and are reflected herein.

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I. INTRODUCTION

The Directorate of Innovative Science and Technology (IST) serves an essential function in the Strategic Defense Initiative Program (SDIP). It supports areas at the frontiers of science, the potentials of which for engineering development are as yet unproven. The long-term contributions of this activity to SDIP are expected to be important in providing innovative inputs that may strongly affect system viability, performance, and cost.

The Institute for Defense Analyses (IDA) was asked to form an ad hoc Committee of eminent scientists and engineers, with experience in national security matters, to comment on the general direction and desirable long-term emphasis in the IST program.

This memorandum reflects the consensus reached at a two-day Committee meeting. Committee discussions were held following a briefing on the programs and management policy of the IST.

II. PROGRAM EMPHASIS

Since the IST deals with innovative research that falls beyond the state of implementation in current concepts for the SDIP, funding must be protected from the demands of concurrent engineering development and applications. It should be long-term and stable, managed flexibly and available when unexpected opportunities arise. As a paradigm, we note that the utilization of undirected research funds at Livermore and Los Alamos provided initial support for development of the Excalibur laser, charged-particle beam and neutral particle-beam programs that are now of central interest in connection with SDIP implementation.

Given the need for long-term support of relatively uncharted areas of the SDIP, the definition of IST program areas, in our opinion, reasonably reflects judgements about fields of science and engineering that are currently perceived to be likely to yield useful results for the SDI Office. We would, nevertheless, place greater emphasis on some of these areas than on others, as will now be discussed. By incorporating word changes into each of the program-area titles, as presented by the Director of IST in his briefing to the Committee, we propose effectively some redirection for several of the program areas. The IST Director should, of course, remain alert to new opportunities arising from research and to the proposal of novel ideas not encompassed in our recommendations. The primary program areas, as modified by the Committee, are:

(i) Novel Directed Energy Concepts

By substituting "Novel" for "Advanced", the Committee intended to underscore the necessity to

distinguish between support for innovative ideas and support for ideas which are difficult, complex, better defined, and form a part of current SDIP effort.

(ii) Novel Sensing, Discrimination, and Data Processing Techniques

By adding "Discrimination", the Committee intended to emphasize the urgent need to pursue long-range research in this important area if the SDIP is to meet its mission goals. Discrimination includes acquisition of sensor outputs and related data processing and interpretation. University research should be supported to obtain innovative inputs and ideas on discrimination.

(iii) Special Supercomputing Needs for the SDI Mission.

By restricting work in ultra high-speed supercomputers to the special needs of the SDI, the Committee intended to avoid diffusing the effort into already heavily funded areas.

(iv) Innovations in Burst-Mode Space Power and Power Conditioning

No changes in area definition were suggested here.

(v) Advanced Materials, Propellants, and Structures for SDI Applications

By adding "Propellants and Structures" to this area, the Committee meant to emphasize the importance of long-term survivability of space assets, as well as the need for advanced propellants in connection with the development of future generations of KEW interceptors.

(vi) Innovative Space Science and Experimentations

By adding "Experimentation", the Committee intended to emphasize the necessity of developing a quick-response space-experimentation program for early space testing of innovative proposals. This

capability appears to be especially important in assuring asset survivability.

We did not have the opportunity to examine in detail the proposed areas for funding and emphasis in the SDIP itself. Here, we are less concerned with overlapping of functions and activities between IST and the SDIP than with the possible perpetuation of important knowledge gaps. Without reviewing the entire SDIP, we cannot comment with complete assurance on the funding distribution in the IST. Nevertheless, we made a first effort to examine this problem and arrived at a significant preference to allocate funds in areas (i), (ii), and (vi), with minimal funding in area (iii). This assessment clearly reflects a Committee preference for funding those areas of study with large potential impacts on program development, while minimizing expenditures in fields of broad technical applicability, such as computers and materials, which are heavily funded in the industrial sector, unless unique research areas which relate to special problems of the SDIP are identified and selectively emphasized.

In addition to the six identified research areas, the Committee considered a seventh topic, namely, Systems Technology and Systems Integration (including Systems Architecture, Peacetime Management of Defense Systems, Maintenance of Systems Reliability, and Battle Management). Although we are convinced of the pervasive importance to the SDIP of studies of this type relating to conceptual formulations and general methodologies and, moreover, have not seen evidence that they are properly addressed elsewhere in the SDIP, we are reluctant to emphasize funding for this area under the IST because of the difficulty of defining truly innovative research. However, in the event that one or more suitable proposals are submitted on innovative studies in systems science, they should receive the same preferred treatment that is accorded to other proposals dealing with central topical areas [topics (i) to (vi)] selected for emphasis in the IST.

III. PROGRAM MANAGEMENT AND PROPOSAL SELECTION

The central issue in program management is to attract and involve the best qualified investigators in all fields and, depending on selections made in areas of research and development, appropriately coupling academic and industrial sectors. An early approach chosen by IST to resolution of this problem was establishment of consortia involving academic and industrial laboratories. While the Committee appreciates the value of an early program start, the emphasis placed on consortia of academic and industrial laboratories may involve significant risks because of overcommitment to an administratively neat package.

The development of a cost-effective and distinguished innovative program clearly requires support for the best qualified investigators. Free access to and participation by university-based scientists and engineers, who are important sources of inventive ideas, will be best obtained by implementing an individual-grants program on a preferred selective and competitive basis.

We recognize the serious operational constraints resulting from the very limited staffing of the IST that has made it initially impossible to fund a multiplicity of individual grants. This constraint requires correction and we therefore recommend that every effort be made to bring staffing of the IST to levels required to achieve a substantially higher fraction of individual grants/contracts relative to support of consortia.

The selection for funding of university-industry consortia should be done with circumspection and full realization of the normally significant differences in time scales, modes of

operation, and objectives that characterize such diverse organizations. The enduring emphasis in IST funding must be on quality research. As we have already noted, initial fund allocations appear to have been unduly biased in favor of consortia because of administrative pressures created by the necessity of managing a relatively large program with a limited staff. Nevertheless, the majority of funds spent in the future should not be allocated in this manner. Funding of developing organizations for the purpose or with the hope of improving their performance is a laudable goal but necessarily requires considerable time for implementation and also involves a large element of risk for failure in achieving program objectives. It is worthwhile investing in special efforts to involve especially competent people in the IST programs.

In view of the highly innovative nature of the IST program, we believe that most of the IST funds should be allocated to carefully selected individual investigators, wherever they may be found. Peer reviews should be obtained and carefully considered but should not necessarily be adhered to by intelligent program managers, who must bear primary responsibility for taking the initiative to foster the development of non-traditional, innovative studies that may be of special importance to the SDIP.

In the IST program, it is equally essential to develop and utilize effective mechanisms to support capable individuals or groups of people working in government or national laboratories, not-for-profit organizations, and in industry.

In view of the anticipated long-range nature of the SDI and IST programs, with funding for the IST directorate ultimately falling in the range of perhaps $250 to $500 millions per annum, it may be appropriate to fund centers of excellence involving multi-university research groups or special laboratories and organizations. Research at these centers should emphasize one or more of the six identified IST areas of investigation. The

studies at these centers should be complemented by substantial, independent research groups that are funded separately by IST. The anticipated budgets for IST and SDIP (which will be ten to twenty time more heavily funded than IST) are so large that we must anticipate potential shortfalls of technically trained manpower for these programs. It is appropriate for the IST directorate to support needed graduate education and research at universities to ensure availability of trained manpower needed for SDIP as the program expands. Particular care should be taken to use mechanisms for accepting good proposals that often do not fit neatly into any particular identified categories.

IV. REQUIRED FUNDING FOR THE IST

The present funding goal for the IST appears to be 5% of the SDIP allocation. Furthermore, the IST Directorate is required by law to distribute 1.0 to 1.5% of the SDIP budget to small businesses under the Small Business Innovative Research (SBIR) program. The SBIR program, when operated by the IST Directorate, is a potential source of funds for collaboration between university researchers and small businesses and is designed to encourage innovation. We believe that protected and unencumbered funding at the 5% level represents a minimum requirement for successful program development and the additional funding for the SBIR at a level of 1.5% of the total SDIP budget should be managed through the IST. If the SBIR program is funded through one of the other SDI offices, the desired collateral benefits to the university research community are less likely to materialize.

We note that the generally required support level for independent research in industry is in the range of 5 to 10% of the total program budget for high-technology developments. For a very high risk activity such as the SDIP, the larger figure of 10% would appear to be appropriate for innovation. The total impact of a basic, long-range, mostly or entirely unclassified, physical science program of this magnitude on research, training of graduate students, and innovation will be very great indeed and may reasonably be expected to benefit the entire spectrum of desirable high-technology activities, including the securing of a competitive trading edge for participating or newly developing U.S. industrial enterprises.

V. RELATION OF THE IST STUDIES TO OTHER SDI PROGRAMS

In general, innovative concepts should be pursued to the point where scientific and technological limits of further development can be properly identified. The IST funds should not be used in support of programs that are judged to be ready for engineering development, nor should they be applied in the rescue of development programs that have faltered or show unanticipated difficulties.

There is a normal and orderly progression in the identification of promising innovative research that becomes suitable for larger scale testing and engineering development. Research managers of the SDIP must be alert to opportunities of this type. After an approved development program is underway, it will become more difficult to accept new approaches. An unending search for optimal solutions would not allow any final system definition or implementation. Obvious pitfalls of this type must clearly be avoided.

VI. FUTURE DIRECTION OF THE IST DIRECTORATE

We recommend the formation of an IDA/IST Advisory Committee to assess program selection and utility on a continuing basis. This Committee should consist of distinguished scientists and engineers from the academic and industrial communities and would provide important links with scientists and engineers working in areas vital to the success of SDI. Equally important, the Committee members would be available to provide informal advice to the IST program managers.

After formal briefings on the total SDIP, updated at appropriate intervals, this Committee should be in a position to provide detailed comments and assessments of individual programs and areas that are preferred or have been selected for IST funding.

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