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USDRE INDEPENDENT REVIEW OF DOD LABORATORIES

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USDRE INDEPENDENT REVIEW OF DoD LABORATORIES

22 March 1982

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**Prepared for:
Under Secretary for Defense Research and Engineering**



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EXECUTIVE SUMMARY

On 3 September 1981, Dr. Richard Delauer, Under Secretary of Defense for Research and Engineering, established a review of Department of Defense laboratories. This review was undertaken by Dr. Robert Hermann, under the direction of Dr. Robert Cooper, with the assistance of representatives of the Army, Navy, Air Force and DARPA.

The study team found:

- There is indeed a strong and continuing need for the DoD to maintain the Laboratories and R&D centers.
- Much good work is being done in the laboratories and technology created by the laboratories continues to make its way into the operating forces.
- There really are several fundamental problems involving laboratory performance and laboratory relationships with the ultimate user community.
- There exists a disconnect between the laboratories and the Operating Forces which exacerbates the problem of technology transition to the field.
- Industry, the laboratories, and the user community all feel cheated by the existing process.

- The time is ripe for improving the DoD/University R&D connection.
- There are new technology opportunities and technology based operational functions, which have evolved in recent years, which require special DoD attention to realize the maximum benefit.
- The technology environment surrounding the laboratories has dramatically changed in recent years, which requires that DoD and the Services reassess the laboratories' roles and missions.

The study team recommends:

- That the USDRE initiate action to upgrade laboratory personnel practices. Special recommendations are included in the report.
- That the USDRE support initiatives to streamline the procurement process, which is viewed as a major deterrent to the laboratories' efficient operation and innovation process.
- That the DoD modestly increase the rate of modernization of facilities (\$70M per year per Service for the next 10 years) and equipment (\$25-30M, per service per year for the next 10 years).
- That the USDRE support the goal of improving the DoD/University connection (six individual recommendations are included).

- That the USDRE support the establishment of an External Advisory group for each laboratory.
- That the USDRE support the establishment of an outside, expert review process which would assess each laboratory's effectiveness every 3-5 years.
- That the USDRE initiate appropriate action to improve industry's visibility of laboratory activities.
- That the DoD undertake the initiation of a formal process to develop operational concept projections to provide scenarios of future military operations. This document should unify the various Service perceptions, and then be used by the laboratory community to guide their respective technology developments.
- That the USDRE undertake a new approach to coupling the laboratories with the Operational Forces by providing the Unified and Specified Commands and subordinate component commands with modestly sized technical staffs, drawn from the DoD laboratories.
- That the USDRE task each military department to establish a formal "Logistics R&D Program." It is perceived that this area of R&D consistently receives inadequate attention by the Services.

- That the USDRE support the expansion of critical demonstration programs by providing the ASD(RT) with a \$300-400M set-aside.
- That the USDRE support the establishment of a Defense Center for Research in Simulation Techniques and Technologies.
- That the USDRE form a special task group to examine the optimum mechanism for establishing a new Center for Micro-electronics and Computer Sciences.
- That the USDRE support the expansion of the Joint Electronic Warfare Center (JEWEC) in San Antonio, TX, to strengthen the DoD capability to develop and apply new electronic warfare techniques; to focus on joint and combined technology-operational techniques; and to conduct test and evaluation.
- That the USDRE support the establishment of a formal Command and Control Research Program and Center, which is consistent with the DSB report of 1978 on C³ acquisition.

Further amplification of each of the above recommendations is included in the report.

Section 1 INTRODUCTION

On 3 September 1981, Dr. Richard DeLauer, under Secretary of Defense for Research and Engineering, established a review of Department of Defense laboratories. This review was undertaken by Dr. Robert Hermann under the direction of Dr. Robert Cooper with the assistance of representatives of the Army, Navy, Air Force and DARPA.

During the course of the review, 28 laboratories, R/D centers, and related organizations were visited; a host of industry and government officials were interviewed; and four major industrial associations (ADPA, AIA, EIA, NSIA) were consulted (see Appendix, pages 4, 5, and 7). In addition, an industrial advisory group was formed, in part from the 1981 DSB Task Force on the DoD Technology Base, to advise, critique, and comment on the final report and its development.

Section 2

BACKGROUND

The "DoD Laboratories" are a set of 73 laboratories, research and development centers, research institutes and development boards which include 60,000 people, \$6 billion in capital facilities and equipment, and 1981 expenditures of more than \$5 billion for research and development effort.

An anxiety exists in the minds of many who observe, work with, and work in the laboratories and R/D centers about the health and future of these activities. They are concerned with a variety of issues and trends which seem to dominate the present circumstances:

- Many laboratories have had consistent difficulty in recruiting new, young engineers at the GS-5/7 levels, and also in retaining the most competent and experienced scientists and engineers. The salary constraints of government employment, escalating industry salaries, increasing bureaucratic administrative burdens in the laboratories, and other factors are causing a loss of work force competence.
- The procurement policies, procedures, and practices forced on the laboratories by legislation and regulation cause an excessive investment in non-productive activities and are so burdensome and counter-productive that innovation is greatly constrained.

- The facilities and, in many cases, the lab equipment are outdated, inefficient, and in need of replacement.
- The laboratories seem to be working on the wrong problem from either viewpoint of technology opportunities or operational needs. Also their ability to adjust and respond to new technology developments seems unduly slow.
- It is evident to all observers that the process of technology transition to operational forces is not working well and some (but surely not most) of the blame is levied on the laboratories.
- The relationship between the DoD and our universities could be measurably improved to the advantage of both sectors.

These concerns have stimulated several previous laboratory reviews which have resulted in relatively consistent conclusions and recommendations:

- The laboratories are essential.
- They need to be better.
- Their personnel practices must be upgraded.
- Their procurement practices must be streamlined.
- Their facilities and equipment need to be kept up to date.
- Their relationships with universities should be improved.

Many of these recommendations have been acted upon with varying degrees of completeness but there is broad agreement that more needs to be done to correct the deficiencies in the laboratories and the processes which surround them.

With this background, the present review was initiated.

Section 3

FINDINGS

3.1 THE TECHNOLOGY ENVIRONMENT SURROUNDING THE LABORATORIES HAS CHANGED

The technology environment in which the laboratories find themselves today has substantially changed and their role and mode of operation has changed. It must continue to change with the environment, as must our collective judgment about the roles and limitations of these centers.

Some of the anxiety about the health of the laboratories comes from those who compare today's laboratories with the performance and influence of the labs of past generations. There may be some merit in making such a comparison but for the most part it is not appropriate. The technology environment surrounding the laboratory has changed profoundly in the past two decades. There has been a massive proliferation of new technologies which have relevance to defense. The technologies have infused the civil and commercial sector in an all-pervasive way causing, among other things, great competition for skilled personnel and a substantial reduction in the leverage DoD can use in the high technology marketplace. Technology options are now wider and the technical questions are more complex; in part because of the increased number of functions being built into systems, and in part because of the phenomenal increase in parts count, cost and development time.

The relative position of the U.S. in technology has changed. In the early years after World War II, the U.S. had

an overwhelming superiority in both the technology and industrial base. Since then, Western Europe and Japan have made remarkable strides and now challenge the U.S position in many areas. Within the U.S., the Defense Department no longer dominates the high technology market as it did in the early 1960's. These factors change many aspects of laboratory life including the type and range of personnel skills needed, the relationship with Program Managers and Commands, and with industry.

3.2 THE NEED FOR AND UTILITY OF THE LABORATORIES AND R/D CENTERS

Most observers and participants in the DoD acquisition process agree that the DoD does need a strong and viable set of R/D laboratories and centers such as those now in existence. There are varying opinions as to which are essential, what the fundamental problems confronting these institutions are, how they should behave, and what corrective measures should be taken. However, there is nearly universal recognition that:

- Good work has been and is being done by the labs through in-house work and sponsored efforts in industry.
- Much of this work has resulted or will result in the transition of new technology into systems now in use in our operational forces.
- Most of the functions assigned to these centers cannot reasonably be transferred to private industry.

These positive assessments are clouded by the concern by many that we may not be getting our moneys worth. For the dollars, personnel, investment, and management attention involved:

- Too little new technology finds its way to the operating forces and, while the laboratories are not the primary agents responsible, they can play an important role in improving this process.
- The government does not seem to be a very smart buyer. Again, the Systems Commands and major Program Managers are primarily responsible but improved laboratories with better procedures for their participation would be a positive factor.
- The quality of laboratory scientific and engineering personnel is eroding.
- Bureaucratic procedures and perhaps an aging work force are suppressing the innovation necessary to advance the technology of these times.

After reviewing past reports, visiting nearly one-third of the laboratories, and listening to the views and recommendations of industrial managers and associations, the judgment clearly emerges that there are several fundamental problems involved with the laboratory performance and the relationship between the laboratories and the ultimate users of their efforts. While the internal situation of the labs should not be judged as disastrous yet, it seems clear that

if the business of the laboratories were to continue to be conducted in the future as it has been in the past 5-10 years, the health and viability of the laboratories and their role in the whole DoD research, development, and acquisition process will be jeopardized.

Many who work in the laboratories agree with the assessment that we are not getting our money's worth. They are profoundly frustrated by the manifold constraints in their personnel system, the procurement procedures, and the programming and budgeting process.

Thus, while the laboratories are essential, it is imperative that changes in the process be made to correct both their real and apparent deficiencies. Either the real deficiencies or those which are perceived could severely damage the system if left unchecked for very long.

Prior studies have also reflected these concerns and, to the extent corrective measures have not been implemented the situation has deteriorated. The urgency is now greater than ever; the problems which caused concern in the past have grown, the technology competition has increased, and our operational posture has become more important.

3.4 THERE IS A DISCONNECT BETWEEN THE LABORATORIES AND THE OPERATING FORCES

Perhaps more serious than the problem of the internal health of the laboratories and R/D centers is the relationship of the acquisition process to the operational forces and the general problem of transitioning the products

of the labs into operating systems which are affordable, reliable, and supportable and fit into realistic operational concepts. This issue is dominated by the broader acquisition management process primarily involving Program Managers which has received very high level attention. Deputy Secretary of Defense Carlucci has originated a set of 32 initiatives aimed at improving the acquisition process. However, the laboratories are also an important element of this process and can be an important instrument in improving the transition of new technology.

We have not effectively applied many of the new and potentially high leverage technologies which have been available over the past two decades. A cursory review of the forces and systems now in the field and being fielded will lead to the judgment that we have been ineffective at both translating technology into a fielded system and adopting operational doctrine and concepts to take advantage of modern technologies and techniques.

We have now suffered many years of the consequences of fielding complex modern systems based on high technology and design rules driven by technical performance. There has been a systematic disregard of issues such as:

- Whether we can afford to buy enough of the item to gain the operational leverage which formed the basis for the investment.
- Whether the system will be reliable enough to be available when needed while avoiding unusual maintenance cost and impact.

- Can the system be maintained by the anticipated maintenance work force without unreasonable cost or impact on the operational availability of the system.
- Will the logistics concepts, procedures, and personnel be adequate to maintain the system's operational availability.

The program managers and supporting laboratories need to make some changes in approach to reverse this situation.

The laboratories have great difficulty understanding and representing what will be needed by operational forces. Industry observes this as an annoying lack of coherence and direction on the part of the government which creates inefficiency through lack of consistency. Laboratory personnel themselves are frustrated at not being able to decipher what operational authorities need through what is displayed or expressed to the labs. The operational commands need a better relationship with both the labs and the system commands.

Functions which are integrated with and imbedded in the command structure such as communications, command and control, electronic warfare, and the battlefield application of intelligence have suffered through lack of adequate means of technology application. These functions demand not only the ability to rapidly adapt to new technology but also the need for combined operational-technical competence in integrating these new technologies into operational doctrine and concepts. The laboratories are organized along the lines of engineering functions, platforms, or commodities and are not well equipped to address these problems.

In general, all participants feel cheated by the process through which the laboratories must make their contribution. Industry is convinced that it could do so much more for the defense effort if the laboratories (as well as others) could consistently represent operational needs and could use reasonable procurement procedures in acquiring their goods and services. They also resent what they feel is unfair competition by the laboratories from a privileged position. Laboratory personnel are frustrated by a nearly unbelievable set of personnel procedures, administrative burdens, and excessive procurement process constraints. Examples abound such as budgetary instability and several levels of reviews, audits, and inspections. They are further troubled by the inability to obtain consistent direction about real operational needs and resource levels. They object to what they see as overly conservative system Program Managers who are unwilling to use their technology products. The Program Managers are unhappy with the lack of realism, insensitivity to cost, and schedule demands on them displayed by their laboratory counterparts. The record of major system cost and schedule overruns provides some justification for this attitude. The operational commands are disappointed and cynical about the application of new technology to their problems as a result of years of observing that it takes an inordinate amount of time to get new technology into fielded systems, and when fielded they are often unreliable, hard to maintain, and difficult to support. Finally, informed citizens feel cheated by the lack of both efficiency and effectiveness of this application of their substantial tax dollars which reflects into the political active assessment of "waste in the DoD."

Those responsible for managing the acquisition process both in the executive branch and in congress must take steps to correct this destructive and seemingly pervasive attitude. It is an injustice to the nation and to those whose talent and energy are applied to the problem of national defense.

3.6 THE TIME IS RIPE FOR IMPROVING DoD LABORATORY AND UNIVERSITY RELATIONSHIPS

The university and DoD laboratory relationship has waxed and waned over the past 30 years with perhaps the worst of times being represented by the late sixties and early seventies. The relationship was obviously strained because of reaction to the Vietnam War, but also because a decreasing amount of DoD funding was going to the academic community.

Since the mid-seventies the situation has improved, with DoD and the university community acting in concert once again. Funding for university research has not reached the levels of the early seventies, but the relationship or co-operation for the mutual benefit of universities and the DoD is improving.

However, the nation now faces a severe shortage of technically trained people. This is reflected in the lack of graduates for government and industry, university faculty, graduate students, and in the lack of facilities to do outstanding research. Both the DoD and the universities should have a high motivation to jointly help to solve their somewhat separate problems. Much of the apathy and antipathy of the past decade is past and both the need and opportunity to solve some of these problems together seems to exist.

This problem is being addressed by several study groups on a nation wide basis. In particular, the Defense Science Board (DSB) has just issued a report entitled "University Responsiveness to National Security Requirements."

3.7 THERE ARE NEW TECHNOLOGIES AND TECHNOLOGY BASED OPERATIONAL FUNCTIONS WHICH NEED SPECIAL ATTENTION

As new technologies have emerged with increasing rapidity, the existing lab structure and work force have not been able to keep up with and organize to apply them to defense problems. Further, the gradual infusion of new technologies into U.S., allied, and opposing forces has created new operational situations and opportunities which require a combination of operational and technical competences to exploit. There are a few specific areas of new technology opportunities which require extraordinary management attention. Those recommended for specific attention now are:

- Micro-electronics
- Software Research and Development
- Artificial/Machine Intelligence
- Electronic Warfare
- Command and Control

Each is treated in more detail in the section covering recommended actions.

Section 4

RECOMMENDATIONS

To help correct some of the deficiencies noted above, and to respond to the technical and operational challenges which face the Department of Defense, several actions are recommended. These initiatives are listed below, and outlined in more detail in the following pages.

1. Upgrade Personnel Practices
2. Streamline Procurement Practices
3. Modestly Increase the Rate of Modernization of Facilities and Equipment
4. Improve University Relationships
5. Establish External Advisory Groups for the Laboratories
6. Establish an Effectiveness Review Process for the Laboratories
7. Improve Industrial Visibility of Laboratory Activities

8. Develop an Operational Concept Basis for Guiding Technology Development
9. Expand Laboratory Relationships with Operational Forces
10. Strengthen Service Logistics R/D Programs
11. Expand Critical Technology Demonstrations

12. Establish a Defense Center for Research in Simulation
13. Establish a New Center for Micro-electronics and Computer Science
14. Form an Electronic Warfare Techniques Development Center
15. Establish a Formal Command and Control Research Program and Center

It is difficult to order these initiatives in a single, declining order of importance. However, they can be grouped as follows:

- The first seven topics are aimed primarily at the internal health of the laboratory system as an operating technical organization and its relationship to industry.
- The second four topics are aimed at the relationship of the laboratories to operational forces and the technology transition process.
- The final four topics address possible initiatives in new technical/operational disciplines.

The above initiatives can be evaluated and prioritized against several criteria.

The greatest return on management energy invested will result from improving our ability to transition technology into operational capability. Thus, improving the lab/operating command connection, generating an operational projection for technology management, an increased technology demonstration program, and logistics research and development investments have high leverage. However, several other actions aimed at other primary objectives will help in this respect also. For example; an improved simulation capability and closer relationship to training operational commands could markedly improve the relevance of lab activities;

inclusion of command representatives in the technical review process will help; and the initiatives in EW, C³, and Logistics will generate useful mechanisms for transition of technology.

It is also true that without sustained quality and competence in the laboratories, a better connection to the Systems Commands and Program Managers will not be of much value. Therefore, improving the personnel practices of the laboratory process is absolutely essential. Of lesser but still profound importance are the issues of: a quality review process, procurement practices, facilities, and general purpose equipment.

Finally, the need to generate new energy and innovation in the technical areas of micro-electronics and computer science, simulation, logistics, electronic warfare and command and control cannot truly be evaluated as secondary. They are needed because of the essential nature of these disciplines and the dependence of our defense posture on our ability to translate their leverage to our operational forces. They are also needed to demonstrate to ourselves as well as others that we have the capacity to change and adapt our institutions and our programs to new situations.

4.1 UPGRADE PERSONNEL PRACTICES

An absolute prerequisite for the maintenance of effective laboratories is a competent work force. The personnel practices of the past 5-10 years have caused an

extensive erosion in the competence, morale, and effectiveness of this work force and, if continued, would lead to the decline of the laboratory system.

Some very important changes have already been initiated with congressional action to raise the pay cap and relax the limitation on high grades. These will provide some much-needed flexibility to laboratory managers to promote good young engineers who have waited at lower grades while reductions in numbers and high grade constraints have held them back.

However, more is required. There are other opportunities to help create and maintain a qualified, motivated, and professional work force. Many of the recommended actions outlined here are already started and only need further support and emphasis. The laboratories need to be encouraged and the procedures need to be made easier for the labs to exercise many of these opportunities.

Recommended actions include:

4.1.1 Expand NWC/NOSC Demonstration

- The NWC/NOSC personnel demonstration should be extended to other centers. Under new guidelines, both NWC and NOSC have created excellent personnel programs which reduce the paperwork of administration and greatly emphasize performance as a basis of promotion, competition, and priority under reduction-in-force procedures. These programs are well thought out and working well.

Other laboratories should be directed to submit proposals within the guidelines which governed the NWC/NOSC demonstration and are tailored to the particular geographic, service and skill needs of each laboratory.

4.1.2 Resurrect PL-313-Like Positions

- Resurrect a modest number of PL-313-like positions. During the 60's and 70's the PL-313 position was a powerful tool for quickly and efficiently acquiring the services of specially qualified scientific and engineering skills on behalf of the government. Yet, it was not a very large population. Although a flexible salary level was one of the leverages available under PL-313, the flexibility most important to resurrect is the ability to designate the skill and the person needed and acquire his/her services rapidly. This flexibility is still needed, is not available through the SES process, and should be created.

4.1.3 Reduce Administrative Impact of Civil Service Reform Act

- Reduce some of the administrative burden and excessively bureaucratic procedures introduced by the implementation of the Civil Service Reform Act of 1978. While the motivation for this act was correctly aimed at efficiency and professional performance, and many of its features are

worthwhile, it also produced some glaring new unproductive burdens which should be corrected. For example;

- Senior Executive Service positions are now routinely left open from 12-24 months because of the extensive and lengthy process of filling an open position. Along with the many other difficulties of laboratory leadership, delays of this magnitude are truly damaging. The harsh effects are amplified even more during these times when inequitable pay is causing alarming departures of competent leaders.
- Fix the merit pay system! During visits to the laboratories, no other subject gave rise to such intense and emotional criticism as the Merit Pay System. The laboratory management and the work force felt doubly cheated by the 1981 merit pay exercise. They all dedicated an unreasonable investment of the time and talent of their organizations to fulfill the excessive paperwork burden of its administration (one organization estimated that it cost \$5 of effort for every dollar awarded). Then, at the last minute, the government reversed itself and made no distinction in pay on the results. This demonstrated a gross insensitivity by wasting a lot of effort and hypocritically disavowed the underlying objective of the program.

4.1.4 Work on a Differential Pay System

A differential pay system for selected scientific and engineering personnel is needed. The concept of comparable compensation is essential for the health of the government in general, and in the case of selected scientific and engineering skills (at this in history,) it is crucial. Our laboratories, which we agree are essential and must be competent to perform their function, cannot compete with industry in some important aspects under present practices. Most importantly, they cannot compete for B.S. graduates in engineering, computer science, and some specific scientific fields. The salary structures of industry and government may differ by a minimum of \$4,000 and routinely as much as \$10,000 per year at these low-experience levels. Although some differentiation is already made for engineers through higher entry-level grades, it is totally inadequate and some form of special compensation must be developed.

The second crucial area of competition is at the senior technical manager level. Most of these laboratories and centers involve guiding several hundred to several thousand personnel and several hundred millions to billions of dollars of effort. To expect that the government can acquire and retain the level of professional technical management capability necessary to guide these efforts without special compensation is unrealistic. At least a few positions in each laboratory, R/D center, or major technical activity should be designated for special salary provisions. This would not be expensive (for example 300 positions with an average of \$10,000 per year differential would total 3 million/year). It would demonstrate that the government

valued what it was asking these centers to accomplish and the advantages would be amplified manyfold by improved motivation and morale of the 60,000 to 100,000 person work force.

4.1.5 Laboratory and Technical Directors Should Have Tenure

Laboratory Directors and Technical Directors should have substantial tenure positions. It would be desirable that they stay at least 3 years. Corporate memory is a problem for the laboratories and is one of the most criticized aspects of laboratory management by industry.

4.1.6 Expand Student Support Programs

There are also several important actions involving improved educational opportunities which should be undertaken to help recruiting and retention, improve the competence of the work force, and foster a quality professional environment. No one action is critical but the collective emphasis on the recruiting, retention and improvement of quality personnel is crucial:

- Student utilization programs should be expanded. Co-op programs have proved to be excellent for recruiting high quality young engineers. These programs should be expanded. Where possible, hiring graduate students on a part-time basis should also be increased.
- The Services should increase their use of the ROTC program to acquire scientific and engineering officers.

- Post baccalaureate graduate fellowships for defense science and engineering employees should be expanded, again with a suitable post education commitment.
- There are a few areas of specialization in which the DoD needs call for targeted post-graduate education with the post education work commitment in industry. The Air Force and Army already have such programs in cooperation with industry for thermionic tubes, aero-propulsion vertical lift technology, and other areas. This is a useful approach and expansion should be encouraged.
- A new initiative recommended is that the Services and Defense Agencies should also establish an auxiliary "Defense Engineering Training Program" patterned after the ROTC program. The last two years of college should be supported with a two-year post-education commitment in a civilian defense engineering job. Summer employment opportunities should also be included in this program.

4.1.7 Provide Consistent DoD Policy

Finally, nothing will do so much for the work force and its management as responsible OSD and Service management. If the lab directors and work force had confidence that senior DoD leadership had a clear direction and objectives and that this leadership were prepared to stand firmly for

programs and actions which placed highest values on the primary purpose of creating a Defense capability, it would do wonders.

4.2 STREAMLINE PROCUREMENT PRACTICES

The present practices by which laboratories and R/D centers presently procure material, computers, and services cannot be rationalized. They create massive, unproductive efforts. They cause unnecessary and extensive delays which produce deficiencies in capability, which are usually not recognized or quantified by those enforcing the procurement practices. They violate the good sense of all participants. They cause extensive waste in the industrial sector. No one will defend them as they are.

These judgements are true for the whole acquisition process of the DoD (which is generally better than the rest of the federal government) and thus the laboratories cannot be expected to be extricated completely. However, there are some steps which would substantially reduce the burdens and delays on a large group of small R/D procurements, which constitute a very large percentage of the actions undertaken by the laboratories.

4.2.1 Improve Procedures for Small Contracts (Less Than 500K)

This review was not extensive enough to do a complete job of defining all of the steps needed to improve the procurement process. It is a vast labyrinth of laws and regulations which are intertwined with a language which tends

to keep all but lawyers and contract administration specialists intimidated. However, there are some initiatives which can be reasonably identified.

- The "Determination and Findings" threshold should be raised. Congress has now authorized this to be raised from 100K to 5 million. The Services should assure that the majority of this flexibility is delegated down to the laboratory and R/D center director.
- Special fast-track contracting procedures should be streamlined further for R/D procurements under 500K. Congress has already assisted in this by raising the level above which pre-contract certification is required to 500K.

4.2.2 Relax Technology Base Obligation Constraints

Obligation and expenditure constraints should be relaxed for technology-based efforts. The pressures to assure a complete expenditure profile has placed extraordinary constraints on the contracting processes of the laboratories. While this pressure may have a rational basis over the whole investment account, it is inappropriate for the relatively small and numerous contracts of the technology base effort.

4.2.3 Select Study Group to Review Small Procurements

These recommendations, even if completely implemented, are not intended to be complete and they are not

enough. The constraints of the contracting process have gotten out of control and it is recommended that a special team of contract administration specialists be identified to specifically address what can be done to improve the situation for small R/D contracts.

4.3 MODESTLY INCREASE THE RATE OF MODERNIZATION OF FACILITIES AND EQUIPMENT

The laboratories appear to be somewhat more deficient in modernization than the rest of the defense establishment, and less well represented in the resource allocation process. While the life or death of the lab system does not ride on this issue, the labs should be allocated a larger share of the available money for facilities and equipment.

4.3.1 Support LMTF Recommendation on Facilities

Many of the facilities are substandard, inadequate, obsolete, or energy inefficient, and they need to be updated. Also, advancing technology in new programs will require appropriate facilities and new facilities need to be provided to the laboratory community. The Laboratory Management Task Force under USDRE recommended that significant monetary investment in R&D facilities for each Service should be insured over the next 10 years. They sought to have the DoD establish a laboratory facilities modernization policy such that replacement could take place in a timely manner and could be tailored to the characteristics of the laboratory systems in each Service. About \$70 million each year for each service over the next 10 years would be required. This recommendation is supported.

4.3.2 Support LMTF Recommendation on Equipment

The general purpose equipment posture of the laboratories is similar. The Laboratory Management Task Force recommended that the DoD modify existing regulations (in this particular case, DoD Directive 7410.4) to permit depreciation charges at appropriate laboratories. Also, they suggest that DoD establish a laboratory equipment modernization policy to insure that general purpose equipment is replaced or acquired in a timely manner. To accomplish this, the Laboratory Management Task Force suggested that each Service have an equipment modernization program of at least \$25 million to \$30 million each year for the next 10 years. This recommendation is also supported. These facility and equipment modernization programs are necessary if the DoD Laboratory system is to remain competitive in high technology area.

4.4 IMPROVE THE DoD/UNIVERSITY RELATIONSHIPS

A series of actions are recommended to support the goal of improving the DoD University connection;

4.4.1 Support DSB Recommendations to Increase University Support by Defense with Associated Equipment Modernization

This recommendation has been put in place by putting \$30 M into the FY83 budget (\$10 M per service for the next 5 years for a total of \$150 M). This should be dealt with by the Services under the cognizance of DoD to insure that the university equipment is well utilized and that the

program does not become a source of funds for things like oscilloscopes and equipment that could well be purchased by the university. These should be items that are of high interest which provide quality facilities for universities to do DoD research. This equipment needs to be funded within the university community, in part because in years of declining budgets within DoD, the DoD support for university facilities was lacking. This was true in the laboratories as well and is discussed in Section 4.3.

4.4.2 Support DSB Recommendation to Establish New S&E Fellowships

The DSB recommended the establishment of new scientific and engineering fellowships in the universities. The DSB recommendation included a \$15,000 stipend to the student during the time that he is involved in the university education process. The fellowships will help get post-graduate education on its feet and will help the universities develop a faculty and develop areas of expertise such that it will be possible for the university community to be preeminent in science.

4.4.3 Continue the Dialogue Regarding the Security of Intellectual Property

The issue of secrecy regarding scientific and technical information relevant to the creation of military capability is a potentially divisive issue between the DoD and the academic sector. The problem is a broad one and extends well beyond the laboratory interface with universities. It is of critical importance to this interface,

however, and it is imperative that a dialogue continue between all parties in pursuit of a rational solution.

4.4.4 Expand Student Utilization Programs

The student utilization programs should be expanded. Co-op students are good sources of new people for the laboratory community. Once people are involved in the laboratory in the summer co-op programs, they generally will at least consider the laboratories favorably when looking for a job after graduation. Along the same lines, graduate student hiring should expand. In this case, the university graduate students can work part time in the DoD laboratory, obviously if it is close to the university.

Another area of student utilization programs is research assistanceships. The Air Force and the Army both offer research assistanceships which are essentially fellowships whereby the student is given a stipend but he does not have to spend any time in the Service or in the Civil Service. These assistanceships are in areas of critical need for the Service. The Army has programs in helicopter aerodynamics and helicopter design, the Air Force has programs in thermionic engineering, composites and propulsion. These programs are designed to build up the technical expertise of the country so that the DoD will have access to such expertise and that there will be people who can be called on as consultants from private industry to work on difficult or time critical problems.

4.4.5 Establish a Two Year Undergraduate Program for Civilian Employment Patterned after the ROTC

In addition to the DSB suggested increase in the ROTC programs, a two-year undergraduate program should be established for the last two years of college, providing an engineering degree while requiring DoD employment for two years afterwards. This would essentially provide the same benefits as the ROTC program, except it would appeal to those who are not sure they want to serve two years in the military, but would like to serve two years in a Defense position. This may provide a different kind of incentive to university people in their junior and senior year which might also entice them to stay on with a DoD technical activity. This seems like a particularly good idea at the lower experience levels where the Services need to recruit quality people, but have problems in that industry is offering much higher salaries than the DoD can offer.

4.4.6 Increase DoD and University Emphasis on Industrial Education Related to Logistics and Manufacturing

Some of the DoD deficiencies in our logistics and manufacturing techniques are derived from the more general national problem of lack of emphasis and shortage of skilled personnel in this area. The DoD and universities should work together to enhance the prestige of these critical professions, enhance the curricula in the universities, and increase the number of students being trained.

4.4.7 Establish Defense Centers of Excellence with Universities in New Technology Areas

There should be Defense centers established with universities in new technology areas. These new technology

areas would include simulation, micro-electronics, artificial intelligence and software research and automation. These new technology areas are ripe for starting new curricula in universities. They would be multidiscipline in nature and cross departmental. However, there must be a mutual need to establish a center of expertise with university help and university participation. This idea seemed to work well where the Army's Corps of Engineers' Construction Engineering Research Laboratory is co-located with the University of Illinois and the Cold Regions Research and Engineering Laboratory is at Dartmouth College. Both of these have a benefit for the university and the Service. Laboratory people co-located can use the same facilities and provide an interchange between the day-to-day practical problems of the Defense Department with the perhaps more theoretical aspects of the university and the faculty research programs. Expanding into new areas provides a good method for increasing the involvement of universities in DoD research and development, but it does it in a way that involves the faculty, the students and the DoD researchers as a team.

4.5 ESTABLISH EXTERNAL ADVISORY GROUPS FOR EACH LABORATORY

The Services and Service labs should be encouraged to establish external advisory groups drawn from industry, universities, and operational command representatives. Although the interaction with such groups brings with it a substantial investment of time and energy and there can be a conflict of interest issues. They can:

- Bring external competence to the problems of the laboratories;

- Be a source of new ideas and perspective;
- Provide a valuable component of corporate memory for a laboratory, and;
- Assist in providing visibility to lab activities for industry and academia.

The value of these contributions can be great and well worth the investment. It would be natural for these to be formed under each service science advisory board and to participate in the effectiveness review recommended elsewhere in this report.

4.6 ESTABLISH AN EFFECTIVENESS REVIEW PROCESS FOR THE LABORATORIES

A number of benefits would result from the creation of process for external expert review of the laboratories and R/D Centers every 3-5 years.

The basic objectives of this initiative are:

- To provide a routine and credible means of assessing the health of each laboratory and research, development and acquisition process in which that laboratory is imbedded;
- To provide an additional mechanism for visibility of the DoR R/D activities by industry, the universities, and operational military representatives, and;

- To provide a channel for the display of in-house direction and work to nationally recognized experts.

The USDRE should task the Defense Science Board to establish a permanent panel to develop the criteria to be applied, define the process of review, and monitor the implementation. The Military Departmental Scientific Advisory bodies should be the primary means used to review Service laboratories and DSB should take the lead for any other laboratory or technical activities to be covered by this process. In order to prevent unnecessary duplication, the individual advisory bodies for each laboratory, recommended elsewhere in this report, should be employed.

4.7 IMPROVE INDUSTRIAL VISIBILITY OF LABORATORY ACTIVITIES

One of the major complaints of industry is that the laboratories too often compete with industries in areas where industry can perform. They further feel that this competition comes from a privileged position in terms of decisive influence and access to information. They note that industry provides detailed reviews of their independent research and development; whereas, the laboratories rarely provide such a view to industry.

In many aspects there is no way to avoid the special decision role which the labs must play and their privileged access to government intentions and information is necessary. Nevertheless, these complaints have a major element of truth behind them. Even though they are often

extrapolations of isolated experiences, actions can and should be taken to reduce the sometimes unnecessarily adversarial nature of lab-industry interactions.

- A principle initiative should be an annual publication by each DoD laboratory describing its in-house R/D activities as a counterpart to industry's R&D technical plans. There are limitations to this symmetry, of course, since the government must control access to sensitive information. Thus, the laboratory publications can only go as far as practical at the unclassified level.
- Industry participation in laboratory advisory groups and evaluation reviews will also provide some improved accountability of government interactions and activities.
- Industry participation in the development of the operational concept projection recommended elsewhere in this report will be helpful as well.

4.8 DEVELOP A FORMAL PROCESS FOR AN OPERATIONAL CONCEPT PROJECTION AND APPLICATION

In order to sensibly evaluate and prioritize DoD efforts to create and apply technology to the problems of national defense, it follows that we must have some notion of the nature of the military operations to which these applications might be applied. The Defense Science Board Summer

Study panel on technology base found this logic appropriate in the methodology they used to identify technologies with potential for "order-of-magnitude" changes. Under the term "Scenario projection," they developed a brief description of some of the most relevant features of how military operations might be conducted in the 1990's in order to assist in the prioritization of new technology opportunities. The Department of Defense should now undertake to develop and maintain a more complete and rigorous document which would project technology opportunities and likely future military operational concepts in a form which would be useful in guiding technology development and application.

The existing procedures for developing and stating required operational capabilities are both essential and useful, but also inadequate to project the nature of military operations ten and twenty years into the future in language useful for making technology management decisions. Yet, that is the time of operational maturity for the weapons and systems which will be generated through application of technology choices of today. The operating commands are not properly staffed to assess and project the combination of technology opportunities and operational procedures which together are likely to form the operational concepts of the future. The laboratories are not charged with this responsibility and find it difficult to participate in the operational requirements process. Present Service staffs attempt through various techniques to make this projection and do so with some success. However, where new concepts might cross Service (or Allied) boundaries, or cause a substantial change in roles, missions, or doctrine, these techniques are severely limited and have not proven to be adequate.

There also exists a widespread conviction that the overall DoD capability to plan, project, and strategize with consistency is not adequate. This, of course, makes it more difficult for subordinate functions such as technology managers to do consistent planning within a larger effort. This initiative is not recommended as a means of solving the broad Defense planning and projection problem. Rather, within the vagaries that will always exist to some extent in our top-level planning, this projection of likely operational concepts is intended to assist in forcing technology choices to be focused on a value system of operational utility.

The Secretary of Defense should task the Defense Science Board to supervise the preparation of this projection and to update it every two years. The DSB is an appropriate body because it is the premier advisory body to the Secretary of Defense and has within its membership nationally recognized leaders in scientific, industrial, and military thinking and can mix that membership with active government, military and civilian leaders. This mixture of separate professions and competencies has been, over the years, a dominant force in influencing (in many ways) how our defense establishment is structured. It is important to capture their judgment in an orderly manner for the purpose of building a consensus strategy to create and apply new technology.

Finally, a small, permanent supporting staff should be organized as the secretariat for this effort. It should be contained within the new Center for Strategic Concepts Development now being organized at the National Defense University to increase their emphasis on the military operational arts. Assignment of this responsibility should provide some useful synergism and complementary emphasis.

The "Operational Concepts Projection for Technology Management" should be submitted to the Secretary of Defense by the DSB after it has been reviewed and commented on by the Joint Chiefs of Staff, Unified and Specified Commands, the Military Services, appropriate Defense Agencies, and OSD Staff elements.

4.9 EXPAND LABORATORY RELATIONSHIPS WITH OPERATIONAL FORCES

One of the most common criticisms of the laboratories is the apparent lack of coupling between what the laboratories are doing and sponsoring and the needs of operational commands. This judgement is reflected in many forms:

- Those who have the opportunity to observe our forces often note that these forces are not modern in many ways and that very reasonable application of newer technology could have great leverage. They conclude, therefore, that the transition process is not working well.
- There has been an increasing awareness that some of the sources of major weakness in our operational forces is lack of reliability, maintainability, and supportability of equipments being provided. Nevertheless, the primary drive from the laboratories and the program managers often seems to be the application of new science and new technology to improved technical performance without emphasis on manufacturing and logistics.

- Many of the more contemporary advances in military force capability involve the application of technology and highly technical systems skills to the force management problem(C³), to the application of signals in military operations (EW), and to the application of intelligence and sensor products to support platform and unit maneuver and weapons control.

Most laboratories are organized around an engineering function, a military platform, or a producible commodity and are not as capable of dealing with the whole and the connecting networks involved in grouping these all together with men and procedures into a command organization to create a force.

- There are great opportunities to apply available technology and competent technical judgment to the systems and forces now in the field with great leverage. However, we are organized primarily to bring new technology into the field through the developments of new systems, not the application of new technology to existing systems. Product improvement of fielded forces could be enhanced significantly if we recognized that product improvement and logistics support are truly sophisticated technical functions, worthy of our finest and most innovative people. Both organizationally, and culturally, we need to recognize and foster these useful applications of technology in support of military forces for there are great

opportunities available. These opportunities can often be less expensive, more quickly implemented, and more rapidly integrated into the operational, maintenance, training, and support environment of the forces.

The objectives of this initiative are:

- To improve the laboratory awareness and understanding of the operational concepts which their scientific and engineering efforts are supporting;
- To illuminate the reliability, maintainability and supportability issues for both the laboratories and the commands they ultimately support;
- Provide an improved channel for laboratory and command cooperation in fielded product improvement, and;
- Provide an improved mechanism for the evolutionary application of technology to improve command C³, EW, and intelligence application.

To accomplish this, the unified, specified, and subordinate component commands should be given modestly sized technical staffs, some development funds, and the responsibility for the definition of and, on a limited scale, the acquisition of evolutionary force improvement through field system modifications and improved coupling or netting of assets.

The command technical staffs should be formed from the personnel from the laboratories under personnel administration and career management of the laboratories but operating as an integral part of the commander's staff. The Services should take the responsibility for providing these staffs and the funds for the specified Service component commands perhaps through a designated lead laboratory. USDRE should arrange for Unified Command needs through the Service and Defense Agency laboratories and technical centers.

4.10 STRENGTHEN THE SERVICES LOGISTICS R&D PROGRAMS

One of the most pervasive problems of fielding a modern force with the new technologies available is the logistics tail associated with the new systems that are developed and produced. The underlying issues have a sophisticated technical content but we have inadequate mechanisms to bring to bear the best technical minds to this subject. The logistics and supply organizations of the services are trying to develop better capabilities and techniques but it is slow, in part because of the tendency to view logistics as a less sophisticated and less glamorous career than the design of new systems. Historically the laboratories have been aimed primarily at the application of new technology in the development of new systems with improved technical parameters. Thus, the focus on logistics has been secondary at best.

This review did not reveal any new, well ordered set of actions by OSD to resolve the situation. It would be inappropriate, however, to take no action towards improvement. It is also clear that any decisive action must be taken by the Services because the logistics function is

completely embedded in the Services "organize, equip and train" role.

It might fairly be argued that the issue is not primarily a "laboratory issue" except that the laboratories, as presently constituted, do play an important role in the early phases of development of a new system. It has also been argued that new logistics laboratories are needed by each service. This review did not develop enough data or testimony to recommend either for or against this latter suggestion.

It is recommended, however, that each military department be tasked to establish a formal "Logistics R&D Program" with appropriate program element and program management structure and report back to the Secretary of Defense their plans for the conduct of such a program. These programs should at a minimum cover diagnostic techniques, weapons system logistics analysis, automated documentation, advanced maintenance concepts, and logistics management and control systems.

4.11 EXPAND TECHNOLOGY DEMONSTRATIONS

The tremendous development of new technology in the past 30 years has brought rapid increases in new capabilities for weapon systems, but often accompanied by increases in sophistication and complexity. This is particularly true in electronics, not only in the radar and radio world, but also pervading every major weapon system in the form of chips and sensors. These increases in capability, sophistication and complexity require new ways of doing business for the DoD laboratories, for the industrial community and for the Armed Forces.

Too many problems appear after the engineering development process has been initiated. Problems of technology, reliability, producibility, and useability begin to show up and result in dollar and schedule overruns. Often major changes can be made in a relatively simple manner and at low cost when caught early, sometimes even small changes are difficult and expensive to achieve when made at the end of the cycle.

The transition to full scale engineering development is not only a critical point in the development cycle, but unfortunately, is where disconnects usually occur. It is often at this juncture, that the DoD lab transfers a great deal of in-house activity to industry. It is also at this point that the need to develop a method to best fit the needs and concepts of the operational military plans is most critical.

The demonstration and evaluation of critical technologies in an operationally relevant form can often be a useful means of helping to assess the appropriate mode and the military value of a technological application. However, these demonstrations can be expensive and are often not undertaken by the military Services in favor of other needed and less risky applications of resources.

Senior DoD management has historically disagreed with this priority judgment by the Services and has found it convenient to use DARPA as a primary vehicle for such critical technology demonstrations. While this has produced some salutary results, it has also produced some antagonisms between some elements of the Services and DARPA which have

worked against the end objective of fair evaluation and ultimate transition of the technology in question into operational capabilities.

The objectives of this initiative are:

- To provide a mechanism for evaluating and prioritizing critical technology demonstration efforts;
- To increase the level of Service critical technology programs, and;
- To reduce the sources of conflict between DARPA and the Services.

It is recommended that \$300-400 million be set aside by USDRE to be used to support the most worthy proposals for critical technology demonstrations submitted by the Services and Defense Agencies, including DARPA. Operational and Training Commands should also be encouraged to develop proposals for in-the-field demonstrations particularly in support of the C³ and Electronic Warfare functions.

4.12 ESTABLISH A DEFENSE CENTER FOR SIMULATION RESEARCH AND DEVELOPMENT

Advances in modern computer and display techniques make it possible to develop and perform simulations of military systems and operations with a power and realism heretofore unachievable. This is true at the weapon level; platoons and small units; for large unit exercise and tactics

development; and for large campaign representation and doctrinal development.

The need to simulate these various levels of military activity has also increased because;

- The price of energy and the cost of weapons operations have escalated such that sustained live practice and training is often prohibitively expensive. As a consequence, we have a large percentage of our uniformed service men unpracticed in the use of weapons we paid dearly to acquire and we depend on for our security.
- We need ways to develop military operational experience without engaging in conflict. Too much of our practiced doctrine and concepts, particularly at the theater and tactical level, are dominated by lessons learned in WWII, Korea, Southeast Asia, and Mideast conflicts. All agree that none of these are representative of most future conflicts involving U.S. forces. Strategic force planners long ago learned to depend on analysis, exercise and simulation to define the rules of combat in regimes never experienced by man. Theater and tactical level planners must do the same and an increased capability to simulate will make this possible.

The art and practice of simulation has a strong part in present military service practice and is an expanding area of interest and investment. It is, properly, distributed to many different developmental and operational activities in order to tailor the application of simulation

techniques to the needs of the particular training or operational commands. This has, however, fractionated the effort with the resultant lack of focus on generic research, common development, maintaining a repository of information about the state-of-the-art, and, most importantly, the development of a community of skilled professionals in the simulation discipline.

This recommendation proposes the establishment of a center of excellence for the application of simulation techniques to the military arts. The objective is the creation of an institution which would insure the continued development and improvement of our skills, capability and practice of military system and force simulations. There are a variety of organizational options to achieve this objective and this review was not sufficient to advocate any particular course of action. However, some elements of an adequate approach include;

- Close association with one or more universities. The context of a simulation program should be very compatible with the aims and capabilities of several universities. This association should be of value to all parties.
- The creation of a private sector organization (such as or similar to the Applied Physics Laboratory of Johns Hopkins University) as a core work force for the development of long-term, professional quality in simulation techniques.
- The constraint of the center to research, equipment and technique development and acquisition,

and technical support to operational and training activities. This role as an organization designed to develop techniques and promote professional technical expertise should dominate rather than act as a bureaucratic coordination or management role function.

A major issue with this recommendation is whether any new organization should be formed around or even include the existing training equipment activities of the Services. They certainly form a large existing body of competence, albeit limited in scope, from which to grow such an organization with its expanded role. Conversely, one can be concerned that development of this broader role might become subordinate to the on-going needs for fielding equipment already defined. In spite of this latter risk, proceeding from the base of these training equipment establishments is recommended.

An ad hoc group should be formed to develop a more detailed implementation plan to form a Defense Center for Simulation Research and Development located with the Naval Training Equipment Center and the Army Program Manager for Training Devices. The Air Force should also establish a larger presence at Orlando as a part of this action. Some additional resources may be required but for the most part the new thrust should be created through private sector organization preferably with a university association. An opportunity for a mutually attractive association may exist at Orlando with the University of Central Florida.

Executive responsibility for the center, which should be defense - wide in scope, should be given to the

Commander NTEC who would respond for these new responsibilities to policies and with resources provided through an executive council of service and agency representatives, chaired by a senior OSD official.

4.13 ESTABLISH A NEW CENTER FOR MICRO-ELECTRONICS AND
COMPUTER SCIENCE

The remarkable advances in micro-electronics devices, new sensors, large computers and display systems have created profound new technology opportunities in defense systems. The proliferation of breakthroughs in these areas apply to almost all aspects of military systems acquisition, integration, and operations. It would be fair to say that the maintenance of an effective U.S. military force in the future depends, in large part, on the competence we develop and the judgment we use in the application of these technologies to our Defense and National Security Systems. However, the competence and dynamism of the existing defense institutions and their relationships with industry are clearly inadequate to address the problem with the urgency required. The need to develop this competence and the institutional mechanisms to translate these technologies into operational systems and practice is so overriding that additional extraordinary management initiatives are appropriate.

There is an awareness of the pervasive impact of these phenomena throughout the whole defense community including the existing laboratories and R&D centers. It is not for lack of conviction that the Defense technical community is inadequate in this area. However;

- The government personnel system cannot compete with the private sector for the new skills needed;
- The governmental process for capitalizing new industrial capabilities through its military construction and general purpose equipment programs is far too slow to respond to this rapidly changing area;
- Many of the high-leverage applications address the integration of separate systems to form operational forces. Our collective ability to manage the injection of new technologies into these integration functions such as command and control, electronic warfare, and application of sensor products is extremely difficult, and;
- This proliferation of breakthroughs in the new micro-electronic phenomenology and devices has not been accompanied by parallel breakthroughs in our ability to develop, test, and maintain the necessary software. The need for automated and fault-tolerant design techniques and efficient testing of micro-electrical systems is recognized by both the government and the private sector, but both feel very much behind in their ability to support the software aspects of the problem.

The objectives of forming a new center for micro-electronics and computer science are:

- To create an institution capable of acquiring and retaining the requisite personnel and facilities needed to create and sponsor the creation of new technologies and techniques for Defense needs in the areas of;

- very high speed and density devices,
- artificial/machine intelligence,
- signal processing,
- software development and automated design and test,
- new generation Defense oriented computation systems,
- and to assist in the application of these technologies and techniques into operational systems and practices.

There are a great variety of organizational alternatives by which these objectives might be met. During the course of this review several were briefly evaluated including:

- Expand the role of a single existing service laboratory under a Service executive agent arrangement (an example would be the Army's Electronic Technology and Devices Laboratory at Fort Monmouth, New Jersey);
- Expand the role of one center in each Service;
- Expand the role of one or more non-government center such as SANDIA, APL, or Lincoln Labs, and;

- Create a new institution with a variety of optional forms;

- primarily government manning capitalization,
- primarily non-government,
- primarily university: one or many,
- various mixtures of government, non-government, and university.

A new institution formed primarily of non-government personnel is recommended. This will provide the best environment for recruiting and retaining the personnel skills necessary to create a center of excellence in these fiercely competitive areas. The creation of a new, defense-wide center in this field along with existing Service and agency laboratories will require careful delineation of responsibilities. However, this should be quite practicable. The area is worthy of increased effort and the Services need their own institutions to aggressively translate these new technologies into the forces.

This study could not give the time and talent necessary to define a specific organizational approach for this new center. It is recommended that the USDRE should establish a separate ad hoc group with membership especially competent in this field to develop the detailed plans, directives, and perhaps legislation needed to proceed.

4.14 FORM AN ELECTRONIC WARFARE TECHNIQUES DEVELOPMENT CENTER

Advances in technologies such as propulsion, materials, micro-electronics, communications, and information

handling have created new weapons and supporting systems which have profoundly affected the nature of modern military operations. Munitions are more lethal and delivery systems can deliver them farther, faster and more accurately. This requires, and technology permits, more precise target acquisition at greater distances, and the control of both weapons and sensors at a distance. All of these trends have caused a fundamental dependence of modern military weapons and forces on electronic and signaling techniques.

Under the functions labeled "Electronic Warfare," "Signal Warfare," "C³ Countermeasures," "Radio Electronic Combat" and/or "Electronic Combat," modern military establishments are developing capabilities to maneuver in this new regime of military operations. For the U.S. and its allies, the processes for specifying and acquiring the hardware needed is most advanced, but their ability to integrate this hardware into effective operational capabilities is not as well developed. The Soviet Union, however, has placed much greater emphasis on the operational concepts and institutional structures necessary to achieve this integration under their "radio electronic combat" functions and organizations.

The objective of this initiative is to strengthen the DoD capability to develop and apply new electronic warfare techniques. To do so it is proposed that a strong systems engineering capability be added to the Joint Electronic Warfare Center in San Antonio to complement existing science laboratory efforts. At present, the JEWEC consists of approximately 140 personnel who are primarily non-technical with strong intelligence or operational backgrounds. In order to develop the new techniques appropriate for modern forces in future operations, it is necessary to include both

the potential of advanced technology as well as operational concepts and doctrine.

By making a substantial addition to the ability of the JEWEC to address both the technology and operational aspects of electronic warfare, it can markedly improve its ability to develop such products as:

- Joint EW procedures and techniques,
- Analysis evaluations of alternative EW methods and techniques,
- EW simulation capabilities and results,
- EW test and evaluation proposals and evaluations,
- Technical support to operational and training commands, training, and exercises.
- EW data bases.
- A library or repository for EW related information and techniques.

This technical strengthening of the JEWEC is not intended to, nor should it, compete with the Service efforts which are primarily hardware oriented. The JEWEC should focus on joint techniques, new combined technology-operational techniques, and test and evaluation support. It will require the JEWEC to be charged with an on-going responsibility for these functions and not merely respond to the tasking of others as is now generally the case.

4.15 ESTABLISH A FORMAL COMMAND AND CONTROL RESEARCH PROGRAM AND CENTER

Many of the technology and operational trends which support aggressive actions to strengthen our Electronic Warfare capability also support the need for increasing our

application of technical skills to the function of command and control. The objective of this initiative is to accelerate that process at the research end of the creative process through the development of analytic concepts and rigor in the command and control field. It is completely consistent with the DSB report of 1978 on C³ acquisition.

A modest Command and Control Research Center should be established at the Naval Postgraduate School as a companion organization to the NPS C³ postgraduate activity. This center should perform and sponsor C² research which should include aspects of:

- Control theory
- Game theory
- Quality theory
- Utility theory
- C² modeling and simulation.

The center should not be capital intensive but rather should depend on the C³ postgraduate facility, service test bed facilities such as exist at NOSC, and live field environments for their research facility needs.

In addition to the C³ research aspects treated above, there is also a need for additional emphasis on the application of technical judgment to the development and acquisition of new command and control capabilities. However, these processes are fundamentally evolutionary in nature and this evolution which must be controlled from a position embedded in the command function. Therefore, strengthening these aspects is best accomplished by establishing a strong configuration management function within the

operational commands. The initiative treated elsewhere in this report to strengthen our command relationships could thus be an important assist in the command and control area.

APPENDICES



RESEARCH AND
ENGINEERING

THE UNDER SECRETARY OF DEFENSE

WASHINGTON D.C. 20301

3 SEP 1981

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
DIRECTORS OF DEFENSE AGENCIES

SUBJECT: Review of DOD Laboratories - ACTION MEMORANDUM

In several recent examinations of the Defense research and advanced development process, the government laboratories which guide that activity, and the associated scientific and engineering work force, there is recurring evidence that the long-term health of the laboratory structure is in jeopardy. I am therefore initiating an intensive, high-level review of DOD laboratories to be undertaken under the direction of Dr. Robert Cooper. Dr. Cooper has asked that this effort be headed by Dr. Robert Hermann, 695-0578, who will be supported by a small ad hoc task force staff and a senior outside advisory group. The date for completion will be March 1, 1982.

The objective of this effort is to identify those high leverage actions which we need to take to insure the long-term health of a sound DOD laboratory structure. At minimum, the product of this review will address:

- . how the laboratories and their products are used,
- . personnel practices,
- . procurement practices,
- . the laboratory management structure and process.

Your support and participation is requested in these areas.

. The Services should identify a qualified officer or civilian to serve as a member of the task force staff from September 1981 through March 1982.

. All should provide a point of contact to work with Dr. Hermann to facilitate laboratory visits, data gathering, and product review and coordination.

cc: Dr. George A. Keyworth

STUDY GROUP PARTICIPANTS

The following individuals were members of the study group:

Study Group Leader:

Dr. Robert J. Hermann	- Special Assistant for Intelligence to the Under Secretary of Defense for Research and Engineering
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Army:

Mr. James A. Bender	- Director, Tech-Planning and Management Directorate, DARCOM
Mr. James E. Spates	- Ass't Dir. for Laboratory Activities Directorate of Army Research
Dr. Ravinder K. Jain	- Chief, Environmental Div. Construction Engineering Research Lab Champaign, Illinois

Navy:

Dr. Theodore A. Jacobs	- Dep. for Tech. Base, Office of Ass't Sec. of the Navy for Research
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Air Force:

Col Richard H. Hartke USAF	- Vice Commander, Air Force Office of Scientific Research
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DARPA:

Mr. David T. Petter	- Executive Ass't to the Director, Defense Advanced Research Projects Agency (DARPA)
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In addition, the following individuals were of great assistance to the study effort.

Dr. Bernard A. Kulp

- Scientific Advisor to
the Director of Laboratories
Air Force Systems
Command

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The study team asked the following four associates for their respective perceptions on the "DoD Laboratory Problem". In each case the association responded with well thought-out and poignant solutions to the problem. Their earnest participation is greatly appreciated. Much of their input directly impacted upon the study recommendations.

American Defense Preparedness Association

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U.S. ARMY LABORATORIES/FACILITIES VISITED

NIGHT VISION AND ELECTROPTICS LAB (NVL)	FT. BELVOIR, VA.
BALLISTICS RESEARCH LAB (BRL)	ABERDEEN, MD.
HUMAN ENGINEERING LAB (HEL)	ABERDEEN, MD.
CHEMICAL SYSTEM LAB (CSL)	EDGEWOOD ARS, MD.
MEDICAL RESEARCH INSTITUTE OF CHEMICAL DEFENSE	EDGEWOOD ARS, MD.
PM TRAINING DEVICES (PM TRADE)	ORLANDO, FL.
ELECTRONIC TECHNOLOGY & DEVICES LAB (ET&DL)	FT. MONMOUTH, N.J.
U.S. ARMY COMBINED ARMS CENTER	FT. LEAVENWORTH, KS.
COMBAT SURVEILLANCE AND TARGET ACQUISITION LAB (CSTL)	FT. MONMOUTH, N.J.
LARGE CALIBER WEAPONS SYSTEMS LAB (LCWS)	PICATINNY ARS, DEL.
FIRE CONTROL AND SMALL CALIBER WEAPONS SYSTEMS LAB	PICATINNY ARS, DEL.
U.S. ARMY MISSILE LAB	HUNTSVILLE, AL.
ELECTRONIC WARFARE LAB (EWL)	FT. MONMOUTH, N.J.
COMMUNICATIONS ELECTRONIC COMMAND (CECOM)	FT. MONMOUTH, N.J.

U.S. AIR FORCE LABORATORIES/FACILITIES VISITED

ROCKET PROPULSION LAB (RPL)	EDWARDS AFB, CA.
ROME AIR DEVELOPMENT CENTER (RADC)	GRIFFITHS AFB, N.Y.
NORTH AMERICAN AIR DEFENSE COMMAND (NORAD)	COLORADO SPRINGS, CO.
WRIGHT AERONAUTICAL LABS	WRIGHT PATTERSON AFB, OH.
MATERIALS LAB	
AVIONICS LAB	
FLIGHT DYNAMICS LAB	
AEROPROPULSION LAB	
AERO-MEDICAL RESEARCH LAB	WRIGHT PATTERSON AFB, OH.
HUMAN RESOURCES LAB DETACHMENT	WRIGHT PATTERSON AFB, OH.

U.S. NAVY LABORATORIES/FACILITIES VISITED

NAVAL UNDERSEA SYSTEMS COMMAND (NUSC)	NEWPORT, R.I.
NAVAL TRAINING EQUIPMENT CENTER (NTEC)	ORLANDO, FL.
NAVAL OCEAN SYSTEMS CENTER (NOSC)	PT. LOMA, CA.
NAVAL WEAPONS CENTER (NWC)	CHINA LAKE, CA.
NAVAL RESEARCH LAB (NRL)	WASHINGTON, D.C.