RESEARCH AND DEVELOPMENT

1. Introduction. "Technological superiority is a principal characteristic of our military advantage. It is the objective of the Department of Defense (DoD) Science and Technology (S&T) Program to develop options for future decisive military capabilities based on superior technology." [1]

a. There are two valid reasons for initiating a new materiel program. The first is to overcome a projected threat and the second is to incorporate new technology.

(1) Overcoming a projected threat is a battlefield imperative. For example, if a potential adversary achieves the capability of destroying our satellites, then much of our intelligence collection and communication capabilities will be lost. Losing these capabilities would jeapardize our ability to fight and win.

(2) Incorporating newer technology into an existing or replacement system will increase our operational capability, enhance system reliability, or reduce costs. For example, laser rangefinders have greatly reduced errors in determining range to target. (This is a critical data element in tank gunnery.) As a result, the first round hit probability has increased. In addition to providing increased leathality, this newer technology reduces the logistics burden.

b. This document discusses the process of using science to create new technology which can be incorporated into military systems. The process of incorporating new technology into existing or future systems is commonly referred to as, research and development.

2. Objectives. At the conclusion of this unit of instruction, you should be able to:

a. Differentiate among science, technology, research, and development.

b. Describe the following programs: (1) technology transfer, (2) dual use technology, (3) accelerated transition, (4) horizontal technology integration, (5) technology insertion (6) modeling and simulation, (7) advanced technology demonstration (ATD), and (8) advanced concept technology demonstration (ACTD).

Note: Information regarding Advanced Concepts and Technology Program II (ACT II) Program, Concept Experimentation Program (CEP), Advanced Warfighting Experiment (AWE), Technology Demonstrations (TDs), Small Business Innovation Research (SBIR) Program, Fast Track Program, and Limited Objective Experiments (LOE) are included in this document.

c. Differentiate between pre-planned product improvement (P^3I) versus product improvement programs (PIPs).

[1] Honorable William J. Perry, Former Secretary of Defense.

d. Discuss the funding categories for research and development programs.

e. Compare the strategic research objectives of the Science and Technology Program with the Joint Warfighting Cabability Objectives.

3. Notes.

a. Additional definitions are contained in Appendix A.

b. A chart showing the life cycle model phases is found on the last page of this document.

c. Because DoD recently changed its 5000 series publications, a myriad of DoD and Army policy documents implementing these changes must be revised. Updating these documents will take years.

4. Strategic Goals of Science and Technology Program. The strategic goal of Army science and technology program is to provide technical solutions to accelerate the Army ’s transformation into a 21st century force that is dominant across the full spectrum of operations. This force must be more strategically responsive and versatile than today’s force. The primary challenge is to develop and mature technologies that will eliminate current distinctions between heavy and light force capabilities. This means that heavy forces must become lighter and light forces must become more lethal and mobile. This Objective Force must also be more survivable with overmatching agility while simultaneously reducing logistics demands. The Objective Force will be equipped with technology and organizational designs to rapidly transition from humanitarian assistance to major theater of war operations without loss of momentum. The centerpiece S&T program for achieving Objective Force capabilities is the Future Combat Systems (FCS) program. The FCS is envisioned as a system of systems land combat capability with multimission functionality. FCS primary design characteristics include networked command and control on the move, beyond line of sight “direct fires,” advanced long--range precision indirect fires,standoff sensors,and robotics.Simultaneous with FCS development,the Army will mature other essential Objective Force technologies for full spectrum operations.This requires advances in fuel-efficient propulsion (ground and rotorcraft), compact electric power generation, advanced simulation,and medical and soldier system technologies. The Army will also seek “paradigm shifts ” in warfighting capabilities perhaps as significant as the introduction of the tank and helicopter in the past. Breakthrough technologies will be pursued in high-payoff basic research investments —the Strategic Research Objectives.[2]

a. Asymmetric Threats. The global spread of advanced technology is transforming the military threats faced by the United States and will challenge our ability to achieve full spectrum dominance.In order to carry out our defense strategy, the U.S. military must be prepared to conduct multiple, concurrent, contingency operations worldwide. It must be able to do so in any environment, including one in which an adversary uses asymmetric means such as nulear, chemical, or biological weapons; information operations; ballistic missiles; and terrorism.

[2] Defense Science and Technology Strategy 2000.

Future adversaries will increasingly rely on unconventional strategies and tactics to offset the superiority of U.S.forces. Our combat forces must be organized, trained, equipped, and managed with multiple missions in mind. We must be conscious of these threats as we foster technology breakthroughs that will lead to new capabilities to cope with that environment.

b. Leveraging the Technology Explosion. Increasingly many defense needs can be met by leveraging the commercial technology explosion and utilizing commercial products such as computers, software, electronics, and communications. As military capability moves toward information-based warfare and as the information age continues to experience a technology explosion in the civilian economy, there will be an abundance of opportunities to leverage commercial technologies and products for military use. The Department will monitor commercial technology and product developments and adopt or leverage such offerings when they show promise of enhancing military capability. The Department will bring together the warfighters, DoD planners, scientists, and engineers to explore ways to take advantage of the opportunities offered by rapid commercial technology advancements. Even in areas where applicable, the commercial technology explosion will not by itself satisfy our warfighter's needs. Many warfighter needs are exclusively military, so there is no commercial technology. Other warfighter needs have elements in common with commercial technology, but are driven by military requirements. The challenge for the defense S&T community will be to choose what technology to leverage and what technologies we must develop with our own investments.

c. Science and Technology Investments. As mentioned above, *Joint Vision 2010* provides a high-level description of the joint warfighter's needs. A more detailed articulation is presented in the Joint War-fighting Capability Objectives (JWCOs) that form the basis of the *Joint Warfighting Science and Technology Plan.* The JWCOs cover a broad area of future warfighting capabilities, and the Defense S&T Program will continue to address each of the JWCOs validated by the Joint Requirements Oversight Council. However, cross-cutting topics deserve special priority. The Department will focus a significant portion of its S&T investment in the following five areas.

(1) Information Assurance. Information technology has been a core research area for the Department since the beginning of computing. This research area remains vital, and will be even more significant to the Department as commercially available information technology proliferates. We are identifying technologies that will address activities related to cyberterrorism and better protection for critical information systems, both on the battlefield and throughout the nation. We will provide the technology to ensure our forces can acquire, verify, protect, and assimilate the information needed to effectively neutralize and dominate adversary forces. Information Superiority is a key enabler for Joint Vision 2010. It is the backbone of the RMA that will allow U.S.forces to achieve total battlefield dominance.

(2) Battlespace Awareness. The near future will see a proliferation of sensors and associated processors available for battlefield use. Total battlespace situation awareness and understanding, coupled with information assurance, will provide real-time intelligence from "sensor to shooter." Commercial and military space technology and systems will provide major leaps in coverage, timeliness, and resolution. As a result, the amount of raw information available to the

battlefield commander and soldier, sailor, airman, and marine is increasing at an ever-expanding rate. In concept, smart sensor webs will be developed to integrate networks of sensors to provide near-real-time representations of complex battlefield information to the warfighters. The sheer weight of information available to the warfighter will result in the need for technical help in sorting, mining, understanding, and acting on that knowledge. Cognitive readiness will be essential to exploiting battlespace awareness. We will continue to find and develop technologies to increase battlespace awareness.

(3) Force Protection. The 21st century warfighter must have the capabilities to survive, fight, and win in a contaminated environment. The Department's Chemical and Biological Defense program integrates all medical and nonmedical programs and invests in technologies to provide improved capabilities against existing and emerging threats, while minimizing adverse impacts on our warfighting potential. Chemical and biological defense is based on three integrated principles: contamination avoidance, protection, and force sustainment. The Department has also initiated a technology development program to detect, characterize, and neutralize hardened and deeply buried targets. This focused activity is in response to the emerging threats from nations with underground facilities that protect weapons of mass destruction (WMD) and communications sites. For counterforce applications, automated systems will be developed to accurately process and analyze large volumes of information in near real time. In addition to the identification of hardened and deeply buried targets and timely notification to shooters, improved penetrating munitions will be developed for counterforce missions. Revolutionary new weapon capabilities such as directed-energy weapons will receive increased emphasis. Developing the technologies that protect the force and allow it to operate wherever needed will be a priority of the Defense S&T Program.

(4) Reduced Cost of Ownership. Defense budget reductions have forced an increasing emphasis on affordability as a leading investment factor governing the S&T program. DoD acquisitions will not meet warfighter 's needs within current budgets unless we reduce the costs of development, procurement, and life-cycle operation. Since 1989 the Department has dealt with declining budgets by judiciously slowing force modernization to concentrate on maintaining force readiness and quality of life. The Department must now embark on the modernization of our forces to ensure continuing readiness in the 21st century. For this modernization to be possible within our reduced budgets, the Defense S&T Program will provide advanced technology that is timely and affordable. The cost to own, operate, maintain, and upgrade is greater than the cost of initial acquisition for most systems. Thus, full life-cycle costs will be considered during technology development and demonstration, and programs specifically aimed at reducing life-cycle costs will be pursued. As an example, new propulsion technology holds great promise to reduce the cost of fuel and the per-pound cost of launching military payloads into space. Where appropriate, S&T projects will focus on increasing the effectiveness and decreasing cost, increasing operational life, and incrementally improving materiel through upgrades. The S&T program will provide options to reduce operating and support costs to enable the modernization of our forces with smaller budgets.

(5) Maintaining Basic Research. New military capability and operational concepts emerge from many different sources. Historically, the Defense S&T Program has responded to the known

needs for military capability and enabled the development of totally new operational concepts and capabilities. This has allowed us to keep the technological edge on which our forces have relied. It follows that the way to address future warfighting needs is to invest in broad areas of research that have high potential of yielding revolutionary advances as well as pursuing solutions to known operational problems. An investment in basic research pays dividends in many ways. Basic research is a long-term investment with emphasis on opportunities for military application far in the future and contributes to our national academic and scientific knowledge base by providing approximately 40 percent of the support for all engineering work. The Department sustains its investment in basic research because of proven, significant, long-term benefits to the military, which in turn enhances our national economic security. Basic research provided the foundation for technological superiority in each of our recent conflicts. Radar made a significant contribution to winning World War II. Stealth, lasers, infrared night vision, and electronics for precision strike played a major role in the Gulf War. Our nation ’s defense advantage is founded on a wide scope of scientific and engineering knowledge. The Department must continue to invest broadly in defense-relevant scientific fields because it is not possible to predict precisely in which areas the next breakthroughs will occur.

5. The Army Research, Development, Test & Evaluation (RDTE) Program.

a. The Future Years Defense Plan (FYDP) is comprised of ten major defense programs:

Element Number	Major Program
1	Strategic Forces
2	General Purpose Forces
3	Intelligence and Communications
4	Airlift and Sealift Forces
5	Guard and Reserve Forces
6	**Research and Development**
7	Central Supply and Maintenance
8	Training, Medical, and Other General Personnel Activities
9	Administration and Associated Activities
10	Support of Other Nations

b. Program 6 -- Research and Development. Consists of all research and development programs and activities that have not yet been approved for operational use and includes: (1) Basic and applied research tasks and projects of potential military application in the physical, mathematical, environmental, engineering, biomedical, and behavioral sciences. (2) Development, test, and evaluation of new weapon systems, equipment, and related programs.[3] Within Program 6, there are a number of sub-categories. These are detailed in the Appendix.

c. Structure of the S&T Program. Congress authorizes and appropriates funds for Defense S&T in three budget categories -- Basic Research (6.1), Applied Research (6.2), and Advanced

[3] DoDI 7045.7, Implementation of the Planning, Programming and Budgeting System (PPBS)

Technology Development (6.3) -- and requires that DoD fund and justify its S&T efforts within these categories. Note: All RDTE program categories are contained in the Appendix.

(1) The Basic Research Program (6.1). Basic Research is scientific study and experimentation directed toward increasing knowledge and understanding in the science fields and discovering phenomena that can be exploited for military purposes.[4] A majority of the scientific research work comprising the DoD Basic Research Program involves twelve technical disciplines:

- Physics
- Chemistry
- Mathematics
- Computer Science
- Electronics
- Materials Science
- Mechanics
- Terrestrial Sciences
- Ocean Sciences
- Atmospheric and Space Sciences
- Biological Sciences
- Cognitive and Neural Science

Funding for basic research in the Army:

Basic Research (6.1) FY 2001[5] $200,988,000	
In-house laboratory	All others
$14,119,000	$190,288,000
Comparison with other fiscal years	
FY 2000	$204,407,000
FY 2002	194,665,000
FY 2003	197,827,000
FY 2004	201,114,000
FY 2005	204,315,000

There is no appreciable funding trend found looking at this small data sample. Based on this sample, I conclude that the Army's budget for basic research is relatively flat.

(2) Applied Research translates promising research into solutions for broadly defined military problems with effort that may vary from applied research to sophisticated breadboard subsystems that establish the initial feasibility and practicality of proposed solutions or

[4] DoDI 5000.2
[5] FY 2001 Green Book

technologies.[6] Another name for applied research is exploratory development. Some of the technologies in Army exploratory development are:

- Materials technology
- Sensors and electronic survivability
- Aviation technology
- Missile technology
- Directed energy
- Combat vehicle and automotive
- Ballistics technology
- Night vision technology
- Environmental quality
- Computer and software technology
- Human factors engineering technology

Funding for applied research in the Army:

Exploratory Development (6.2) FY 2001[7] $602,489,000	
Comparison with other fiscal years	
FY 2000	$790,919,000
FY 2002	595,656,000
FY 2003	591,034,000
FY 2004	620,424,000
FY 2005	654,417,000

Compared to FY 2000, there will be significant decreases in funding for exploratory development each successive year.

(3) Advanced Technology Development demonstrates the performance payoff, increased logistics or interoperability capabilities, or cost reduction potential of militarily relevant technology.[8] Examples of advanced technology programs are:

- Logistics
- Medical
- Aviation
- Weapons and munitions
- Combat vehicle and automotive
- Manpower, personnel and training
- Command, control and communications
- Air defense/precision strike

[6] DoDI 5000.2
[7] FY 2001 Green Book
[8] DoDI 5000.2

o Electronic warfare o Joint tactical radio system o Joint service small army program o Night vision o Environmental compliance o Military HIV research

Note that some research efforts such as Combat Vehicle and Automotive have some programs in exploratory development while others are in advanced technology development.

Funding for advanced technology development in the Army:

Advanced Technology Development (6.3) FY 2001[9] $490,905,000	
Comparison with other fiscal years	
FY 2000	$684,393,000
FY 2002	463,435,000
FY 2003	514,244,000
FY 2004	557,112,000
FY 2005	575,041,000

As noted in the chart, there is an obvious decline in this category of research and development funding following FY 2000.

d. Noting these budgets for the Army's research efforts, do you foresee any problems in accomplishing the strategic goals of the Science and Technology Program?

6. Army Research and Development Policies and Programs.

a. Technology transition. One path into systems acquisition begins with examining alternative concepts to meet a stated mission need. This path begins with a decision to enter Concept and Technology Development at Milestone A. The phase ends with selecting a system architecture(s) and completing entrance criteria into Milestone B and System Development and Demonstration Phase.[10] To ensure innovative concepts and superior technology transitioning to the user and acquisition customer, the Army uses three mechanisms: (1) Advanced Technology Demonstration (ATD), (2) Advanced Concept Technology Demonstration (ACTD), and (3) Experiments, both joint and service-specific. The specific plans and processes for these transition mechanisms are described in the Joint Warfighting S&T Plan and the individual DoD Component S&T Plans. S&T activities are conducted in a way that facilitates or at least does not preclude the availability of competition for future acquisition programs.

[9] FY 2001 Green Book
[10] DoDI 5000.2

(1) Transitioning from technology demonstration into a new system occurs at Milestone B, after a validated need has been approved at Milestone A and technologies critical to performance have been proven during Concept and Technology Development.

(2) A formal acquisition program begins in the System Development and Demonstration Phase. Technologies, once proven, can be inserted into existing acquisition programs from science and technology (S&T) efforts at predetermined points in the phases as specified in the acquisition strategy of that program. Transitioning into a new acquisition program or into an existing one requires coordination by the S&T developer, the program manager, and the combat developer. Prior to transitioning from S&T, the following criteria must be met:

- The technologies have been demonstrated, thoroughly tested, and shown to be predicable.
- There is a clear and verified military need for the new capability system or system upgrade.
- The new capability system or system upgrade is cost effective.

b. Key elements in the Army Science and Technology Program include:

(1) Strategic Research Objective (SRO). The Army Basic Research program supports a set of SRO that reflect the high-payoff potential of newer but maturing research fields.

(2) Science and Technology Objective (STO). A STO is a significant, reasonably predictable science and technology achievement, fully funded by exploratory development (6.2) or advanced development (6.3) resources, which is described by one or more specific, quantified technical objectives to be achieved by a specific fiscal year.

(3) Army Science and Technology Master Plan (ASTMP). The ASTMP provides explicit, resource-constrained guidance to the Army's science and technology organizations, consistent with the National Military Strategy, Defense Planning Guidance, and the Army's force modernization plans to achieve a trained and ready modern Army. Updated annually and published by the Deputy Assistant Secretary for Research and Technology (DAS (R&T)) and approved by the Secretary of the Army and Chief of Staff, Army, the ASTMP:

- Provides top down guidance to the Army S&T community
- Enhances the leveraging of other service, industry, and academia investments
- Responds to DA, DoD, White House, and Congressional guidance and interests
- Focuses S&T investment at critical mass level on relevant technologies
- Improves science and technology stability, quality, relevance, and efficiency
- Addresses the Army's complete S&T program

c. Dual use technology development projects.

(1) "At the level of technology development, the fundamental mechanism for carrying out this new approach is the cost-shared R&D partnership between government and industry. All federal R&D agencies (including the nation's 726 federal laboratories) will be encouraged to act as partners with industry wherever possible. In this way, federal investments can be managed to benefit both government's needs and the needs of U.S. businesses. Emphasis upon dual use technology has been boosted by declining procurement resources limit our ability to sustain a defense-unique industrial base, other than in selective areas. Many technologies critical to future warfighting are being developed and matured, commercially and internationally. Therefore, in the future, if DoD is to develop, field and sustain superior materiel, we must rely increasingly on the same industrial base that builds commercial products. There will still be a place for defense industries, both to produce large weapon systems and sustain uniquely defense needs. However, overall, a common commercial and defense industrial base will serve defense needs better, enhance US economic competitiveness, and provide US industry with the benefit of combined, larger markets. The S&T program will contribute to building a common industrial base by utilizing commercial practices, processes, and products, and by developing, where possible, technology that can be the base for both military and commercial products and applications. This reorientation is particularly urgent for the Department of Defense, which accounts for 56 percent of all federal R&D. A significant portion of the DoD research and development budget is already focused on dual-use projects--particularly projects supported by the Defense Advanced Research Projects Agency (DARPA). Since a growing number of defense needs can be met most efficiently by commercial products and technology in the years ahead, this fraction will increase. DoD is developing a strategy to improve the integration of defense and commercial technology development."[11]

(2) There is an alternative view of the military benefits of dual use technology. The Pentagon's increasing reliance on commercial technology has created a problem for Defense Department officials who must determine the future funding for science and technology programs. Ironically, as the Pentagon relies on commercial technology, that same technology will become

[11] "Technology for America's Economic Growth: A New Direction to Build Economic Strength," by President William J. Clinton and Vice President Albert Gore, Jr., February 22, 1993.

available to hostile regimes as well. With Defense Department officials continuing to favor information technologies to ensure superiority of American forces, they see much of that technology emerging from the commercial sector.

...'The U.S. warfighting edge is eroding. The reliance on commercial technology is [the military's] Achilles' heel,' Arthur Bisson, director of science and technology for the Office of Naval Research, Washington, said March 29 (1995). 'What we buy [with commercial technology] is a couple of years of technological superiority,' However, the Pentagon loses that lead when its allies sell advanced commercial technology on the global market, he said."[12]

(3). Perhaps our challenge is to determine which technologies could be developed for dual use and which must remain a unique military technology. Examples are: Improving batteries, tires, track, and intercom sets; enhancing the range and sensitivity of radar, increasing the speed of computers, improving the accuracy of global positioning sets; developing secure telephones and radios; creating new high strength plastics, and manufacturing cheap lasers and solar cells. Which of these would you classify as candidates for dual use technology programs?

d. Fast Track Program. The Fast Track process focuses on synchronizing technology candidates with the acquisition process. In the initial phase, Concept and Technology Development, the Army Science and Technology Working Group reviews, evaluates and recommends Fast Track candidates to the Milestone Decision Authority (MDA) for approval as a Fast Track program. The MDA evaluates not only the priority of the requirement and the maturity of the technology but also verifies that there is funding in the Program Objective Memorandum (POM) and Extended Planning Period (EPP) to take the technology through development and production. Concept and Technology Development continues for up to one year beyond the successful conclusion of the ATD to transition the S&T program to program management. This provides up to a one-year transition period for risk reduction initiatives and milestone decision review preparation. During this transition period, the Program Manager (PM) requests placement of the Fast Track program in the appropriate acquisition category (ACAT) and prepares all documentation for the milestone decision review.

e. Accelerated Transition - To maintain our technological superiority, DoD must field new state-of-the-art systems, within our reduced budgets, at the rapid pace set by the technology revolution. Increasingly, advanced technology is becoming available in international markets, requiring DoD to accelerate the development process as never before. Rapid technology transition from earliest S&T concepts to the operational forces is crucial. Accelerated Transition seems to be another name for Fast Track Program. Also, do you see a relationship between these programs and Dual Use Technology?

f. Technology Transfer. "The Army, for example, has developed an open federated laboratory system to access and leverage the expertise of industry and academia in selected areas such as advanced displays, sensors, telecommunications, and other application-oriented technologies that

[12] "Defense News," April 3-9, 1995, page 25.

form the foundation for Force XXI and Army After Next (AAN)."[13] The following statistics provide an estimate of the potential of Federal laboratory scientists.

The U.S. Patent and Trademark Office (PTO) granted the following:

1999 – patents granted by PTO[14]	
o 153,493 utility (inventions) o 14,732 design o 421 plant patents total = 169,154	All US Govt Agencies awarded 955 patents (> ½ % total) o Army – 146 o Navy – 306 o USAF – 83
U.S. inventors 55.6% of total	Foreign inventors 44.4% of total

"The ingenuity and creativity of American inventors has established the U.S. as the technological leader among nations, fueling this country's longest economic expansion," noted Q. Todd Dickinson, Assistant Secretary of Commerce and Commissioner of Patents and Trademarks. In spite of this quote lauding American inventors, patents issued to the U.S. versus foreign inventors in 1999 provides an interesting statistic! Is there a relationship between this statistic and the relative ranking of U.S. schools compared to schools of other nations?

g. Technology Insertion. In an effort to obtain the best use of research and development funding, technology insertion is a viable program. Through research and development efforts, new technologies are incorporated into a system. As another system progresses through its own research and development cycle, there sometimes exists an opportunity to use previously developed technology in the system currently being developed. This reuse of technology is called "technology insertion." Examples are: (1) Installing air bags in a variety of makes and models of automobiles after Chrysler Corporation first used the technology for its cars. (2) Technology developed for personal computers is being used in the M-1 tank fire control computer. It is incumbent upon each program manager to minimize program expenditures. Using technology insertion is one method.

h. Horizontal Technology Integration. "HTI is the application of common enabling technologies across multiple systems within a force to increase force effectiveness."[15] Policies are: (1) Upgrade fielded equipment to insert modern technology and focus long-term solutions on leap-ahead technologies. (2) Promote HTI programs as the first choice for modifications or upgrades as an acquisition solution to a materiel requirement. (3) Combine, to the maximum extent practical, similar or overlapping acquisition efforts into a single HTI program. (4) Use HTI programs to achieve Army modernization goals as efficiently as possible. Horizontal Technology Integration is one means of achieving technology insertion.

[13] DoD Basic Research Plan, January 1997.
[14] U.S. Government Patent and Trademark Office web page, September 2000
[15] AR 70-1

i. Advanced Technology Demonstrations. ATDs are the military Departments' [e.g., Army] and Defense Agencies' narrowly focused technology demonstrations, to identify key technologies ready for transition and demonstrate their performance parameters.

j. Advanced Concept Technology Demonstrations. ACTDs are DoD's broadly-based proof of concept demonstrations, to evaluate the military utility of mature advanced technologies. Jointly planned by users and technology experts, an ACTD enables operational forces to experiment in the field with new technology in order to evaluate potential changes to doctrine, operational concepts, tactics, modernization plans, and training. ACTDs are warfighter-oriented, even warfighter-dominated. They have three motivations: (l) to have the user gain an understanding and evaluate the military utility of a technology concept before committing to acquisition; (2) to develop corresponding concepts of operation and doctrine that make best use of the new technology; and (3) to provide residual operational capability to the operating forces for in-depth, sustained evaluation. Each ACTD provides the commander with the ability to continue to refine doctrine and tactics to maximize the potential of new technologies.

The outcome of an ATD or ACTD is judged by both the warfighters and S&T planners. If a military Department decides that an ATD’s or ACTD's demonstration does not satisfy their needs, an ATD or ACTD terminates consistent with the user's reasons. If, on the other hand, a military Department determines that the demonstrated concept should be brought into the operating forces, there are two possible avenues. First, if large numbers are required, the system will enter the acquisition process at whatever stage good judgment dictates. Second, if only small numbers are required, it may be preferable to modify the demonstration system appropriately and then to replicate it as needed. This latter avenue might apply to command and control, surveillance, and Special Operations equipment, as well as to complex software systems where evolutionary development, with routine upgrades, is preferred.

k. Experimentation is the primary focus of Battle Laboratories. Insights, impacts, and recommended changes to Doctrine, Training, Leader Development, Organization, Materiel and Soldiers (DTLOMS), based on inputs from soldiers and their leaders, as well as emerging technologies and materiel initiatives to support Future Operational Capabilities (FOCs), are the products generated by the Battle Laboratories. Experiments are discrete, single events or progressive, iterative simulations (constructive, virtual, or live) to assess the military utility/potential for a new or revised DTLOS concept or new technology to satisfy user needs. Data is gathered through a designed event(s), or through a data collection effort subordinate to a field or training exercise involving field units and soldiers. Experiments are conducted using a team approach. The focus is on a specific capability or technology opportunity. The experimentation process consists of conceptualization, planning and reviews, approval, execution, decision, and possibly exploitation. Whether conducting experiments or designing experiments to be done elsewhere, Battle Laboratories are the central focus for all experiments leading to requirements within their battlefield dynamic area. Experimentation: (1) Supports DTLOMS requirement determination. (2) Supports material requirement development. (3) Provides opportunities to streamline acquisition testing and evaluation. (4) Provides insights to FOC solutions.

l. Advanced Warfighting Experiments (AWEs) will have large teams, consisting of elements from the other Services and several Army MACOMs. Joint Venture (JV) Directorate is the executive and coordination element for AWEs. Other participants may be USAF and USMC experimental teams, a Digital Force Coordination Cell (DFCC), an Experimental Force (EXFOR), multiple battle labs, combat developers (CBTDEVs), training developers (TNGDEVs), doctrine developers (DOCDEVs), materiel developers (MATDEVs), S&T, TRADOC Analysis Center (TRAC), Army Test and Evaluation Command (ATEC), industry, academia, etc. Smaller experiments, on the other hand, may primarily have personnel from a single battle lab, the school sponsor, the ATEC Test And Evaluation Coordination Office (TECO), and, for a technology item, MATDEV/S&T representatives. Each member brings expertise to assist in the experiment, as well as an interest in the item under experiment. This is particularly true of ATEC. They provide a bridge between experiments and a system's evaluation for acquisition decision. This reduces the likelihood of duplicate testing and provides for streamlining acquisition. ATEC's TECOs, located with TRADOC schools and battle labs, provide quick response support and access to all of ATEC, as well as contacts with AMC's research organizations. ATEC, as the Army's evaluator, is key in determining the data, testing, and simulation effort needed to support acquisition decision making. The experimentation team is an essential ingredient to maximum return on investment of experimentation dollars and efficient acquisition.[16]

m. Models and simulations (M&S) are tools that can be used to support the program manager in each phase of the acquisition process. M&S is the application of those tools to support decisions. It is an efficient and effective source of valuable information to be used in the development and evaluation of new defense systems. M&S can aid in minimizing risks to cost, schedule, performance and supportability. When used properly, in an accredited and integrated manner, it can reduce the expenditure of resources, accelerate understanding through early insight, and shorten overall cycle time. At the same time, M&S can improve the quality of the system under development. In the area of test and evaluation, M&S have become an integral part of the “model-test-model” testing process. The application of M&S is viewed as another method of evaluation, complementing traditional tests, and an essential element of an integrated test and evaluation strategy. Implementing state-of-the-art M&S for planning, design, analysis, management, and testing can significantly improve the effectiveness of the Integrated Product and Process Development (IPPD) management technique. It is through IPPD, and the Integrated Product Teams (IPT), that the full potential of M&S to support acquisition can be realized. Modeling and Simulation should be applied, as appropriate, throughout the system life cycle in support of the various system acquisition activities, including: (1) requirements definition, (2) program management, (3) design and engineering, (4) test and evaluation, (5) manufacturing, and (6) logistics support.

(1) “Program managers shall plan and budget for effective use of modeling and simulation to reduce the time, resources, and risk associated with the entire acquisition process; increase the quality, military worth and supportability of fielded systems; and reduce total ownership costs throughout the system life cycle.”[17]

[16] TRADOC PAM 71-9.
[17] DoDD 5000.1

(2) Simulations are used to support warfighting experiments to evaluate new warfighting ideas and technology. Warfighting experiments are designed to examine new technologies and warfighting ideas to discover emerging battlefield opportunities. Each type of simulation has its characteristic strengths and weaknesses. Simulations are classified into three categories: live, virtual, and constructive. The optimal solution to experimental analysis is probably a combination of the three types of simulation. The live simulations offer the most realistic environment for analysis, but the expense may be prohibitive. Warfighting experiments should maximize the use of available live and virtual simulations augmented by constructive simulations. The current ability to link live and virtual simulations to constructive simulations, through distributed interactive simulation High Level Architecture (HLA) links, permits optimizing the contribution of each type of simulation. Modern simulations allow the Army to look at current and future force capabilities, determine requirements, and compare the contributions of alternative solutions. (1) Constructive simulations replicate warfare in the form of computer modeled war games. In some constructive simulations, the computer presents the participants with a graphical portrayal of the operational situation and allows them to make decisions to influence the situation. The most commonly used simulations employ models that wargame against a competent and active opponent. Other simulations run independently of human interaction once initial parameters and data are established. The advantage of constructive simulations is the ability to replicate live exercises; simulate technologies that are not currently available as prototypes; vary the mission, threat, terrain, and weather; and repeat events a sufficient number of times to gain statistical confidence in the outcomes. (2) Virtual simulations are conducted with electronic mock-ups of real weapons systems. These mock-ups use computers to replicate on-board systems and the external combat environment. Flight and tank gunnery simulators are representative of these kinds of simulations. Virtual simulation allows man-in-the-loop assessment of new doctrine, training, soldiers, organizations, and materiel. Simulators at various locations can be netted to offer a common warfighting scenario for multiple elements of the force. Insights are derived at an operational level as well as system level. The advantage of virtual simulations is the ability to put real soldiers making warfighting decisions into the loop and using the simulations to do analysis. (3) Live simulations are exercises conducted by TOE units in field environments, preferably against a tactically competitive opposing force (OPFOR). Live simulations are useful to experiment with new doctrine, training, organizations, and materiel. They offer the unique advantage of using real soldiers and real equipment in an actual training environment. The advantage of realism in live simulations must be balanced by expense and the inability to repeat the live exercise.

n. Concept Experimentation Program (CEP). The CEP is a separately funded one year TRADOC program providing sponsors (TRADOC Schools) the ability to evaluate and capitalize on emerging technology, materiel initiatives, and warfighting ideas. It facilitates experimentation (conducted primarily by TRADOC Battle Laboratories) to determine the military utility or potential of an idea to become a DTLOMS solution to FOCs. The CEP provides funding and other resource support to conduct concept exploration and experimentation as a means to resolve DTLOMS issues and should be focused on developing ideas in support of FOCs.

o. Limited Objective Experiments (LOE). LOEs are designed around single events or progressive, iterative simulations with primary relevance to a single issue. LOEs allow the proponent and Battle Laboratory to conduct low-cost, quick analysis of an issue or to a

limited set of issues. LOEs will normally be sponsored by one Battle Laboratory, but there may be several Battle Laboratories participating in the planning and execution phases of an experiment. LOEs are funded by sources other than the CEP (e.g., within the experimentation campaign plan, school discretionary funds, or by funding from another government agency). LOEs follow the same requirements for experimentation planning and reporting as CEPs.

o. Advanced Concepts and Technology program II (ACT II). The ACT II program provides industry a vehicle to demonstrate its 6.3 independent research and development products to TRADOC and provides TRADOC a means to examine potential technology solutions to FOCs. This unique program is executed in a partnership between TRADOC and AMC's Army Research Laboratory (ARL). Individual contracts are limited to 12 months or less and have a ceiling of $1.5 million. At the conclusion, the contractor provides a demonstration to the Battle Lab. The goal of the program is to find and acquire new and innovative hardware and software that can satisfy capability requirements.

7. Pre-Planned Product Improvement Versus a Product Improvement Proposal.

a. A Product Improvement Program (PIP) is not previously planned, but is initiated to correct a design problem or implement a change based on an emerging user requirement. A PIP is made to the fielded inventory of a type classified item. The improvement requires testing to assure that it accomplishes what is intended. The PIP also identifies all of the resources required and provides the plan, including schedules and milestones, for developing and applying the modification or making changes during production. Within the Materiel Change Management program, PIP is the preferred method of satisfying materiel requirements.

b. A Preplanned Product Improvement (P^3I) is a planned future evolutionary improvement of a developmental system in which design considerations that provide future applications of projected technology are applied as incremental improvements to system capability. P^3I provides for deferred insertion of selected emerging technology and support capabilities in new weapon systems. It is deferred until the technology development is completed or logistic support capabilities are required.

(1) Documentation must spell out the Army's intent to field a basic system and then incrementally upgrade it over time. A good example is, "25 kilometer range required in initial system, 40 kilometer range required not later than 5 years after Initial Operational Capability (IOC).

(2) “To ensure that the Defense acquisition system provides useful military capability to the operational user as rapidly as possible, evolutionary acquisition strategies shall be the preferred approach to satisfying operational needs. Evolutionary acquisition strategies define, develop, and produce and deploy an initial, militarily useful capability (“Block I”) based on proven technology, time-phased requirements, projected threat assessments, and demonstrated manufacturing capabilities, and plan for subsequent development and production and deployment of increments beyond the initial capability over time (Blocks II, III, and beyond). The scope, performance capabilities, and timing of subsequent increments shall be based on continuous communica-

tions between the requirements, acquisition, intelligence, and budget communities. In planning evolutionary acquisition strategies, program managers shall strike an appropriate balance among key factors, including the urgency of the operational requirement; the maturity of critical technologies; and the interoperability, supportability, and affordability of alternative acquisition solutions. To facilitate evolutionary acquisition, program managers shall use appropriate enabling tools, including a modular open systems approach to ensure access to the latest technologies and products, and facilitate affordable and supportable modernization of fielded assets. Sustainment strategies must evolve and be refined throughout the life cycle, particularly during development of subsequent blocks in an evolutionary strategy."[18]

Specific objectives of the P^{3}I program can be summarized as follows: (a) Shorten the acquisition and development time for systems. (b) Extend the useful military life of systems. (c) Reduce the cost, schedule and technical risks associated with introducing advances into a weapon system. (d) Upgrade weapon system capabilities to meet unexpected changes in mission or threat, or to explore newly discovered enemy weaknesses. (e) Reduce the requirement for new starts. (f) Reduce logistics and support problems that may be associated with the introduction of new weapon systems.

(3) The P^{3}I concept cannot be applied to all new system developments, but can be applied, and should be considered, under the following conditions: (a) There is a long-term military requirement to be satisfied. (b) The threat or need is projected to change as a function of time requiring a change in the response. (c) System performance requirements are expected to increase over time. (d) A near term basic system is necessary and acceptable. (e) The sponsoring Service is willing to pay the higher initial costs to obtain growth potential for future exploration.

[18] DoDD 5000.1

Joint Warfighting Capability Objectives[19]

The Joint Staff has articulated ten high-priority warfighting needs, called Joint Warfighting Capability Objectives. They are not all-inclusive. They are goals that help provide a joint warfighting focus to a significant portion of the Defense S&T program. Although progress can be made on all of them, full mastery of these objectives is in the far future. The objectives will be updated annually as the Joint Requirements Oversight Council reviews and identifies new priorities. The ten current Joint Warfighting Capability Objectives are:

a. Information Superiority combines the capabilities of intelligence, surveillance, and reconnaissance (ISR) and command, control, communications, computers, and intelligence (C4I) to acquire and assimilate information needed to dominate and neutralize adversary forces and effectively employ friendly forces. It includes the capability for near-real-time awareness of the location and activity of friendly, adversary, and neutral forces throughout the battlefield area. It also includes a seamless, robust C4 network linking all friendly forces to provide common awareness of the current situation throughout the battlefield area. Information superiority encompasses information warfare -- that is, the capability to affect an adversary's information, information-based processes, information systems, and computer-based networks while defending one's own information, information-based processes, information systems, and computer-based networks.

b. Precision Force is the capability to destroy selected targets with precision while limiting collateral damage. It includes precision guided munitions, surveillance, targeting capabilities, and the "sensor-to-shooter" C4I capabilities necessary for responsive, timely force application.

c. Combat Identification is the capability to differentiate potential targets as friend, foe, or neutral in sufficient time, with high confidence, and at the requisite range to support weapon release and engagement decisions.

d. Joint Theater Missile Defense is the capability to use the assets of multiple services and agencies to detect, track, acquire, and destroy enemy theater ballistic missiles and cruise missiles. It includes the seamless flow of information on missile launches by specialized surveillance capabilities through tracking by sensors from multiple services to missile negation or destruction.

e. Military Operations in Urban Terrain (MOUT) is the capability to operate and conduct military operations in built-up areas and to achieve military objectives with minimum casualties and collateral damage. It includes precise weapons, surveillance, navigation, and communications effective in urban areas.

f. Joint Readiness and Logistics is the capability to enhance readiness and logistics for joint and combined operations. It includes capabilities for enhanced simulation for training; improved and affordable operations and maintenance (O&M) and life-cycle costs; mobility and sustainability (i.e., transportation support technologies, speed of delivery); and near-real-time visibility of people, units, equipment, and supplies that are in storage, in process, in transit, or in theater, linked with the ability to act on this information.

[19]Joint Warfighting Science and Technology Plan, January 1997.

g. Joint Countermine is the capability for assured, rapid surveillance, reconnaissance, detection, and neutralization of mines to enable forced entry by expeditionary forces. It includes the capability to control the sea and to conduct amphibious and ground force operational maneuvers against hostile defensive forces employing sea, littoral, and land mines. For land forces, dominance means the ability to conduct in-stride tempo operations in the face of severe land mine threats.

h. Electronic Combat is the capability to disrupt or degrade an enemy's defenses throughout the area and time required to permit the deployment and employment of U.S. and allied combat systems. It includes the capabilities for deceiving, disrupting, and destroying the surveillance and command and control systems as well as the weapons of an enemy's integrated air defense network; and the capabilities for recognizing attempts by hostile systems to track or engage.

i. Chemical/Biological Warfare Defense and Protection is the capability for standoff detection of biological agents -- our single most pressing need. Capabilities in both point and standoff detection of chemical and biological agents, combined with the ability to assess and disseminate threat information in a timely manner, are critical to protecting fielded forces.

j. Counter Weapons of Mass Destruction (WMD) is the capability to detect and evaluate the existence of a manufacturing capability for WMD, and to identify and assess the weapon capability of alert and launched WMDs on the battlefield to permit the appropriate level of counterforce to be exerted promptly. It includes counterforce against hardened WMD storage and production facilities.

Term	Meaning
Advanced Concept Technology Demonstration (ACTD)	Used to determine military utility of proven technology and to develop the concept of operations that will optimize effectiveness. *DoDI 5000.2* ACTDs are a DoD sponsored program to assess the utility of near-term, readily fieldable technology solutions which respond to military needs validated by the Joint Requirements Oversight Council and to develop the concept of operations that is needed for effective use of these solutions. ACTDs are designed to provide residuals that are left behind with an operational unit for a two-year extended user evaluation (EUE) period after a field demonstration. By the end of the evaluation period a decision is made whether or not to proceed with acquisition based on the results of the assessment and, ultimately, on prioritization by the Army. ACTDs evaluate the military value of advanced technologies through a large-scale experiment with an operational unit while ATDs evaluate technical performance in conjunction with a TRADOC Battle Lab or Center. *DA PAM 70-3*
Advanced Concepts and Technology II (ACT II)	The ACT II program enables the Army to demonstrate industry's advanced technologies at the TRADOC Battle Laboratories in a year or less while minimizing industry bid and proposal burden. Unique in DoD, the program solicits brief two-page mature technology concepts from industry in response to Army mission requirements as developed by the TRADOC Battle Labs, Schools, and Centers. Only proposers who have submitted concept papers, which, after careful review, show excellent technical and warfighting merit are invited to submit streamlined, 25-page proposals. From this pool of short proposals, TRADOC selects for funding only those that best satisfy the military needs and have been judged as technically sound by the Army materiel development community. *DA PAM 70-3*
Advanced Technology Demonstration (ATD)	Used to demonstrate the maturity and potential of advanced technologies for enhanced military operational capability or cost effectiveness. *DoDI 5000.2* ATDs help speed the maturation of advanced technologies needed to upgrade existing systems and enable development of next generation and future systems, allowing experimentation with technology-driven operational issues; and resulting in a more informed requirements document prior to Milestone I decisions. ATDs bring the CBTDEV, MATDEV, and industry together to explore the technical feasibility, affordability, and potential of technologies to support current and emerging warfighting concepts. ATDs permit exploration of technical options and the elimination of unattainable technologies in the early stages of a program. This is accomplished through an Integrated Product or Process Development (IPPD) team, which is mandatory for all ATDs. ATDs ensure a higher probability of success when technology is transitioned to a formal acquisition program. *DA PAM 70-3*

Army Science and Technology Master Plan (ASTMP)	The ASTMP is published annually by the Office of the Secretary of the Army for Acquisition, Logistics and Technology. The ASTMP captures how the Army will maintain a technological edge and ensure continuous modernization of Army systems. TRADOC is responsible for Chapter 2, Science and Technology Integration and Annex C, Future Operational Capabilities. Chapter 2 captures how TRADOC interacts with the S&T community to ensure alignment of TRADOC requirements and MATDEV solutions. Annex C is a listing of TRADOC Future Operational Capabilities.
Budget Activity 1	Basic Research. Basic research is defined as systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind. Program elements in this category involve pre-Milestone 0 efforts. Explanation: Basic research includes all effort of scientific study and experimentation directed toward increasing fundamental knowledge and understanding in those fields of the physical, engineering, environmental, and life sciences related to long-term national security needs. It provides farsighted, high payoff research that provides the basis for technological progress. It forms a part of the base for: (a) subsequent applied research and advanced technology developments in Defense-related technologies, and (b) new and improved military functional capabilities in areas such as communications, detection, tracking, surveillance, propulsion, mobility, guidance and control, navigation, energy conversion, materials and structures, and personnel support. Program elements in this category involve pre-Milestone 0 efforts. D*oD 7000.14-R*
Budget Activity 2	Applied Research. Applied research is defined as systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met. It is a systematic application of knowledge toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements. Explanation: This activity translates promising basic research into solutions for broadly defined military needs, short of development projects. This type of effort may vary from systematic mission-directed research beyond that in Budget Activity 1 to sophisticated bread-board hardware, study, programming and planning efforts that establish the initial feasibility and practicality of proposed solutions to technological challenges. It includes studies, investigations, and non-system specific technology efforts. The dominant characteristic of this category of effort is that it be pointed toward specific military needs with a view toward developing and evaluating the feasibility and practicability of proposed solutions and determining their parameters. Applied Research precedes the system specific research described in DoDD 5000.1. Program control of the Applied Research program element will normally be exercised by

	general level of effort. Program elements in this category involve pre-Milestone 0 efforts, but not all pre-Milestone 0 efforts are funded in Budget Activity 2. Some efforts are introduced by field activities. *DoD 7000.14-R*
Budget Activity 3	Advanced Technology Development. Includes all efforts that have moved into the development and integration of hardware for field experiments and tests. The results of this type of effort are proof of technological feasibility and assessment of operability and producibility rather than the development of hardware for service use. Projects in this category have a direct relevance to identified military needs. Advanced Technology Development is used to demonstrate the general military utility or cost reduction potential of technology when applied to different types of military equipment or techniques. Advanced Technology Development also includes evaluation and synthetic environment and proof-of-principle demonstrations in field exercises to evaluate system upgrades or provide new operational capabilities. Program elements in this category involve pre-Milestone I efforts, *but not all pre-Milestone I efforts are funded in Budget Activity 3.* Some efforts are introduced by field activities. Projects in this category do not necessarily lead to subsequent development or procurement phases. *DoD 7000.14-R*
Budget Activity 4	Demonstration and Validation. [The Program Definition and Risk Reduction (PDRR)] phase includes all efforts necessary to evaluate integrated technologies in as realistic an operating environment as possible to assess the performance or cost reduction potential of advanced technology. The [PDRR] phase is system specific and also includes advanced technology demonstrations that help expedite technology transition from the laboratory to operational use. Program elements in this category involve efforts between Milestone I and Milestone II. A logical progression of program phases and (development and/or production) funding must be evident in the FYDP. *DoD 7000.14-R*
Budget Activity 5	Engineering and Manufacturing Development (EMD). Includes those projects in engineering and manufacturing development for Service use but which have not received approval for full-rate production. This area is characterized by major line item projects and program control will be exercised by review of individual projects. Engineering Development includes engineering and manufacturing development projects consistent with the definitions within DoDD 5000.1. Program elements in this category involve efforts between Milestone II and Milestone III. A logical progression of program phases and (development and/or production) funding must be evident in the FYDP consistent with the Department's full funding policy. *DoD 7000.14-R*
Budget Activity 6	RDT&E Management Support. Includes research and development effort directed toward support of installations or operations required for general research and development use. Included would be test ranges, military construction, maintenance support of laboratories, operation and

	maintenance of test aircraft and ships, and studies and analyses in support of the R&D program. Costs of laboratory personnel, either in-house or contractor operated, would be assigned to appropriate projects or as a line item in the Basic Research, Applied Research, or Advanced Technology Development program areas, as appropriate. Military construction costs directly related to a major development program will be included in the appropriate element. *DoD 7000.14-R*
Budget Activity 7	Operational System Development. Includes those development projects in support of development acquisition programs or upgrades still in engineering and manufacturing development, but which have received Defense Acquisition Board (DAB) or other approval for production, or production funds have been included in the DoD budget submission for the budget or subsequent fiscal year. All items in this area are major line item projects that appear as RDT&E Costs of Weapon System Elements in other programs. Program control will be exercised by review of individual projects. Program Elements in this category involve efforts that involve post-Milestone III. A logical progression of program phases and (development and/or production) funding must be evident in the FYDP, consistent with the Department's full funding policy. *DoD 7000.14-R*
Development	The process of working out and extending the theoretical, practical, and useful applications of a basic design, idea, or scientific discovery. Design, building, modification, or improvement of the prototype of a vehicle, engine, instrument, or the like as determined by the basic idea or concept. Development includes all efforts directed toward programs being engineered for Service [Army] use but which have not yet been approved for procurement or operation, and all efforts directed toward development engineering and system testing, support programs, vehicles, and weapons that have been approved for production and service deployment. Further, development includes formulating and refining techniques and procedures that improve Army capabilities in non-materiel areas. *DSMC Dictionary*
Dual-Use S&T Program	The purpose of this program is to demonstrate new approaches for leveraging commercial research, technology, products, and processes into military systems. These new approaches to working with industry must become common throughout the DoD in order to take full advantage of the technological opportunities offered by the commercial sector. In particular, DUST enables the Services to leverage commercial R&D and investments to improve the cost and performance of military systems and leverage the commercial production base for fielded and future systems. To accomplish this mission, the DUST program cost shares with industry in the development and demonstration of militarily useful, commercially viable technologies. Success of the program depends on intentionally leveraging the commercial sector's resources, research, products, and processes for the benefit of the DoD. *DA PAM 70-3*
Experiments	Used to develop and assess concept-based hypotheses to identify and

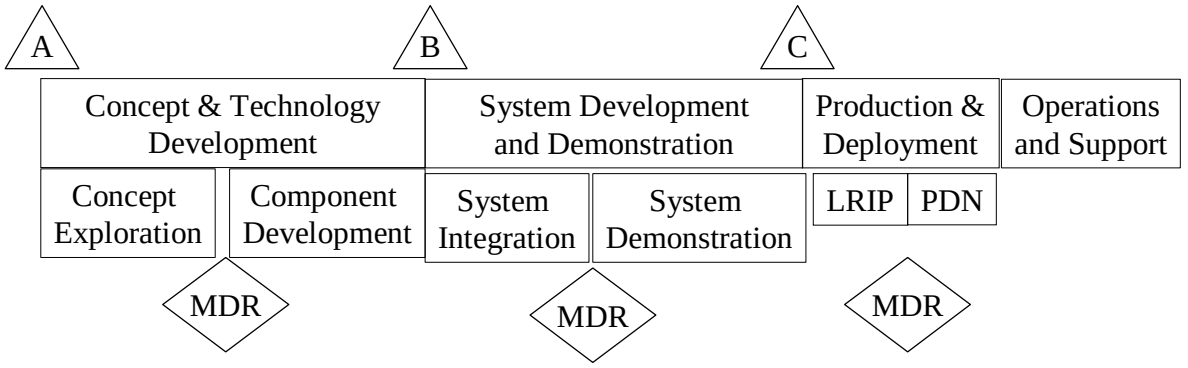
	recommend the best value-added solutions for changes to doctrine, organizational structure, training and education, materiel, leadership, and people required to achieve significant advances in future joint operational capabilities. *DoDI 5000.2*
Fast Track Program	Fast Track is an Army initiative which formalizes a method to promote a streamlined, effective, timely transition of high priority technology into the acquisition process. This program implements a two step acquisition. It provides up-front designation to a select few ATDs that have a good chance of successful transition directly to the System Development and Demonstration Phase. The Fast Track designation is essential for obtaining increased management attention from stakeholders. It also helps justify the expenditure of additional S&T funds in preparing for program transition to the System Development and Demonstration Phase. *DA PAM 70-3*
Force XXI	During this transformation, the continuation of the Force XXI process is vital to sustain the capabilities of current forces and minimize the cost of operating aging equipment. The Force XXI process leverages the power of information age technology through a series of experiments ranging from large-scale Advanced Warfighting Experiments (AWE) to smaller-scale efforts focused on particular functional areas. The lessons gleaned from these experiments compress the development cycle for new systems and inform changes to organizational structure, training, and doctrine. Recent experiments have charted the course for digitizing mechanized forces. The Army will continue to capitalize on the lessons generated by the Force XXI process to integrate information age capabilities in mechanized forces through implementation of the Division XXI design, selected fielding of already-programmed systems with essential capabilities, and re-capitalization of existing systems. *http://www.army.mil*
Future Operational Capability (FOC)	FOCs are structured statements of desired operational capability that establish the foundation upon which Army requirements are based to achieve the progressive ideas articulated in HQ TRADOC-approved concepts. They are intended to apply to tomorrow's Army on the ever-changing battlefield, and should be expressed as objectives with clear, quantifiable and measurable goals. The two types of FOCs are integrated and proponent/branch. Examination of potential solutions to support an FOC must span all DTLOMS domains, and should be considered in order, D-T-L-O-S-M. Collectively, the results of these examinations define the strategy for how the proponent envisions achieving the capability over time. All warfighting requirements have a linkage to the capstone concept through one or more FOCs. *TRADOC PAM 71-9*
Horizontal technology integration (HTI)	Provides for the application of common technology across multiple systems or items to improve the warfighting capability of the force. It is a modernization requirements and acquisition process in which technology is simultaneously integrated into different weapon systems*DA PAM 70-3*

Objective Force	The Army is implementing a strategy to transform itself into the Objective Force--a force that will embody the mobility and decisive warfighting capabilities of today's mechanized forces as well as the strategic responsiveness of today's light forces. The redesign of initial Brigade Combat Teams at Fort Lewis, Washington, will begin with surrogate equipment. These initial Brigade Combat Teams will validate the organizational and operational features and requirements for future tactical units. Based on the initial Brigade Combat Team-validated structure, the Army will field the Interim Force: a force with the characteristics of the Objective Force but within the constraints of available equipment. The surrogate and loaned equipment used to equip the initial Brigade Combat Teams will be replaced by the IAV, a yet-to-be-selected, off-the-shelf system which the Army will begin procuring in FY2000. The IAV will be used to equip Interim Force units until the Army is ready to begin fielding the Objective Force. The Army will develop the enhanced capabilities of the Objective Force by combining the integration of information technologies that have been part of Army modernization programs for several years with advanced S&T still under development. The effort to integrate information technologies, known as digitization, greatly enhances unit effectiveness. Anticipating this enhanced capability, the Army has redesigned its mechanized divisions. This redesign, to be implemented over the next few years, makes mechanized divisions more deployable by reducing their size, yet maintains their current lethality. In addition to these continuing efforts, the Army has made significant adjustments to its modernization strategy. *http://www.army.mil*
Research (basic)	Scientific study and experimentation directed towards increasing knowledge and understanding in fields directly related to explicitly stated long-term national security needs. Specifically, research includes the scientific study and experimentation directed toward increasing knowledge and understanding in those fields of the physical, engineering, environmental, bio-medical, and behavioral social sciences directly related to national security needs. Research provides fundamental knowledge for the solution of identified military problems, and a base for subsequent exploratory and advanced developments. *DSMC Dictionary*
Research, Development, Test, and Evaluation (RDTE)	Activities for the development of a new system that include basic and applied research, advanced technology development, demonstration and validation (DEM/VAL), engineering development, developmental and operational testing and the evaluation (OT&E) of test results. RDTE includes activities to expand the performance of fielded systems. Also, an appropriation category that includes funds allocated to the future years defense program (FYDP) major force program 6. *DSMC Dictionary*
Science	Knowledge covering general truths or the operation of general laws. *Webster's New Collegiate Dictionary*
Small Business Inno-	The SBIR and Small Business Technology Transfer (STTR) programs

vation Research (SBIR)	are technology programs which allow the Army to access the innovative dual-use technologies of small (less than 500 employees), high-technology firms and to provide incentives to small businesses to partner with researchers at universities, non-profit research institutions, or federally-funded R&D centers (FFRDCs), respectively. In accordance with Public Laws PL97-219, PL99-443, and PL102-564, Small Business Administration Policy, and Office of the Secretary of Defense (OSD) General Counsel guidance, the SBIR and STTR programs allow sole-source Phase III awards to participating SBIR and STTR companies. Competition in Contracting Act (CICA) requirements for follow-on Phase III activities are fully met through the competitive award process in Phase I and Phase II. Sole source Phase III work must represent an application of, or continued research and development for, activities funded in Phase I or Phase II. Under Phase III, the small business is expected to obtain funding from the private sector or non-SBIR Government sources to develop the prototype into a viable product or non-R&D *DA PAM 70-3*
Technology	Applied science. *Webster's New Collegiate Dictionary*
Technology Demonstration (TD)	Technology Demonstration programs, whose designation is at the discretion of the Technical Director, are a means to demonstrate a new technical capability that has potential application to an ATD, ACTD, or systems acquisition program. Funded in either 6.2 or 6.3, these programs differ from ATDs and ACTDs in that they either are not conducted in an operational environment or do not involve experimentation with technology-driven operational issues. A Technology Demonstration can serve as the means to demonstrate that a STO has successfully achieved its objectives, to highlight a new technical capability developed in the S&T community, or to assess the technical maturity of a capability identified outside of the S&T community. *DA PAM 70-3*
Technology Transfer	Technology transfer is an important concept because some technologies developed by Federal laboratories should be available to businesses so they can create jobs and generate tax revenues. Through using technologies developed by Federal laboratories, industry can spend their own research funding for other products and processes. Office of Technology Transition STATUTE- (a) Establishment. - The Secretary of Defense shall establish within the Office of the Secretary of Defense an Office of Technology Transition. (b) Purpose. - The purpose of the office shall be to ensure, to the maximum extent practicable, that technology developed for national security purposes is integrated into the private sector of the United States in order to enhance national technology and industrial base, reinvestment and conversion activities consistent with the objectives set forth in section 2501(a) of this title. *10 USC Sec. 2515*
Warfighting Lens Analysis (WFLA)	The Warfighting Lens Analysis (WFLA) process produces several outputs which will ensure a better focus of the S&T Review process. The WFLA Force Assessment process determines how well battlefield tasks

	are done in three separate timeframes for a given deployment scenario. The Force Assessment Document highlights specific capability shortfalls for specific tasks in each of those timeframes. It also assists in determining whether the shortfall is due to a shortage of currently available systems, a technology that is available but not affordable, or a technology that is not yet available. The S&T Review process should ensure that those technologies that are required to fulfill a critical capability shortfall receive adequate focus. The WFLA process also determines how important each task is, and will also assist in prioritizing the critical technology efforts assessed during the S&T Review and possibly identify new technology focus areas not previously recognized. *TRADOC PAM 71-9*
Warfighting Rapid Acquisition Program (WRAP)	WRAP implements the Army's accelerated procurement of systems identified through TRADOC warfighting experiments as compelling successes that satisfy urgent needs. It is implemented within existing Army structures and organizations. WRAP is compatible with and supports the FAR and DoD policy (DoDD 5000.1/DoD Reg 5000.2-R), and is in keeping with the objectives of the National Performance Review and DoD acquisition reform initiatives. AR 71-9 provides Army WRAP policy. The WRAP process is a bridge linking TRADOC experimentation and systems acquisition. WRAP provides CG, TRADOC a mechanism to accelerate the acquisition of selected operational warfighting enhancements borne of successful warfighting experiments. WRAP can apply to AWE, CEPs, LOEs, ATD, ACTD, or similar demonstrations, experiments, and evaluations. *TRADOC PAM 71-9*

New DoD 5000 Life Cycle Model



Previous Life Cycle Model

Life Cycle Terminology Conversion Chart

Old Terminology	New Terminology
Concept Exploration (CE) Phase	First portion of Concept and Technology Development (Concept Exploration)
Program Definition and Risk Reduction (PDRR) Phase	Second portion of Concept and Technology Development (Component Development) and some portion of System Development & Demonstration
Engineering and Manufacturing Development Phase	Remaining portion of System Development & Demonstration and first portion of Production and Deployment (LRIP)
Production, Deployment and Operational Support Phase	Second portion of Production and Deployment (Full Production) and the Operations and Support Phase
Milestone Decision Review 0 (zero)	Milestone Decision Review A
Milestone Decision Review 1	First Interim Milestone Decision Review (between MDR A and B)
Note: remaining old MDRs (2 and 3) do not correlate with new MDRs (B and C)	