# ARMY MANUFACTURING TECHNOLOGY PROGRAM RESPONDS TO 21ST CENTURY CHALLENGES

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## Introduction

The Army Manufacturing Technology (MANTECH) Program has seen dramatic changes in project selection and technical direction since oversight responsibility was transferred to the Office of the Deputy Assistant Secretary of the Army for Research and Technology (DASA(R&T)) in the mid-1990s. Today, the Army's transformation path to the Future Combat Systems (FCS) and the Objective Force necessitates another shift in how Army MANTECH operates. That shift involves a strategic, top-down approach for defining MANTECH requirements as opposed to the bottom-up methodology used in the past.

The bottom-up methodology was adopted in August 1997 in response to congressional concerns of insufficient investment levels and Office of the Secretary of Defense Technology Area Review and Assessment guidance to focus on larger, higher impact projects. This substantially modified the approach and priorities of the MANTECH Program. (See "A New Approach To The Army Manufacturing Technology Program," *Army RD&A* magazine May-June 1998 and "Army MANTECH Community Recognized At Defense Manufacturing Conference 2001," *Army AL&T* magazine March-April 2002.) Today's accelerated pace of Army transformation requires the science and technology (S&T) base to transition technology with sufficient performance maturity for the program manager (PM) to enter into system development and demonstration with low to medium risk. The S&T response to the Army's accelerated transformation now requires a top-down identification of MANTECH projects to enable the affordable transition of critical technologies into FCS. This change is driven from the very top of the Army, and the Army S&T leadership is responding accordingly and forthrightly.

## Addressing Risks

In addition to performance, several other factors must be taken into consideration. While a single demonstrator can achieve the performance required by the user, the PM is faced with delivery of multiple units on a timely basis at an affordable cost. Therefore, there is further inherent risk in manufacturing that must be addressed if the technology is to successfully transition to the FCS PM and enter into system development and demonstration. This requirement has led to a new feature of the revised Army program that is unique in the Services—that is, to meld, where appropriate, both exploratory and advanced development (6.2/6.3) funding with MANTECH (6.7) funding in a single project. Combining these resources enables achievement of both performance goals, as defined by the Technology Readiness Levels, and manufacturing goals, as defined by the descriptors relating to manufacturing. (See Figure 1.) This ensures that technology development achieves the user's needs, is mature enough to meet the PMs' needs, and is manufacturable and affordable in the quantities required to meet fielding goals and timelines. This approach has also required that the research and development and product engineering communities merge.

## Assessment Panel

To validate the identification of the most critical areas of investment, the DASA(R&T)/Army Chief Scientist Dr. A. Michael Andrews II commissioned a blue-ribbon Independent Assessment Panel through the National Center for Advanced Technologies (NCAT). The panel identified and evaluated the manufacturing technologies necessary for affordable manufacturing and fielding of the Army's Future Combat Systems and other components to the Objective Force. Herm M. Reininga, Vice President of Operations, Rockwell Collins Inc., chaired the panel.

The panel made the following general suggestions:

- Incorporate manufacturing and affordability issues in advanced concept technology demonstrations (ACTDs), advanced technology demonstrations (ATDs), and other technology development programs;
- Exploit Integrated Product and Process Development in Army and Defense Advanced Research Projects Agency (DARPA) technology development programs; and
- Use manufacturing readiness level descriptors, similar to the currently employed technology readiness levels.

The panel also identified the following specific FCS issues:

- Advanced technologies likely to be critical to the Future Combat Systems Program,
- Capability gaps in the Army's MANTECH Program with regard to those critical technologies,
- An estimate of the funding needed to close the MANTECH capability gaps in a timeframe that was likely to meet the current schedule for FCS development (structured within specific technologies and technology areas), and
- Recognition of the strong relationship between overall FCS Program risk and manufacturing technology resources needed for the FCS Program.

The panel made two recommendations. First, existing requirements, including affordability considerations (especially manufacturing) in Service/DARPA, ACTD, and ATD programs, should be enhanced and

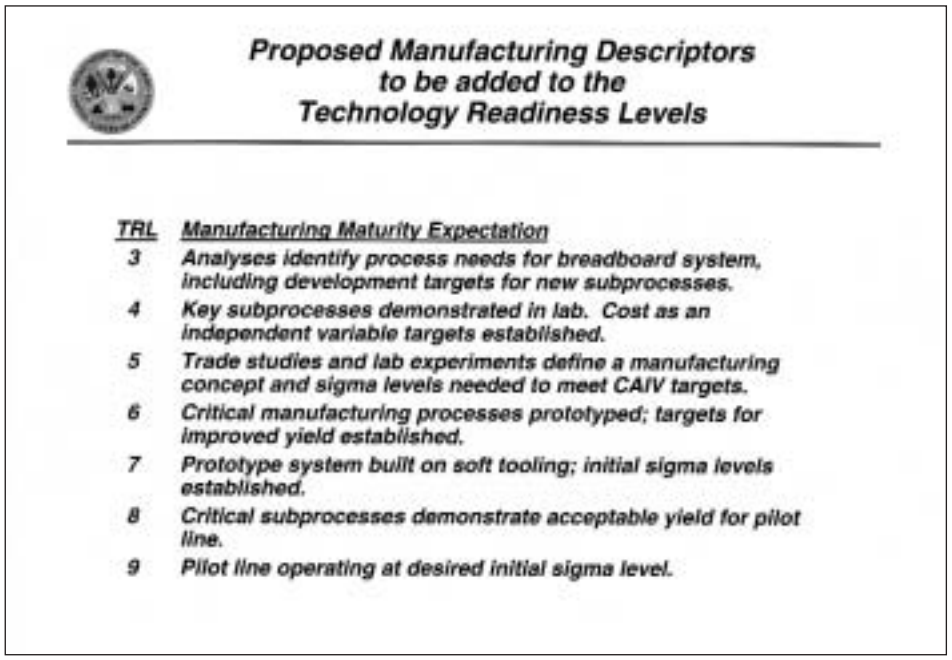



***Figure 1.***

enforced. Second, ATD and ACTD manufacturing technology issues should be identified so that that they can be effectively addressed, either within the ATD/ACTD or by a separate, coordinated, and focused MANTECH effort.

The panel's final report stated, "The collective experience of the members of the Independent Assessment Panel clearly indicate that the resources (time and funding) devoted to these efforts will be paid back manyfold both during the development of the system (e.g., reduced probability of schedule delays and financial overruns) and especially during their service lives."

As a result of this study, the DASA(R&T) initiated major changes to the Army's MANTECH Program. In the project selection process developed in 1997, Army Materiel Command labs and research, development, and engineering centers provided proposals for MANTECH projects in concert with PMs. Therefore, the Army was not anticipating systemic manufacturing problems that were surfacing either during the engineering and manufacturing development phase, production, or postproduction. The new approach resulting from the NCAT study focuses the MANTECH Program on earlier phases of development prior to handoff of technology to the PM. (See Figure 2.)

The new strategy concentrates the Army MANTECH investments in the following areas. These areas correspond to top priorities recommended by the NCAT panel. The Army is pursuing these technologies within the funded program.

## Sensors

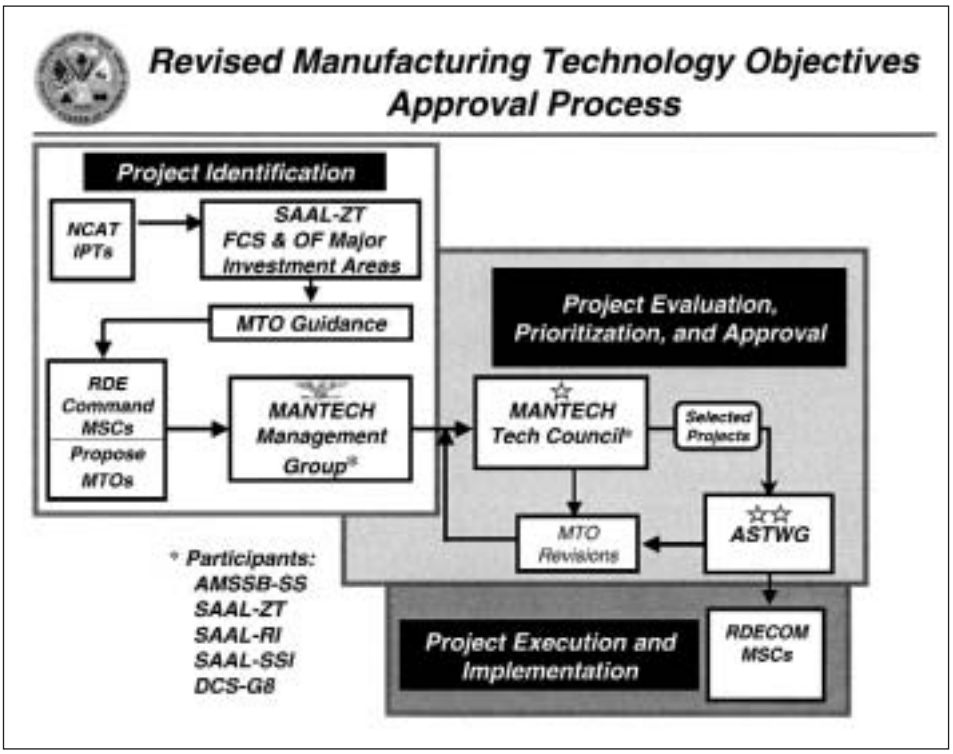
Low-cost uncooled infrared sensors are of paramount importance because of their many uses in seekers and other weapons, target detection and recognition, surveillance, robotic operations, dismounted operations, etc. The Army investment is in cooled dual-band focal plane arrays.

Laser pumping sources are required for solid-state lasers given the applications for solid-state laser radars and high-energy lasers. The Army investment is in laser diode arrays.

## Electronics And Power Systems

Pulse power for advanced protection systems and weapons are a critical need for FCS and the Objective Force. Commercially available high voltage, fast rise time capacitors are too large and heavy for Army applications. The Army investment will be in high energy density capacitors.

Compact energy and power storage systems are required for hybrid platforms and for advanced protection systems and weapons. The Army investment will be in very high power lithium-ion batteries.




IPT: Integrated Product Team; MSC: Major Subordinate Command; MTO: Manufacturing Technology Objective; ASTWG: Army Science and Technology Working Group; OF: Objective Force

***Figure 2.***

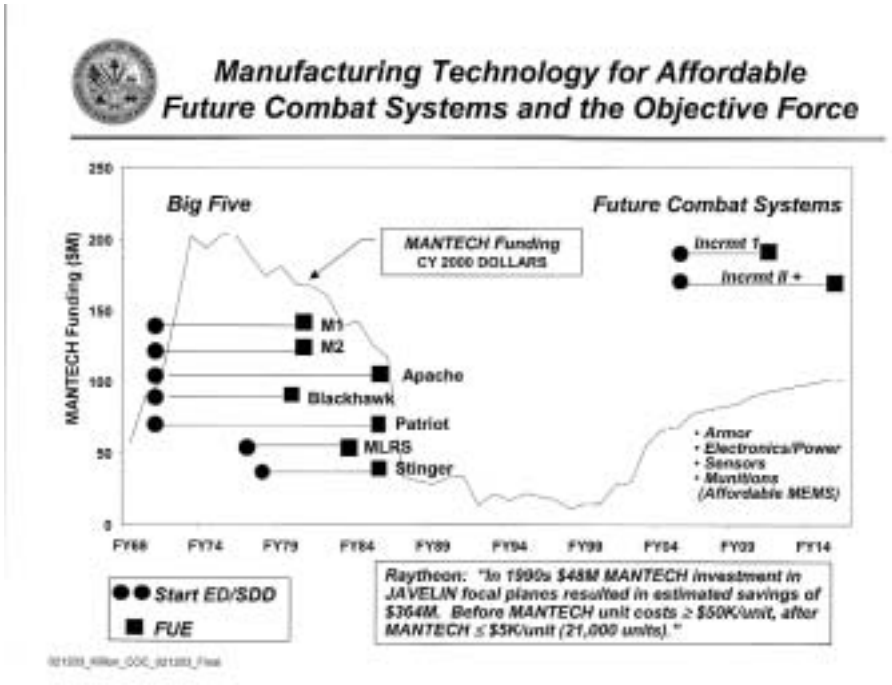



***Figure 3.***

Pulse power and compact power electronics for advanced vehicles, weapons, and protection systems also require the ability to switch high currents in high-voltage circuitry. The Army investment in this area is in silicon carbide switches.

The Army requires high-data-rate, on-the-move communications to meet the transformation goals of a lighter, faster, more lethal force. Affordable phase arrays provide the means to achieve these requirements. The Army investment is in microelectromechanical systems (MEMS) electronically scanned array antennas and ferroelectric phase shifters for affordable phased arrays.

The Joint Tactical Radio System (JTRS) is aimed at developing lightweight, low power network-centric tactical communications. The Army investment is in wearable software-defined radios that meet size, weight, and power requirements through modularization and the implementation of high-density packaging for embedded applications.

Display technology is particularly important for receiving and visualizing the information now available to the individual soldier. The Army investment is in flexible display technologies (transparent conductive and emissive materials) for soldier applications.

## Armor

Affordable lightweight armor for lightweight combat platforms is a critical issue for FCS and the Objective Force. The Army investment in this area is low-cost composites and high-performance appliqué armor.

Signature management and low-observable technologies in all bands of interest are, in the words of the panel, "likely to be critical to the success of the FCS Program." The Army investment is in low-observable materials and structures.

## Munitions

The accuracy of cannon-launched projectiles as well as advanced missiles can be significantly improved by the use of advanced guidance systems coupled to global positioning technology. The Army investment is in low-cost, high g-force, high accuracy, MEMS-based inertial measurement units. This was the first program to also combine both S&T development funding with MANTECH funding.

Current funding is not adequate to cover all of the NCAT recommendations, but the Army's MANTECH Program has responded within budget guidance. Manufacturing programs that are currently on the Band 1 Unfunded Requirement List include low-cost uncooled infrared focal planes, conformal optics, 3-D laser radar, energetics (propellants and explosives), durable barrel materials, and MEMS for safety, arm, and fuzing.

What should be the appropriate level of funding per year necessary for MANTECH to properly address FCS and the Objective Force? There are two sources of guidance available to us. During the development of the "big-five" weapon systems in the 1970s and the early 1980s, the Army's MANTECH investment peaked near $200 million per year and was consistently more than $150 million per year for a number of years, declining sharply in the mid- to late-1980s. (See Figure 3.) The NCAT panel also provided us an estimate for funding both Level I and Level II projects of $164 million per year. In the FY04 budget, MANTECH is funded at $66 million, about 40 percent of the NCAT estimate.

## Conclusion

Finally, it is important to recognize that MANTECH is an investment for which there is a savings in production cost. There have been a number of studies over the years attempting to quantify this number. Our best estimates, both from industry and government studies suggest a 10-to-1 average return on investment. As stated by Raytheon, "In the 1990s $48 million MANTECH investment in Javelin focal planes resulted in estimated savings of $364 million. Before MANTECH, the unit cost was greater than or equal to $50,000 per unit; after MANTECH it is less than or equal to $5,000 per unit (21,000 units)." Clearly there are potentially significant savings in production cost through strategic MANTECH investments.

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