REPORT TO THE CONGRESS

Need To Improve Management Of The Army's Tactical Vehicles Development Program

B-133256

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

JAN. 27, 1971

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-133256

To the President of the Senate and the
Speaker of the House of Representatives

This is our report on the need to improve management of the Army's tactical vehicles development program.

Our review was made pursuant to the Budget and Accounting Act of 1921 (31 U.S.C. 53) and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

Copies of this report are being sent to the Director, Office of Management and Budget; the Secretary of Defense; and the Secretary of the Army.

Elmer B. Staats

Comptroller General
of the United States

COMPTROLLER GENERAL'S REPORT TO THE CONGRESS

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D I G E S T

WHY THE REVIEW WAS MADE

The Army Tank-Automotive Command is responsible to the Army Materiel Command for the development and procurement of tactical wheeled and tracked vehicles. During fiscal year 1970, a total of $35.5 million was programmed by the Army Tank-Automotive Command for functions relating to research and development of vehicles, and the command awarded contracts valued at about $545.7 million for tactical vehicle production.

Previous studies by the General Accounting Office (GAO) and the Army Audit Agency revealed management weaknesses. Recommendations for improvement had been made as a result of the studies. This review was made as a follow-up to the earlier reviews and concerned all tactical vehicle development programs initiated subsequent to the previous GAO review.

FINDINGS AND CONCLUSIONS

The review established that problems have continued despite organizational and procedural changes.

--Vehicle engineering development efforts were initiated and permitted to continue although required determinations had not been made to show that the development objectives expressed by the prospective user were valid and technically feasible. As a result there were many deviations from desired design or performance characteristics and the vehicles either did not meet user requirements or were only marginally acceptable. (See p. 11.)

--Emphasis on reducing development lead time resulted in premature authorizations for mass production and the manufacture of vehicles that were defective or did not fully satisfy user requirements. As a result, costly modifications were necessary to vehicles after production. (See p. 23.)

--Decisions made on the future course of development effort at in-process review meetings were based on incomplete or outdated information, or projects were unnecessarily delayed because available information was not furnished for consideration prior to the meeting. Also, continuity of personnel was lacking from one meeting to the next. As a result, meaningful evaluation was hampered,

timely and proper decisionmaking was impaired, and projects were delayed. (See p. 32.)

RECOMMENDATIONS OR SUGGESTIONS

The Army should improve the management of its tactical vehicles development program to ensure that

--requirements documents specifying, in accordance with existing regulations, the desired characteristics of the vehicles to be developed are prepared, thoroughly analyzed, and approved at the Department level before any full-scale development efforts are initiated (see p. 20),

--approved requirements documents clearly set forth valid and realistically attainable requirements, based upon prior exploratory and experimental work, to permit full-scale development and production within the designated time frame (see p. 20),

--coordination and communication between the developing and using agencies are improved, to preclude the need for significant deviations from, or later waiver or relaxation of, design or performance characteristics deemed essential by the user (see p. 20),

--mass production of vehicles is authorized only after the vehicles have demonstrated the capabilities to meet the essential characteristics established and after the prospective user has pronounced them suitable, thereby minimizing costly changes during production (see p. 29), and

--management places greater emphasis on the timely dissemination of complete and current data to decisionmaking agencies and, to the extent possible, maintains continuity of participants from one meeting to the next throughout the development project to promote stability (see p. 38).

AGENCY ACTIONS AND UNRESOLVED ISSUES

The Assistant Secretary of the Army (Research and Development), in general, agreed with the GAO recommendations. He said that the report was a case study, using selected programs, of how not to execute a development program. He felt, however, that actions taken had significantly reduced the possibility that the same errors would be repeated.

Recent actions reported include:

--Army regulations were changed in April 1970 to require an in-process review that will show proof that advanced development is progressing satisfactorily, or that the degree of risk is known

and is acceptable to the Army, prior to continuing development. (See p. 20.)

--Another change in Army regulations, effective January 1970, requires more detailed information to obtain authorization for mass production. (See p. 30.)

--Continuity has been maintained at the review meetings by project managers' deputies and other high-level project management members. The in-process review procedure has been strengthened by requiring voting members to comment on the meeting minutes within 30 days. (See p. 39.)

GAO believes that adequate implementation of the above actions should improve the Army's management of its tactical vehicles development program. GAO believes, however, that continuing management attention is necessary to prevent recurrence of conditions presented in the report. As shown in a February 1970 report of the Army Audit Agency on a comprehensive review of the Army Materiel Command's research and development program, weaknesses in management of current development projects still exist. (See p. 31.)

The Blue Ribbon Defense Panel stated in its July 1970 report to the President and the Secretary of Defense that a major problem with the requirements process occurred at its very beginning. The Panel said that there was no doubt that the overall requirements process could be improved greatly by specifying that operations analysts study requirements at the point of origin--so that requirements reaching higher headquarters would have greater validity. (See p. 22.)

MATTERS FOR CONSIDERATION BY THE CONGRESS

This report is being submitted to the Congress because of continuing problems in the management of the Army tactical vehicles development program. GAO previously reported areas needing management improvement in November 1960. Some of the conditions noted in that report were found to exist at the time of this review.

Tear Sheet

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CHAPTER 1

INTRODUCTION

Significant expenditures are made by the Army for the research, development, and production of tactical vehicles. During fiscal year 1970, $35.5 million was programmed for the Army Tank-Automotive Command for functions relating to research and development of vehicles, and the command awarded contracts valued at about $545.7 million for the production of tactical vehicles. These awards were based mainly on drawings and specifications furnished by the command.

We previously reviewed the Army's tactical vehicles development program and reported our results in a November 1960 report to the Congress (B-133256) entitled "Review of Development and Procurement of New Combat and Tactical Vehicles by the Department of the Army." In addition, the Army Audit Agency issued a report on its 1966 review of the M107, M110, M578 weapon/vehicle family since our earlier review.

Our most recent review of the Army's management of its tactical vehicles development program was a follow-up to our earlier review and the Army Audit Agency review. It was directed toward (1) an evaluation of the policies and procedures established for the management of major phases of development and (2) a determination as to whether actual practices conformed to the stated policies and procedures. The scope of our effort is more fully described on page 40.

A list of the principal officials of the Department of Defense and the Department of the Army responsible for administration of activities discussed in this report is shown as appendix II.

The Army Combat Developments Command, Fort Belvoir, Virginia, is primarily responsible for directing the Army's combat developments activities. The Combat Developments Command recommends materiel development objectives to the Chief of Research and Development and materiel requirements to the Assistant Chief of Staff for Force Development,

Department of the Army, Washington, D.C. The Chief of Research and Development has Army Staff responsibility for the overall planning, programming, coordinating, and supervising of all Army research, development, test, and evaluation activities. The Assistant Chief of Staff for Force Development has Army Staff responsibility for overall supervision and coordination of combat developments and related policy in conjunction with research and development functions assigned to the Chief of Research and Development.

The Army Materiel Command, Washington, D.C., under the functional supervision of the Army Staff, is responsible for research, development, engineering, testing and evalution, and procurement and production of tactical and combat vehicles. The Army Materiel Command's development, testing, and production functions are carried out by its major subordinate commands. The Army Tank-Automotive Command develops and produces tactical vehicles for the Army and other defense agencies either in-house or through contracts with industry. In connection with its development and production efforts, the Army Tank-Automotive Command is responsible for preparing the technical data package which sets forth drawings, specifications, etc., for use in mass production of the vehicles. The U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland, tests and evaluates the vehicles.

Following is a brief description of the policies and approved procedures covering the process after economic, technical, and operational feasibility of the product has been determined.

--The Combat Developments Command prepares or processes and the Assistant Chief of Staff for Force Development approves a document--called a Qualitative Materiel Requirement--identifying the essential and desired characteristics for the end-item vehicle. The Qualitative Materiel Requirement is required to be preceded by prior developmental work.

--The Technical Committee, Army Materiel Command, authorizes the initiation of a development[1] project to accomplish the work required to meet the characteristics stated in the approved Qualitative Materiel Requirement.

--The Army Tank-Automotive Command prepares an engineering plan identifying the approach to be undertaken in the development[1] of the vehicle. The command is also responsible for the detailed development and refinement of the technical characteristics of a militarily acceptable vehicle. When there is necessity for supplementing its own capabilities, the command awards a contract to a private company for the development work. The Army Tank-Automotive Command's responsibilities include preparing component drawings and specifications and making certain tests.

--The Army Test and Evaluation Command performs engineering tests to evaluate the technical performance and safety characteristics of the vehicle finally designed by the Army Tank-Automotive Command. These tests establish the vehicle's general adequacy for service tests. The Army Test and Evaluation Command then makes service tests to determine whether the vehicle is militarily acceptable under certain actual or simulated field conditions.

--The Army General Staff approves the decision as to the adequacy of the vehicle for mass production. This decision is termed the type classification Standard A action. The Army Tank-Automotive Command prepares the draft of the type classification action which should include all pertinent information relating to the vehicle's readiness for mass production, deployment, and use.

--The Army Tank-Automotive Command prepares the technical data package used in making initial and

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[1]This is also called engineering development and follows the phase in which feasibility is determined called advanced development.

follow-on awards to contractors to produce the vehicle. The technical data package includes the necessary drawings and specifications. The command also makes the necessary design changes and furnishes engineering assistance to contractors to resolve any technical problems that arise during production.

--The Test and Evaluation Command performs separate tests of the initial lots of production vehicles to ensure that specifications are met.

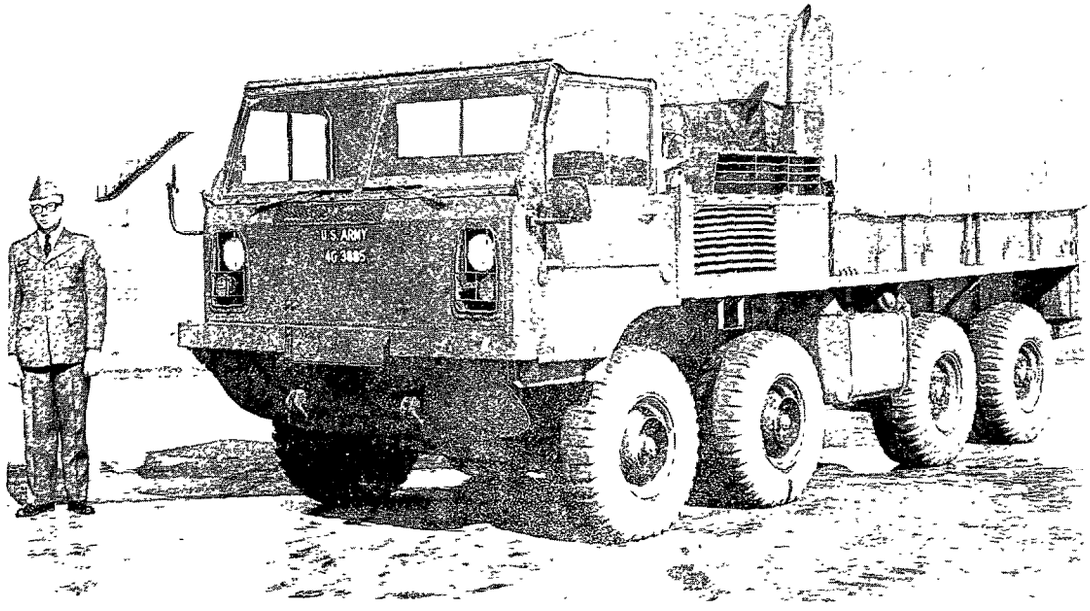
Research and development of vehicles and components have been continuing processes at the Army Tank-Automotive Command since 1942 when it was initially assigned that responsibility. Since our November 1960 report to the Congress, seven new tactical vehicle developments have been initiated at the Army Tank-Automotive Command. One of these was terminated while in development; three are still in development; one is in production and has not yet been issued to the troops; and two have completed development and have been produced and issued to the troops. During this period four new combat vehicle developments were also initiated and other vehicle developments initiated before November 1960 were continued. In addition, existing vehicles were modified to satisfy specific needs.

This report concerns the effectiveness of the Army's management of its tactical vehicles development program. Although development of the seven tactical vehicles was initiated many years ago and organizational and procedural changes have been made, the management weaknesses still exist as shown by the Army Audit Agency report of February 1970. (See p. 31.)

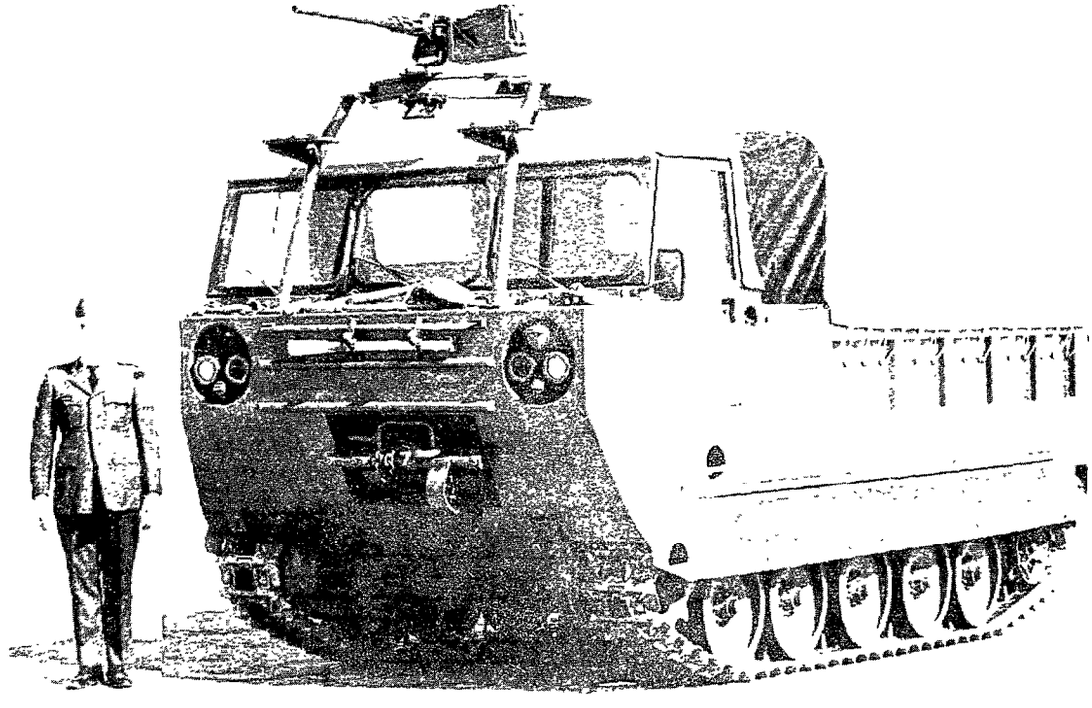
The following five tactical vehicle developments initiated since 1960 are reported herein to illustrate these management weaknesses.

XM410E1 2-1/2-ton, 8x8 cargo truck
M548 6-ton tracked cargo carrier
M561 1-1/4-ton, 6x6 cargo truck (Gama Goat)
M656 5-ton, 8x8 cargo truck
XM759 1-1/2-ton, soft tire tracked cargo carrier

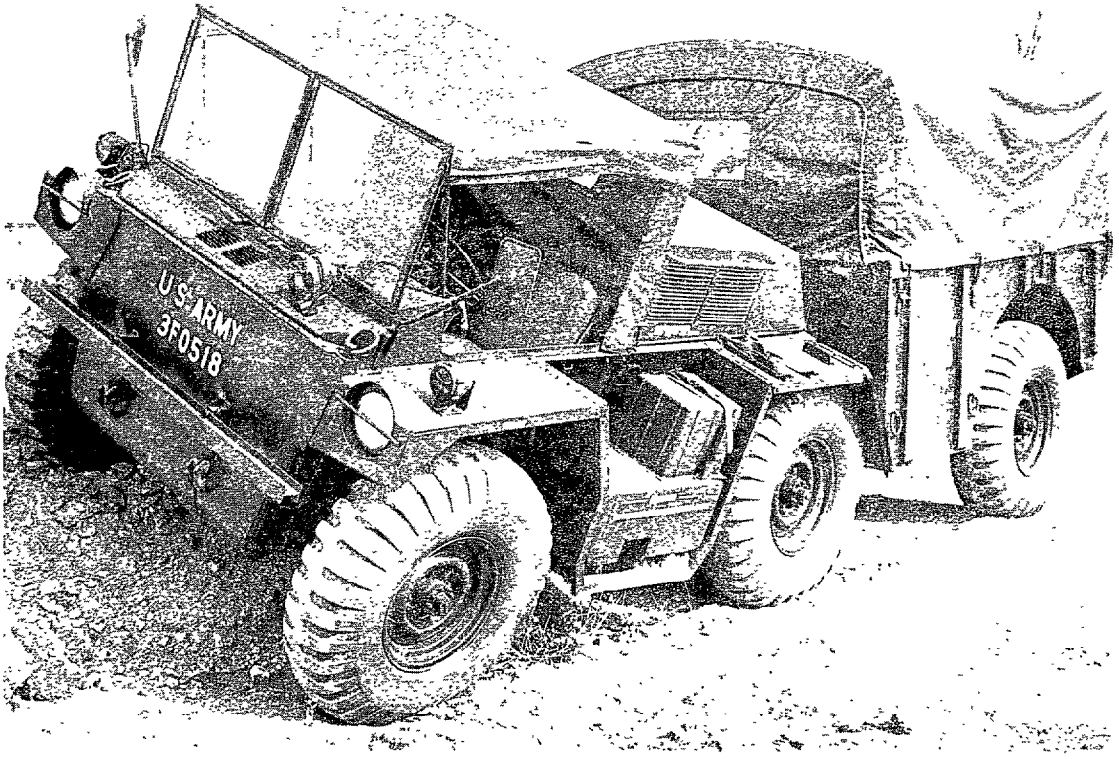
U.S. Army photographs of these vehicles follow.



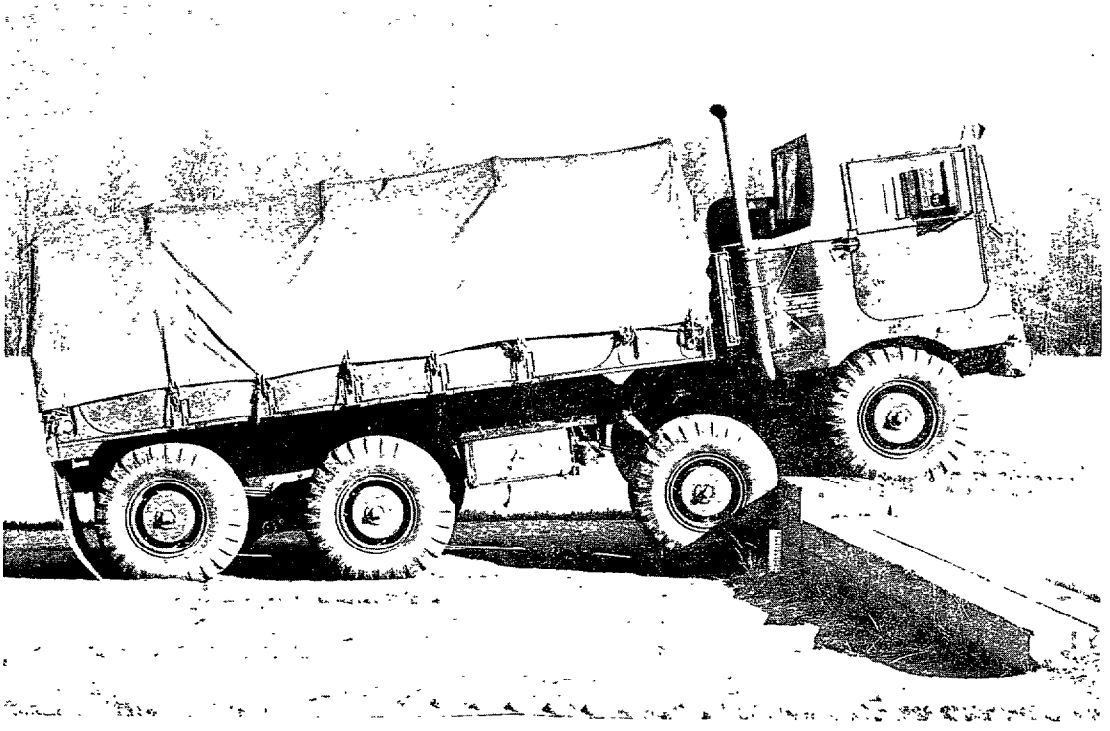
XM410E1 2½-ton, 8x8 cargo truck



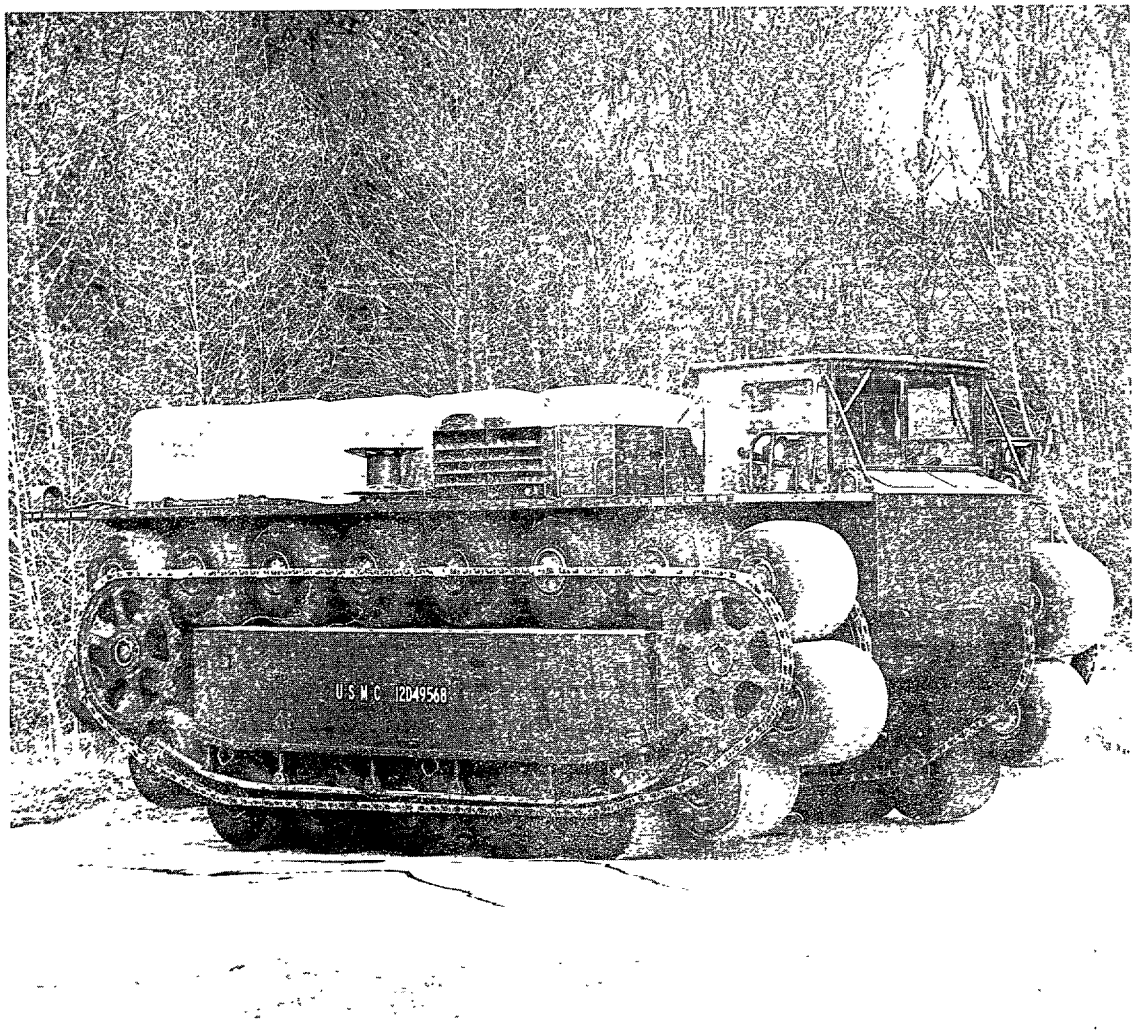
M548 6-ton tracked cargo carrier



M561 1¼-ton, 6x6 cargo truck



M656 5-ton, 8x8 cargo truck



XM759 1½-ton soft tire tracked cargo carrier

CHAPTER 2

NEED TO PRECLUDE INITIATION OF DEVELOPMENT PROJECTS UNTIL REQUIREMENTS ARE DETERMINED VALID AND FEASIBLE

Army Regulation 705-5 states that research and development activities are to be directed primarily toward developing materiel which satisfies the valid needs of the using forces as set forth by them in a document called a Qualitative Materiel Requirement. The document is prepared by the Combat Developments Command and approved by the Assistant Chief of Staff for Force Development. The Qualitative Materiel Requirement states materiel needs in terms of required characteristics and priorities and relates them to the operational and organizational context in which they will be used. It includes a listing of specific requirements to permit a clear understanding of features that are essential to a product's acceptance.

As provided in the Army regulation, after economic, technical, and operational feasibility has been determined by prior development[1] and testing, a Qualitative Materiel Requirement is to be published which authorizes the development[2] of specific materiel toward end-item use.

Items requiring major developmental effort must conform to a Qualitative Materiel Requirement unless there has been specific exception granted by Headquarters, Department of the Army.

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[1]This stage of development is known as advanced development during which the feasibility of developing the item is determined.

[2]This stage of development is referred to as engineering development during which the item is engineered for service use.

Our review indicated that vehicle engineering development efforts had been initiated and were permitted to continue although a Qualitative Materiel Requirement had not been authorized. Thus there was no assurance that development objectives were valid or technically feasible. As a result, many deviations from design or performance characteristics were required during development and resulting vehicles either did not meet user requirements or were only marginally acceptable. In the following cases, the waiver of essential requirements and the user's acceptance of vehicles not meeting such requirements, in our opinion, cast doubt on the validity of the initial requirements determinations.

XM410E1 2-1/2-TON CARGO TRUCK

In 1956 the U.S. Army Continental Army Command established a requirement for a 2-1/2-ton, 6x6 truck, simple in design, with a curb weight (fully equipped, less payload and personnel) not to exceed 7,500 pounds. However, the Assistant Secretary of Defense (Engineering), over objections from the agency that requested development of the vehicle, directed the development of an 8x8 version. The 8x8 pilot models weighed about 9,000 pounds each and were unable to meet the reliability, durability, and maintainability requirements. After several design modifications, this project--designated XM410--was terminated.

However, the Continental Army Command's study of motor vehicle requirements approved by the Army in April 1961 recognized a continuing need for a lightweight 2-1/2-ton, 8x8 truck, and the project was reestablished in June 1961. This truck was designated the XM410E1. Neither the XM410 project nor the XM410E1 project had a Qualitative Materiel Requirement.

When the project was reestablished in 1961, some characteristics were revised and others were added by the Continental Army Command which resulted in weight increases. For example, the added requirement for a diesel engine rather than for a gasoline engine increased the weight by about 900 pounds. The maximum curb weight of 7,500 pounds specified by the original characteristics was eliminated with no corresponding limitation other than "a high payload

to net weight ratio is desired but shall not compromise the requirements of durability and reliability." The pilot models produced were frequently modified after testing and the curb weight was eventually increased to about 11,300 pounds. Nevertheless, this truck also failed to meet durability and reliability requirements and the project was again terminated in April 1966.

The Chief of Research and Development decided to terminate the project because of the inability of the XM410E1 to demonstrate adequate durability, reliability, and maintainability. He noted that a third redesign would not correct major deficiencies. He also stated that the similarity of characteristics and costs of the XM410E1 2-1/2-ton truck and the XM656 5-ton truck did not justify having both vehicles in the inventory and that cost savings could be obtained by producing more 5-ton trucks and reducing the total line-item inventory by substituting 5-ton trucks for 2-1/2-ton trucks. As a result, after 9 years of development effort at a cost of about $6 million, the project was terminated and the user's need for a lightweight 2-1/2-ton truck was not satisfied.

We believe that the ultimate issue to the troops of a 5-ton, 8x8 truck having a curb weight of more than 17,000 pounds can hardly be construed as satisfying either the user's original requirement for a 2-1/2-ton truck having a curb weight of 7,500 pounds or the revised requirement for a lightweight 2-1/2-ton truck. In this regard, available studies continue to show a need for a new 2-1/2-ton truck. The Chief of Research and Development stated in November 1965 that the Qualitative Materiel Requirement authorization procedure would be used for any future 2-1/2-ton truck development. We were advised by an Assistant Chief of Staff for Force Development official in May 1969 that a Qualitative Materiel Requirement would probably be processed for development of such a truck in the next 2 years.

Conclusions

We believe this example demonstrates that vehicle development efforts, if uncontrolled, can lead to numerous changes and eventually result in a vehicle not meeting stated needs. Had the project been controlled by a valid

and technically feasible Qualitative Materiel Requirement, we believe that a 2-1/2-ton truck might have been developed and the Army might have fulfilled the need for such a vehicle rather than using a 5-ton truck for that need.

M548 6-TON TRACKED CARGO CARRIER

The first indication of a need for a vehicle to accompany and support the M107, M108, M109, and M110 self-propelled artillery weapons was identified in a January 1962 study conducted by the Office of Combat Development and Doctrine, U.S. Army Artillery and Missile School. This study concluded that the proposed XM548 was the least desirable of the vehicles studied to fill the role of an accompanying vehicle for the M107, M108, M109, and M110 weapons because of limitations in its cruising range and capability for trench crossing and vertical wall climbing, its inadequate cargo capacity, and the vulnerability of its suspension system. The study compared the XM548 with various existing and certain proposed tracked and wheeled cargo vehicles.

Although the study concluded that other cargo carriers would better fill the role of an accompanying and support vehicle, the Chief of Research and Development in March 1963 approved a proposal by the Fifth Army Corps for the XM548. Since the Fifth Army Corps did not propose a Qualitative Materiel Requirement nor identify the specific characteristics desired in such a vehicle, the Chief of Research and Development requested the Combat Developments Command to initiate action toward establishing requirements and characteristics. He also directed the Army Materiel Command to initiate development of the vehicle. Thus development was expedited before a Qualitative Materiel Requirement was officially established.

The draft of the XM548 Qualitative Materiel Requirement prepared by the Combat Developments Command stated that the then-standard 2-1/2- and 5-ton trucks used as accompanying and support vehicles for the self-propelled weapons would not satisfy the requirement because the trucks did not possess operational characteristics equal to the weapons. Further, it stated that the failure to develop adequate accompanying vehicles would severely degrade mission accomplishment.

As stated previously, a January 1962 study showed that the XM548 also could not realistically satisfy such user requirements. In addition, the draft document did not propose design characteristics which would overcome the shortcomings identified by the study. For example, the XM548 cannot cross more than a 66-inch trench whereas the vehicles it must accompany can cross a 93-inch trench.

Subsequent testing of the XM548 models disclosed that the vehicles would not even meet the essential characteristics stated in the draft document. For example, test reports showed that the XM548 (1) was incapable of carrying the required 6-ton load without degrading the suspension system, (2) had a cruising range of only 240 miles without a towed load over the required course in relation to the required 300 miles with a towed load, and (3) had failed to attain the essential reliability, durability, and maintainability requirements. Thus the vehicle fell short of the requirements of the draft document which in itself did not meet the justification for the project in the first place. For example, although the self-propelled artillery weapons which the XM548 was to accompany have a cruising range of 450 miles, the draft Qualitative Materiel Requirement stated that the required cruising range for the XM548 was 300 miles, and the demonstrated range of the XM548 was only 240 miles.

In December 1964--19 months after project initiation and after test results were available--the Qualitative Materiel Requirement was approved. We noted that several essential characteristics included in the approved document agreed with the performance exhibited during testing but were less stringent than the draft document. For example, the cruising range was relaxed from 300 miles--consisting of 75 miles on highways, 75 miles cross-country, and 150 miles on secondary roads while carrying full payload and towing a load--to 300 miles over paved roads with full payload but without towing a load. One essential characteristic--a 6-ton capacity--was retained in the approved Qualitative Materiel Requirement but was not included in the development contract, which specified only a 5-ton capacity.

Although this vehicle was type classified Standard A and authorized for mass production, we believe that it fell

far short of meeting the requirements for which it had been justified, i.e., possessing operational characteristics equal to the vehicles which it was to accompany.

Agency comments and our evaluation

The Assistant Secretary of the Army (Research and Development), in commenting on our draft report (see p. 48), compared several mobility characteristics of the M548 with M107, M109, and M110 vehicles. In addition, he stated that "the M548 has been a mainstay and workhorse in Southeast Asia and is satisfying a user requirement."

The comments did not address the fact that the vehicle was incapable of carrying a 6-ton load without degrading the suspension system; failed to attain essential durability, reliability, and maintainability requirements; and its trench-crossing capability fell far short of equaling the characteristics of the vehicles to be supported. Simply stating that the M548 has been a mainstay and workhorse in Southeast Asia and that it is satisfying user requirements ignores the fact that the user had to settle for much less than it desired.

Conclusions

We believe that the example illustrates how a development project can be justified, continued, and completed although original development objectives and requirements are not feasible and realistic. In addition, the apparent failure to adequately consider available study results illustrates, we believe, the lack of emphasis on a thorough analysis before proceeding with development effort.

In this case, initiation of development without an approved Qualitative Materiel Requirement not only violated Army regulations but also precluded the screening for technical feasibility and the control over development efforts necessary to ensure materiel satisfying user's expressed needs. Moreover, although the Qualitative Materiel Requirement was later approved, it had been relaxed to agree with the lesser performance exhibited during testing. A thorough beforehand analysis might have precluded the

initiation of this development or instigated a more feasible alternative. The prior preparation of a requirements document should have led to such an analysis.

M561 1-1/4-TON CARGO TRUCK

The need for a 1-1/4-ton cargo truck was determined by a motor vehicle requirements study (see p. 12) approved by the Army in 1961. Although the preparation and approval of a Qualitative Materiel Requirement was required, it was never prepared for this development project. The essential characteristics originally expressed by the user included decreased weight, increased cargo space, improved reliability, and ease in loading and unloading of personnel as compared with characteristics of the M37 3/4-ton truck which it was to replace.

These characteristics were not met, however, and possibly were not realistically achievable. For example, the M561 weighs 7,445 pounds (the user desired a curb weight of 2,500 pounds) compared with 5,700 pounds for the M37. The cargo space is only slightly increased over the M37, and, in our opinion, the M561 could hardly provide the capacity needed to carry light, bulky loads which the M37 was also unable to carry. Loading and unloading of cargo and personnel are more difficult in the M561 because of its hull-type design. Reliability, durability, and maintainability, although somewhat improved over the M37, are still far from meeting user requirements despite a waiver of some requirements after tests showed that the vehicle was incapable of meeting them.

In addition, since various special purpose kits--such as weapon, winterization and heater, winch, and ambulance--are necessary for the vehicle to perform its mission, it was considered essential that such kits be developed concurrently with the vehicle. We found, however, that, because in some cases firm kit requirements were not established on a timely basis, development of some of the kits was not completed concurrently with the vehicle. As a result, such kits could not be tested with the vehicle and modifications to the current production contract will have to be made to procure such kits. Any delay in delivery of kits to the user might impair accomplishment of vehicle missions.

Conclusions

We believe that the M561 development, costing at least $9 million, is another example of how, in the absence of a Qualitative Materiel Requirement, development efforts can be expended on requirements that are not technically feasible and can result in materiel which, although eventually accepted by the user, substantially deviates from the user's expressed needs. We believe that, had the M561 development been preceded by an approved Qualitative Materiel Requirement, it is more likely that the development effort would have been directed to satisfying user needs or that the analysis leading to such approval would have indicated that some of the requirements established by the user were unrealistic or not feasible. In addition, adequate review of the Qualitative Materiel Requirement, we believe, would have resulted in the initiation of more timely and firm determinations involving kit requirements.

ACTIONS BY THE ARMY AND OUR EVALUATION

The Army, in September 1968, revised its regulations governing the preparation of the Qualitative Materiel Requirements to provide for greater clarity in describing essential characteristics and to require more justification for them prior to proceeding with development. The Combat Developments Command advised us that the revised regulation required that each Qualitative Materiel Requirement submitted for approval must be supported by a written rationale justifying each vehicle characteristic shown in the document. In addition, the revised regulation which contains the format for the Qualitative Materiel Requirement submission explains that (1) essential characteristics are those which cannot be relaxed, (2) the user must be able to justify them, and (3) the technical feasibility must have been established by the developer.

We believe that, although the revised regulation does provide improved guidance for the Qualitative Materiel Requirement preparation, it is basically a reiteration of guidance already provided but not adhered to in the past. For example, approved Qualitative Materiel Requirements have been required at least since 1958 as a prerequisite to development effort but, as noted by the examples in this

report, such documents have not always been prepared and thereby have not been available as a controlling feature during development. In our opinion, therefore, revision of the regulation in itself will not resolve a more basic problem pointed out in this report. We believe that the basic problem has been the lack of emphasis on careful analysis of the validity and feasibility of meeting expressed user requirements based upon sufficient experimental work and testing conducted prior to approval of the Qualitative Materiel Requirement and initiation of engineering development.

This led, we believe, to unrealistic or overly optimistic development objectives which later necessitated relaxation of or significant deviations from essential requirements. We found that, in some instances, essential characteristics of major significance had been relaxed or waived to agree with development and test results simply because at that point in time no other alternative was practicable.

In this regard, the Combat Developments Command advised us that relaxation of requirements in trade-off analyses[1] had been considered throughout vehicle development and particularly at each in-process review, when development or test results had disclosed that original (essential) characteristics were attainable only at drastic cost increases or perhaps were beyond the state of the art. In our opinion, such relaxation of requirements would be minimized if sufficient experimental work and testing were performed as a basis of determining feasibility (including what is within the state of the art) prior to establishing the specific requirements for an item included in a Qualitative Materiel Requirement.

We believe that better analyses and controls are needed prior to the Qualitative Materiel Requirement approval to lessen the need for significant trade-offs such as occurred in the cases noted in this report.

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[1] A trade-off analysis is the process of weighing alternatives in terms of time, cost, and performance to decide which is best.

RECOMMENDATION

We recommend that the Army improve its management of the tactical vehicles development program to ensure that

--in accordance with existing regulations, Qualitative Materiel Requirements are prepared, thoroughly analyzed, and approved by the Army at the Department level before initiation of effort specifically directed toward development of an end-item,

--approved Qualitative Materiel Requirements clearly set forth requirements that are valid and are realistically attainable, based upon prior exploratory and experimental work, within the designated time frame, and

--improved coordination and communication exist between the developing and using agencies to preclude the need for significant deviations from or later waiver or relaxation of design or performance characteristics deemed essential by the user.

AGENCY COMMENTS AND OUR EVALUATION

The Assistant Secretary of the Army (Research and Development) commented on our recommendations and advised us of several actions being taken to improve the management of vehicle development projects. (See app. I.)

The Assistant Secretary concurred with the first part of our recommendation and advised that a change to Army regulations had been prepared to require an in-process review that would show proof that advanced development was progressing satisfactorily or that the degrees of risks were known and were acceptable to the Army prior to continuing development.[1] We plan to examine into the implementations of the revised regulation during our future audit work.

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[1]We were subsequently advised that the Assistant Secretary was referring to change 2 to Army Regulation 705-5 dated April 14, 1970, which became effective on June 15, 1970.

In connection with the second part of our recommendation, the Assistant Secretary of the Army (Research and Development) advised us that, although the user's representative (Combat Developments Command) had originated the materiel requirements for hardware, including tactical vehicles, the requirements document would be reviewed extensively both before and after approval by the Department of the Army. He stated that the requirement usually would be presented in the requirements document in terms which made development possible and was intended to incorporate only those characteristics which were determined to be within the state of the art. He stated, however, that, in some cases, achievement of required characteristics, once development had started, had been found to be beyond the state of the art or too costly, which necessitated revisions to the document.

We believe that adequate prior experimental work and testing will provide good indications of what is feasible and within the state of the art and thereby minimize revisions to the document to eliminate characteristics later found to be beyond the state of the art or too costly.

Concerning the third part of our recommendation, the Assistant Secretary agreed that it was desirable in most instances for the developing agency not to significantly change an essential user requirement for any reason. He stated, however, that the relaxing of certain requirements might be more cost effective, in terms of money and time, than to continue development to attain a capability which, if deleted, would not significantly degrade performance of the end-item. We agree with the Assistant Secretary that changes may be necessary in limited instances during early phases of development such as he described. We believe, however, that, when changes are necessary, they should always be coordinated with the user agency to ensure that essential requirements remain unchanged.

The Assistant Secretary also commented on the individual tactical vehicle projects which we used to demonstrate the need to preclude initiation of development projects until requirements are determined to be valid and feasible. (See p. 48.) We were advised that our examples demonstrated

the utility of pilot fabrication and testing prior to initiation of mass production to (1) confirm or deny the feasibility of a design concept or (2) provide a mechanism for developing and testing trade-offs between the user performance objectives and the realities of cost, reliability, durability, and maintainability.

We agree that our examples show that pilot fabrication and testing are preferable to mass production. For example, the M548 vehicle was authorized for mass production without meeting user reliability, durability, and maintainability requirements.

We believe that, had the necessary prior experimental work and testing been performed before preparation and approval of the Qualitative Materiel Requirement as required by Army regulations, the user would have had a better chance of receiving equipment to satisfy its essential requirements. As already pointed out, we believe that such preparatory work would lessen the need for such significant trade-offs as occurred in the cases noted in this report.

We noted that the Blue Ribbon Defense Panel in its report to the President and Secretary of Defense in July 1970, also pointed out that a major problem with the requirements process occurred at its very beginning. The Panel indicated that there was no doubt that the overall requirements process could be improved greatly by specifying that operations analysts study requirements at the point of origin. In that way those requirements reaching higher headquarters should have greater validity.

CHAPTER 3

NEED TO ENSURE THAT DEVELOPMENT OBJECTIVES ARE MET BEFORE VEHICLES ARE AUTHORIZED FOR MASS PRODUCTION

Army regulations require Department of the Army--Assistant Chief of Staff for Force Development--approval of a type classification action before production is authorized. Type classification actions are considered major decision points in the life cycle of materiel and operational planning is affected by them.

Standard A-type classification is the designation given a combat-acceptable item suitable for mass production which, through engineering and service tests, has demonstrated the capability to meet all essential characteristics specified in the Qualitative Materiel Requirement. The Army Materiel Command procedures state that a technical data package suitable for competitive procurement should be complete at the time an item is type classified as Standard A. Type classification as Standard A signifies completion of development effort and adoption for overall Army use.

Army regulations stress the need, however, for direct and forceful action to reduce development lead time. In this regard, implementing regulations permit type classification as Standard A prior to completion of all tests and correction of defects if correction can be made during initial production of the vehicle. In addition, Army regulations provide for type classifying an item as limited production which permits production prior to completion of development and tests to fill an urgent operational requirement for which no other existing item is adequate.

Our review indicated that the Army's emphasis on reducing development lead time has led to premature type classification actions and release of technical data packages which, in turn, has resulted in production of defective vehicles or vehicles that do not fully satisfy user requirements. In addition, premature type classifications not only resulted in expensive modifications during production, but also might have increased rather than reduced the time necessary to field an acceptable vehicle.

M548 6-TON TRACKED CARGO CARRIER

As discussed on page 14, the M548 cargo carrier was developed beginning in 1963 under an expedited program to satisfy a stated urgent need for an accompanying and support vehicle for the M107, M108, M109, and M110 self-propelled weapons which were issued to the troops in 1963. Because of its stated urgency, the planned development cycle was severely reduced from the normal 4 years to 16 months from project initiation to Standard A-type classification. We believe that the compressed schedule did not provide for sufficient testing prior to type classification.

Although engineering and service tests conducted during the period February to October 1964 disclosed that the vehicle had numerous and serious defects and did not meet expressed user requirements, the Chief of Research and Development in February 1965 approved type classification as limited production to permit the Army Materiel Command to take advantage of a multivehicle, multiyear procurement. Because of the defects disclosed by engineering and service tests, the technical data package used for procurement incorporated numerous design modifications proposed to correct the defects. The adequacy of these modifications, however, was not verified by tests prior to release of the technical data package for procurement.

The Army awarded a 3-year production contract for 2,638 units in April 1965 and in October 1965 approved the vehicle for Standard A-type classification on the basis of assurance that tests would be completed and defects corrected prior to initial production. Check tests performed from February 1965 to March 1966, however, to determine the adequacy of the proposed modifications, disclosed that the modifications--although incorporated in the technical data package--were inadequate and that additional modifications and tests were necessary. We noted that testing of these modifications and necessary redesign continued for over a year after release of the technical data package for procurement.

In addition, although the vehicle was made Standard A in October 1965, environmental tests were not completed

until March 1966 and--due to the compressed development cycle--the vehicle had not demonstrated the ability to operate under arctic and desert conditions as specified by the Qualitative Materiel Requirement.

Moreover, tests from April through September 1966 of vehicles in the initial production lot continued to show various defects requiring correction. We noted that numerous additional modifications became necessary as production and testing progressed simultaneously. As a result, as many as 500 of the vehicles initially procured were unsuitable for troop use and were stored while awaiting modifications. Consequently, the vehicles, deemed urgently needed by the user in early 1963, were not issued to the troops until May 1967.

Conclusion

We believe that this example illustrates the consequences of prematurely proceeding with Standard A-type classification and production of vehicles before the vehicles are tested and proven adequate. In this case, the Army's effort to expedite the development to meet a stated urgent requirement not only resulted in a failure to meet the urgency, but also undoubtedly resulted in additional cost since modification to production vehicles costs considerably more than modification during engineering development. The change then was not limited to a few developmental models but instead had to be applied to large quantities of production vehicles.

M561 1-1/4-TON CARGO TRUCK

The M561 1-1/4-ton truck was made Standard A in June 1966 and authorized for mass production on the basis of assurances that numerous defects would be corrected prior to award of a production contract. The technical data package, although incomplete, was initially released in September 1966. However, the production contract, normally awarded about 6 months after type classification, was delayed for nearly 2 years. We found that numerous design changes, made to correct defects found during engineering and service tests and included in the technical data package, had not

been validated by test when the type classification action was approved. During preproduction testing, many of these changes proved inadequate and necessitated additional revisions to the technical data package in January and again in September 1967.

As late as September 1967, major equipment defects found during engineering and service tests remained unresolved and many of the modifications made to correct preproduction defects had not been tested sufficiently to validate their adequacy. Nevertheless, the revised technical data package was used in the September 1967 solicitation of bids for production of the vehicle. Tests were then initiated to test the adequacy of modifications, some of which constituted completely new components, such as sealed brakes. As a result of the continued testing, numerous additional changes were made to the technical data package. Contractors, in the middle of bid preparation, experienced considerable difficulty because of the vacillating design and nearly all of them requested an extension of the bid opening date because of problems encountered with the technical data package. Tests were not completed until after award of the production contract in June 1968 and necessary design changes resulting from the tests were incorporated by contract modification.

Agency comments and our evaluation

The Assistant Secretary of the Army (Research and Development) said that the technical data package was not incomplete or inadequate for competitive procurement and that seven firms competed for the procurement without submitting a protest for any reason. (See p. 50.) He said that the Army believed that the intensity of the competition and the requirement for bidders to thoroughly evaluate the technical data in accordance with the pre-production-evaluation clause were responsible for requests for extension of the bid preparation period.

As shown above, unresolved major equipment defects existed when the bids were solicited which indicated that the technical data package was incomplete. In addition, testing continued after bids were solicited and numerous changes were subsequently made to the technical data package.

Although we have no evidence of any formal protests by the seven firms that competed for the procurement, the record shows that a 30-day extension for bid submission was recommended in view of complaints by four of the contractors that the technical data package was inadequate or required changes.

The Assistant Secretary also stated that there were relatively few cost-type engineering change orders processed during the life of the contract and that the time spent between type classification (June 1966) and issuance of the solicitation (September 1967) was well spent in generating product improvements. We recognize that the time interval of more than a year from the standardization action to the request for bids permitted correction of many of the known deficiencies. Nevertheless, the classification as Standard A denotes that the item is ready for mass production and issuance to the troops, and it is evident that such classification of this vehicle in June 1966 was premature.

Conclusions

We believe that this case illustrates how the Army's emphasis on leadtime reduction can cause management to orient decisions toward Standard A-type classification irrespective of known vehicle defects and the incompleteness of the technical data package. In our opinion, both the approval of Standard A-type classification and the initial release of the technical data package were premature. Revisions to the data package during and after preproduction testing indicate, we believe, that the technical data package was obviously incomplete and inadequate when initially released in September 1966 and was still incomplete when released in September 1967 and used for bid solicitation and contract award.

M656 5-TON CARGO TRUCK

The M656 truck was type classified as Standard A in April 1966 although extensive engineering and service testing showed that numerous essential characteristics had not been met. For example, the time and cost of maintenance was excessive, durability and reliability requirements were not

attained, fuel economy was not improved, numerous engine failures were experienced, and the vehicle contained safety hazards in swimming, braking, and protection of the crew from exhaust fumes. Type classification was approved, however, on the basis of assurance by the Project Manager that unresolved problems would be corrected during the preproduction phase.

In February 1967, however, preproduction tests were terminated prior to completion because of an excessive failure rate (one every 300 miles). For example, in the two trucks tested, five transmissions and six engines failed for various reasons, and maintenance cost was excessive. After numerous modifications were made to overcome the problems, additional tests were made. Late in 1967, however, because of the excessive engine maintenance, the test agency (Army Test and Evaluation Command) recommended deferring a decision to release the M656 for production pending additional extensive testing of improved engines. Shortly thereafter, however, in January 1968 a limited buy of 500 vehicles was made, primarily for use in converting the Pershing 1A missile system from tracked to wheeled transport.

Information obtained from the Project Manager in March 1969 (nearly 3 years after type classification) indicated that another engine may be substituted in future procurement. We were told that this would probably delay fielding of the vehicle by about 2 years because of necessary redesign and retest.

Conclusion

As in the previous examples, we believe that this case also illustrates how the Army--on the basis of promises--can prematurely type classify a known defective vehicle as Standard A and put the vehicle in production before development is completed. The Army, in our opinion, has placed more emphasis on reducing development lead time than on ensuring that satisfactory vehicles are obtained.

ACTION BY THE ARMY AND OUR EVALUATION

In April 1968, a revision to Army Regulation 705-5 gave the Assistant Chief of Staff for Force Development

(user-oriented) the responsibility for the life cycle evaluation of materiel, including coordination and integration of development, validation of materiel objectives and requirements, and type classification, and reclassification of materiel. Formerly, the development-oriented Chief of Research and Development had the responsibility.

We believe that this action should ensure that vehicles are satisfactorily developed to meet user requirements prior to approval of type classification as Standard A and authorized for production. We plan to continue monitoring the tactical vehicles development program including implementation of the revised Army Regulation and the effects the reorganization has on the program.

RECOMMENDATION

We recommended, therefore, that Army regulations be revised to permit classification of vehicles as Standard A and that mass production be authorized only when such vehicles have demonstrated the capabilities to meet all essential characteristics of the Qualitative Materiel Requirement and are considered by the user to be suitable, thereby minimizing costly changes during production.

AGENCY COMMENTS AND OUR EVALUATION (see p. 45)

The Assistant Secretary of the Army (Research and Development) concurred with our conclusion that type classification of some items as Standard A has been granted in the past prior to successful completion of all tests. However, he stated:

> "The Army is of the opinion that the decisions to initiate production, in the foregoing three cases, were sound and based on careful analysis of alternatives."

He stated also that the implementation of Army Regulation 71-6, effective January 1, 1970, should eliminate recurrence of this particular deficiency because the regulation establishes additional procedures to be followed and requires more detailed information to accomplish a request for type classification action.

Our review showed that each of the examples cited was type classified as Standard A and production initiated before the items were proven by satisfactory results in service tests. We believe that the quantity of modifications made to these three vehicles and the testing made of the modifications after type classification action clearly indicate that the vehicles were not ready for production when type classified.

We examined Army Regulation 71-6, which became effective on January 1, 1970, and noted that the regulation provides more detailed procedures for obtaining a Standard A-type classification action. Previously an item was designated as Standard A when it was suitable for mass production, had completed engineering and service tests, and had demonstrated the capability to meet all essential characteristics specified in the Qualitative Materiel Requirement. Under the new regulation, the designation of a Standard A item is a preferred and fully acceptable item which has successfully completed all required test and evaluation, meets Department of the Army-approved requirements, military characteristics, and specifications for worldwide or specified geographic areas, is totally suitable for performing the required mission, can be properly maintained and logistically supported,

and is suitable for mass production. An appendix to the regulation explains the type of information and technical data needed for type classification and reclassification actions.

We believe that the April 1968 reorganization action and proper implementation of Army Regulation 71-6 issued in November 1969 should improve the Army's management of its tactical vehicles development program by preventing premature type classification and authorization for production. The need for continuing management attention is further demonstrated, however, in a February 1970 audit report by the Army Audit Agency on a comprehensive review of the Army Materiel Command's research and development program. Their review, like ours, disclosed that

--items were type classified and procurements initiated, although prescribed classification criteria were not met, and

--some items were type classified as Standard A before the materiel had been successfully tested and, in a few cases, before a specific need had been established.

Further, the Army Audit Agency report indicated that:

"It seemed that there was a general trend of pushing a type classification action through because funds were available for procurement--or a promised date had been reached--rather than tying in the timing of the type classification to achievement and need."

The Army Audit Agency's recommendations were also similar to ours. The Agency recommended that the Assistant Chief of Staff for Force Development not approve Standard A-type classification proposals unless sufficient supporting data were furnished to provide reasonable assurance that all prescribed type classification criteria were met and that materiel not be classified as Standard A until after sufficient tests have demonstrated that the materiel meets firm approved characteristics. According to the Army Audit Agency, its recommendations were fully implemented by Army Regulation 71-6, effective January 1, 1970, and by Chief of Staff Regulation 71-6, dated November 29, 1969.

CHAPTER 4

NEED TO ENSURE MEANINGFUL EVALUATIONS AND TIMELY AND PROPER DECISIONS DURING DEVELOPMENT

Regarding management decisionmaking during development, applicable Army guidelines state:

> "*** The most important and relatively inexpensive phase of the materiel life cycle is research and development *** Research and development is most efficiently conducted sequentially because problems at one stage are not fully apparent until the test data is available from the previous stage, *** it is cheaper to do engineering development work than it is to procure and field a system. Hence, successive decisions become more costly as a system nears completion and is distributed for field use."

To provide for periodic evaluation of the progress and potential success of Army developmental materiel, accomplish effective coordination, and facilitate proper and timely decisions bearing on the future course of a project, the Army requires that in-process reviews be held at a minimum of five critical points in the development cycle. In-process reviews are formal meetings intended to result in decisionmaking at each of these checkpoints by obtaining opinions, recommendations, and acceptance from all commands concerned.

Also, Army regulations specify that an in-process review agenda will be published and distributed to each participating agency. The agenda will identify each area for which a decision is required and contain data, such as test results, necessary to permit each participating agency to establish a valid position prior to the meeting. A participant from each agency, therefore, should be prepared to state the official position of his command at the in-process review meeting.

The Army's Inspector General reported that, on the basis of his inquiry in 1965 into development of the XM410/XM410E1 2-1/2-ton truck, the in-process review meetings were used as sounding boards for desired concepts rather than for review and decisionmaking points. He found (1) that, in many instances, the lack of adequate preparation by interested agencies for in-process reviews negated an objective and timely decision by responsible individuals, (2) that a lack of unanimity of position within interested and decisionmaking agencies was prevalent, and (3) that some representatives at the meetings did not have the authority to make decisions for the agencies which they represented.

Our review showed that required in-process review meetings were held and attended by representatives of the various decisionmaking agencies for most of the vehicle developments we reviewed. We believe, however, that some meetings were ineffective in achieving their objectives because, prior to the meeting, decisionmaking agencies were furnished incomplete data on which to establish their positions, and, from one meeting to the next, there was a lack of continuity of agency personnel. As a result, meaningful evaluation was hampered, timely and proper decisionmaking was impaired, and projects were delayed.

INCOMPLETE OR UNTIMELY DATA FURNISHED TO DECISIONMAKERS

M561 1-1/4-ton truck and M548 6-ton tracked cargo carrier

For the in-process review on the M561 held in April 1966 to decide on type classification of the M561, we found participants were furnished data on the results of tests completed only through November 1965 on which to establish their agency positions for the meeting. Tests, however, continued until June 1966. At the April meeting, results of testing since November 1965 were summarized and other data were presented which the decisionmaking agencies had not had a chance to consider prior to the meeting. Because of the data not previously considered, the Combat Developments Command, the user representative, nonconcurred in type classification of the M561 as Standard A. Later, in June,

the Combat Developments Command concurred in type classifying the vehicle as Standard A on the condition that an in-process review meeting be held after completion of the pre-production test and before the award of a production contract.

Again, at the M561 in-process review held early in April 1968 to consider whether to award a production contract, the Combat Developments Command would not concur because of unsatisfactory pre-production-test results furnished to them for the meeting. Subsequent to the meeting, however, results of additional tests, begun after the pre-production tests, were furnished to the Command officials that had not been previously provided to or considered by them when developing the Command's position. We were told that these data, although available, were not provided to decisionmakers prior to the meeting because it was not thought necessary. On the basis of the additional data, however, the Combat Developments Command later in April concurred in awarding the M561 production contract.

With respect to the M548 6-ton tracked cargo carrier, we found that pertinent data apparently were not furnished to all participants prior to the in-process review held in August 1965 to consider Standard A-type classification for the M548. After the meeting, the Combat Developments Command obtained test results available but not furnished prior to the meeting which showed that the vehicle failed to meet at least one essential characteristic of the Qualitative Materiel Requirement. Whether such disclosures would have altered the Command's decision on the M548 is not known. However, the Combat Developments Command said that, to improve future in-process review meetings, such pertinent data must be furnished to participants for consideration prior to the meeting for establishing official agency positions.

XM759 1-1/2-ton soft tire tracked cargo carrier

The XM759, not previously discussed in this report, was originally being developed by the Army for the Marine Corps under an expedited program to satisfy a stated urgent need in Southeast Asia. The approved development project initiated in May 1966 provided for just 17 months to first

production roll-off, including only 4 months of initial testing on which to base a production decision. In April 1969, the Marine Corps directed a revision of the program to a more normal development program and termination of the accelerated production phase because of problems and delays. Records at the Army Tank-Automotive Command revealed that the Command's research and development experts, prior to program initiation, did not endorse the proposed abbreviated schedule because of the following anticipated problems.

--Slope operation--hazardous--concept extremely dangerous.

--Braking--unsafe--possibility of rolling vehicle over.

--Riding characteristics--exceed acceptable human tolerance limits.

--Water speeds--unachievable.

--Reliability--requirements too stringent, extensive research and development necessary.

--Tires--vulnerable--a long way from reliable and durable bag-type suspension.

--Maintenance--may be as high as 50 percent of operating hours.

--Curb weight of 8,000 pounds--unattainable without compromising performance, durability and reliability.

Although the Marine Corps concurred in the 17-month development schedule, records at the Army Tank-Automotive Command revealed that the anticipated problems were not made known to the Marine Corps or the Army Materiel Command for consideration at the initial decisionmaking point.

We noted that the problems anticipated by the Army Tank-Automotive Command's research and development experts continued to plague the vehicle development after 3 years of effort. For example, the vehicle is incapable of attaining the required water speed without assistance, and improvement is still needed in the braking.

We believe that, had the Army provided complete information to the Marine Corps on the anticipated problems at the initial decisionmaking point in early 1966, the compressed development schedule might have been deemed not feasible and accordingly not approved. We have noted that this lack of communication also resulted in the premature procurement of a quantity of 405 power-train assemblies costing $2 million which might become excess.

LACK OF CONTINUITY OF AGENCY PERSONNEL AT IN-PROCESS REVIEWS

The Inspector General reported in 1965 that agency representatives at in-process review meetings on the XM410E1 2-1/2-ton truck development were frequently rotated, were not completely conversant with the history of the project, and were not prepared to express a firm position for their agency. He found that 503 different individuals representing 29 agencies participated in one or more of 11 decisionmaking meetings. Seven of the agencies had decisionmaking responsibilities. Two of these seven agencies had nine individuals who attended only one meeting, and four agencies had three individuals who attended only one meeting. Highlighting this lack of continuity, one decisionmaking agency sent 132 different individuals at one time or another to the 11 meetings during the development. The Inspector General concluded that the lack of continuity of personnel from one meeting to the next tended to impair decisionmaking and confuse the issues.

In our review of the development of the M561 1-1/4-ton truck and the M656 5-ton truck, we found conditions similar to those identified by the Inspector General. For example, we found that 192 representatives of various agencies attended one or more of five in-process review meetings during the development of the M561 (the roster for one meeting is unavailable). The record shows, however, that 133 of the 192 individuals attended only one meeting and only 24 attended more than two meetings. No one individual attended all the meetings.

Further, we found that 78 of the 192 individuals represented decisionmaking agencies. Of the 78 individuals,58 attended just one meeting and four attended more than two meetings. Of the 29 individuals representing the developing agency, 27 attended only one meeting. Similarly, 13 of the 20 individuals representing the user attended only one meeting.

CONCLUSIONS

The in-process review procedure appears to provide an effective means for coordinating and facilitating

decisionmaking bearing on the progress of an item through various development phases. Although most of the required meetings were held for the vehicle developments we reviewed, we question the effectiveness of many of these meetings in achieving coordination and control over development efforts. Agency representatives responsible for decisionmaking who attended in-process review meetings had been furnished data prior to the meetings which often were neither current nor complete, and therefore they were not in a position to make well-founded decisions. Consequently, decisions were based on incomplete or outdated information or projects were delayed pending evaluation of additional data furnished during or subsequent to the meetings. In addition, the lack of continuity of personnel from one meeting to the next, in our opinion, was also detrimental to the decisionmaking process. Earlier findings of the Inspector General tend to substantiate this opinion.

In the case of the XM759, we believe an inappropriate decision to proceed with an unrealistic development schedule might have been averted through complete disclosure of available information.

RECOMMENDATIONS

So that in-process reviews can be more effective and facilitate proper decisionmaking, we recommend that management place greater emphasis on the timely dissemination of complete and current data to decisionmaking agencies and, to the extent possible, maintain continuity of participants from one meeting to the next throughout development to promote stability.

AGENCY COMMENTS AND OUR EVALUATION (see p. 46)

The Assistant Secretary of the Army (Research and Development) agreed that, where there is continuity of personnel, information flow is good. He stated that the lack of personnel continuity in key materiel development positions, cited in our report, occurred during a period of almost constant turbulence due to major reorganization in the Army and because of the increase in level of activity in Southeast Asia. He advised us that recently, attendance at in-process reviews had improved.

The Assistant Secretary said that the lack of continuity of attendance at the in-process-review meetings had been effectively eliminated or diminished through the stable structures established by project management, commodity management, and system engineering. He said also that, although project managers or staff supervisors might be rotated, their deputies and other high-level project management staff members had maintained continuity at the meetings. He said further that the in-process review procedure had also been strengthened by requiring that voting members comment on the meeting minutes within 30 days so that voting-member concurrence or comment would be obtained regardless of the authority of the representative attending the meeting.

We believe that implementation of the above actions should improve the in-process review meeting procedure. We plan to examine into the implementation during future audits.

With respect to the XM759 vehicle, the Assistant Secretary advised us that corrections to current remaining principal problems were under test and that upon completion of the tests, a review was planned to determine the future course of the program.

The Assistant Secretary took exception to our statement that the Army Materiel Command and the Marine Corps agencies were not apprised of the numerous significant anticipated problems. (See p. 37.) He stated that they had been informed of the technical risks and schedule problems throughout the program. He stated also that, despite prior developmental experience in a similar program, problems and delays had occurred and that in April 1969 the Marine Corps directed a revision of the program to a more normal development program and termination of the accelerated production phase.

There is no record to show that the Army Materiel Command or the Marine Corps was advised of the problems. The record does show, however, that all the problems experienced in this program had been identified by the Army Tank-Automotive Command's research and development experts before development began. Had such information been furnished to the involved agencies, they would have been alerted not only as to the unlikelihood of meeting the compressed development schedule, but also of the possible program failure.

CHAPTER 5

SCOPE OF REVIEW

We reviewed the regulations and procedures, issued by the Department of the Army and the Army Materiel Command, setting forth the policies and practices to be followed in managing development projects. We also examined pertinent records and interviewed officials to determine the extent of compliance with such regulations and procedures by those responsible for the tactical vehicles development program. Specific tactical vehicle developments which we reviewed are listed on page 7 of this report. Our review, which included an evaluation of the effectiveness of Army management of major phases of the vehicle development process, was performed at the following locations:

Department of the Army, Washington, D.C.
- Office of Assistant Chief of Staff for Force Development
- Office of Chief of Research and Development

Army Materiel Command, Washington, D.C.
Army Combat Developments Command, Fort Belvoir, Virginia
Army Tank-Automotive Command, Warren, Michigan

In addition, we reviewed an audit report--issued in 1966 by the Army Audit Agency, Midwestern District, St. Louis, Missouri--involving the M107, M110, M578 weapon/vehicle family and an Army Audit Agency report issued in February 1970--subsequent to completion of our fieldwork--on a comprehensive review of the Army Materiel Command's research and development program.

Further, we reviewed the results of the Blue Ribbon Defense Panel study on the Department of Defense which was reported to the President and the Secretary of Defense on July 1, 1970.

APPENDIXES

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON D.C. 20310

29 APR 1970

Mr. Charles M. Bailey
Director, Defense Division
United States General Accounting Office
Washington, D. C. 20548

Dear Mr. Bailey:

The Secretary of Defense directed the Department of the Army to reply to your letter of 29 January 1970 forwarding the January 1970 draft report on "Need to Improve Management of Tactical Vehicle Development Program" (Code 66504) (OSD Case #3074).

The inclosed comments were prepared by the Department of the Army and coordinated with the Office, Secretary of Defense.

R. L. Johnson
Assistant Secretary of the Army
(Research and Development)

2 Incls
1. DA Position, GAO Recommendations
2. Army Comments, GAO Findings

DEPARTMENT OF THE ARMY POSITIONS

ON

General Accounting Office Draft Report to the Congress of the United States RD-54, dated January 1970, subject: Need to Improve Management of Tactical Vehicle Development Program, Department of the Army (Code 66504) (OSD Case #3074).

I. GAO Recommendations:

A. Recommendation No. 1. That the Army improve management of its tactical vehicle development program to assure that:

1. In accordance with existing regulations, materiel requirements documents are prepared, thoroughly analyzed, and approved by the Army at the Department level before any initiation of development effort specifically directed toward end-item use;

2. Approved requirements documents clearly set forth requirements that are valid and are realistically attainable--based upon prior exploratory work--within the designated time frame; and

3. Improved coordination and communication exist between the developing and using agencies to preclude the need for significant deviations from or later waiver or relaxation of design or performance characteristics deemed essential by the user.

Army Position:

1. Concur. A change to Army Regulations has been prepared. This change will require a review (System Development Plan/ Coordinated Test Program In-Process Review) to be held prior to entering Engineering Development. This In-Process Review will show proof that Advanced Development is progressing satisfactorily or that the degrees of risks are known and are acceptable to the Army prior to continuing development. This is but the latest action in a series of corrective measures which have been instituted in recent years.

2. Materiel requirements for hardware, to include tactical vehicles, originate with USACDC, the user's representative. The

requirements document (Qualitative Materiel Requirement or Small Development Requirement) is extensively reviewed prior to submission to Department of the Army for approval and is subject to a disciplined challenge even after Department of the Army approval. The Qualitative Materiel Requirement or Small Development Requirement states the requirement in terms which make development possible and is intended to incorporate only those characteristics which are determined to be within the state-of-the-art. Of necessity, this is sometimes a judgment area and not infallible. In some instances achievement of required characteristics, once development has started, is found to be beyond the state-of-the-art or too costly. When this happens, it often necessitates revision of the requirement document to reflect that which is both realistic and reasonable. The Army should not be prevented from taking this approach.

3. The third part of this recommendation indicates that the Department of the Army should not significantly change an essential user requirement for any reason. Admittedly this is desirable in most instances. However, the relaxing of certain requirements may be more cost effective, in terms of money and time than to continue development to attain a capability, which if deleted would not significantly degrade performance of the end item. In this light it would appear prudent for the Department of the Army to reevaluate the overall requirement (after a period of Advanced Development) and to analyze trade-offs rather than to blindly continue development to achieve capabilities written in a requirements document which, for various reasons, may no longer be completely valid.

B. Recommendation No. 2. That the Army improve management of its tactical vehicle development program to assure that classification of vehicles as Standard A is approved only when such vehicles have demonstrated the capabilities to meet the essential characteristics established and are considered by the user to be suitable in every respect for mass production.

Army Position: Concur. Type classification of an item as Standard A has been granted in the past prior to successful completion of all tests and production checks in some cases. Adherence to the provisions of the most recent Army Regulation on type classification should eliminate recurrence of this particular deficiency. (AR 71-6, 20 November 1969, subject: Force Development Type Classification/ Reclassification of Army Materiel, establishes additional procedures to be followed and requires more detailed information to accomplish a request for type classification action. The implementation of these regulations should provide the required emphasis to preclude or reduce premature type classification Standard A).

[See GAO note 1, p. 54.]

D. Recommendation No. 4. That the Army improve management of its tactical vehicle development program to assure that:

1. Management place greater emphasis on the timely dissemination of complete and current data to decision-making agencies, and increased efforts are made to maintain continuity of personnel in decision-making meetings to promote stability and continuity; and

[See GAO note 1, p. 54.]

Army Position:

1. Information flow and continuity of key personnel are related. In general, where there is a continuity of key personnel the flow of information is good. The basic period addressed by the GAO report was one of almost constant turbulence among both military and civilian personnel of the Army. The early sixties saw major reorganization of the Army staff and establishment of both

USACDC and USAMC. The increase in the level of activity in Southeast Asia from about 1965 on further contributed to the lack of personnel continuity in key materiel development positions. Continuity is desirable among key personnel in the development chain; recently, attendance at In-Process Reviews has improved.

[See GAO note 1, p. 54.]

E. General. Concur in general in the remarks contained in subject GAO report regarding tactical vehicle development programs. The report is a case study, using selected programs, of how not to execute a development program. The reported deficiences and errors of management cited had their origin in the mid to late fifties and very early sixties, and were some of the reasons for major reorganization of the Army in 1962. Although no system can be guaranteed foolproof, the reorganization in 1962 and subsequent actions up to the current time have significantly reduced the possibility that the same errors will be repeated. The current system and supporting organizational structure have an inherent array of checks and balances designed to prevent future error.

ARMY COMMENTS ON PRINCIPAL FINDINGS

1. The GAO Report contains four principal findings which are allegedly supported by detailed examples related to each finding. The comments set forth below address these four (4) findings and the cited examples.

2. GAO Finding - There is a need to preclude initiation of development projects until requirements are determined to be valid and feasible.

Example #1 -- XM410E1 2-1/2 Ton Cargo Truck

The Army's objective was to develop a high mobility 2-1/2 ton truck with a curb weight of approximately 7,500 pounds and with improved reliability, durability, and maintainability characteristics.

After building and testing pilot vehicles with both gasoline and diesel engines, the Army concluded that, although this type vehicle remains a design objective, the durability, reliability, maintainability and projected production cost were unsatisfactory and not correctable by redesign of the XM 410E1 vehicle. The development project was terminated in April 1966.

Example #2 -- M548 Tracked Cargo Carrier

The Army's objective was to develop an ammunition carrying vehicle with mobility characteristics approximating those of its self-propelled artillery pieces M109 (155mm howitzer), M107 (175mm gun), and M110 (8" howitzer). The M548 was type classified Standard A in October 1965.

Mobility characteristics of this vehicle with its supported artillery are compared below:

	M548	M109	M107	M110
Range (miles) [See GAO note 2, p. 54.]	300	220	450	450
Speed (max mph)	39	35	34	34
Fording Depth (in)	swims	swims (with kit)	42	42
HP/Ton	15.3	15.7	13.8	14.5

	M548	M109	M107	M110
Ground Pressure (PSI)	8.6	11.1	11.1	10.9
Ground Clearance (in)	16	17.6	18	18
Angle of Approach (°)	57	65	30	65
Angle of Departure (°)	37	78	43	43
Vertical Step (in)	36	21	40	40
Wheel Travel (in)	6	9.8	7	7
Turning Radius (ft)	14	18.5	26	15
Vehicle Width (in)	105.7	124	124	124
Longitudinal Slope (%)	60	60	60	60
Side Slope (%)	30	30	30	30

The M548 has been a mainstay and workhorse in Southeast Asia and is satisfying a user requirement.

Example #3 -- M561 1-1/4 Ton Cargo Vehicle

The Army's objective was to develop a high mobility vehicle for use by combat elements forward of the brigade rear boundary. The primary use of the vehicle was to be as an equipment and personnel carrier. First priority in design was in cross-country mobility. The M561 met its cross-country mobility, specific weight, cargo area and ease of loading requirements. Although it weighs approximately 1600 pounds more than the M37 it provides a significant improvement in payload to curb weight ratio. The M561 was type classified Standard A in June 1966.

In the Army's view, the foregoing examples demonstrate the utility of pilot fabrication and testing prior to initiation of mass production to (1) confirm or deny the feasibility of a design concept, or (2) provide a mechanism for developing and testing trade-offs between the user performance objectives and the realities of cost, reliability, durability and maintainability.

3. GAO Finding -- There is a need to assure development objectives are met before vehicles are type classified Standard A.

Example #1 -- M548, 6 Ton Tracked Cargo Carrier

The Army expedited the development of this vehicle and awarded the first production contract in April 1965 because its automotive components were identical to those of the M113 Personnel Carrier which had been in production since 1960. The difference between the two vehicles was in the configuration of the bodies of the vehicles: the M113 intended as a personnel carrier with a closed roof, the M548 intended as a cargo carrier with an open roof and somewhat thinner walls. The accelerated program was considered to be a low risk, particularly since the developer (Food Machinery Corporation) was selected to be the first producer.

The contractor ran into production difficulties at his new plant, located in Charleston, West Virginia, primarily with the welding of the M548 cargo bodies. After solution of these production difficulties, the M548 vehicles were deployed to Vietnam and proved to be the only common ammunition carrying vehicle able to move cross-country in support of the artillery weapons.

Example #2 -- M561 1-1/4 Ton Cargo Truck

The M561, 1 1/4 ton truck offers the front line infantryman a degree of mobility heretofore not available to unmechanized forces. As described in the technical data package this vehicle comes as close to meeting the user's requirements as the state-of-the-art will allow. The original technical data package released in Aug 66 was for record purposes only, not procurement. Release for procurement was made 22 Sep 67 as part of Step 1 of a two step invitation for bid. Step 1 included notification to all bidders of intended changes including sealed brakes, which were not included in Step 2 in Jan 68.

The Army does not agree that the technical data package for the Gama Goat was either incomplete or inadequate for competitive procurement. Seven reputable firms competed for this procurement and none submitted a protest for any reason. The Army believes that the intensity of the competition and the requirement for bidders to thoroughly evaluate the technical data in accordance with the pre-production evaluation clause were responsible for requests for extension of the bid preparation period. Of the seven firms that picked up a bid package only one dropped out of the competition, all others submitted respectable bids. The Army considers the number of ECO's processed during the life of contract, a better measurement of the validity of the technical data than the time required for bid preparation. In the case of the Gama Goat contract, cost type ECO's have been remarkably few attesting to the worth of the package and the enforcement of the pre-production evaluation clause.

The Army also feels that the time between type classification and issuance of the solicitation was well spent by the developer and the Army in generating a number of product improvements which materially improved the reliability and durability of the vehicle.

While there may be instances when the Army prematurely approved type classifications actions and used incompleted TDP's on the basis of false promises, which eventually led to the production of defective vehicles, the Gama Goat does not fairly represent such an instance.

Example #3 -- M656 5-Ton Cargo Truck

The Army's objective was to develop a high mobility, 5-ton truck for use by the forward area combat elements. Design emphasis was on cross-country mobility, including a swimming capability.

The Vehicle, as developed, essentially met its mobility design objectives and was type classified Standard A in April 1966.

Subsequently, the Army decided to replace the multi-fuel engine in its 5-ton truck fleet with a standard commercial diesel engine. The Army, on the basis of this engine decision coupled with an overall re-examination of vehicle mix requirements for the post-Vietnam war period, has for the time being limited procurement of the M656 to a quantity of 500, primarily for the specialized PERSHING requirement.

Several commercial diesel engines have been applied to the M656 for testing. After testing and after vehicle mix and trade-off analyses are complete, decisions will be forthcoming as to future procurement of this vehicle.

The Army is of the opinion that the decisions to initiate production, in the foregoing three cases, were sound and based on careful analysis of alternatives.

[See GAO note 1, p. 54.]

[See GAO note 1, p. 54.]

5. GAO Finding -- There is a need for adherence to the decision-making process to assure meaningful evaluations and timely and proper decisions during development.

Example #1 -- M561 1-1/4 Ton Truck and M548 6-Ton Tracked Cargo Carrier

The GAO report states that complete data were not furnished to decision-makers at In-Process Reviews during 1965 and 1966 in connection with the M561 1-1/4 ton truck and the M548 tracked cargo carrier.

The GAO report is not clear as to what the impact, if any, of these incomplete data was on the two vehicle programs. Lacking such a conclusion the Army can do little more than agree that total information was not available to the decision-makers at the cited In-Process Reviews.

Example #2 -- This example relates to the development of the XM759 1-1/2 ton soft tire track cargo carrier. This development was undertaken by the Army for the Marine Corps in May 1966 to meet an urgent Southeast Asia requirement. The GAO report alleges that if the Army had fully informed the Marines of the infeasibility of meeting the design requirements, the compressed development schedule would not have been approved.

The XM759 was an ambitious program intended to meet an existing combat requirement. The reduction in intensity of combat in Vietnam coupled with troop withdrawals, particularly of Marine forces, has provided a climate which will permit a somewhat longer and therefore lower risk development program for the XM759. The requirement still exists and the Marine Corps is in agreement with the extended development program.

Example #3 -- The GAO reports on the turnover among these individuals who attend decision-making In-Process Review meetings. The Army, based on its own evaluations, reached this conclusion some time ago.

The lack of continuity of attendance at In-Process Review meetings has, from the developer's viewpoint, been effectively eliminated or diminished through the stable structures established by project management, commodity management and system engineering. While project managers or staff supervisors may be rotated their deputies and other high level project management staff members have maintained continuity at In-Process Review meetings. Consideration is currently being given to further improvement through greater stabilization of project managers assignments. In addition, the Army's procedures and regulations have since been revised for formalized stratified review to ensure uniform and adequate management throughout development programs. The effectiveness of In-Process Reviews, as addressed on pages 51-53 of the report, are particularly pertinent. The concept of the In-Process Review is excellent and a better system probably does not exist. However, the human element often reduces the effectiveness of this management tool. Although the report goes into great detail to show the large number of personnel attending In-Process Reviews and the lack of continuity among those in attendance, the report ignores the key fact of who these representatives were. In-Process Reviews are constituted with only four voting members; the principal representatives are CONARC, USACDC, USAMC and LDSRA. Any others in attendance are either observers or backup for the voting members. The In-Process Review process has been strengthened. Information copies of In-Process Review minutes must be forwarded to all voting members and interested Department of the Army Staff elements. The letter of transmittal requires that command/agency comments or concurrence

with the minutes be forwarded to Office Chief of Research and Development within 30 days. This technique will obtain voting member concurrence or comment regardless of authority of representative attending the In-Process Review. The objective of the In-Process Review is not to obtain concurrence but to give visibility to differing opinions.

It is the Army's view that this GAO finding addressed to the materiel development decision-making process is not without merit. The Army has long been aware of shortcomings in this area and had addressed considerable effort, in the past, to analysis and correction of difficulties. The new structure of the Army, established in 1962, brought the elimination of the Technical Services and the advent of three (3) new organizational elements, the Army Materiel Command, the Combat Developments Command, and the Assistant Chief of Staff for Force Development. Necessarily, there have been growing pains with the new organizations and new organizational relationships and process. The Army took a look at itself with the Brown Board, in the 1968-9 time frame, and has evolved the Life Cycle Management Model which should go far toward achieving the improvements recommended in this GAO report.

GAO notes:

1. Deleted comments relate to matters presented in the draft report which have been omitted in the final report.

2. Although the Army comments indicate that the M548 has an all-terrain cruising range of 300 miles, test reports indicate a cruising range of only 240 miles on roads, but without the required towed load.

PRINCIPAL OFFICIALS OF THE DEPARTMENT OF DEFENSE AND THE DEPARTMENT OF THE ARMY RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
DEPARTMENT OF DEFENSE		
SECRETARY OF DEFENSE:		
Melvin R. Laird	Jan. 1969	Present
Clark M. Clifford	Mar. 1968	Jan. 1969
Robert S. McNamara	Jan. 1961	Feb. 1968
Thomas S. Gates, Jr.	Dec. 1959	Jan. 1961
UNDER SECRETARY OF DEFENSE:		
David Packard	Jan. 1969	Present
Paul H. Nitze	July 1967	Jan. 1969
Cyrus R. Vance	Jan. 1964	June 1967
Roswell L. Gilpatric	Jan. 1961	Jan. 1964
James H. Douglas	Dec. 1959	Jan. 1961
DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING:		
Dr. John S. Foster, Jr.	Oct. 1965	Present
Dr. Harold Brown	May 1961	Sept. 1965
Herbert F. York	Dec. 1958	Apr. 1961
ASSISTANT SECRETARY OF DEFENSE (INSTALLATIONS AND LOGISTICS):		
Barry J. Shillito	Jan. 1969	Present
Thomas D. Morris	Sept. 1967	Dec. 1968
Paul R. Ignatius	Dec. 1964	Aug. 1967
Thomas D. Morris	Jan. 1961	Dec. 1964
Perkins McGuire	Jan. 1957	Jan. 1961

PRINCIPAL OFFICIALS OF THE

DEPARTMENT OF DEFENSE AND THE

DEPARTMENT OF THE ARMY

RESPONSIBLE FOR ADMINISTRATION OF

ACTIVITIES DISCUSSED IN THIS REPORT (continued)

	Tenure of office	
	From	To
DEPARTMENT OF THE ARMY		
SECRETARY OF THE ARMY:		
Stanley R. Resor	July 1965	Present
Stephen Ailes	Jan. 1964	July 1965
Cyrus R. Vance	July 1962	Jan. 1964
Elvis J. Stahr, Jr.	Jan. 1961	June 1962
Wilber M. Brucker	July 1955	Jan. 1961
UNDER SECRETARY OF THE ARMY:		
Thaddeus R. Beal	Mar. 1969	Present
David E. McGeffert	July 1965	Mar. 1969
Stanley R. Resor	Mar. 1965	July 1965
Vacant	Dec. 1964	Mar. 1965
Paul R. Ignatius	Mar. 1964	Dec. 1964
Vacant	Jan. 1964	Feb. 1964
Stephen Ailes	Feb. 1961	Jan. 1964
Hugh M. Milton II	Aug. 1958	Jan. 1961
ASSISTANT SECRETARY OF THE ARMY (RESEARCH AND DEVELOPMENT):		
Robert L. Johnson	Nov. 1969	Present
Vacant	Jan. 1969	Nov. 1969
Russel D. O'Neal	Oct. 1966	Jan. 1969
Willis M. Hawkins	Oct. 1963	Oct. 1966
Vacant	Aug. 1963	Sept. 1963
Finn J. Larson	Aug. 1961	July 1963
Richard S. Morse	June 1959	July 1961

PRINCIPAL OFFICIALS OF THE

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DEPARTMENT OF THE ARMY

RESPONSIBLE FOR ADMINISTRATION OF

ACTIVITIES DISCUSSED IN THIS REPORT (continued)

	Tenure of office	
	From	To
DEPARTMENT OF THE ARMY (continued)		
ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS AND LOGISTICS):		
J. Ronald Fox	June 1969	Present
Vincent P. Huggard (acting)	Mar. 1969	June 1969
Dr. Robert A. Brooks	Oct. 1965	Feb. 1969
Daniel M. Luevano	July 1964	Oct. 1965
A. Tyler Port (acting)	Mar. 1964	June 1964
Paul R. Ignatius	May 1961	Feb. 1964
Vacant	Jan. 1961	May 1961
Courtney Johnson	Apr. 1959	Jan. 1961
CHIEF OF STAFF, UNITED STATES ARMY:		
Gen. William C. Westmoreland	July 1968	Present
Gen. Harold K. Johnson	July 1964	July 1968
Gen. Earle G. Wheeler	Oct. 1962	June 1964
Gen. George H. Decker	Sept. 1960	Sept. 1962
OFFICE OF CHIEF OF RESEARCH AND DEVELOPMENT:		
Lt. Gen. A. W. Betts	Apr. 1966	Present
Lt. Gen. W. W. Dick, Jr.	Sept. 1963	Mar. 1966
Lt. Gen. D. Beach	July 1962	Aug. 1963
ASSISTANT CHIEF OF STAFF FOR FORCE DEVELOPMENT:		
Lt. Gen. Robert R. Williams	Nov. 1970	Present
Vacant	Aug. 1970	Nov. 1970
Lt. Gen. Frederick C. Weyand	Jan. 1970	Aug. 1970

PRINCIPAL OFFICIALS OF THE

DEPARTMENT OF DEFENSE AND THE

DEPARTMENT OF THE ARMY

RESPONSIBLE FOR ADMINISTRATION OF

ACTIVITIES DISCUSSED IN THIS REPORT (continued)

	Tenure of office	
	From	To
DEPARTMENT OF THE ARMY (continued)		
ASSISTANT CHIEF OF STAFF FOR FORCE DEVELOPMENT (continued):		
Lt. Gen. Arbor S. Collins, Jr.	Jan. 1967	Dec. 1969
Lt. Gen. Harry W. O. Kinnard	Nov. 1966	Jan. 1967
Lt. Gen. Polk	Mar. 1966	Nov. 1966
Lt. Gen. Davidson (acting)	Feb. 1966	Mar. 1966
Lt. Gen. Conway	Aug. 1965	Feb. 1966
Lt. Gen. Davidson (acting)	May 1965	June 1965
Lt. Gen. Harrell	Feb. 1963	May 1965
COMMANDING GENERAL, UNITED STATES ARMY MATERIEL COMMAND:		
Gen. Henry A. Miley, Jr.	Nov. 1970	Present
Gen. Ferdinard J. Chesarek	Mar. 1969	Nov. 1970
Gen. Frank S. Besson, Jr.	July 1962	Mar. 1969
COMMANDING GENERAL, COMBAT DEVELOPMENTS COMMAND:		
Lt. Gen. John Norton	Oct. 1970	Present
Lt. Gen. George Forsythe	Sept. 1970	Oct. 1970
Lt. Gen. Harry W. O. Kinnard	July 1967	Aug. 1970
Lt. Gen. Ben Harrell	May 1965	June 1967
Lt. Gen. Dwight E. Beach	Aug. 1963	May 1965

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