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The Avenger Air Defense System: an examination of the nondevelopmental item acquisition strategy

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The Avenger Air Defense System: An Examination of the Nondevelopmental Item Acquisition Strategy

by

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ABSTRACT

With the Department of Defense's (DoD) budget being reduced to ever diminishing levels, DoD acquisition managers must acquire technologically superior weapon systems within fixed time periods with the least amount of resources. One way they can effectively accomplish this is by using a Nondevelopmental Item (NDI) acquisition strategy. One weapon system program that has successfully used such an NDI strategy is the U.S. Army's Avenger Air Defense System Program. This thesis examines the DoD acquisition process and how NDIs are used within the process. The thesis then analyzes the Avenger Program and its NDI acquisition strategy to determine what factors made the program successful. From this analysis, lessons-learned are identified that can be used by other acquisition managers and their staffs to effectively manage future NDI programs. Significant lessons-learned indicate that high-level support, a thorough market investigation and a tailored acquisition process are critical to the success of an NDI program.

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ABSTRACT

With the Department of Defense's (DoD) budget being reduced to ever diminishing levels, DoD acquisition managers must acquire technologically superior weapon systems within fixed time periods with the least amount of resources. One way they can effectively accomplish this is by using a Nondevelopmental Item (NDI) acquisition strategy. One weapon system program that has successfully used such an NDI strategy is the U.S. Army's Avenger Air Defense System Program. This thesis examines the DoD acquisition process and how NDIs are used within the process. The thesis then analyzes the Avenger Program and its NDI acquisition strategy to determine what factors made the program successful. From this analysis, lessons-learned are identified that can be used by other acquisition managers and their staffs to effectively manage future NDI programs. Significant lessons-learned indicate that high-level support, a thorough market investigation and a tailored acquisition process are critical to the success of an NDI program.

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I. INTRODUCTION

A. BACKGROUND

It has become increasingly critical that Department of Defense (DoD) acquisition managers acquire technologically superior weapon systems within fixed time periods with the least amount of resources. One way they can efficiently accomplish this is by using a Nondevelopmental Item (NDI) acquisition strategy. One weapon system program that has used such an NDI acquisition strategy is the U.S. Army's Avenger Air Defense System Program.

There are two major characteristics that make the study of the Avenger Program interesting. The first characteristic is the success with which the Army has used an NDI acquisition strategy to acquire a major weapon system such as the Avenger. This is of particular interest because of the problems with which the Army Air Defense (ADA) branch and Army acquisition managers have had with past NDI acquisitions such as the Roland, Sergeant York and Air Defense Anti-Tank System (ADATS) Programs. The success of the Avenger Program has caused Army procurement and acquisition officials to praise it lavishly as a virtually trouble-free program [Ref. 1:p. 22].

The second characteristic is that the Avenger Program used an accelerated acquisition cycle because of the urgent need

for forward area air defense systems. This accelerated acquisition cycle resulted in the first Avenger being delivered only 14 months after the first contract was awarded. This is a significant accomplishment when compared to the fact that many DoD full-scale development programs take from 15 to 20 years to field a weapon system.

B. OBJECTIVE

The objective of this thesis is to examine the major factors that have made the implementation of the Avenger Program's NDI acquisition strategy successful. From this examination, lessons-learned will be identified that will help other acquisition managers and their staffs to effectively manage future NDI acquisition programs. These lessons-learned will also be beneficial for students studying acquisition management.

C. RESEARCH QUESTIONS

In pursuing the objectives of this thesis, the following primary research question was addressed: What are the major factors of the Avenger Program's NDI Acquisition Strategy that made the program a success and what lessons can be learned from these factors that can be applied to other acquisition programs?

The subsidiary questions that were used to aid in determining the answer to the primary question were:

1. How do DoD and the Army define NDI acquisition and how is it different from other acquisition processes?

2. What are the benefits and challenges of using an NDI acquisition strategy?

3. What is an NDI acquisition strategy and what is the Avenger Program's NDI acquisition strategy?

4. What made the Avenger Program's NDI acquisition strategy successful and what were the program's shortcomings?

5. What lessons-learned, that can be applied to DoD acquisition programs in general, can be gained from the study of the Avenger Program's NDI acquisition strategy?

D. SCOPE

This thesis covers only those aspects relating to the program's NDI acquisition strategy. Additionally, because this thesis focuses primarily on program management and not on technical aspects, only a general description of the Avenger is provided and only as much technical specificity as necessary is included. Classified aspects of the Avenger Program were not examined. Aspects such as system operational requirements and threat assessments, while important to the program, were not critical in the examination of the NDI acquisition strategy.

E. LITERATURE REVIEW AND METHODOLOGY

Background information was obtained from periodicals, reports, papers, DoD documents and U.S. Army manuals. These materials were obtained from the Defense Technical Information Center, the Defense Logistics Systems Information Exchange and

and the Naval Postgraduate School Library. The Forward Area Air Defense (FAAD) Project Office, which now has program management responsibility for the Avenger, at Redstone Arsenal, Alabama was the primary source for Avenger information. Interviews with current and former Avenger Program personnel were conducted and program documents were examined. Additional program information came from the Boeing Aerospace, Missiles & Space Division of the Boeing Defense & Space Group, Huntsville, Alabama and the Directorate of Combat Development, Fort Bliss, Texas.

F. DEFINITIONS AND ACRONYMS

DoD and Army definitions and acronyms used in acquisition management and the Avenger Program are provided throughout the thesis where needed, and Appendix A provides a consolidated list of acronyms.

II. THE DEPARTMENT OF DEFENSE ACQUISITION PROCESS AND NONDEVELOPMENTAL ITEMS

A. INTRODUCTION

This chapter begins with a general overview of the current standard DoD acquisition process and acquisition strategies. Next, NDI policy is examined by exploring the definition and history of NDIs. Finally, the benefits and challenges of NDIs are described.

B. THE DEPARTMENT OF DEFENSE ACQUISITION PROCESS

DoD has one of the largest acquisition organizations in the world. Its Research, Development, Test and Evaluation (RDT&E) budget authority for Fiscal Year (FY) 1993 was $38.2 billion and for FY 1994 it was $38.6 billion. For the Procurement budget, DoD was authorized $53.6 billion in FY 1993 and for FY 1994 it was authorized $45.5 billion. [Ref. 2:p. 5] To manage this acquisition organization DoD employs over 17,000 military personnel and over 76,500 civilian employees [Ref. 3:p. 7].

This large and complex DoD acquisition structure is guided by many external laws and regulations outlined in such documents as Office of Management and Budget (OMB) Circular A-109, Major System Acquisitions, and the Federal Acquisition Regulation (FAR). However, DoD has combined its acquisition

management guidance into two primary documents. The first document is DoD Directive 5000.1, Defense Acquisition, and the second is DoD Instruction (DoDI) 5000.2, Defense Acquisition Management Policies and Procedures. Together these two documents outline the basic acquisition process for all DoD organizations.

DoD Directive 5000.1 provides broad basic policies covering defense acquisitions, while DoDI 5000.2 establishes more specific policies and procedures for managing these programs. To manage defense acquisition programs, DoDI 5000.2 outlines an acquisition process of five phases with five milestone reviews. The Defense Systems Management College (DSMC) describes this acquisition process as "The sequence of acquisition activities starting from the agency's reconciliation of its mission needs, with its capabilities, priorities and resources and extending through the introduction of a system into operational use or the otherwise successful achievement of program objectives." [Ref. 4:p. 1.4-5]

The determination of mission need is completed by combat developers before the first milestone review of the acquisition process and is documented in the Mission Need Statement (MNS) which describes a warfighting deficiency. The Joint Requirements Oversight Council (JROC) then reviews the MNS. Members of the JROC include the Vice Chairman of the Joint Chiefs of Staff, the Vice Chiefs of Staff of the Army

and the Air Force, the Vice Chief of Naval Operations and the Assistant Commandant of the Marine Corps. For major acquisition programs, the JROC forwards the MNS to the Defense Acquisition Board (DAB) for Milestone 0 review. The DAB is the senior DoD acquisition review board chaired by the Under Secretary of Defense for Acquisition and includes DoD, JCS and service representatives. For non major acquisition programs, the Milestone 0 review and all other Milestone reviews are conducted at the service component level or other appropriate level.

Milestone 0, the Concept Studies Approval milestone, is the decision point that begins Phase 0, the Concept Exploration and Definition (CE/D) phase. During the CE/D Phase various materiel alternatives are defined and analyzed to determine the most promising system concept(s). In this phase the Operational Requirements Document (ORD) is prepared. It identifies required performance capabilities.

Milestone I is called Concept Demonstration Approval. During this review the DAB determines if the results of the CE/D phase warrant a new acquisition program. If the DAB feels a new acquisition program is needed the program moves into Phase I, Demonstration and Validation (DEM/VAL). During the DEM/VAL Phase acquisition managers define critical design characteristics and expected capabilities. Also, technologies critical to the concept are proven and critical processes are demonstrated.

Once the DEM/VAL Phase is complete, the program is reviewed at Milestone II, Development Approval. At this review the DAB determines if the results of DEM/VAL warrant continuation. If continuation is warranted a baseline is developed. If the DAB feels the program should continue it moves into Phase II, Engineering and Manufacturing Development (EMD). During the EMD Phase acquisition managers develop the most promising design approach into a stable, producible and cost-effective system design.

When EMD is complete the DAB again reviews the program at Milestone III, Production Approval. At this milestone review the DAB determines if the results of EMD warrant the production of the new system. If the DAB makes the decision to produce the system, the program moves into Phase III, Production and Deployment (P/D). During this phase the new system is placed into full production and fielded to satisfy the mission need. If the system fully satisfies the operational requirements, the program moves directly into Phase IV, Operations and Support (O/S). If the system requires subsequent major changes, the DAB reviews the program again at a Milestone IV review, Major Modification Approval, before any changes are made. Figure 1 depicts DoD Acquisition Milestones and Phases.

This acquisition process is the basic framework for all acquisition programs. It is a long and detailed process. There are many review and reporting requirements and test and

evaluation requirements that must be completed. This process takes from 15 to 20 years for most full-scale development systems. For example, the U.S. Army's Patriot Air Defense System Program took 16 years to field the first system [Ref. 5:p. 2].

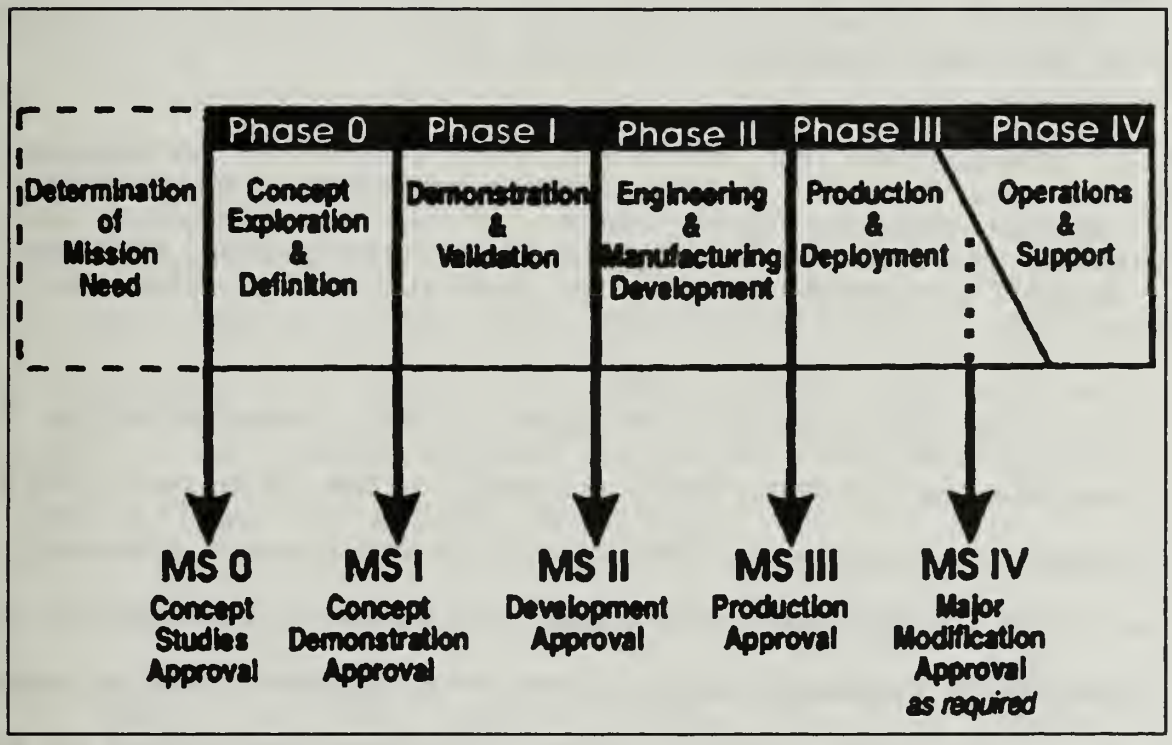

Figure 1 - Acquisition Milestones and Phases [Ref. 6:p. 2-1]

To help acquisition managers streamline this process, DoDI 5000.2 allows them to modify the process when it is in the best interest of the program to do so. This is an important point for acquisition programs using an NDI acquisition strategy. When a program uses an NDI strategy acquisition, acquisition managers usually modify the acquisition process in

some manner. An acquisition manager modifies the acquisition process by developing and implementing the acquisition strategy for the program.

C. ACQUISITION STRATEGY

An acquisition strategy is the comprehensive approach for managing a program throughout the acquisition process. The DSMC defines acquisition strategy as:

> A combination of business and technical management concepts designed to achieve program objectives within imposed resource constraints. It is the framework for managing research, development, test, production, fielding support and other essential program activities. [Ref. 4:p. 1.5-2]

It is the Program Manager's (PM) responsibility to formulate and execute this strategy. The main goal the PM attempts to achieve in developing the acquisition strategy is to ". . . minimize the time and cost of satisfying an identified, validated need consistent with common sense, sound business practices and the basic policies established by DoD Directive 5000.1." [Ref. 6:p. 5-A-1]

Program managers can use many approaches, individually or in combination, to build acquisition strategies. Besides an NDI approach, a PM can use a variety of other approaches such as: concurrency, pre-planned product improvements, second sourcing, design-to-cost, evolutionary acquisition, or any other approach that best meets the needs of the program.

Whatever approach a PM decides to use it must be evolutionary and updated periodically.

It is important to note that the NDI approach usually calls for the use of a tailored version of the standard DoD acquisition process. This point is critical and will be discussed in more detail when the Avenger program's NDI acquisition strategy and its execution are examined in Chapter IV.

D. DEFINITION OF NONDEVELOPMENTAL ITEM

There are many sources that provide definitions of NDI. While all these definitions are worded differently, they are all generally the same. The definitions that are most relevant to the Avenger Program are DoD and Army definitions.

DoD defines NDI in DoDI 5000.2 as:

1. Any item available in the commercial marketplace.

2. Any previously developed item in use by a Federal, State, or local agency of the U.S. or a foreign government with which the U.S. has a mutual defense cooperation agreement.

3. Any item described in subparagraph 1 or 2, above, that requires only minor modifications to meet the requirements of the procuring agency.

4. Any item currently being produced that does not meet the requirements of subparagraph 1, 2, or 3, above, solely because the item is not yet in use or is not yet available in the commercial marketplace. [Ref.6:p. 6-L-1]

The Army further defines NDI by using three general categories:

1. Category A - off-the-self items (commercial, foreign, other service) to be used in the same environment for which the items were designed. Research and Development (R&D) funds are not required to develop or modify hardware or operational software.

2. Category B - off-the-self items (commercial, foreign, other service) to be used in an environment different than that for which the items were designed. The item may require modification to hardware or operational software.

3. There is a third level of NDI effort. This approach emphasizes integration of existing componentry and the essential engineering effort to accomplish systems integration. The strategy requires a dedicated R&D configuration, to develop or modify software, and to ensure that the total system meets requirements. [Ref. 7:p. 17.2]

There are many examples of the above NDI acquisitions. A good example of an Army Category A NDI is the Beretta nine millimeter pistol [Ref. 7:p. 17.2]. An example of an Army Category B NDI is the Commercial Utility Cargo Vehicle (CUCV) [Ref. 7:p. 17-1]. The Avenger system is an example of the Army's third category of NDI.

The definitions of NDI clearly allow the term NDI to describe a wide range of items. The term off-the-self item is frequently used synonymously with NDI, but the two terms are not the same. Off-the-self items are only one category that DoD considers an NDI. [Ref. 8:p. 1.3]

E. HISTORY OF NONDEVELOPMENTAL ITEMS

The use of NDI acquisition is not a new idea for DoD, but it is new for acquisition of major weapon systems. The emphasis on using NDIs began in 1972 when the Commission on Government Procurement recommended that the Federal Government shift toward a more commercial acquisition policy. This recommendation became policy in 1976 when the Office of Federal Procurement Policy stated that the Government's policy was to ". . . use commercial distribution channels in supplying commercial products to its users." [Ref. 9:p. 4] During the late 1970s DoD tried to implement the commercial procurement policy by establishing several programs including the Commercial Commodity Program, the Commercial Commodity Acquisition Program and the Commercial Item Support Program. DoD also issued DoD Directive 5000.37 on the acquisition and distribution of commercial products [Ref. 9:p. 5]. However, DoD was slow to begin using NDIs until the late 1980s.

The year 1986 was a turning point for NDI acquisition. President Ronald Reagan established the Blue Ribbon Commission on Defense Management (the Packard Commission) and this Commission made the following recommendation:

> Rather than relying on excessively rigid military specifications, DoD should make much greater use of components, systems, and services available 'off the self.' It should develop new or custom-made items only when it has been established that those readily available are clearly inadequate to meet military requirements. [Ref. 10:p. xxv]

This recommendation was taken seriously by the U.S. Congress and it passed the NDI Preference Act as part of the 1987 Defense Authorization Act. This act required DoD to define requirements so that acquisition managers could acquire NDIs to fulfill them. The act also required DoD give preference to NDIs in defense acquisitions. [Ref. 8:p. 1-2]

To ensure all DoD components were making full use of NDIs the 1991 versions of DoD Directive 5000.1 and DoDI 5000.2 both included guidance on NDIs. DoD Directive 5000.1 states that ". . . maximum practicable use shall be made of commercial and other nondevelopmental items." [Ref. 11:p. 1.4] In addition, DoDI 5000.2 directs ". . . materiel requirements shall be satisfied to the maximum practicable extent through the use of nondevelopmental items when such products will meet the user's needs and are cost-effective over the entire life cycle." [Ref. 6:p. 6-L-2]

Even with this increased emphasis on the use of NDIs, there continues to be calls for more use of NDIs within DoD. In January 1993 DoD Advisory Panel on Streamling and Codifying Acquisition Law reviewed over 600 DoD-related procurement laws and recommended to Congress that stronger policy language favoring the use of commercial and nondevelopmental items be incorporated into future statutes [Ref. 12:p. 10]. Most recently, Vice President Al Gore's National Performance Review of the Federal Government recommended the increased use of commercial goods within DoD. The review, titled From Red Tape

to Results: Creating a Government that Works Better and Costs Less, proposed ". . . that the Pentagon make greater use of commercial products and abandon military specifications as much as possible." [Ref. 13:p. 3] Senior Army leadership also stressed the use of NDIs. The Army Chief of Staff, General Gordon R. Sullivan, stated that the Army is ". . . moving toward maximum use of commercial specifications and standards for weapons systems and upgrades and is taking advantage wherever possible of commercial items to meet military requirements (a non-developmental approach)." [Ref. 14:p. 11]

The many internal and external influences will cause some DoD acquisition managers to increase their use of NDIs in the future.

F. BENEFITS AND CHALLENGES OF NONDEVELOPMENTAL ITEMS

1. Benefits of Nondevelopmental Items

There are numerous benefits of using an NDI acquisition strategy described in DoD documents. A partial list presented here are the broad, general ones that will vary from program to program.

One of the greatest benefits is the reduced time of the acquisition process. Many phases of the acquisition process can be eliminated or reduced in time.

Another benefit is reduced cost. Cost reductions occur by eliminating or reducing R&D and testing.

The ability to use state-of-the-art technology more easily is another benefit. By using an NDI, DoD can usually take advantage of the commercial marketplace's current technology.

Another benefit is the reduction in technical, cost, and schedule risks [Ref. 8:p. 1-5]. By allowing the commercial marketplace to research, develop and test new items, DoD can minimize the risks involved in acquiring new items. However, acquisition managers must balance the amount of risk the Government accepts and the amount of risk that Government contractors are expected to accept.

The use of NDIs also broadens and maintains the production base by increasing the number of defense contractors [Ref. 15:p. 10]. This benefit is important because as DoD becomes smaller, maintaining the industrial and mobilization base will be critical.

The General Accounting Office (GAO) asserts that an NDI acquisition simplifies contracting procedures and allows for the increased use of fixed-price type contracts [Ref. 16:p. 11]. Contract administration and management of fixed-price type contracts is easier and less costly than the administration of cost-reimbursement type contracts used for R&D efforts.

2. Challenges of Nondevelopmental Items

An NDI acquisition strategy presents several challenges. Acquisition managers will weigh these challenges against benefits when developing their acquisition strategy.

Straight forward use of NDIs may result in reductions of system performance parameters. Some trade-off analysis may be required to ensure all major user requirements are met.

One of the most widely documented challenges of using an NDI is the difficulty of logistical support for the NDI. The shortened acquisition process of an NDI acquisition does not allow time for a complete Logistic Support Analysis (LSA) to be conducted before the system is to be fielded. There have been numerous problems with logistical support aspects of past DoD NDI programs. Logistical planning that accounts for NDIs must begin early in the acquisition cycle.

The use of NDIs may require acceptance of some minor safety deficiencies that a full-scale development program would not accept [Ref. 7:p. 17.3].

The use of NDIs may cause problems with integrated logistics support, training and configuration management [Ref. 7:p. 17.3]. With a large number of NDIs within DoD, standardization and implementation of the above operations could be difficult. Also challenging is the integration and interface of related weapon systems.

An additional challenge of an NDI acquisition is that the standard internal support processes must be expedited or

tailored to accommodate an NDI [Ref. 17:p. 384]. These processes of developing organization and equipment authorizations are complex and DoD has not designed them for NDIs. For the Army these processes include such items as Basis of Issue Planning (BOIP) and the Table of Organization and Equipment (TOE) authorization process [Ref. 7:p. 17.3]. To ensure an NDI acquisition fielding is conducted effectively, acquisition managers must know these processes and modify them accordingly.

An NDI acquisition may restrict important Government Research and Development (R&D) efforts [Ref. 18:p. 8]. A robust R&D effort in key areas of science and engineering is critical to the development of technologically superior weapon systems.

III. THE AVENGER PROGRAM

A. DESCRIPTION OF THE AVENGER

The Avenger is the Line-of-Sight Rear (LOS-R) component of the Army's five part Forward Area Air Defense (FAAD) system. It is a lightweight, mobile Surface-to-Air Missile (SAM) and gun system mounted on an M998 1 1/4 ton High Mobility Multipurpose Wheeled Vehicle (HMMWV).[1] The Avenger carries four Stinger SAMs in each of two Standard Vehicle Mounted Launchers (SVML) mounted on either side of a 360 degree traversing turret that make up the missile subsystem of the Avenger's fire unit. The Avenger also has one .50-caliber M3P machine gun and an ammunition system mounted on the right side of the turret under the SVML that make up the gun subsystem of the Avenger's fire unit.

A crew of two (gunner and driver) operates these weapons through an integrated target acquisition, fire control and communication system. The gunner performs target acquisition by using a Forward-Looking Infrared (FLIR) sensor that is mounted under the left SVML. A laser range finder is also

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[1]Currently, production Avengers are being mounted on the M1097A1 HMMWV Heavy Variant (HHV) as prescribed in the Avenger System Improvement Plan. The HHV provides an increased payload capacity to accommodate Pre-Planned Product Improvements (P^3I). The first production Avengers that were initially mounted on the M998 HMMWV will be retrofitted with the HHV as funds are available.

mounted adjacent to the FLIR to provide range data to the fire control computer. These components give the fire unit the capability to engage targets during both bad weather and at night. An AN/PPX-3 Identification Friend-or-Foe (IFF) sensor provides positive identification of friendly aircraft. The gunner controls all these components from an enclosed canopied compartment between the SVMLs, using a set of turret hand controls for manual tracking. The gunner can also set the system to automatic by using the Automatic Video Tracker (AVT) that is slaved to the FLIR. The AVT controls turret rotation and SVML movement until the engagement is complete or the gunner turns the AVT off. All these devices enable the Avenger to engage targets while either the HMMWV is moving or stationary.

The Avenger Control Electronics (ACE) is the main computer for the entire system. It continually monitors system functions and allows for function testing by the crewmen. The crew can also perform all the target acquisition and fire control actions by using the Remote Control Unit (RCU). This unit is stored in the cab of the HMMWV and the crew can carry it to any location within 50 meters of the system.

The Avenger is equipped with radio, intercom and Communication Security (COMSEC) subsystems. The radio subsystem consists of a Single-Channel Ground and Airborne Radio System (SINCGARS) or an AN/VRC-47 series radio which provides secure communications. The intercom consists of an

AN/VIC-1 set that allows the gunner and driver to communicate with each other. New FAAD Command, Control and Intelligence (C^2I) equipment will be incorporated into the Avenger as Pre-Planned Product Improvements (P^3I) are fielded.

The Avenger will operate within the family of FAAD systems with a mission of countering both high-speed fixed and rotary-wing aircraft. The primary targets will be aircraft attacking stationary and mobile critical assets in brigade, division and corps rear areas. The Avenger is used in all types of terrain and weather and will normally not be deployed farther forward than the battalion rear boundary. To perform its mission the Avenger is assigned to the FAAD battalions of heavy, light, special divisions, as well as armored cavalry regiments and corps air defense brigades. Figure 2 illustrates the major components of the Avenger System and Appendix B furnishes a more detailed description of Avenger specifications.

B. ACQUISITION HISTORY OF THE AVENGER

The development of the Avenger began in the early 1980s as an unsolicited private venture project by the Defense Systems Division of the Boeing Aerospace Company[2] [Ref. 19]. At that time Boeing was under contract to produce the Roland Air Defense System for the U.S. Army. During company testing of

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[2]The Defense Systems Division of Boeing Aerospace is now known as the Missiles & Space Division of the Boeing Defense & Space Group.

Figure 2 - Avenger System

the Roland, Boeing conducted several successful test firings of Stinger missiles from Roland launchers using Roland's acquisition and track radars to point the Stingers [Ref. 20:p. 29]. These successful firings convinced Boeing that they could integrate Stinger launchers into an air defense system that they could mount on the Army's newly developed HMMWV.

Boeing began development of the Avenger in 1983 and by May 1984 the first prototype was ready for testing. With the help of the 9th Infantry Division's (Motorized) Division Air Defense Artillery (DIVADA), Boeing carried out test firings at the Yakima Washington Firing Center. Crewmen fired three missiles at aerial targets, two from a moving HMMWV and one from a stationary HMMWV. One of the moving shots was a direct hit and evaluators scored the other as a tactical kill. The stationary firing was also a direct hit. These test firings were the first demonstrations of shoot-on-the-move SAM firings for the Army.

While Boeing was developing and testing the Avenger, the U.S. Army's Missile Command (MICOM) was working with General Dynamics Corporation to develop a Stinger missile system similar to the Avenger called the Setter. The Army called these types of Stinger Missile Systems Pedestal-Mounted Stingers (PMS). In the Summer of 1985 the Army Air Defense Artillery Board and Army Development and Employment Agency (ADEA) tested both the Setter and Avenger systems. The 9th

Infantry Division's (Motorized) DIVADA conducted these tests at the Yakima Washington Firing Center. These tests ". . . indicated that the technology was advanced enough to warrant an NDI acquisition strategy." [Ref. 21] Based on these test results, in August 1985 the Army Vice Chief of Staff, General Max Thurman, directed the Army to buy a PMS.

Another event in August 1985 had a significant impact on the acquisition of PMS systems for the Army. Secretary of Defense Caspar Weinberger terminated the Sergeant York Air Defense Gun system which was to have been the mainstay of divisional air defense units. This program termination forced the Army to reexamine the way it provided air defense for its divisions. To conduct this reexamination the Army formed the Forward Area Air Defense (FAAD) Working Group at Fort Leavenworth, Kansas. The working group's mission was ". . . to develop a comprehensive and fully integrated counterair approach to the forward area air defense problem." [Ref. 22:p. 12]

The FAAD Working Group, which convened from August 1985 to January 1986, concluded that the Soviet Union was rapidly expanding and upgrading its aerial weapon systems and that no one air defense system could counter all air threats to the Army's divisions. The working group's solution to counter the increasing air threat was to create the Forward Area Air Defense System (FAAD) system. This FAAD system was a system of five components. The FAAD Working Group developed the FAAD

system so that the components would work together to counter all types of air threats to the division. The five components of the FAAD system were: Command, Control and Intelligence (C^2I); Line-of-Sight Rear (LOS-R); Non-Line of Sight (NLOS); Line-of-Sight Forward (LOS-F); and the Combined Arms Initiative (CAI).

The FAAD Working Group and Army Air Defense Artillery (ADA) leadership realized that they would have to field the FAAD system quickly because of the rapidly increasing air threat to Army divisions and the limited ability of the current divisional air defense systems to deal with this threat. They also understood that besides acquiring the FAAD components quickly, they would have to acquire them at the lowest possible costs. Because off-the-self equipment and technology were available to meet most requirements of the FAAD components, and because of the urgent need for the system, senior Army leaders directed that an NDI approach be used whenever possible to acquire FAAD components [Ref. 22:p. 14]. With this guidance, and because of the prior market investigation conducted on the Avenger and Setter systems, the FAAD Working Group recommended that a PMS system be used as the LOS-R component of the FAAD system. This recommendation, along with the rest of the FAAD system concept, was then presented to the Secretary of Defense Caspar Weinberger in January 1986. He approved both the recommendation and the

FAAD system concept. This led to the FAAD system becoming one of the Army's top acquisition requirements, second only to the requirement for the Bradley Fighting Vehicle [Ref. 5:p. 1].

With the FAAD system approved, Army acquisition managers began the acquisition process for the FAAD components. In March 1986 the DAB approved the FAAD system Required Operational Capability (ROC) document.[3] Since the LOS-R component was going to be an NDI PMS system, DoD considered this approval a Milestone IIIA review decision, Low Rate Initial Production (LRIP), and the Army began planning for an NDI Candidate Evaluation (NDICE) for PMS.

In July 1986 the Army issued a Request For Proposal (RFP) for a PMS system. Three companies submitted proposals and a $100,000 test support contract was given to each to supply a single prototype PMS for testing during the NDICE. The three companies were Boeing Aerospace with the Avenger, General Dynamics/Thomson-CSF/Hughes Electro-Optical Data Systems Group with an unnamed prototype and LTV Aerospace with the Crossbow, formerly called the Setter. [Ref. 23:p. 151]

In November 1986 the Army began the NDICE that was conducted in two phases at Fort Bliss, Texas and White Sands Missile Range, New Mexico. The Army soon excused the General Dynamics Systems Group candidate from the competition when the

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[3]The Required Operational Capability document is now known as the Operational Requirements Document (ORD) which was discussed in Chapter II.

candidate could not meet the weight requirements [Ref. 20:p. 30]. The Army then continued tests between the Avenger and Crossbow until July 1987.

Based on the results of the NDICE, Boeing's Avenger was selected to fulfill the requirement for a PMS to be the LOS-R component of the FAAD system. In August 1987 the Army awarded Boeing an engineering development contract with production options to produce the Avenger for the Army. This was a $16.2 million contract for the first option buy of 20 Avengers [Ref. 23:p. 151]. The contract also contained production options for FY 1987 through FY 1991 for a total procurement of 273 Avengers [Ref. 24:p. 1]. Also in 1987 the Army categorized the Avenger as Type-Classified Limited Procurement Urgent (TC-LPU) because of its critical need. The TC-LPU designation met the operational requirements for the Avenger were urgent because no system in the Army's inventory at that time could satisfy them [Ref. 7:p. 17.12]. Fourteen months after awarding the Avenger contract to Boeing in November 1988, the Army received the first two production models of the Avenger.

During the time until the first production Avengers were received, the Army began the first phase of Force Development Test and Evaluation (FDT&E) with the NDICE Avenger prototype to establish a baseline for tactics, doctrine and training issues. The Army conducted this test in June and July 1988 at Fort Bliss, Texas. Once production model Avengers were received, six were used to conduct the second phase of FDT&E

at Fort Hunter Liggett, California in February and March 1989. This phase was used to test and validate the concepts established in the first phase of FDT&E.

While the Army was conducting these tests, Boeing continued to deliver Avengers and by April 1989 the Army equipped its first tactical unit with Avengers.[4] During the next two years the Army continued to exercise the production options of the Avenger contract and Boeing continued to deliver Avengers. Initial Operational Capability (IOC), which was the first attainment of the minimum capability to effectively employ the Avenger, was reached in January 1991 during the deployment of Avengers in support of Operation Desert Storm.

The Army conducted two additional tests in 1989. These tests were the Initial Operational Test & Evaluation (IOT&E) and the Production Qualification Test (PQT). These tests cleared the way for the Avenger to be Type-Classified Standard (TC-S), which meant the Avenger was categorized as a standard system within the Army's inventory. It also cleared the way for a full-scale production Milestone IIIB review. At the Milestone IIIB review in April 1990, the DAB approved full-scale production of the Avenger and returned control/oversight of the program to the Department of Army. Once the original contract expired, the Army awarded a $436.2 million five-year

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[4]This unit was the ADA platoon of 3rd Armored Cavalry Regiment (ACR) stationed at Fort Bliss, Texas.

multiyear (FY 1991 through FY 1995) production contract to Boeing in February 1992 for the production of 679 Avengers This number included 600 for the Army and 79 for the U.S. Marine Corps. The Army has fielded Avengers to the units as shown in Table 1 with the systems it has received so far.

TABLE 1 - AVENGER FIELDINGS

Unit	Fielding Dates
3rd ACR (III CORPS)	April 1989
4-5 ADA (1st CAV DIV)	August - November 1990
5-5 ADA (2nd ID)	September - November 1991
1-5 ADA (24th MX)	January - March 1992
1-2 ADA (108th ADA BDE)	June 1992 - October 1992
2-62 ADA (7th LID)	November 1992 - March 1993
2-44 ADA (101st ABN DIV)	May - July 1993
2-2 ADA (35th ADA BDE)	August - October 1993

Currently, Boeing is producing Avengers in the fourth year of the multiyear production contract. The Army is continuing to field Avengers to its units through the use of a New Equipment Training (NET) Program. Avenger acquisition managers are also continuing to improve the Avengers through the use of P^3I block upgrades. Appendix C provides a consolidated chronological list of the major events of the Avenger Program.

C. PROGRAM MANAGEMENT OF THE AVENGER

In 1986 the Army placed the control of the PMS Program[5] under the control of the Stinger Project Office at the U.S. Army's Missile Command (MICOM), Redstone Arsenal, Alabama. Army acquisition executives placed the PMS Program under the control of the Stinger Project Office because at the time the Stinger PM was responsible for managing all weapon systems that were using Stinger missiles, including the man-portable air defense system (MANPADS) Stinger and the Air-to-Air Stinger. The Stinger Project Office had all the personnel and resources to support the Avenger Program. [Ref. 25]

The Stinger PM and the Avenger staff had the overall responsibility for the accomplishment of the Avenger Program objectives and were charged with acquiring and fielding a cost-effective Avenger system. To help meet these responsibilities, the Stinger PM had the support of the Avenger staff, the Stinger Project Office and MICOM. In fulfilling his responsibilities the Stinger PM interfaced with the many organizations involved with the Avenger Program. Some of the major organizations included the combat developer, test and evaluation agencies and cost analysis agencies. The PM was also the principal Government representative to the Avenger contractor.

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[5]The PMS Program was later renamed the Avenger Program after the Avenger was selected to fulfill the LOS-R requirement.

As the Avenger Program proceeded through the acquisition process and grew in size, Army acquisition executives made the Avenger Program a separate program with a separate Avenger PM reporting directly to the Program Executive Office-Air Defense (PEO-AD). This elevated the status of the Avenger Program and made it more visible. The Avenger Program remained a separate program until 1993 when it was consolidated with other FAAD Programs under the control of the FAAD Project Office. Currently, the Avenger Program remains under the control of the FAAD Project Office at Redstone Arsenal, Alabama.

IV. THE AVENGER PROGRAM'S ACQUISITION STRATEGY

A. INTRODUCTION

As discussed in Chapter II the acquisition strategy is the basic approach for managing a program throughout the acquisition process. The acquisition strategy serves as the foundation for the development of other program functional plans such as the Test and Evaluation Master Plan (TEMP) and the Integrated Logistics Support Plan (ILSP). An Acquisition Plan (AP) is also developed that describes how the acquisition strategy will be implemented through the use of contractual instruments.

The initial acquisition strategy for the Avenger Program was developed in September 1986 and approved by the Assistant Secretary of the Army for Research, Development and Acquisition. Because the Avenger Program was moving rapidly through the acquisition process, this acquisition strategy and many other program documents were prepared quickly and then revised later in the program [Ref. 26]. The Avenger acquisition strategy was updated in May 1988 to reflect changes in the program and this version is the one that will be examined because it was the one that primarily guided the program.

B. AVENGER ACQUISITION STRATEGY

The Avenger acquisition strategy was prepared in the format required by Army Regulation 70-1. It identified 12 major elements that were critical to the overall management of the program. Each of these elements will be described below:

1. Program Structure

The program structure for the Avenger Program called for a prime contractor with total system integration responsibility. The Army implemented this program structure by using a competitive NDI procurement. This program structure was selected because the market investigations indicated that a PMS system could be produced primarily by integrating available militarized or commercial subsystems, with a minimum amount of modification. [Ref. 27:p. 1]

2. Contracting Strategy

The Avenger acquisition strategy called for a contracting strategy that made the maximum possible use of competition throughout the acquisition process. This strategy was adopted because of the results of the market investigations and the Army's earlier evaluations of the Avenger and Setter systems. The Avenger acquisition strategy defined this competition strategy in a Total Life Cycle Competition Strategy (TLCCS). This TLCCS incorporated the following elements:

1. Broad-based, full and open competition in the procurement and sustainment phases.

2. Full and open competitive selection of the initial contractor.

3. Multiyear follow-on acquisitions of the system.

4. Competitive, dual source procurement of the SVML.

5. Use of contract options to enhance competitive reprocurements.

6. Spare Acquisition Integrated with Production (SAIP) with flexibility to competitively break-out spares procurement.

7. Competition by the prime contractor in sub-contracting.

8. No Government funding for contractor facilitization or tooling. [Ref. 27:p. 1]

The contracting strategy also called for the use of firm-fixed-price (FFP) contracts to the maximum extent possible throughout the program because of the anticipated low risk involved with the program. Additionally, the strategy stated that the initial contract would be an FFP contract that would include the following major options:

1. Delivery of the first system 14 months after contract award.

2. Provisions for Interim Contractor Support (ICS) and SAIP until the Army could implement its logistics support structure.

3. Planned annual procurement quantities for four additional years.

4. Delivery of a Technical Data Package (TDP) with rights delineated in a license agreement. [Ref. 27:p. 2]

In addition, the contracting strategy called for the contractor to provide a 36-month warranty at no cost to the Government. The warranty would require the contractor to repair or reimburse the Government for all defective components returned to the factory. Defective components were defined as both individual item failures and systemic defects.

3. Tailoring the Acquisition Process

In this section of the acquisition strategy there was an explanation of how the acquisition process would be tailored for the Avenger Program. The strategy stated that because of the market investigations and because of industry responses to the RFP, there was little risk in the immediate acquisition of the PMS as an NDI. To implement the NDI strategy, program management officials were allowed to tailor the acquisition process so that the Avenger could move directly into the P/D phase. The strategy stated, "There was no need for either an advanced development (AD) or full scale development (FSD) program to precede procurement." [Ref. 27:p. 14] The strategy called for approval to move directly into the P/D phase to be made at the Milestone IIIA review that was also the Low Rate Initial Production (LRIP) decision review.

The strategy also called for other areas of the acquisition process to be tailored. During the P/D phase, the strategy called for concurrent design of P^3I requirements to further compress the acquisition process and to accelerate the

deployment of improvements. During contracting for the Avenger the strategy stated that the use of specifications, standards, test plans and contract data requirements should be minimized to eliminate no-cost effective contractual requirements. The strategy also directed that requirements not mandated by law or established by DoD or Army policy and that do not contribute to the operational effectiveness, effective management, or support of the Avenger be excluded from the program. Finally, the strategy allowed the contractor maximum freedom to use contractor format for reports, plans, training manuals and maintenance manuals.

4. Manpower Personnel Integration

Manpower Personnel Integration (MANPRINT) was an important part of the Avenger strategy even though it was an NDI strategy. Because the tailored acquisition process of the Avenger Program precluded the early analysis of the man and machine interface, the acquisition strategy had to define how these analyses would be conducted later in the acquisition process. The strategy directed that MANPRINT analyses begin with the assurance that the initial RFP would require each bidder to address the implications of their design for manpower, personnel, training, health hazards and safety. The strategy also directed that MANPRINT considerations continue to be evaluated during all tests of the Avenger Program from NDICE through PQT. Finally, the strategy stated

that MANPRINT considerations would be built into all P^3I development tasks.

5. Supportability

To ensure there would be proper logistical support for the first Avengers fielded the acquisition strategy called for the contractor to provide Interim Contractor Support (ICS) for at least the first 29 months of fielding. The acquisition strategy also directed that supply support be accomplished through the procurement of Mandatory Parts List (MPL) and Authorized Stockage List (ASL) items as recommended by the contractor and approved by MICOM. The acquisition strategy called for the stockage of both MPL and ASL items at ICS centers and for the ICS centers to provide parts on a direct exchange basis to Avenger units as needed.

Although the Avenger was an NDI acquisition, the acquisition strategy established supportability goals for the system. The strategy called for the maximum use of built-in-test equipment; line replaceable units; standard support equipment; and test, measurement and diagnostic equipment. The use of these items was important because the strategy called for the Avenger to be incorporated into the standard Army logistics support system when ICS was complete. A detailed plan of how the Avenger was to be supported was outlined in the Avenger Integrated Logistics Support Plan (ILSP).

6. Manufacturing and Production

The manufacturing and production section of the acquisition strategy directed that the contractor have total system integration responsibility for the Avenger. This involved the prime contractor assembling components and subsystems provided by subcontractors and the Government into a complete system. The strategy called for three key subsystems to be provided to the contractor as Government Furnished Equipment (GFE). These three GFE subsystems were the SVML, the Electronic Component Assembly (ECA) and the HMMWV. All other components and subsystems not provided by the Government were to be procured from approved subcontractors.

The manufacturing and production section called for the total production of 1,207 Avenger systems through FY 1999. This total was later changed to 1,779 and then to 1,001. All of these production quantities included systems produced under the initial contract options and the five-year multiyear contract planned for FY 1991 through FY 1995. The details of how manufacturing and production were to be completed were described in the Production Readiness Master Plan (PRMP) for Avenger.

7. Test and Evaluation

The test and evaluation section of the acquisition strategy called for a test and evaluation program tailored to support the NDI acquisition strategy and to ensure essential

operational and technical tests were performed on the Avenger. To meet this objective the strategy listed four types of tests that would be conducted on the Avenger. These tests were NDI Candidate Evaluation (NDICE), Force Development Test and Experimentation (FDT&E), Production Qualification Test (PQT) and Initial Operational Test and Evaluation (IOT&E). The test and evaluation section described these tests in the following manner.

The NDICE would be a combined technical and operational evaluation of the proposed candidate systems using representative soldiers. The primary objective of this evaluation was to collect sufficient technical and operational data to assess the capability of each candidate system to satisfy the PMS requirements.

The FDT&E would be conducted in two phases to define/refine tactics, techniques, procedures and organizations. Phase I would be conducted in modules to allow experimentation with an established baseline to simplify the development of tactics, deployment, training, organization and operator Preventive Maintenance Checks and Services (PMCS) at the squad level. Phase II would be conducted by the U.S. Army Training and Doctrine Command (TRADOC) to test/validate training, tactics, techniques, procedures, doctrine, logistics, organizational concepts and organizational maintenance training at the platoon level.

The PQT would be used to validate Avenger specification compliance and to obtain data to type classify the M3P .50-caliber machine gun. It would also provide data to support a safety release and the type classification of the system as standard equipment. The test would include environmental testing; acquisition and tracking; missile firings; and transportability testing.

The IOT&E would test the operational suitability and overall effectiveness of the Avenger system. The test would follow the approved TRADOC operational mode summary/mission profile for system reliability evaluation and include a maneuver phase and a missile firings phase.

The test and evaluation section also stated that the U.S. Army Test and Evaluation Command (TECOM) would be responsible for planning, conducting and reporting on Avenger technical testing. It also stated that the U.S. Army Operational Test and Evaluation Agency (OTEA) would be responsible for overseeing operational testing. In addition, it said that the Army Materiel Systems Analysis Agency (AMSAA) would be the independent evaluator for technical tests and for the preparation of the Independent Evaluation Plan (IEP). Details of the test and evaluation of the Avenger were outlined in the Avenger Test and Evaluation Master Plan (TEMP).

8. Cost Growth and Drivers

As with any acquisition program the cost of the Avenger was a critical issue. The Avenger acquisition strategy addressed cost by stating, "Because of the NDI Acquisition Strategy, many of the normal cost goals are not appropriate to the PMS." [Ref: 27:p. 5] The only cost goal to be used in the Avenger Program would be the Program Acquisition Unit Cost (PAUC). The PAUC included the procurement costs plus RDT&E costs. The strategy also said that design-to-cost would not be used because the system was available for immediate production as an NDI.

9. Technical Risk

The acquisition strategy assessed the technical risk of the program to be low because the Avenger was an NDI and because of the previous test and evaluation of the Avenger and the Setter systems. It said the primary technical risks would be in achieving the required Reliability, Availability and Maintainability (RAM) characteristics and operational readiness. To ensure these risks were reduced, the strategy called for a test and evaluation program that included elements to identify technical problems that would then be corrected.

10. Human Factors Engineering, Safety and Health

Human Factors Engineering (HFE), safety and health issues were important in the Avenger Program as they were in any acquisition program. The Avenger acquisition strategy

stated that HFE analyses and safety/health assessments would be conducted throughout the testing of the system to identify any issues affecting soldier and system effectiveness. The strategy also said that a system safety and health hazard prevention program would be implemented for the life of the system.

11. Standardization and Interoperability

Standardization and interoperability issues present special challenges for the Avenger program. The Avenger acquisition strategy stated that because of the use of an NDI no effort would be made to use standard hardware except for the GFE provided to the contractor. It also said that the hardware would be used "as is" with non-metric design standards. In addressing interoperability the acquisition strategy stated that because the Stinger missile was interchangeable with other weapon systems interoperability with NATO and other allies will be enhanced.

12. Survivability and Endurance

The acquisition strategy addressed survivability and endurance by directing that several measures be taken. First, it stated the system must have ballistic protection equal or greater than that of the HMMWV within specified weight constraints. Secondly, it said the system must meet the standards of AR 70-71 for Nuclear, Biological and Chemical (NBC) survivability. Thirdly, it directed that the system must be decontaminable using materials that resist contaminant

absorption and must be designed to allow easy access to exposed surfaces for decontamination. Finally, the strategy stated that collective protection equipment, a ventilated faceplate system, was desired within specified weight and configuration constraints.

C. ANALYSIS OF THE AVENGER PROGRAM'S ACQUISITION STRATEGY

To determine why the Avenger Program's NDI acquisition strategy was a success, both the factors that made the program successful and the shortcomings that occurred during the execution of the program will be analyzed. These factors and shortcomings are the result of the execution of the program as guided by its NDI acquisition strategy. From these factors and shortcomings lessons-learned will be identified in the next chapter, but first it must be established that the Avenger Program was indeed a success.

The Avenger Program is considered successful because the program achieved its primary goal of satisfying an identified, validated mission need. The Avenger Program did field an effective weapon system that met the Army's FAAD needs. The program also met cost, schedule and performance objectives, which DoD uses to measure the effectiveness of its acquisition programs.

In meeting the Army's mission need for a LOS-R component of the FAAD System, the Avenger has been praised by ADA leaders and soldiers at all levels because they believe the

Avenger met their user mission requirements. The Avenger especially received superb reviews during the Persian Gulf War as illustrated by the following comments from ADA soldiers.

An Avenger battalion commander during the Persian Gulf War said of the Avenger, "The system worked great, the soldiers loved it, leaders believed in it and it provided significant new capabilities to the division." [Ref. 1:p. 24] The same battalion commander stated, "During Operation Desert Shield and Desert Storm, Avenger lived up to the expectations of soldiers who have been singing its praises since its initial fieldings." [Ref. 1:p. 24] The commanding general of the Army's MICOM also lauded the Avenger's performance. He declared, "Of all our systems in Southwest Asia, Avenger was one of the standouts." [Ref. 1:p. 22]

The Avenger also received favorable comments during fieldings after the Persian Gulf War. A battalion commander whose unit was fielding the Avenger said, "With Avenger, we believe the Army got its money's worth." [Ref. 28:p. 37] Also important in fielding of the Avenger was what the soldier thought about the system. Soldiers using the Avenger generally praised the system. Typical of their comments was what one Avenger gunner said about the Avenger's capabilities. He declared, "It doesn't matter where the bogey's[6] coming

[6]Bogey is an Army term for enemy aircraft.

from, we'll get him." [Ref. 29] These comments illustrate the confidence ADA leaders and soldiers had in the Avenger.

In meeting cost objectives the Avenger Program also did well. The Avenger Program's Acquisition Program Baseline (APB) objective cost for RDT&E, in base year (1989) dollars, was $13.3 million with a threshold of $15.3 million. The program met the threshold objective. The program's current APB objective cost for procurement, in base year (1989) dollars, is $1,638.8 million with a threshold of $1,720.7 million. This estimate was based on the procurement of 1,779 Avengers. Because of force reductions the directed total number of Avengers to be procured has been changed to 1,001. Based on this quantity of Avengers, the PM currently estimates procurement costs to be $1,258.0 million. [Ref. 30:p. 5-3-1]

Even though the average unit production cost per Avenger will increase from $921,000 to $1.075 million because of the decrease in the total number of Avengers procured, the program is not expected to incur any major cost overruns.

In the area of schedule objectives the Avenger Program was one of few DoD acquisition programs to meet its schedule objectives. The Avenger Program's acquisition strategy called for the first Avenger to be delivered to the Army 14 months after the initial contract was awarded. When the initial contract was awarded to Boeing, the first Avenger was required to be delivered to the Army in November 1988. Boeing met this

date and delivered the first two Avengers on November 1, 1988. The program's schedule also called for the First Unit Equipped (FUE) to be in 1989. Boeing delivered Avengers on schedule and in April 1989 the Army equipped the Air Defense Artillery (ADA) Platoon of the 3rd ACR with Avengers. Today, Boeing is continuing to deliver Avengers on time or ahead of schedule and the Army is fielding Avengers on schedule.

In meeting its performance objectives the Avenger system has met or exceeded all but one of the major performance objectives. Table 2 presents several major unclassified performance objectives and the respective demonstrated performances [Ref. 30:p. 5-1-1]. It can be seen, with the exception of the machine gun range, that the Avenger system has demonstrated or exceeded expected performance requirements.

From the above cost, schedule and performance data it can be seen that the Avenger Program was a successful NDI acquisition. Now that it has been established that the Avenger Program was successful, the factors that made it a success will be examined.

1. Success Factors

The Avenger Program has demonstrated that the Army can acquire and field a major weapon system by using an NDI acquisition strategy. The analysis of this acquisition reveals many factors that led to the program's success. The factors examined here are not all inclusive, but rather the

TABLE 2 - PERFORMANCE CHARACTERISTICS

Performance Characteristic	Initial Objective	Demonstrated Performance
Number of Stinger Missiles	4	8
Range of Machine Gun (kilometers)	4	1.5
Fire Unit Full Reload Time (minutes)	15	15
Remote Operations (meters)	50	50
FLIR Detection Range		
Fixed Wing AC	10	10
Rotary Wing AC (kilometers)	7	7
Laser Range Finder		
Minimum Range	.5	.5
Maximum Range (kilometers)	10	10
Fire Unit Operational Availability	71%	83%
Fire Unit MTBOMF (hours)	45	120
Weapon Subsystem Operational Availability	89%	90%
Weapon Subsystem MTBOMF (hours)	54	176

*MTBOMF - Mean Time Between Operational Mission Failure

ones the author feels are most significant. Each factor will be analyzed to determine how they contributed to the overall success of the Avenger Program.

An important factor that led to the success of the Avenger Program was the overall high-level approval and support that the program received. This approval and support was critical because ". . . most successful and stable programs will be those that have a well defined need/ requirement that is firmly supported and advocated by the user community at all levels." [Ref. 31:p. 10-10] A program must also ". . . be perceived at all levels, including Congress, as being a well-managed program with a credible program manager and staff." [Ref. 31:p. 10-11]

DoD, Army leaders, Congress and ADA users all strongly backed the Avenger Program because it was within cost, was usually ahead of schedule and exceeded performance requirements [Ref. 26]. Some of the strongest approval and support for the Avenger Program came from the ADA users. Typical of the comments supporting the program were the following statements from Major Generals Donald Infante, Chief of ADA from 1985-1989 and Donald Lionetti, Chief of ADA from 1989-1991. General Infante called the Avenger highly effective and ". . . a real success story." [Ref. 32:p. 54] General Lionetti said the Avenger ". . . provides a tremendous improvement in our ability to defend forward forces." [Ref. 29:p. 10] The Avenger Program also received support because

it was the first component of the FAAD System to be fielded. General Lionetti said in 1991:

> The top branch modernization priority continues to be the fielding of the FAAD systems to our light and heavy divisions. It enjoys solid backing from the Secretary of Defense on down through the Army leadership. [Ref. 29:p. 15]

The Avenger Program also received approval and support from Congress as evidenced by Congress' continued funding of the program. The Avenger program has received stable funding from the beginning of the program and Congress has approved the use of multiyear production funding. This stable funding has allowed the Avenger program to implement its acquisition strategy in a timely manner.

The Avenger Program received this high-level approval and support because program management officials developed a comprehensive NDI acquisition strategy and then implemented it in an effective manner. The Avenger Program also received the support of the users because the Avenger was an effective weapon system that performed well and was fielded in a timely manner.

The next factor that made the Avenger Program successful was the effective market investigation that was conducted by the Army. The market investigation is a crucial factor in making an NDI acquisition work well. In the case of the Avenger Program, the Army investigated several different systems to determine if a PMS concept was feasible. From

these market investigations senior acquisition officials and the users determined that the PMS concept was feasible and that an NDI acquisition strategy was appropriate. Without making this thorough market investigation successful implementation of the Avenger acquisition strategy would have been difficult if not impossible.

As explained in Chapter II logistical support of an NDI is one of the most difficult challenges that acquisition managers face when trying to manage an NDI acquisition program. Program management officials realized that total logistical support would not be available when the system was first deployed because of the speed of which the Avenger system was to be fielded. To meet this challenge program management officials developed and implemented a successful acquisition strategy that ensured that the Avenger would be fielded with adequate logistical support. This strategy was successful primarily because of the use of ICS during the first 29 months of fielding. The use of ICS allowed the program officials time to establish the logistical structure needed for the Army to support the Avenger with its own resources.

An additional factor that led to the Avenger Program's success was the effective use of FFP contracts for most of the program's contracts. The use of a multiyear production contract was also important. Because the Avenger was an NDI with little R&D involved and because there was little risk

involved in the program, program management officials were able to take advantage of the benefits of using fixed-price type contracts. These benefits included reduced contract administration and management costs and reduced contractual risk. Also, because of the stability of the program a multiyear production contract was appropriate. This allowed the Government to take advantage of lower Economic Order Quality (EOQ) prices offered by the contractor. The contractor was able to offer these lower EOQ prices because there was a guarantee that the Army would buy Avengers for five years rather than just one year.

Another factor that helped make the Avenger Program a success was the program's effective tailoring of the acquisition process. As pointed out earlier, the tailoring of the acquisition process is critical when using an NDI acquisition strategy. Program management officials were given great latitude in tailoring the acquisition process because of the urgent need for the Avenger, because the Avenger was an NDI, and because of the expected low technical risk in producing the Avenger. The tailored acquisition process allowed much of the administrative and procedural requirements to be eliminated or modified. This allowed both time and costs to be reduced.

One more factor that contributed to the success of the Avenger Program was the tailored approach that called for the

concurrent design of P^3Is during the P/D phase of the acquisition process. Since the need for the Avenger was urgent, the Army decided to procure the Avenger from Boeing with only two major changes. The two changes were the addition of a Predicted Fire Weapon (PFW)[7] and an RCU [Ref. 26]. All other improvements were scheduled to be made later as outlined in the Avenger System Improvement Plan (SIP). The advantage of using this approach was that it allowed the Army to field the Avenger quickly and yet make materiel changes to improve the performance of the system later.

Another factor that contributed to the success of the Avenger Program was the tailored test and evaluation (T&E) program, especially the NDICE. Again, because the Avenger was an NDI the Army was allowed to modify the T&E of the Avenger. This tailoring of T&E allowed the Army to reduce overall testing and to combine developmental testing and operational testing. This tailored T&E of the Avenger allowed the Army to field the system quicker and to save T&E funds.

One last factor that contributed to the success of the Avenger Program was the dedication and experience of the prime contract, Boeing Aerospace. Army acquisition managers made a wise choice in the selection of Boeing as the prime contractor for the Avenger. Boeing had experience with several air

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[7]The Predicted Fire Weapon (PFW) that Boeing used to fulfill this requirement was the M3P .50-caliber machine gun.

defense systems, as well as experience with the Avenger. This indicated that Boeing could produce the Avenger on time and within cost. This indication proved to be true and Boeing has constantly delivered Avengers on time and within cost.

2. Shortcomings

Although the Avenger Program was an overall success, the program still had several shortcomings. It is important to analyze these shortcomings, as well as the successes, to learn from past difficulties. Again, these shortcomings are not all inclusive, but the ones the author feels are significant. Each shortcoming will be analyzed to determine what happened and what effect the shortcomings had on the program.

When Army acquisition managers decided to procure the Avenger they directed Boeing to make two major changes to the system. These changes were the addition of a PFW and an RCU. Boeing was able to easily add an RCU to the Avenger, but the addition of the PFW proved to be more difficult.

The original performance requirement called for a PFW with a range of four kilometers. To meet this requirement Boeing decided to use a nonstandard M3P .50-caliber machine gun made by Fabrique National Herstal. The machine gun was an old refurbished Army M2 machine gun that was modified for use on the Avenger. Army acquisition managers approved the use of the M3P, but because the machine gun was of an old design and because of production quality control problems, it did not

meet the range requirement and experienced reliability difficulties. [Ref. 25]

Although there were problems with the M3P the Avenger passed PQT in 1989 and full production approval for the Avenger was given. However, because of the problems with the machine gun the Avenger was fielded without the M3P. There was also difficulty obtaining assistance to correct the machine gun problems. The U.S. Army's Armament, Munitions and Chemical Command (AMCCOM), which is the Army's proponent for all machine guns, had difficulties helping because the M3P was not developed by them. Many regulations and policies also prevented AMCCOM from assisting because the M3P was a nonstandard weapon. This unavailability of assistance resulted in little being accomplished from 1990 to 1992 to correct the problems and therefore no M3Ps were fielded during that time.

In 1992 the Avenger PM began pressuring Boeing to correct the M3P problems. To begin correcting the problems MICOM began assisting and two tests were conducted on the M3P at Redstone Arsenal, Alabama with the help of Boeing. These tests were conducted using a Test-Analyze-and-Fix method to ensure problems were identified and corrected [Ref: 30:p. 1-1]. With the results of these tests Boeing ensured Fabrique National Herstal corrected the problems and began building better machine guns.

In June 1993 operational live fire testing of the improved M3Ps was conducted at Fort Bliss, Texas. The tests resulted in a hit percentage of better than 90% for targets at a range of 1.5 kilometers. The users agreed this demonstrated performance was within performance thresholds and the PM began working on a machine gun materiel release so that M3P fielding could begin. Fielding to the Army ADA School and the Army Ordnance, Missile and Munitions Center is currently scheduled to begin in March 1994. Fielding to other units is subject to future DA approval. [Ref. 33]

From this shortcoming one can see that adding additional requirements to an NDI may cause problems. In the case of the Avenger Program the Army should have conducted additional testing of the M3P during PQT. This additional testing would have ensured that the M3P met requirements before the Avenger system was approved for production. This would have prevented almost four years of additional difficulties with the fielding of the M3P machine gun.

While the major production contract for the Avenger was an FFP contract, the contract for Avenger Test Program Sets (TPS) was a Cost Plus Incentive Fee (CPIF) contract. Avenger TPSs were maintenance test sets that were required to interface with the Army's Integrated Family of Test Equipment (IFTE). The TPSs consisted of Line Replaceable Unit (LRU) test equipment, Subassembly Repairable Unit/Shop Replaceable (SRU) test equipment and related software. The LRUs were

major components such as the FLIR, ACE and RCU. The SRUs were subcomponents that were used in the LRUs and the related software was used in the IFTE. The maintenance concept called for the Avenger LRU TPSs to be used with the IFTE at the direct maintenance level to isolate faults in the LRUs. The faulty LRUs would then be sent to depot level maintenance where faulty SRUs would be isolated and repaired using SRU TPSs.

Since these TPSs were developmental items the Army entered into a letter contract with Boeing in May 1990 to begin development of nine LRUs and 32 SRUs, which the PM later changed to seven LRUs and 29 SRUs by altering the scope of the contract through contract modifications. This letter contract was to be definitized into a 34-month CPIF contract within 180 days, but because of problems with the contract it was not definitized until almost half-way through the 34-month contract period. When the contract was finally definitized, it had a target cost of $18.6 million, a ceiling cost of $20.6 million and a minimum fee of $1.1 million. [Ref. 25]

The problems with the contract were that Boeing did not have much experience with this type of TPS development, and there were problems with personnel turnover on the program. [Ref. 25] In February 1991 the MICOM Cost Analysis Directorate began reporting to the PM and the MICOM Commanding General that Boeing was having difficulties with the contract. The Cost Analysis Directorate reported that with the TPS

contract into its tenth month the contract was still undefinitized and there was a projected $7.9 million cost overrun. [Ref. 34]

At this time Boeing said that there were no problems with the contract and assured the PM that the TPSs would be developed on time and within cost. Boeing was allowed to continue development of the TPSs and continued to assert that there were no problems until the contract was definitized. One month after the contract was definitized Boeing told the PM it was experiencing developmental problems with the TPSs.

Boeing continued to work on the TPSs, but because of the problems discussed above, Boeing was unable to develop all of the TPSs, especially the SRU TPSs. This led the PM to terminate Boeing's work on the SRU TPSs in October 1992 and to direct Boeing to concentrate all further work on the LRU TPSs. As a result of the difficulties, funds for the contract ran out seven months from the end of the contract period and Boeing was only able to deliver seven LRU TPSs, no completed SRU TPSs and some incomplete software. [Ref. 25]

This shortcoming illustrates that although fixed-price type contracts can effectively be used to acquire NDIs, any modifications or additions that require cost-reimbursement type contracts must be monitored closely. The Avenger Program's TPS contract demonstrates the problems that can develop if letter contracts are not used properly and cost-reimbursement type contracts are not monitored closely.

Because Boeing was performing well on the main FFP production contract, it may have been assumed they would perform well on the CPIF TPS contract as well. However, because none of the TPSs were developmental items, contract performance should have been closely monitored and actions taken to ensure the contract was executed properly.

Another shortcoming of the Avenger Program was that the Avenger was fielded without an Environmental Control Unit (ECU)/Prime Power Unit (PPU). The ECU was a unit that provided air-conditioning, heating, ventilation and dehumidification for the gunner. The PPU was a separate power source for the turret. Boeing's candidate Avenger did not have an ECU/PPU, and the Army did not originally require an ECU/PPU for the Avenger because of weight restrictions. Although the original system requirements did not call for an ECU/PPU, during the Persian Gulf War it was confirmed that the turret needed an air-conditioner because of the hot climate.

Due to the urgent need to field an ECU/PPU during the Persian Gulf War, the PM began an effort to procure an NDI ECU/PPU. A program management official found an Alabama company, Motivair, which specialized in air-conditioning systems for trucks. After reviewing Motivair's air-conditioner, program management personnel developed a set of specifications to meet the Persian Gulf War requirements for an ECU/PPU. Motivair developed the ECU/PPU and the PM bought

and fielded 182 units, but not before the Persian Gulf War was over. [Ref 1:p. 23]

After the Persian Gulf War and the urgency to field an ECU/PPU had passed the PM began to develop a program to procure ECU/PPUs for all Avengers. The weight of the ECU/PPU was no longer an issue and the ECU/PPU could be added as a P^3I because the Avenger SIP called for the Avenger to be retrofitted with the new Heavy HMMWVs. Since the program was a P^3I, MICOM wanted a FFP contract for the ECU/PPUs. Boeing's version of an ECU/PPU was expensive and they would not accept a FFP contract. The PM then put out an RFP for an NDI ECU/PPU, and it was designated a small business set-aside with source selection being made on a best value basis [Ref. 26]. Selection was made in January 1993 and two contractors were requested to provide two prototypes each for competitive Government evaluation. One contractor did not provide any prototypes so the Government began testing the other contractor's prototypes. Testing of these prototypes identified several technical difficulties that the contractor attempted to correct.

Currently, additional testing is being conducted to ensure the technical difficulties have been corrected. Current schedules call for ECU/PPU fielding to begin in the first quarter of FY 1995 [Ref. 35:p. 12].

From this shortcoming one can see that when acquiring an NDI it may not totally meet the user's needs. This inability to meet all user needs may lead to problems; as it did with the Avenger's ECU/PPU during the Persian Gulf War. Acquisition managers must realize that when dealing with NDIs all user requirements may not be met. They should identify any unfulfilled user needs and have a plan to deal with them, such as a P^3I program.

One additional shortcoming of the program was that the Army logistics managers did not authorize any spare systems or parts for unit fielding [Ref. 36]. This created a problem when Avengers broke down during NET. Then other Avengers would have to be used for spare parts to bring NET Avengers up to operational status. This resulted in tactical unit Avengers being inoperable for lack of spare parts.

This shortcoming illustrates that even though the Avenger Program had a good logistical support plan for systems that had already been fielded, there should be adequate logistical support during the fielding period as well. A lack of logistical support during initial system fielding and NET could lead to training difficulties and could cause slips in fielding schedules.

V. LESSONS-LEARNED FROM THE AVENGER PROGRAM'S ACQUISITION STRATEGY

A. INTRODUCTION

The analysis of the Avenger Program's acquisition strategy reveals many acquisition management lessons-learned. These lessons-learned are not based on quantitative analysis, but are based on a qualitative analysis of the Avenger Program's NDI acquisition strategy and how it was implemented. The intent is to document the lessons-learned, not to make any conclusions about how well Avenger Program management personnel managed the program.

The lessons-learned presented in this chapter are not all inclusive, but are the significant ones identified from the analysis presented in this thesis. Other lessons-learned can be identified from a study of the individual functional areas of the Avenger Program.

These lessons-learned are intended to help acquisition managers and their staffs in effectively managing future NDI acquisition programs. The lessons-learned will also be helpful for students studying acquisition management.

B. LESSONS-LEARNED

The significant lessons-learned from the examination of the Avenger Program and its NDI acquisition strategy include the following:

- **NDI acquisition strategy works well and can be used successfully to acquire a major weapon system.**

The Avenger Program has shown that a major weapon system can be successfully acquired by using an NDI acquisition strategy. The use of an NDI acquisition allowed the Army to rapidly field a weapon system to fill the requirement for a LOS-R component in the FAAD system. As the LOS-R component of the FAAD system, the Avenger was acquired within cost and schedule objectives and met all but one major performance requirement. This was accomplished by taking advantage of the NDI acquisition benefits and by overcoming NDI challenges.

- **The approval and support of Congress, DoD and Army leadership is key to the success of a program.**

As with any acquisition program the approval and support of high-level DoD leadership, Congress and the users is important to the successful acquisition and fielding of a weapon system. The Avenger Program received approval and support from senior DoD leaders, Congress and Army leadership because the acquisition officials successfully employed an NDI acquisition strategy that resulted in the acquisition of a system that met the mission need and that also resulted in cost, schedule and performance objectives being met. This

widespread approval and support was essential for the overall success of the Avenger Program.

- **The NDI acquisition strategy must be tailored to the program.**

To be successful an NDI acquisition strategy must be tailored to the program. This is important because, to take full advantage of NDI benefits, acquisition managers must be allowed to structure a program differently from that of a full-scale development program. In the Avenger Program, program management officials ensured the acquisition strategy outlined how the acquisition process would be tailored and then the program was effectively implemented according to this strategy.

- **A thorough market investigation is critical when using an NDI acquisition strategy.**

A thorough market investigation is important in the use of an NDI acquisition. The results of the market investigation will indicate if the use of an NDI is feasible. Without this information the decision about whether an NDI should be used cannot be adequately made. In the Avenger Program the Army began to investigate the possible use of a PMS early in the acquisition process. This early investigation provided timely information to senior acquisition managers and users with the necessary information to base program decisions on.

- **When using an NDI acquisition strategy logistical support planning must begin early.**

When using an NDI logistical planning must begin early in the program because of the shortened acquisition cycle. This early logistical support planning will allow acquisition managers time to properly plan for the support of the NDI. Without adequate logistical planning, system fielding may be delayed because proper support structures may not be in place. In the Avenger Program acquisition managers realized they did not have adequate logistical support planning time so they used ICS until sufficient support planning could be completed and a logistical support structure established.

- **NDIs allow the increased use of fixed-price type contracts that save both time and costs.**

The GAO has noted that because of the reduced risk to the Government; simpler contract procedures can be used for NDIs. These contract procedures include increased use of fixed-price type contracts. This was true of the Avenger Program. Army acquisition managers were able to use an FFP production contract for the Avenger that led to reduced contract administration and management costs. This savings helped ensure that program cost objectives were met.

- **Selection of a dedicated contractor is important to the accomplishment of program objectives.**

One advantage of using an NDI is that the NDI contractor usually has had some experience with the system before the contract is awarded. The Army's selection of Boeing's Avenger

was a good decision because Boeing had had experience with the Avenger and several other air defense systems. This previous experience enabled Boeing to successfully deliver the Avenger on time and within cost.

- **Do not begin full production of a weapon system until it is fully tested.**

The decision to begin full production of a weapon system should not be made until testing is complete. During the Avenger Program the decision was made to begin production even though the M3P machine gun had not passed the PQT. This decision led to many problems with the M3P that had to be dealt with for the next four years. This demonstrates that it is critical for all acquisition officials to understand that a system must be fully tested before it is approved for production.

- **Program managers must monitor cost-reimbursement type contracts closely.**

While NDIs can usually be acquired using fixed-price type contracts, some elements of an NDI program might have to use cost-reimbursement type contracts to procure P^3I items or other support items. These cost-reimbursement type contracts must be monitored more closely than the fixed-price type contracts. The Avenger Program used a CPIF contract for the development of the TPSs. Because the TPSs were developmental items and because a CPIF was being used, the contract should have been monitored more closely. This increased monitoring

could have reduced the number of problems the Government had with the TPS contract.

- **Acquisition managers must realize that NDIs may not meet all user mission requirements.**

Even though NDIs save both time and costs, they may not meet all user needs. Performance trade-off analyses must be conducted during the process of deciding whether to acquire an NDI. During these analyses acquisition managers must identify to the users what requirements may not be met. And if the decision is made to acquire an NDI that does not meet all critical user requirements, acquisition managers must develop a plan to address any shortcomings. The Avenger did have several user requirements that were not met, but the PM developed a plan to ensure that they would be met at a later date.

- **Committed program management is critical.**

A committed program management team is important to the success of any program. Key program management personnel should be brought on board early and kept on the program for the duration of the program. This continuity will lead to reduced turbulence and greatly enhance the program. Although the responsibility for management of the Avenger was first given to the Stinger Project Office, then moved to a separate PM, and finally moved to the FAAD Project Office, key personnel were kept on the Avenger Program. This continuity

of personnel helped ensure that the Avenger Program was managed and executed in an effective manner.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. GENERAL CONCLUSIONS

It is clear that with the current emphasis on the use of NDIs within DoD, acquisition managers will need to learn more about how to successfully acquire them. In an effort to provide acquisition managers with lessons-learned about NDI acquisition this thesis has examined an example of a successful NDI acquisition program - the Avenger Program. This thesis has focused on NDI acquisition strategy and how Avenger Program acquisition management officials have used this type of strategy to field an effective weapon system. The Avenger Program was considered a success because it provided a system that met the user's requirements and because it met cost and schedule objectives. The program also met all but one of its performance objectives.

From the analysis of the Avenger Program's acquisition strategy, the factors that made it successful, and the program's shortcomings, it is clear that an NDI acquisition strategy can be used to acquire a major weapon system. However, the use of an NDI acquisition strategy for major programs must be carefully implemented and managed.

B. SUMMARY OF LESSONS-LEARNED

A summary of the lessons-learned from the study of the Avenger Program is listed below.

- **NDI acquisition strategy works well and can be used successfully to acquire a major weapon system.**
- **The approval and support of Congress, DoD and Army leadership is key to the success of a program.**
- **The NDI acquisition strategy must be tailored to the program.**
- **A thorough market investigation is critical when using an NDI acquisition strategy.**
- **When using an NDI acquisition strategy logistical support planning must begin early.**
- **NDIs allow the increased use of fixed-price type contracts that save both time and costs.**
- **Selection of a dedicated contractor is important to the accomplishment of program objectives.**
- **Do not begin full production of a weapon system until it is fully tested.**
- **Program managers must monitor cost-reimbursement type contracts closely.**
- **Acquisition managers must realize that NDIs may not meet all user mission requirements.**
- **Committed program management is critical.**

C. RECOMMENDATIONS

From the examination of the Avenger Program and its NDI acquisition strategy the following recommendations are made:

1. The lessons-learned should be disseminated to current and future program management personnel, as well as other DoD acquisition officials.

2. DoD acquisition management officials should ensure NDIs are considered during the Concept Exploration and Definition phase of each major weapon system program.

3. Other NDI programs should be examined to broaden the base of NDI lessons-learned.

APPENDIX A

ACRONYMS

ACRONYM	FULL TITLE
ABN	Airborne
AC	Aircraft
ACE	Avenger Control Electronics
ACR	Armored Cavalry Regiment
ADA	Air Defense Artillery
ADATS	Air Defense Anti-Tank System
ADEA	Army Development and Employment Agency
AMSAA	Army Materiel Systems Analysis Agency
ASARC	Army Systems Acquisition Review Council
ASL	Authorized Stockage List
AVT	Automatic Video Tracker
BDE	Brigade
BOIP	Basis of Issue Planning
C^2I	Command, Control and Intelligence
CA	Combined Arms
CAV	Cavalry
CE/D	Concept Exploration and Definition
COMSEC	Communications Security
CPIF	Cost Plus Incentive Fee
CUCV	Commercial Utility Cargo Vehicle
DA	Department of the Army
DAB	Defense Acquisition Board
DAES	Defense Acquisition Executive Summary
DCP	Decision Coordinating Paper
DEM/VAL	Demonstration and Validation
DIV	Division
DIVADA	Division Air Defense Artillery
DoD	Department of Defense
DoDI	Department of Defense Instruction
DSMC	Defense Systems Management College
ECA	Electronic Component Assembly
ECU/PPU	Environmental Control Unit/Prime Power Unit
EMD	Engineering and Manufacturing Development
EOQ	Economic Order Quantity

FAAD	Forward Area Air Defense
FDT&E	Force Development Test and Experimentation
FFP	Firm Fixed Price
FLIR	Forward-Looking Infrared
FSD	Full-Scale Development
FUE	First Unit Equipped
FY	Fiscal Year
GFE	Government Furnished Equipment
HFE	Human Factors Engineering
HHV	Heavy HMMWV Variant
HMMWV	High Mobility Multipurpose Wheeled Vehicle
ICS	Interim Contractor Support
IFF	Identification Friend-or-Foe
IFTE	Integrated Family of Test Equipment
ILS	Integrated Logistic Support
ILSP	Integrated Logistics Support Plan
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
IEP	Independent Evaluation Plan
JROC	Joint Requirements Oversight Council
LID	Light Infantry Division
LOS-F	Line-of-Sight Forward
LOS-R	Line-of-Sight Rear
LRU	Line Replaceable Unit
LRIP	Low-Rate Initial Production
LSA	Logistic Support Analysis
MANPADS	Man-Portable Air Defense System
MANPRINT	Manpower Personnel Integration
MICOM	Missile Command
MTBOMF	Mean Time Between Operational Maintenance Failure
MPL	Mandatory Parts List
MNS	Mission Need Statement
MX	Mechanized Infantry Division
NBC	Nuclear, Biological and Chemical
NDI	Nondevelopmental Item
NDICE	Nondevelopmental Item Candidate Evaluation
NET	New Equipment Training
NLOS	Non-Line-of-Sight
OCONUS	Outside Continental United States
OMB	Office of Management and Budget
ORD	Operational Requirements Document
O/S	Operations and Support

OTEA	Operational Test and Evaluation Agency
P^3I	Pre-Planned Product Improvement
PAUC	Program Acquisition Unit Cost
P/D	Production and Deployment
PEO	Program Executive Officer/Office
PFW	Predicted Fire Weapon
PM	Program Manager; Project Manager; Product Manager
PMCS	Preventive Maintenance Checks and Services
PMO	Program Management Office
PMS	Pedestal Mounted Stinger
PQT	Production Qualification Test
PRMP	Production Readiness Master Plan
RCU	Remote Control Unit
RDT&E	Research, Development, Test and Evaluation
RFP	Request for Proposal
ROC	Required Operational Capability
SAIP	Spare Acquisition Integrated with Production
SAM	Surface-to-Air Missile
SECDEF	Secretary of Defense
SINCGARS	Single-Channel Ground and Airborne Radio System
SRU	Subassembly Repairable Unit/Shop Replaceable Unit
SVML	Standard Vehicle Mounted Launcher
TC-LPU	Type-Classified Limited Procurement Urgent
TC-S	Type-Classified Standard
TDP	Technical Data Package
TECOM	Test and Evaluation Command
TEMP	Test and Evaluation Master Plan
TLCCS	Total Life Cycle Competition Strategy
TOE	Table of Organization and Equipment
TPS	Test Program Set
TRADOC	Training and Doctrine Command

APPENDIX B

AVENGER SPECIFICATIONS (UNCLASSIFIED)*

Main Armament	Eight Stinger SAMs in two four-missile pods (SVMLs)
Missile Speed	Mach three plus
Maximum Missile Range	Six kilometers plus
Minimum Missile Range	1,000 feet
Maximum Missile Altitude	16,000 feet
Minimum Missile Altitude	30 feet
Missile Launch Weight	22.3 pounds
Missile Warhead	2.2 pound high-explosive fragmentation warhead
Turret	Gyro stabilized. Made of composite material
Turret Weight Loaded	2,568 pounds
Secondary Armament	One M3P .50-caliber machine gun with 200 rounds basic load
Secondary Armament Range	1,500 meters maximum effective range 1,100 rounds per minute rate of fire
FLIR detection Range	Fixed Wing AC - 10 kilometers Rotary Wing AC - 7 kilometers

*Adopted from Avenger System Overview Briefing, Avenger Program Office, July 28, 1993.

Laser Range	Minimum - .5 kilometers Maximum - 10 kilometers
Fire Unit Full Reload Time	15 minutes
Vehicle	M998 HMMWV or M1097A1 HMMWV Heavy Variant (HHV)
Total System Weight	8,660 pounds - HMMWV 10,000 pounds - HHV
System Height	104 inches
System Length	195 inches
System Width	87 inches
Crew	Two (gunner and driver)

APPENDIX C

AVENGER PROGRAM CHRONOLOGY

DATE	EVENT
April 1982	First Feasibility Demonstration of Multiple Stinger Launcher
June 1983	Boeing Aerospace Begins Development of Avenger
May 1984	First Prototype Avenger Firing
August 1984	ADA Board Evaluates Avenger
October 1984	Boeing Submits Unsolicited Proposal to Build the Avenger
March 1985	Market Investigation Completed
August 1985	SECDEF Cancels Sergeant York Program
August 1985-January 1986	FAAD Working Group Convenes
October 1985	Boeing Begins Avenger Production Configuration
January 1986	SECDEF Approves FAAD Concept
March 1986	FAAD ROC Approved (Milestone IIIA)
July 1986	RFP for PMS Released
August 1986	Initial Production Avenger Ready for Testing
September 1986	Contractor Proposals Received
November 1986-July 1987	Nondevelopmental Item Candidate Evaluation (NDICE) Conducted
April 1987	Avenger Type-Classified Limited Production Urgent (TC-LPU)

August 1987	Initial Avenger Contract Awarded to Boeing
March 1988	Contract Award - Option II
May-July 1988	FDT&E I Conducted
November 1988	First Production Model Avenger Delivered
December 1988	Contract Award - Option III
February-March 1989	FDT&E II Conducted
April 1989	First Unit Equipped (3rd ACR)
April-December 1989	PQT Conducted
April-September 1989	IOT&E Conducted
July 1989	Option II Deliveries Start
February 1990	Avenger Type-Classified Standard
April 1990	Full-Scale Production Approved (Milestone IIIB)
May 1990	Contract Award - Option IV (Army Authorizes Production Increase From Five to 12 Avengers Per Month)
July 1990	Option III Deliveries Start
August 1990	First Avengers Are Deployed toSouthwest Asia in Support Of Operation Desert Shield
August 1990	Boeing Provides Condensed Avenger NET to 4-5 ADA in Preparation for Operation Desert Shield Deployment
September 1990	4-5 ADA and 3rd ACR deploy Southwest Asia in Support of Operation DesertShield
January 1991	Initial Operational Capability Achieved
January 1991	Contract Award - Option V
September 1991	First Avengers Deployed to an OCONUS unit (Korea)

September 1991	Option IV Deliveries Start
February 1992	Multiyear Procurement Contract Awarded to Boeing
June 1992- August 1992	M3P Reliability Test Conducted
July 1992	Option V Deliveries Start
October 1992- December 1992	Second M3P Reliability Test Conducted
December 1992	Multiyear Procurement Contract Deliveries Start
June 1993	M3P Customer Test Conducted

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