TOMORROW'S WEAPONS AND EQUIPMENT - HOW WE DETERMINE WHAT WE NEED

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ABSTRACT

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This essay sets forth the optimum procedures which have evolved to determine objectively the requirements for materiel for tomorrow's Army. Involved is the need for close working relationships between the Combat and Materiel Developer and the essentiality of conducting analytical concept formulation rather than rely solely on military judgment which is based, for the most part, on limited personal experience. Proposals to revise the Army's organizational establishment should not subjugate the important combat development process to competing functions. An effective combat development organization will produce realistic requirements which must be predicated on projected operational concepts and tempered by acceptable cost thresholds. Materiel requirements procedures should also have the goal of reducing lengthy lead times which have tended to increase with the layering of decision makers and systems analysts. Data for the essay was developed from Army regulations, documented CDC experience with Materiel Needs, interviews and research into a myriad of diverse ideas and suggestions on how to improve our acquisition process.

THE NEED TO HAVE THE BEST EQUIPMENT IS OF PRIME IMPORTANCE

In assessing an Army's fighting potential or its ability to wage and win wars there are four dominant factors:

a. the efficacy of the equipment; the side with the best guns, aircraft, missiles, rifles, mines and munitions has a decided edge.

b. the knowledge of how to use this equipment (doctrine and tactics) in the most effective manner such as evidenced by the Germans during the early stages of World War II when they employed the tactic of massed armor, the principal innovative development of the war. Similarly the role of the helicopter during the Vietnamese War showed how aircraft could best be used in a combined arms team under the control of the ground leader.

c. the employment of weapons and equipment by well-trained soldiers imbued with a belief in cause and a will to fight.

d. support of the fighting men by a populace with the industrial capability to produce quality equipment in sufficient quantity and a perseverance to see the struggle through to a satisfactory conclusion.

All of these factors that produce an effective military force are interrelated and all are important but the most important is the development of the best materiel and equipment. Even the boldest of infantry cannot attack against superior effective machine gun fire; and the side without atomic weapons cannot cope with an adversary that possesses such weapons and the will to employ them.

This paper will address this most important factor of waging successful war -- the development of military hardware and the procedures that have been used and new procedures that will be used to ensure that our troops get the best equipment.

Almost on a daily basis there is criticism enunciated in the press, in the Congress and from within the military ranks. The xenophobic attitude once expressed about American B-17's and M-1 rifles has been replaced by continuing allegations of cost overruns and statements by high-ranking officers that we need a better tank including the rationale that the German tanks were far better in World War II "in both hitting power and armor protection and we paid for this inferiority with much American blood."[1] There have also been recent criticisms about Vietnam charging that the M-16 rifle could not take abuse, the M-60 machine gun being totally unsatisfactory and the Light Antitank Weapon (LAW) called ineffective and awkward.[2]

The subject of new equipment and what we need for the future is quite complex; criticism will never be stopped nor should it be. But there should be a better understanding within the army and within the minds of the general public and the Congress as to how and why equipment is developed. The problem is more acute than ever because each new system is now necessarily more sophisticated,

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[1]James H. Polk, "We Need a New Tank," Army, (June, 1972), p. 9.

[2]David H. Hackworth, "Our Great Vietnam Goof," Popular Mechanics, (June, 1972), pp. 71-72.

takes longer to develop and involves increased costs. While some critics attack the requirements for a new tank or aircraft as "asking for the moon" the fact is that warfare has become more complex with the added problems of vulnerability and survivability of helicopters, electronic countermeasures, integrated battlefield control systems and continued emphasis on the use of computers for fire direction, management and command and control.

SOURCE OF REQUIREMENTS

A requirement for military hardware is prepared under three general conditions: first, when potential enemies are developing equipment superior to ours or when their equipment poses a threat that we must be prepared to meet.[3] If the Russian rifle can fire accurately at 1,000 meters we do not want a weapon that can fire at only 600 meters. If the Russian Redeye (SA-7) can shoot down our aircraft we must develop either passive or active countermeasures. If the Russians or Chinese develop sophisticated jamming devices we must ensure that our equipment and employment techniques can counteract them.

Secondly, we establish requirements when a technological opportunity appears.[4] Work is now being done with high energy lasers and when the technology is advanced to the point that it provides

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[3]US Department of the Army, Army Regulation 1000-1: Basic Policies for Systems Acquisition by the Department of the Army (30 June 1972), p. 1.

[4]Ibid.

insight into possible weaponry, a requirement document will be prepared. In the third case, a requirement will be established when there is a general consensus that equipment in the hands of our troops is or soon will be obsolescent and that a better system can be procured at a reasonable cost.[5] We are always looking for a better rifle, a lighter pack, stronger body armor, a better tank, a longer range artillery piece and a safe, more reliable helicopter.

With these general reasons for establishing new requirements the next question is where the ideas come from for specific concepts. Many ideas come from individuals. The Army Combat Developments Command is besieged with proposals from altruistic people or those who seek monetary gain. Ideas also come from the laboratories of the Army Materiel Command which conduct research and exploratory development to see what technology is feasible. Overseas commands are another source of concepts and this is particularly true during a combat situation such as in Vietnam; the Army was literally flooded with ideas that emanated from the forces in Southeast Asia and many of these ideas resulted in hardware, not all of which proved efficacious. Some ideas are directed by high-ranking officials from the Defense Department or from the Army staff; many of these ideas have their origin from members of the Army Scientific Advisory Panel. And many ideas come from industry who have products to sell or want to profit from their own industrial R and D. They either

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[5] Ibid.

want to develop new materiel or find differing and wider use of existing equipment.[6]

Most companies maintain a staff of marketing representatives who keep in contact with the military departments. These representatives serve a dual function in that they keep the military informed of current developments in industry and attempt to keep their companies informed of potential military requirements. Industry doesn't always wait to react to a specific military requirement. Often they will develop a piece of hardware (or product improve an item already in the inventory) and then attempt to convince the services of the military worth of the developmental effort.

An example of industry initiative is the effort of the ground vehicle system division of Lockheed Missiles and Space Company to develop a wheeled vehicle that would compete with tracks in cross-country mobility. In early 1965 Lockheed funded an in-house development program which resulted in a series of high mobility wheeled vehicles known as "TWISTERS". One test model was built and demonstrated to various Army representatives. Although no specific requirement existed, the Army was interested in the new technology that the TWISTER represented and ordered three vehicles for military potential testing. The tests demonstrated that the TWISTER was more mobile than any tactical vehicle currently in the

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[6]USACDC Materiel Systems Briefing, How Our Requirements are Developed, (Ft. Belvoir, Va., 15 August 1972), pp 1-8.

inventory, under almost all weather and terrain conditions. The Armor and Engineer Board concluded that the system offered "potential for military use"; however, since no military requirement existed for such a vehicle no further action was taken despite urging by Lockheed and many enthusiastic supporters within the Army.[7]

Lockheed, convinced of the potential of the TWISTER technology, adapted the articulated concept to the Army's scout vehicle requirement (ARSV) and the family of engineer construction equipment (FAMECE) competition and won prototype development contracts for both systems. Competition between Lockheed and Food Machinery Corporation (FMC) for the ARSV and Clarke for FAMECE will give Lockheed ample opportunity to demonstrate the potential and reliability of the TWISTER concept. The ARSV competition is especially significant in that wheeled and tracked combat vehicles will be tested against each other and against current inventory vehicles. If the wheeled version emerges as the ARSV candidate, much of the current thinking regarding the necessity of tracked vehicles for off-the-road tactical operations may be re-evaluated.[8]

While ideas literally come from all over, the requirements are prepared in the form of documents at the agencies of the Combat Developments Command, which was organized in 1962 to determine how

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[7]Interview with J. Robert Abbott, Lockheed Missiles and Space Co., Ft. Belvoir, Va., 15 August 1972.

[8]Ibid.

the Army should fight, be equipped and be organized.[9] The agencies of CDC have the advantage of being, for the most part, collocated at the various branch schools so they can take advantage of the latest concepts as developed during instruction at the schools; additionally, they can take advantage of the expertise of the officers who come from diverse assignments to spend a year at their branch advanced class.

OPERATIONAL CAPABILITY OBJECTIVES (OCO'S)

The preparation of requirements documents is the pre-requisite to R and D money expenditures by the materiel developer. Prior to 1968 research and exploratory development (called 6.1 and 6.2 funding) was left largely to the laboratories of the Army Materiel Command (AMC). The need for some control so that researchers do not go off on wild goose chases led to the establishment of broad requirements objectives called Operational Capability Objectives or OCO's.[10] The original 56 OCO's were developed on an ad hoc basis but the system has been formalized by the Land Combat System Study which was started in 1968 and is scheduled for completion in late 1972. This study effort has evaluated national policies, joint plans, conflict situations, long range intelligence and technical forecasts and advanced materiel concepts. The result is an insight

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[9]US Department of the Army Pamphlet: US Army Combat Developments Command Industry and Research (1972), pp. 1-2.

[10]US Department of the Army, Army Regulation 71-1: Army Combat Developments (16 September 1968), p. 2-1.

into tactics and doctrine for the future but also is producing new and revised OCO's.

The existing OCO's are broad in nature such as the one calling for a "capability to engage in all types of operations under conditions of darkness or low visibility with near daylight efficiency."[11] While this is quite general it is felt this establishment of the OCO system and the Land Combat Systems study effort represents a legitimate attempt to put more meaning into R and D and gives guidance to industry and the laboratories as to where the Army should be looking and what it may require.

MATERIEL REQUIREMENTS DOCUMENTATION

The keystone of the materiel development process is an efficient documentation system which permits us to develop uniform and detailed requirements statements that are equally useful to the combat developer (CDC) and the materiel developer (AMC). In the 18 month period preceding August 1972 there have been three different documentation procedures used by the Army. The first change in almost ten years was a result of efforts by CDC and the Army Materiel Command (AMC) to refine the old procedures. The latest effort was directed by the Army staff with the goal of further streamlining the process.[12] Three different systems in less than

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[11] US Army CDC Materiel Systems Briefing, p. 6.

[12] Henry A. Miley, Jr., "Blueprint for Acquisition of Army Materiel," Army Logistician, (Sept - Oct 1972), pp. 4-7.

two years has caused some confusion but the latest system takes advantage of the improvements developed through the years.

The original system started with a document called the Qualitative Materiel Development Objective (QMDO) which set forth broad performance characteristics. In the revised system the document was called a Materiel Need (MN). The latest system names the document the Required Operational Capability (ROC), a term borrowed from the Air Force. The ROC differs from the MN primarily in that it is restricted to four pages thereby reducing the reams of paper that frequently accompanies a Materiel Need (most of which, however, was rationale).[13] This apparently will save the valuable time of the Army staff and make it easier for the document to be read and understood.

The QMDO, MN and ROC are merely the preliminary stages in the development of the requirement. They are the start of what is called concept formulation though some theorists believe that concept formulation actually starts with research, exploratory development or the statement of the Operational Capability Objective. In any case the conclusion of concept formulation results in a more detailed and specific requirement which was once called the Qualitative Materiel Requirement (QMR), then called the Materiel Need/ Engineering Development (MN/ED) and which now will be incorporated in a Development Plan (DP).

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[13]US Army Regulation 1001-1, pp. 1-2.

HOW A REQUIREMENT IS WRITTEN

The pick and shovel work of preparing a requirements document is now accomplished at the proponent agencies of the Combat Developments Command (CDC) which are usually collocated at the appropriate branch schools. Hence, the requirement for a rifle is prepared at the Infantry Agency at Fort Benning while the requirement for a SAM-D is prepared at the Air Defense Agency at Fort Bliss. A joint working group is convened at the CDC agency to address the requirement. An officer from the agency chairs this group and the Army Materiel Command (AMC) provides a co-chairman. Membership also includes the branch school, the Logistics, Doctrine, Systems and Readiness Agency (LDSRA) for logistical input, Continental Army Command (CONARC) to address training and related aids, AMC technical and cost expertise, and from the CDC Maintenance Agency to consider reliability, maintainability and availability.[14] Where appropriate, because of joint interest, representation from the other services may also be invited.

Following numerous working sessions, a proposed materiel need (MN) or required operational capability (ROC) document is prepared by the CDC agency and forwarded to the CDC group and the AMC commodity command for review. This process is iterative until group approval is received. The document is then forwarded to CDC and AMC

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[14]US Department of the Army, Joint CDC/AMC Materiel Needs Procedures Handbook (March 1972), pp. 15-1 to 15-4.

headquarters where a high level review is conducted and when agreement is achieved the document is forwarded to the Army staff for approval.[15] Such approval marks the need to initiate detailed concept formulation.

CONCEPT FORMULATION

This is conducted jointly by CDC and AMC and can take from a few months to four or five years with extensive contractor assistance for sophisticated systems. The concept formulation package consists of the following:

a. A mission and performance envelope. This is a statement of potential operational missions to be performed by the equipment. It sets forth scenarios in which the equipment will be evaluated and which determine the performance characteristics required.

b. A trade-off determination of various candidate systems using different technologies and concepts including consideration of product improvement of existing systems. In the case of the heavy lift helicopter, the trade-off determination developed and costed 26 prime variants with numerous alternatives.

c. A trade-off analysis and selection of best technical approach. This analysis is conducted within the frame work of the mission and performance envelope and evaluates system trade-offs, risks, capabilities, costs, schedules, human factors and integrated

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[15] Ibid.

logistic support. The result is the selection of the best and prime alternate approaches.[16]

d. A cost and operational effectiveness analysis. This analysis compares costs of the selected design against competing systems, existing or proposed, and usually is predicated on life cycle costs; that is, costs of maintaining equipment over a ten year period as well as initial costs. The effectiveness portion relates to comparisons conducted in a manner similar to the cost comparisons; however measures of effectiveness are not as readily adapted to quantitative analysis.

e. A basis of issue of plan. This prescribes how many of an item are required and how many of existing items can be replaced. It also gives an insight into the personnel requirements.[17]

Upon completion of this concept formulation the performance characteristics will be more finitely spelled out and the materiel developer will be given the necessary information to enter into what is called the validation process, sometimes referred to as contract definition; this normally means the development of actual hardware, either in the form of advanced components or complete prototypes. While this process may appear on the surface to be cumbersome and time consuming, it is for the most part analytical and objective and utilizes the most modern operational research

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[16]US Army Regulation 71-1, pp. 2-3.

[17]Joint CDC/AMC Materiel Need Procedures Handbook (March 1972), pp. 20-1 to 27-4.

methods and mathematical models. A critic can say that military experience cannot be replaced by analysis; but the problem with military opinion and expertise is that very few soldiers, because of their restricted personal experiences, have the same opinion on what equipment is required. Some generals are small helicopter men because they learned to fly the Huey and are reluctant to recognize the relative ineffectiveness of the machine with its maintenance workload, 1950 state-of-the-art and limited payload under high density altitude conditions. Similarly, many soldiers dislike the caliber .45 pistol because they cannot fire it very well and continue to urge that a new personal defense weapon be developed; others believe that the .45 cannot be replaced with anything approaching equivalent effectiveness without expending an excessive amount of money which can better be applied to more urgent requirements

We cannot rely on subjective opinion predicated on limited personal experience. Hence, the need for detailed concept formulation. It is not possible or correct for us to prescribe the requirements for a tank as General Guderian did in 1941. His concept formulation was a simple statement based on his experiences with the panzer forces in Poland. He told Hitler that the tanks needed to be more heavily armored, particularly in front; the range and power of penetration of the guns also needed to be increased, which meant longer barrels and a shell with a heavier charge.[18] Hitler immediately

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[18]Heinz Guderian, Panzer Leader (est. 1948), pp. 74, 276-280.

ordered it done but later when Guderian fell from favor, Hitler himself became the chief tank designer. In a militaristic society concept formulation is much simpler when the head of the state is readily available to render a decision. The problem becomes acute when the leader (or the arms developer) has the sole power of decision and is frequently wrong either because of errors in judgment or lack of objective analysis.

An essential element of concept formulation is the idea that performance characteristics will be stated in bands of performance rather than single design points. This permits the materiel developer to make system trade-offs with some flexibility and may save time, effort and money. Normally CDC expresses the low end of the band as the minimum operational requirement while AMC sets the high end as that within the projected state-of-the-art considering realistic costs.[19] For example, the range of an artillery piece may be expressed as from 26 to 30 kilometers or the payload of a heavy lift helicopter might be from 21 to 25 tons. The bands are wide at the start of concept formulation and narrowed, sometimes to a single design point, at the completion.

USE OF TASK FORCES

Under the new ROC procedures a change effected is that CDC and AMC may not be tasked to conduct concept formulation but the Army

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[19]Joint CDC/AMC MN Procedures Handbook, pp. B-1 to B-64.

staff, for selected major systems, may organize a task force to accomplish this under the aegis of the Assistant Chief of Staff for Force Development (ACSFOR).[20] The Task Force will draw on members from CDC and AMC and other commands and may direct additional assistance from these commands. The idea is that high level management may be more responsive and closer in touch with the realities of the funding and programming world of the Pentagon. Past history shows five task forces: two, to determine Army aviation requirements (ARCSA I and II); an Air Defense Evaluation Board; and recently, task forces conducted studies on requirements for a new main battle tank and advanced attack helicopter. The obvious disadvantages of the task force system are the loss of continuity, lack of a data base, administrative problems such as housing and clerical help and the confusion resulting in drawing expertise together from diverse agencies, thereby disrupting normal efforts. The goal of managing all major systems by ad hoc task forces appears to be costly and sets the example for high level management of all Army activities, the philosophy of which carries over to troops in the field as evidenced by overcommanding such as division commanders directing platoons. Obviously task forces can be of benefit for especially complex, high visibility, costly and controversial items but only when the number of such activities is kept to the lowest possible level.

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[20] US Department of the Army (ACSFOR), Letter of Instructions for Implementing the New Materiel Acquisition Guidelines (23 Aug 72), Annex E.

THE IMPORTANCE OF THE COMBAT DEVELOPMENT PROCESS

Military journals and declarations of high defense officials in the press have recently tended to emphasize the problems of materiel acquisition and the need to effect changes. Statements such as fly-before-buy, low-risk, operational testing, competitive prototyping and designing to cost are the new "buzzwords."[21] Implicit in these statements is the thought that perhaps the combat development process can be altered and that there need not be a separate command devoted to this effort.

It is important that the combat development effort not be lost in any proposed improvement or reorganization scheme. A recent proposal is that the branch centers and schools be designated the user and the developer of requirements. Another suggestion is to combine the branch schools with CDC.[22] CDC was organized in 1962 after extensive study to ensure that the combat developments function was well managed and not subservient to other competing interests such as training.[23] Prior to 1962 combat developments functions were split among the various technical and branch service schools in such a manner as to cause duplication of effort and overlapping of functions. These self-sufficient development entities

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[21]"Directive 5000.1 is Loaded", Government Executive, April 1972, pp. 58-

[22]Larry Carney, "Plan to Split CONARC," Army Times (27 September 1972), p. 1, 22.

[23]US Department of the Army, CDC Pamphlet: Origins and Formation (May 1972) Ft. Belvoir, Va., pp. 1-18.

often expressed divergent views and interests which did not always coincide with the overall Army aims and objectives. Although ten years is a short time to evaluate the success of CDC, available evidence shows that an organization with its single purpose of combat developments has been more successful than the conglomerate of individual combat developers which preceded it. Allowing the branch center commanders to represent the user is a step back to a system which was relatively ineffective. The centers are of necessity training and education oriented and must direct the majority of their resources toward accomplishing these goals. Each center is oriented on a narrow spectrum of the overall mission and tends to focus its organizational attention on promoting and improving this field of interest. Without parochialism the centers would be of little value; however the competing desires of the individual centers do not always coincide with the needs of the Army as a whole and if the centers are the users' representative and developers of requirements, no agency short of Department of the Army can temper these points of view. CDC provides the moderating influence which is necessary to evaluate branch viewpoints and place competing materiel requirements in the proper perspective.

The proposal to combine the combat developments and training/education functions in a single organization has some merit but the problem is that training/education may become the prime consideration and motivating factor of the commander and the combat developments function would again become submerged as a secondary interest.

It makes little difference if CDC remains as is or becomes combined with the school system so long as the combat development process does not become subjugated to other competing interests. The record indicates that high level recognition of the importance of combat developments with a major command representing the user and originating objective materiel requirements is viable and represents one of the most forward looking and far-reaching developments in organization since World War II.

At the same time we must insist on realistic requirements. We cannot adopt every new idea, each with increasing complexity and sophistication. We must find less expensive ways of fighting and we must establish meaningful priorities. In the future, high level management may be beneficial for a few selected systems but this should not become commonplace. In any case the goal for documentation procedures should be the reduction in lead time. This is important as it is undoubtedly true that the military advantage goes to the side whose short lead time allows it not only to counter the enemy's new weapons but also to provide new weapons superior to those of potential opponents.

CONCLUSIONS

1. Ideas for military hardware emanate from many sources. The problem is to refine, review, validate, and prepare rationale in order to prove the need for a new system.

2. The development of materiel requirements must be correlated with the concept of operations, the threat, and an appreciation of cost thresholds.

3. Either the current (Materiel Need) or the new (Required Operational Capability) materiel documentation procedure is an effective means of presenting the Army's requirements for equipment and hardware.

4. Concept formulation - the establishment of valid performance characteristics by analytical, objective procedures - must be conducted for all new materiel systems under consideration; military judgment, predicated on limited experiences, cannot by itself be the justification for requirements.

5. There is no evidence that centralized concept formulation (Department of Army Task Forces) leads to a better requirement or results in better equipment.

6. A combat developments organization is the optimum command that can view and reflect the users' requirements objectively and without parochialism.

7. There must be continuing emphasis on developing procedures which reduce the materiel acquisition lead-time, a difficult but essential goal in the era of expanding levels of decision-making.

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