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Report of the Defense Science Board
Gun System Acquisition Review Committee

OCTOBER 1975

**OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH
AND ENGINEERING
WASHINGTON, D. C. 20301**

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Report of the Defense Science Board

GUN SYSTEM ACQUISITION REVIEW COMMITTEE

October 1975

Office of the Director of Defense Research and Engineering
Washington, D. C. 20301

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OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

20 November 1975

MEMORANDUM FOR SECRETARY OF DEFENSE

THROUGH: DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

The Defense Science Board's Review Group on the Gun System Acquisition Process has completed its assessment of the principal findings and recommendations of recent studies of the Army gun development and acquisition system. The final report is hereby submitted.

The recommendations of the DSB Review Group are presented in the final section of the report.

Solomon J. Buchsbaum
Chairman
Defense Science Board

[redacted]

OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

25 November 1975

MEMORANDUM FOR THE CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Report of the Review Group on the Gun System Acquisition Process

Submitted herewith is the report of the Defense Science Board Review Group on the Gun System Acquisition Process. Our attention has been devoted to recent studies that bear on the Army gun acquisition system.

The Review Group believes that major changes are required if productivity is to be restored to Army gun development activity. The recommendations of the Review Group are put forward with the intention of encouraging such change.

The Review Group has had excellent cooperation from the Army during the preparation of this report. We have discussed our conclusions informally with Lt. Gen. Cooksey and other Army representatives on September 26.

John M. Deutch
Chairman, Review Group on
the Gun Acquisition Process

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

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I. Introduction

The Secretary of Defense and the Director of Defense Research and Engineering have been concerned about the limited success the Defense Department has had over the past decade in developing and fielding advanced gun systems. Gun systems are defined to include small and medium calibre arms, air defense guns, artillery, naval guns, tank cannon, and aircraft cannon. Several studies have been commissioned by the DoD recently to investigate the difficulties encountered in the gun acquisition process. On August 21, 1975 Dr. Malcolm R. Currie, DDR&E, requested that an ad hoc group of the Defense Science Board review the principal findings and recommendations of these studies and formulate concrete proposals for a plan to remedy existing deficiencies. The membership of this DSB review group is Messrs. Boileau, DeLauer, Deutch (Chairman) and Steininger. The group has initially limited its inquiry to the Army gun development and acquisition process because this Service has the largest gun development program. Furthermore, the members of the review group are more familiar with the Army gun acquisition system than with the acquisition systems of the Navy and Air Force.

Four recent studies bear on the Army gun acquisition process:

(1) The Army Materiel Acquisition Review Committee (AMARC) Report, April 1, 1974.

(2) The Army Materiel Command (AMC) Committee-Armamant Report regarding establishment of an Armament Development Center (ADC), December 1974.

(3) The final draft Report of the ODDR&E Task Force on Gun Systems Acquisition, August 1, 1975.

(4) The Report of the NASA/DA Task Team on Technical Management of Artillery System Development, dated June 20, 1975.

These studies will be referred to as the AMARC, ADC, GSATF, and NASA study respectively below. The first two studies address the Army acquisition problem generally, the third study is concerned with gun acquisition in all three Services, and the NASA Artillery report investigates all aspects of requirements and development, including technical competence, for a single weapon family, the 155 mm artillery system.

In addition the Army has been of great assistance in making available to the review group, a Decision Memorandum on alternatives for the

Armament Development Center, dated August 25, 1975. This document contains the current status of Army plans to establish an Armament Development Center and thereby improve its gun acquisition process.

II. Common Principal Findings

The studies cited above are largely in agreement in their principal findings. It is not necessary to detail here all of the findings presented in the studies or to reconcile minor discrepancies that may exist. Instead attention will be focused on the salient findings; these are:*

(1) The productivity of the Army gun acquisition community has been inadequate. The GSATF report states that only six new Army gun systems (three are variations of the VULCAN system), have been fielded during the past ten years. This output results from an estimated annual development effort of 4500 man-years which conservatively represents $225M in annual expenditures. /AMARC, ADC, GSATF/

(2) Failure of the Decision Making Process. The length of time required for the Army to develop a new gun system has been judged to be excessive. Frequently the development cycle exceeds seven years, e.g. BUSHMASTER. This excessively long development cycle has been attributed to an overly complicated and indecisive decision-making process. It has been speculated that the origin of this difficulty lies in the absence of agreement within the Army on the appropriate mission for guns and the associated problem of establishing strong ties between the user and development community. Excessive layers of decision making results in changing and/or ambiguous requirements. /AMARC, GSATF, NASA/

(3) Complexity of Organizational Structure and R&D Management. A highly complex and fragmented organization and management structure accompanies the inadequate decision process. So many layers of management exist that a substantial fraction of everyone's time is spent on overly detailed review rather than on new work. This results in a "no trust environment" where "everyone can say no and no one can say yes" which inevitably stifles programs. In the fragmented organizational structure, one finds separate development of fire-control, ammunition, platform etc. so that the gun is never adequately regarded as an integrated system and there is inadequate configuration control. /AMARC, ADC, GSATF, NASA/.

*The studies noted in brackets at the end of each item, mention one or more of the specific points included in the finding.

(4) Program Managers. Career Army officers have not viewed program manager assignments as providing an adequate opportunity for advancement. Inadequate support and authority has been given to project managers. /AMARC, GSATF/

(5) Competence of Civilian Laboratory Technical Personnel. The AMARC, GSATF, and NASA studies have stated that the technical competence in the in-house laboratories is high. /AMARC, GSATF, NASA/

(6) Conflict of Interest Between Industry and Army Laboratory/Arsenal System. There are serious conflicts of interest in the relationship of the Army Arsenal laboratories with industry. Army labs sponsor advanced development, engineering development, and production activities in industry while undertaking the same activities in-house. At the same time the arsenals have an important voice in evaluating competing industry and in-house programs. As funds available for gun development decrease, the arsenal motivation for survival inhibits its objectivity and industry has little opportunity to introduce new ideas. Industry interest in producing and developing guns is disappearing. /GSATF/

III. Salient Recommendations of Prior Studies

The recommendations put forward in the various studies have much in common, and can be summarized as follows:

(1) Establish requirements clearly and provide control over requirement changes. /AMARC, GSATF, NASA/

(2) Strengthen the interaction between the developer and the user; improve technical capability in the requirement and user organizations. /AMARC, GSATF, NASA/

(3) Reorganize and consolidate the Army Gun Development System and thereby:

(a) Improve communication among the technical labs, establish early technical review, and tie the labs more closely to engineering development activities. /AMARC, GSATF, NASA/

(b) Reduce layers of decision-making and management between AMC and the labs. This will help mobilize the technical competence that exists in the in-house labs. /AMARC, GSATF/

(c) Shorten the excessive time required for acquiring prototype gun systems. /GSATF, NASA/

(d) Assure that the gun is adequately regarded as an integrated system in the development cycle; tighten the technical configuration management. /GSATF, NASA/

(4) Place greater reliance on competing prototype design teams and separate the evaluation from the advocate/developer. /GSATF/

(5) Establish a gun system executive in ODDR&E to expedite the gun system acquisition process. /GSATF/

(6) Remove the conflicts of interest between industry and government. The GSATF report proposes that the Army in-house labs should be responsible for preparation of specifications, acceptance testing, and performance evaluation; that, if possible, all prototype design, engineering development and production be

carried out by industry and that technical base work be shared between industry and Army labs. /GSATF/

Only one of these recommendations--the reorganization and consolidation of the Army gun development system--has been translated into a Decision Memorandum for consideration by the Army chain of command. For this reason it is worthwhile to summarize the various reorganizational proposals and the one being recommended in the decision memorandum.

One of the principal AMARC recommendations was that AMC be split into a logistics (readiness) and development (acquisition) command. The rationale for this recommendation was that readiness dominated development considerations in the Army acquisition system. AMARC further proposed the establishment of a new Armaments Development Center, ADC, with arsenal activity (from Frankford, Picatinny, Rock Island, Watervliet, and BRL) consolidated at a single location; only minimum engineering functions, required to support production, would be retained at other arsenals.

The Army which has demonstrated an awareness of the deficiencies in its acquisition system and a willingness to consider change, established the AMC Committee-Armament, chaired by Brig. General B. L. Lewis, (now Major General Lewis, Commanding General ARMCOM), in response to this AMARC recommendation. The resulting ADC study recognized a compelling need to improve and consolidate the armament development and acquisition process. The ADC study recommended establishing an Armament Development Center and, after examining eleven alternatives, it proposed that ADC consist of three systems laboratories--large calibre (> 40 mm), small calibre (< 40 mm), chemical material--and one support laboratory--ballistics research. The preferred alternative involved two sites with the ADC Headquarters, small and large calibre laboratories at Picatinny and with the Ballistic Research and Chemical Systems Laboratories at Aberdeen. It was anticipated that the reorganization would take four years (1976-80) and that there would be a net personnel reduction of approximately 2700 individuals from the present level of 10,500 as well as annual savings at a steady state of approximately $60 M from the present level of $350 M.

The Army Decision Memorandum of the ADC, presently under active consideration, essentially recommends the preferred alternative in the ADC study with the slight modification of retention of the small Benet material research laboratory at Watervliet. The Decision Memorandum confirms the ADC study's judgment that, while a single site alternative remained most desirable for improving the Army's acquisition process,

total consolidation was neither practical nor feasible in the foreseeable future.

It should be mentioned that there is not universal agreement on this reorganization plan. The Artillery Study notes that there are many present difficulties at Picatinny (note, however, that under the proposed plan there would be a 42% turnover at Picatinny) and that the Artillery study recommendations do not require either geographical consolidation or reorganization to be implemented.

The GSATF proposed an entirely different reorganization that did not include a new ADC. The GSATF proposed reorganization, which does not address geographical consolidation, contains two separate chains of command. One chain, for technical base activity (6.1-6.3A), has laboratory directors reporting directly to a Director of Laboratories in the office of the Assistant Secretary of the Army (R&D). The second chain, which includes engineering and systems development programs, would report to the Deputy Chief of Staff (RD&A) through AMC. The primary functions of the laboratories would be to develop new technology and provide technical support to the systems development programs.

IV. Observations of the DSB Review Group

The common findings naturally lead one to consider draconian measures to remedy the situation and restore productivity to the Army gun development activity. However, recommendations for change are valueless when unaccompanied by an operational implementation strategy. In fact, the reports do not typically include concrete plans for implementing their recommendations. But the difficult aspect of improving the Army gun system acquisition process is not suggesting change but achieving change. Effective implementation of proposed changes will require a profound understanding of how the bureaucracy presently works and how incentives within this bureaucracy can be redirected. Successive blue-ribbon committees will not solve the problem. Indeed such committees are costly, both in terms of the time required of the professional soldier, gun developer, and outside expert, and in terms of the uncertainty and disruption introduced in the development organizations. The review group strongly urges that top DoD management decide on a course of action, assure stability in the new development system, and then turn its attention to what promises to be the most difficult task, the implementation of the decisions. If sustained attention and strong leadership is not given to implementation, periodic reorganizations will only prove to be cosmetic.

With a view to assisting Army Management and OSD in devising and selecting implementing plans for the recommendations mentioned above, the review group offers the following observations:

(1) The requirements making process: All the studies have noted the difficulty the Army has encountered in establishing stable requirements for gun systems. The review group has seen no concrete proposals for remedying this difficulty and doubts that the Army will be successful in fielding new gun systems until it resolves this fundamental problem. The unstable requirements process may have its origin in the absence of agreement on the mission of guns in the Army or it may reflect a deeper doubt that new gun systems are needed. In the latter instance, the Army should be asking not why the acquisition system has fielded so few weapons, but why they have expended so much effort on such activity.

(2) Program Managers: The Army has been taking steps to recognize the importance of program managers to its mission by placing greater emphasis on these tours of duty in promotion decisions. However, the DSB review group is concerned that insufficient attention is being placed in developing the technical

skills and management experience that are required to make a good project manager. Line officers, who have an incentive for these assignments, but have not followed a career that developed their skills, may not prove to be successful program managers.

(3) Competence of In-House Technical Personnel: Despite affirmations in the prior studies, there persists a widespread belief that there is much deadwood and unproductive activity remaining in the Army Arsenal Laboratory System. The review group maintains that the question of technical competence in the laboratory is moot; if the development system does not encourage innovation, whatever talent that may exist at the bench, will not emerge.

(4) Gun System Executive: The review group believes that this proposal would have greater merit if an executive was designated in each Service. The Army may wish to give an individual the responsibility and authority to see that the gun acquisition job is done right.

(5) Reorganization and Geographical Consolidation: The review group believes that the ADC/two-site alternative has potential for improving the process of developing and fielding new Army gun systems. However, the review group notes that one cannot rely upon the proposed reorganization and geographical consolidation, by itself, to either remedy the deficiencies embodied in the principal findings or to effectively implement the principal recommendations of the prior studies.

V. Recommendations of the DSB Review Group

It appears likely that the Army will act favorably on the Armament Development Center and will proceed to reorganize development activity at two sites, Picatinny and Aberdeen Proving Grounds. The review group recommends that OSD encourage this reorganization plan should it come forward. This recommendation is based on the judgment that the consolidation has the potential for improving the gun acquisition process particularly through the co-location of small and large calibre activities at Picatinny. The reorganization should be accompanied by a reduction in the size and cost of the in-house Army development effort.

The review group wishes to make four recommendations concerning this ADC reorganization:

1. Basic Policy Guidance

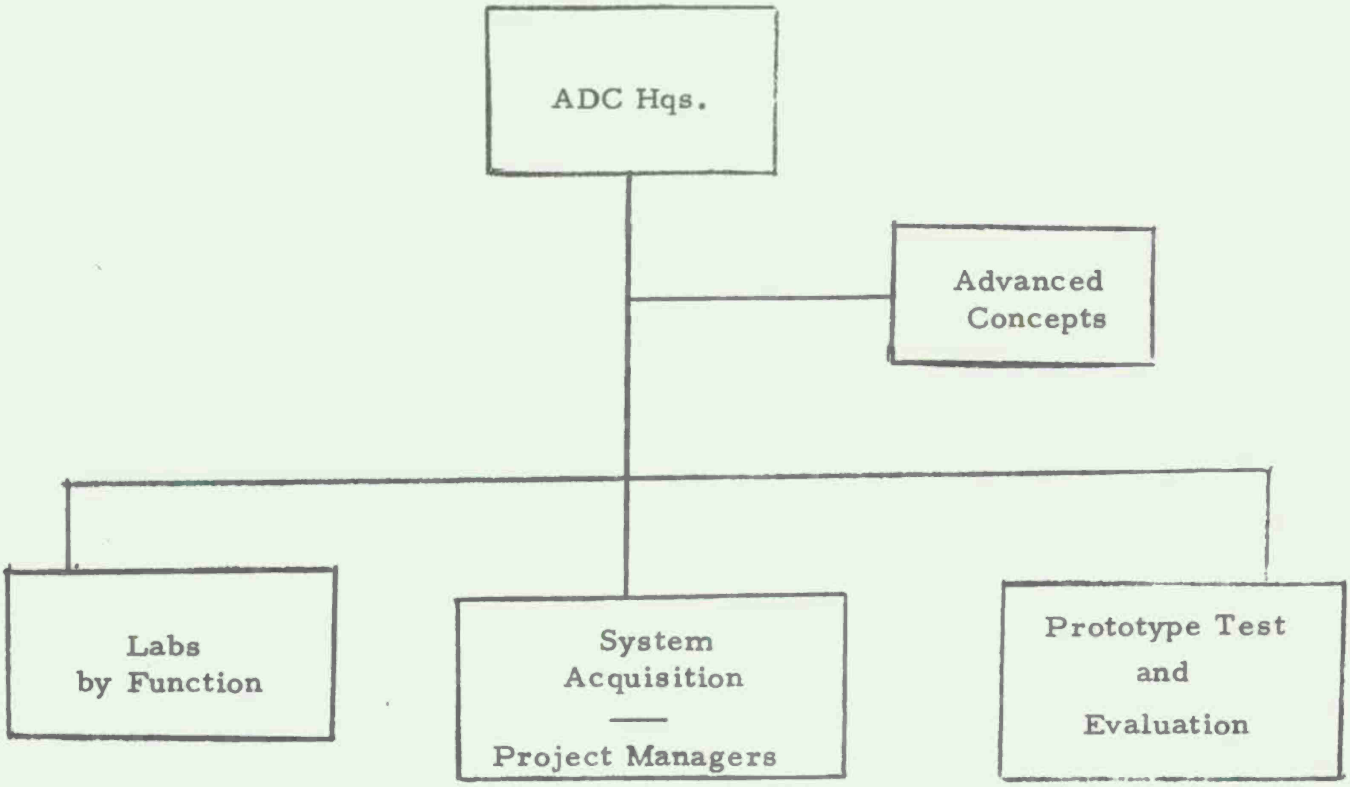
The Army should adopt a new policy on the division of gun development activity between in-house laboratories and industry. The DSB review group recommends that the new ADC program be based on the following division of effort: all engineering development and prototype design of systems and major sub-systems to be undertaken by industry; all production to be done by industry wherever possible; all prototype testing and evaluation to be done under the direction of the program manager. Some testing may be conducted by the contractor and some by the in-house laboratories; a roughly equal split between industry and in-house laboratories for 6.1 and 6.2 technology base work.

The review group notes that while this basic policy represents a major change in Army gun development, it is a familiar pattern in other DoD and Army areas, e.g., MICOM and Army helicopter acquisition. Furthermore, such a major change will be required if the productivity of the Army gun development activity is to be restored.

The review group assumes that the establishment of the ADC will be accompanied by establishment of an Armament Logistics Center (ALC) that will be responsible for the readiness and logistics concerns of the present ARMCOM organization. Much of the technical support for system readiness or upgrade should come from the ALC. When the upgrading of fielded weapons is sufficiently major to require participation of the ADC development organization, the basic policy, set forth above, should be retained.

2. Organization of the ADC

The DSB review group recommends the following functional organization for the new ADC.



It is worthwhile to note that the conceptual functional organization recommended here, differs from the large calibre-small calibre laboratory concept presented in the ADC report.

The salient features of the organization recommended by the review group are:

(a) Laboratory, i.e., technology base work is centralized in ADC and restricted to 6.1-6.2 work on research, exploratory development and breadboard test and demonstration of advanced concepts. The Labs would not perform advanced development or engineering development or have access to 6.3 or 6.4 funds unless such activity is directly contracted to the lab by a program manager.

(b) The System Acquisition component is composed of program managers responsible for prototype design and development of systems and major sub-systems. The program manager's policy should be to go to industry for all work. If there is no industry response or capability then the program manager would be free to contract for the work at an in-house lab.

3. Work Statement for the new ADC

There is a serious limitation in the present Army plan. The reorganization plan does not include a 'work statement' that indicates the precise gun system developments that the Army will be undertaking. Furthermore, the plan does not provide explicit milestones or performance measures for OSD review of the Army's progress in developing new gun systems. The proposed reorganization will take four years to accomplish. In the absence of performance milestones, it is inevitable that concerns will reappear, in a few months or a year, and that another round of disruptive inquiries will be initiated. Neither OSD or top Army management should permit the reorganization to take place without prior agreement on performance milestones.

The review group recommends that the Army prepare a work statement to accompany the ADC reorganization plan. This work statement should indicate the nature and cost of the development activity that will be undertaken during the next four years and the output, particularly new gun systems, that can be anticipated from this effort. In addition to establishing performance milestones, the work statement will provide a basis for comparing alternative functional organizations for the new ADC.

4. An Army Gun Prototype Project

The DSB review group proposes that the Army be required to commit itself to deliver two prototypes for two new gun systems within two years. It is anticipated that all four prototypes would be contracted out to industry. This proposal is based on the recognition that the Army's inability to produce new candidate gun systems in a timely manner, has been of paramount concern. Requiring the early delivery of competing prototypes provides a mechanism for accomplishing the following:

(a) Establishes early the pattern of systems acquisition project

management activity that is anticipated for the new ADC organization and provides experience for operation of this part of the organization.

(b) Assures that specific performance milestones, in this case the delivery of four prototypes in a specified time, will be set by the Army.

(c) Provides an opportunity for the Army to demonstrate that gun development can be effectively carried out by U.S. industry.

The review group does not wish to specify the two gun systems that might be selected for this experiment. This selection should be made in consultation with the Army. However, there are several candidates that appear attractive to the review group. These candidates include (1) a new Gun Low Altitude Air Defense System; (2) a tank gun; (3) a BUSHMASTER type for the Mechanized Infantry Combat Vehicle (MICV); and (4) an artillery system in the 155 mm family. The review group notes that the air defense gun is a particularly suitable candidate. The present Army debate about the appropriate calibre for this weapon (25 mm to 40 mm) reflects serious disagreement on the role of guns for the air defense mission and major differences between the user and the developer/evaluator. In light of past history, one can anticipate a long and difficult development cycle for this system unless a new way of doing business is adopted.

If one employs a rule-of-thumb that a new gun development, including amunition, requires $200K/mm to build a prototype and a few test guns, then the proposed prototype competition would cost approximately $12M/year assuming 20-mm and 40-mm systems were selected.

The review group cautions the Army against taking too much time to specify precise requirements prior to commencing this prototype project. The primary purpose of the proposed project is to demonstrate that the Army can produce prototype designs in a reasonable period of time, at acceptable cost. These advanced gun systems present options to the Army and DoD for fielding new systems.

APPENDIX

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C 20301

21 AUG 1975

MEMORANDUM FOR THE CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: DSB Review of the Gun System Acquisition Process

Several recent studies such as the AMARC study and the Gun Acquisition Task Force have addressed the difficulties DoD has had in gun system acquisition. Each of these studies made somewhat different conclusions and recommendations.

I request that a group of the Defense Science Board undertake a brief review of the principal findings and recommendations of the relevant studies with initial emphasis on the Army gun development and acquisition process. The objective should be to develop a consolidated set of tractable recommendations that form the basis of a cohesive DoD action plan in this area. The group should prepare a brief written report with an associated briefing by the October 1975 DSB meeting.

It is my understanding that Messrs Boileau, DeLauer, Deutch and Steininger have agreed to undertake this task with John Deutch serving as chairman. My contact in ODDR&E will be the Deputy Director (R&AT).

Malcolm R. Currie

Malcolm R. Currie