



096759
~~4.14.74~~
096759
74-0711
UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

PROCUREMENT AND SYSTEMS
ACQUISITION DIVISION

B-167034

FEB 14 1974



LM096759

The Honorable
The Secretary of Defense

Dear Mr. Secretary:

On March 20, 1973, we advised you that we were initiating a survey of the Department of Defense's (DOD's) and the military services' efforts to plan for the support of innovative research. This survey was to ascertain whether DOD and the military services have established and/or are maintaining a deliberate relationship between the support of long-term, high-risk, inventive (innovative) research programs designed to produce entirely new military equipment, systems, and processes and the support of low-risk (evolutionary) research programs designed to solve relatively short-term technical barrier problems. Such a relationship would necessarily rely upon the characterization and categorization of these two types of research for measurement purposes.

We interviewed officials from the Army; Navy; Air Force; Defense Advanced Research Projects Agency; and the Office of the Director, Defense Research and Engineering.

The services support both long-term innovative and short-term evolutionary research, but make no attempt to distinguish the extent of effort going into such types of research to maintain the desired balance between them. None of the service officials interviewed agreed exactly with the former Director of Defense Research and Engineering's characterization of innovative and evolutionary research. The various officials, however, generally agreed on defining broad categories of research as cited above and on the apparent need for more innovative research.

~~701842~~

096759

We believe a need exists for increased visibility and accountability for the support of innovative research.

DEFINITION OF INNOVATIVE RESEARCH

For this report we are defining research as (1) a continuing search for new knowledge (funded by the DOD 6.1 budget category) and (2) an exploration of how, whether, and when to apply this knowledge to defense problems (funded primarily by the DOD 6.2 budget category). DOD and the military services spend approximately \$1.5 billion annually for such efforts. The results of such research constitute the "technology base" from which must come the knowledge and advancements needed to keep military capabilities viable 10, 20, and 30 years.

Dr. John S. Foster, Jr., Director of Defense Research and Engineering from 1965 to 1973, identified two types of research programs--one that he described as innovative and the other evolutionary. Innovative programs were characterized as generally high-risk and high-payoff. These programs did not evolve from a current situation, but rather they created a whole new situation. Evolutionary programs, on the other hand, were characterized as generally low-risk and low-payoff and were primarily improvements of the current situation.

NEED FOR INNOVATIVE RESEARCH

Dr. Foster expressed a desire to see more innovative research to counteract the "evolutionary" tendency to make existing equipment, systems, and processes "bigger and better" and therefore more expensive.

The Joint Chiefs of Staff also expressed their desire for innovative research in the 1971 Joint Research and Development Objectives Document:

"There should be a serious effort to determine when equipment improvement has reached the limit of useful evolution so that a timely decision can be made to terminate further efforts in improvement and to orient resources toward new technological approaches

to the problem. More innovative investigations which may lead to unexpected results or breakthroughs must be pursued."

DOD officials informed us that there probably was not enough high-risk, innovative research being done and that they would like to increase their efforts in this area.

The December 1972 report of the Commission on Government Procurement also pointed out the need for more innovative research programs.

"The Government has paid a spiralling cost to meet growing public needs by stretching existing technology and 'goldplating' old approaches instead of seeking innovative approaches that ultimately might prove less complex, less costly, and more effective."

The report further stated that frequently the search for alternatives with a specific operational need is conducted in a way that nourishes the technology base in constrained areas of relatively "old" technologies. The Commission concluded that the effect is a closed cycle where innovative technologies are suppressed and relatively stagnant ones are carried too far as possible subsystem and system candidates for a particular program.

The need for more innovative research appears to be a national problem. The National Science Board, in its report entitled "Science Indicators 1972," stated that a 12-member panel chosen for its expertise in the interaction of science, technology, and society, judged the support for "high-risk, high-payoff" basic research to be increasingly inadequate from 1968 to 1972. High-risk, high-payoff research was defined as "projects which may have a low probability of producing results and yet promise results, if achieved, of such significance that the projects are deemed worth the risk." The decline in risky research was attributed to overall economic factors, lack of understanding of the process of discovery, and general dissatisfaction with technology.

ATTEMPTS TO ENCOURAGE INNOVATIVE RESEARCH

To encourage more innovative research, Dr. Foster, in fiscal year 1972, introduced a program called "New Initiatives." To stimulate more original or innovative thinking, this program provided about \$300 million in additional funds to undertake new projects that offered potential high payoff but which would otherwise be neglected. The New Initiatives program, however, has fallen far short of its initial expectations, primarily because the additional funds were not provided. Therefore, what have been called new initiatives are primarily extensions of ongoing projects.

FACTORS TENDING TO LIMIT INNOVATIVE RESEARCH

Service officials state that, before approving funds, the Congress requires the services to provide some indication of the results expected from a research effort. They believe this requirement restrains the funds allocated to innovative research because it is very difficult to predict what specific results, if any, will be achieved from high-risk, long-term research.

Certain officials of the Office of the Director, Defense Research and Engineering, however, expressed an opinion that all research efforts, both innovative and evolutionary, should be related to either a DOD problem area or an end product and that good researchers would not allow this to stifle innovation. In this regard, the Office of the Director is requiring the services to develop Technology Coordinating Papers that will summarize their research activities and opportunities in various fields of endeavor by results that are or could be expected (by potential payoffs).

Although some research officials feel that the Papers will inhibit innovative (or unconventional) exploration of technologies whose future military potential cannot yet be projected, the Office of the Director feels that the Papers are a mechanism to encourage researchers to consider military needs and to weed out less promising projects. For example,

in a May 1972 materials technology conference, Dr. Gus D. Dorrough, then Deputy Director, Research and Advanced Technology, Office of the Director, stated the following in regard to the recently developed materials Paper:

"This first coherent look at our materials field shows that it certainly has some deficiencies. The program lacks proper balance, for it seems to put too much effort into areas where additional progress will have small payoff, and it leaves relatively underfunded areas where payoff is much more likely or areas where the needs are simply greater."

* * * * *

"I think we'll get to a point where imbalances in the materials program will be corrected and the Military Departments will implement a better program, more suited to our fairly immediate and long-range requirements."

Our review of the first revision of the materials Paper, dated December 1972, and subsequent discussions with the official of the Office of the Director responsible for the materials Paper, indicated shifts in emphasis. However, we were unable to ascertain either the initial amounts or the subsequent changes in DOD's support of innovative research. After some thought, the same official stated that the revised materials Paper may have shifted the emphasis from innovative research to evolutionary research in an attempt to pinpoint potential applications.

The Director of the Defense Advanced Research Projects Agency also has stated that research has become too application oriented and that now even basic research is expected to be directed at some end product. He felt that DOD was making very few contributions to new technology. In fact, the Director stated that the Agency, which was expected to be an independent and innovative source for the introduction of new technological concepts into the defense establishment, was becoming too application oriented.

More specifically, the Agency is supposed to conduct high-risk, high-payoff research in areas where defense technology appears to be falling behind. The Agency, however, does not review the services' research programs (6.1 and 6.2) to determine whether there is an adequate balance between innovative and evolutionary research. Instead, it reviews the service programs to identify "gaps" in the technology which it can fill. The Director told us that when such areas are identified the research does not necessarily have to be innovative. The emphasis is to fill the gaps in the technology whether innovative or evolutionary efforts are required.

Another factor which officials believe limits innovation is pressure from those in the services who are responsible for the day-to-day operations to undertake research efforts which will improve existing capabilities or solve present problems. The Director of the Agency stated that, in his opinion, the services engage mostly in short-term evolutionary research because they have the responsibility for being prepared to defend the country today; therefore, they are less likely to be planning for the long range.

It seems that this overemphasis on current needs would be particularly prevalent during military engagements, such as Vietnam, and during periods of decreasing budgets. Although we were unable to ascertain the adequacy of DOD's support for innovative research, we noted that support for research, in general, had decreased about 30 percent over the last 10 years--during our major military involvement in Vietnam.

Other factors which have caused program managers to hesitate to perform innovative research are:

1. Availability of funds. It is becoming more difficult to obtain funds for research that is not directed toward solving an existing problem in a relatively short time.

2. Extremely high risk. Program managers hesitate to take big risks because they are pressured to show results to justify the funds spent on research.
3. Transfer difficulties. Often great difficulty exists in finding a "customer" who will buy a new or unconventional "idea." Program managers do not know if new ideas resulting from innovative research will be accepted and used.

Officials from the three services, as well as the officials from the Agency and the Office of the Director felt that the above factors were significant in determining the mix of research being conducted.

CONCLUSIONS

The services do not plan or review their research programs with the objective of establishing and/or maintaining a balance between innovative and evolutionary research; therefore, they lack the means, other than individual subjective judgment, for determining whether they are conducting an adequate amount of innovative research.

We realize that in many cases there is a fine line between innovative and evolutionary research and that which starts out as one may very well end up as the other. We believe that, if innovative research is not encouraged during the planning stage of a research program, the program will tend to be dominated by evolutionary research which is mainly defensive and designed to protect established products, systems, and processes.

As expressed by Dr. Foster, evolutionary research is evidenced by the tendency to make existing products, systems, and processes bigger and better. These expensive product improvements become more marginal and can eventually lead to stagnation or, worse, to technological surprises by potential adversaries. Therefore, to aggressively search out alternatives to existing products, systems, and processes, a conscious and determined effort must be made to support innovative research.

RECOMMENDATIONS

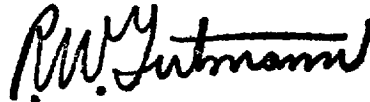
To encourage such conscious efforts, we recommend that the Director of Defense Research and Engineering develop more explicit policies and procedures for DOD's support of innovative research designed to develop the technology base for new ideas and capabilities. We recommend further that innovative and evolutionary research be defined and distinguished and that the research be categorized for measurement purposes. We believe increased visibility and accountability for this support of innovative research, possibly through top-level summary documents, such as the Technology Coordinating Papers, are needed especially in periods of limited budgets.

- - - -

We would appreciate your comments and advice on the matters discussed above and especially on any actions taken or planned. If you or your representatives wish to discuss these matters, please contact Mr. Harold H. Rubin, Deputy Director (code 129, extension 4325).

We are sending copies of this letter to the Director of Defense Research and Engineering and to the Secretaries of the Army, Navy, and Air Force.

Sincerely yours,



Director