Technology for the Warfighter
Defense Manufacturing Conference

November 27, 2001

Dr. Ronald M. Sega
Director, Defense Research & Engineering
**Title and Subtitle:** Technology for the Warfighter: Defense Manufacturing Conference

**Author(s):** Sega, Dr. Ronald M.

**Performing Organization Name(s) and Address(es):** Department of Defense

**Abstract:** Briefing given by Dr. Ronald Sega about the direction for Defense research and engineering.
Quadrennial Defense Review (QDR)
September 30, 2001

• Move From “Threat-Based” to “Capabilities-Based” Planning

• Key Military-Technical Trends of Adversaries

• Exploit R&D to Maintain Decisive lead in Technologies

• Develop & Exploit Technologies

• Reduce Cycle Time

“Protecting the American Homeland From Attack is the Foremost Responsibility of the U.S. Armed Forces…”
• Achieve credibility and effectiveness in the acquisition and logistics support process
• Revitalize the quality and morale of the DoD Acquisition, Technology, and Logistics workforce
• Improve the health of the defense industrial base
• Rationalize the weapon systems and infrastructure with the defense strategy
• Initiate high leverage technologies to create the warfighting capabilities, systems, and strategies of the future
Direction for Defense Research and Engineering

- Enable future DoD capabilities through an integrated technology program
- Accelerate technology transition to the warfighter
- Enhance near term technical support
- Revitalize the DoD laboratories
- Develop, attract and retain a quality national security technical workforce
Strategic Environment

Global US Interests
Political - Economic - Humanitarian

Globalization of Technology

Asymmetric Threats
In any domain - Air, Land, Sea, Space or Information
U.S. and Worldwide Research Base since WWII

Source: Report of the Defense Science Board Task Force on the Technology Capabilities of Non-DoD Providers; June 2000; Data provided by the Organization for Economic Cooperation and Development & National Science Foundation
FY02 RDT&E Budget Request

FY02 RDT&E = $47.2B requested (6.1 thru 6.7)

(6.6 + 6.7 = $16.7B)

(6.4 + 6.5 = $21.6B)

Science and Technology (6.1 + 6.2 + 6.3 = $8.8B)

Technology Base (6.1 + 6.2 = $4.9B)

19% of RDT&E

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FY02 Budget Request DoD S&T

Total FY02 S&T= $8.8B requested

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<td>Other Def Agencies</td>
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Science & Technology Priorities

**Technical**
- Basic Research
- JV 2020 Capabilities
  - Chemical & Biological Defense
  - Information Assurance
  - Hardened & Deeply Buried Targets
  - Smart Sensor Web
  - Cognitive Readiness
- Revolutionary Capabilities
  - High Energy Laser
  - Electric Drive
  - Autonomous Systems
- Enabling Capabilities
  - Propulsion
  - Software Intensive Systems
  - High Performance Computing
  - Modeling & Simulation

**Non-Technical**
- Funding Stability
- S&T Workforce
  - Technology Transition
    - Technology Readiness Assessments
    - Technology Readiness Levels
DoD 5000-Series
S&T Role in Evolutionary Acquisition

- **DoDD 5000.1**
  - Rapid Transition From S&T to Products
  - Emphasis on Affordability
- **DoDI 5000.2**
  - Focus on S&T Solutions in Pre-Acquisition
  - Use Mechanisms with User & Acquisition Customer to Ensure Transition
- **DoD 5000.2-R**
  - Conduct Technology Readiness Assessment for Critical Technologies

**Defense Acquisition Management Framework**

- **Process entry at Milestones A, B, or C (or within phases)**
- **Program outyear funding when it makes sense, but no later than Milestone B**

Documents Available At
http://www.acq.osd.mil/ara/
DoD 5000.2-R
Assess Technology Maturity

• Technology Readiness Assessments (TRAs) for Critical Technologies
  – Use Technology Readiness Levels (TRLs), or Some Equivalent
• TRAs Conducted by the Services & Agencies (Except Joint Programs)
• Assessments Evaluated by the Dep Under Sec of Defense (S&T)
• Findings Forwarded to the Overarching IPT and Defense Acq. Board

Technology Readiness Levels (TRLs)

- TRL 9: Actual system “flight proven” through successful mission operations
- TRL 8: Actual system completed and “flight qualified” through test and demonstration
- TRL 7: System prototype demonstration in an operational environment
- TRL 6: System/subsystem model or prototype demonstration in a relevant environment
- TRL 5: Component and/or breadboard validation in relevant environment
- TRL 4: Component and/or breadboard validation in laboratory environment
- TRL 3: Analytical and experimental critical function and/or characteristic proof-of-concept
- TRL 2: Technology concept and/or application formulated
- TRL 1: Basic principles observed and reported
Technology Readiness Assessment (TRA)
Example: Joint Strike Fighter (JSF)

- **FLIGHT SYSTEMS**
  - STOVL IFPC
    - FADEC SW
    - VMS SW
    - IFPC GND TESTS
    - STOVL FLT CONTROL
    - FLIGHT DEMONSTRATION

- **STRUCTURES & MATERIALS**
  - UNITIZED COMPOSITES / METALLIC STRUCTURE

- **MISSION SYSTEMS**
  - INTEGRATED RF SYSTEMS
  - CORE PROCESSING (ICP) & SOFTWARE
  - MISSION SYSTEMS INTEGRATION

- **MANUFACTURING/PRODUCIBILITY**
  - LEAN & COMMON TOOLING
  - FLOW TIME EFFICIENCIES
  - 3-D MODELING DESIGN TO FABRICATION

- **INTEGRATED SUPPORT**
  - AUTONOMIC LOGISTICS
  - SUPPORTABLE LO

- **PROGNOSTICS & HEALTH MGMT**
  - REDUCED MAINTENANCE MANPOWER
  - INCREASED SORTIE GENERATION RATE
  - ENABLES AUTONOMIC LOGISTICS

- **INTEGRATED SUBSYSTEMS (J/IST)**

- **Lean & Common Tooling**
  - Flow Time Efficiencies
  - 3-D Modeling Design to Fabrication
JSF Digitally Driven Product Design & Manufacture

• **Solid Model Data**
  - NC Ready Models
  - Reduced Span Time

• **Data Re-Use**
  - Eliminates Interpretation Error
  - Reduce Task Span Times

• **Digital Product/Process Verification**
  - Form, Fit, & Productivity Verified Prior to Assembly
  - Improved Quality
  - Reduced Cost and Reduced Risk

**Digital Verification**

- **Creation**
  - Solid Model Data

- **Integration**
  - Digital Process Verification
  - RM&S Simulation
  - Factory Simulation

- **Producibility**
  - Digital Fab (NC Driven)
  - Digital Inspection
  - Lean Assy Planning
  - Digital Assy (NC Auto Drill)

**Digital Hardware Applications**

- **Data Re-use**
  - Digital Data Flow
  - Common Digital Data Flow
  - Solid Model Part
  - Solid Model Tool
  - Electronic Mock-up

**Digital Data** Data Re-use Eliminates Errors, Drives Down Cost
Air Force Manufacturing Technology (ManTech) Program: F-22 Impact

Integrally Bladed Rotors (IBR)
- Reduced Part Count From 87 to 1
- Reduced Weight 54lbs

Comm/Nav Modules
- Potential $120M Cost Avoidance

T/R Modules
- Reduced Cost 90%

Subarray Interconnects
- $80M Cost Avoidance

Multi-Function Radome
- $50M Cost Avoidance
- Reduced Cycle Time 50%

Laser Shock Peening
- Reduced Cost $10K / Blade
- Increased Throughput 6X

Welded Titanium Structure
- Potential $100M Cost Avoidance

Other ManTech Initiatives
- Lean Manufacturing
- Digital Product Models
- Ultra-thin Castings
Army ManTech
Enhanced Manufacturing Processes for Body Armor Materials

- **Objective:** Develop & Implement Economical Production of Ceramic / Composite Small Arms Protective Plates for Personnel Protection

- **Participants:**
  - Army Natick Soldier Center
  - PM, Soldier Systems
  - Marine Corps
  - Simula Safety Systems Inc.
  - CERCOM Inc.

- **Benefits:**
  - Stops Rifle / Machine Gun Fire
  - 55% Lighter, 60% Lower Cost Compared to Armor Plates
  - Cost Avoidance (NPV): $193M

- **Implementation:**
  - Over 50K Plates Delivered & Fielded; 140K Plates on Contract
  - Supports “Operation Enduring Freedom”
Bottom Line: Warfighter Capability

Right Materiel, Right Place, Right Time, at the Right Cost - All The Time
BACKUPS
DDR&E Organization

Integrated Approach to Technology in DoD

CTO

Director, Defense Research & Engineering
Dr. Ronald M. Sega

- DoD Needs Focus (QDR)
- Resources
- Technology “Pull”

Technology Areas
- Planning
- Oversight
- Review Programs across Services and Agencies
- Technology “Push”

Capabilities & Budget

Projects and Systems
- Efficient Technology Transition
- Synergy and Integration of S&T Efforts
- Mutual Support for Programs within DoD (and outside of DoD as appropriate)
**Navy ManTech Impact on V-22**

<table>
<thead>
<tr>
<th>ManTech Project</th>
<th>Benefit</th>
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<tbody>
<tr>
<td>Heat Treatment for High-Performance Transmissions</td>
<td>Increased Power Density and Loss of Lube Tolerance</td>
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<tr>
<td>Thermoplastic Bearing Cages</td>
<td>Reduced Weight by 60%</td>
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<tr>
<td>T406 Engine Vane Actuators Powder Injection Molding</td>
<td>Life-cycle Cost Avoidance up to $1.5M</td>
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<tr>
<td>Resin Impregnated Honeycomb Core Structures</td>
<td>Excellent Impact Resistance and Lighter Structure</td>
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<td>Fiber Steering for Lightweight Composites</td>
<td>Improved Structural Efficiency</td>
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<tr>
<td>Gear Metrology &amp; Performance Prediction</td>
<td>Reduced Vibration and Gear Wear</td>
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<td>Hi-Speed Gear Inspection</td>
<td>Reduced Gear Inspection Time</td>
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<tr>
<td>Non-Contact Work Piece Positioning</td>
<td>Enhanced Precision Machining</td>
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<tr>
<td>Powder Metal Processing of T406 Turbine Disks</td>
<td>Life-cycle Cost Avoidance up to $19M</td>
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<tr>
<td>In-Situ Composites Fiber Placement</td>
<td>20% Reduction in Fabrication Costs</td>
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<td>Smart Sensors/Actuators</td>
<td>Increased Operational Capabilities</td>
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<tr>
<td>Ausform Finished Gears</td>
<td>Increased Gear Durability</td>
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<tr>
<td>Superalloy Casting Technology:</td>
<td>Reduced Manufacturing Costs</td>
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**Life-Cycle Cost Avoidance Exceeds $45M**

**Payoff**
- Weight Reduction
- Increased Maintenance Cycle Time
- Improved Performance