REPORT OF THE

DEFENSE SCIENCE BOARD

TASK FORCE

ON

LOGISTICS MODERNIZATION

July 1996

OFFICE OF THE UNDER SECRETARY OF DEFENSE
FOR ACQUISITION & TECHNOLOGY
WASHINGTON, D.C. 20301-3140

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THE UNDER SECRETARY OF DEFENSE
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ACQUISITION AND
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JUL 18 1996

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDER SECRETARY OF DEFENSE (POLICY)
PRINCIPAL DEPUTY UNDER SECRETARY OF DEFENSE (A&T)
DEPUTY UNDER SECRETARY OF DEFENSE LOGISTICS

SUBJECT: Report of the Defense Science Board Summer Study Task Force on Logistics Modernization.

The Defense Science Board report on Logistics Modernization is provided for your review.

I convened this Task Force to address the technologies that will affect the cost of ownership for current and future weapon systems. The Task Force's principal conclusion is that DoD can leverage technology best in the reliability and maintainability area with both enhanced readiness and reduced costs. They recommend a need for focused commitment by DoD leadership, as well as, a shift in logistic information systems modernization strategy towards service-developed applications within a DoD standard architecture. Additionally, the Task Force reports a clear vulnerability regarding information warfare and chemical-biological warfare threats. Recommendations include adding these vulnerabilities to the CINC's war plans and training exercises, and secondly, to take concrete steps to minimize the effects of attacks.

Please provide your comments regarding the Task Force findings and conclusions to the Executive Director of the Defense Science Board. Comments are requested by 15 September 1996, including negative replies.

In parallel with this review action, I am approving release of this report to the Defense Technical Information Center for appropriate dissemination.

Paul Kaminski

Paul G. Kaminski

Attachment

OFFICE OF THE SECRETARY OF DEFENSE
3140 DEFENSE PENTAGON
WASHINGTON, DC 20301-3140

DEFENSE SCIENCE
BOARD

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE (ACQUISITION & TECHNOLOGY)

SUBJECT: Report of the Defense Science Board (DSB) Task Force on Logistics Modernization

I am pleased to forward the final report of the DSB study on Logistics Modernization, chaired by General William Tuttle, USA (Ret). This Task Force identified significant logistic technology opportunities that can reduce weapon system Operating and Support (O&S) costs while providing enhanced readiness, deployability and sustainability. Investment strategies were also developed for these technologies. The report also assessed logistic vulnerabilities.

The Task Force concluded that there are two significant technology areas to exploit: (1) Reliability and maintainability improvements for fielded systems and (2) Logistics information systems. Both areas offer potential readiness improvements. The cost savings realized from these opportunities are available to recycle into weapon systems modernization. The Task Force estimates that a $300 million a year investment within these two areas, can lead to O&S cost reductions of three to four times that amount. Conservatively, this gives the Services at least another billion dollars a year for modernization.

Additionally, the Task Force concluded that US logistics systems are particularly vulnerable to an adversary's use of chemical and biological agents and could be vulnerable to it's use of information warfare. This report recommends a more thorough treatment of the chemical/biological threat by CINCs and exercise planners, and continued support of the joint program for chemical/biological defense. The DSB Information Warfare Task Force will include logistics systems in it's report.

I concur with the Task Force's conclusions and recommend you forward the report to the Secretary of Defense.

Craig I. Fields
Chairman

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9 July 1996

Dr. Craig Fields
Chairman, Defense Science Board
3140 Defense Pentagon, Room 3D869
Washington, DC 20301-3140

Dear Dr. Fields,

Enclosed is the Report of the Defense Science Board Task Force on Logistics Modernization. The members of the Task Force worked diligently to frame what we believe are the most pressing issues dealing with improving defense logistics through the application of the bountiful technologies available. As you requested, we also dealt with issues on logistics vulnerability.

We concluded that DoD can leverage technology best in logistics through investment in improvements in reliability and maintainability of weapons and support systems. The benefits are both enhanced readiness and reduced operating and support costs. We recommend a focused commitment by DoD leadership to this investment program. We also recommend a shift in strategy in modernizing logistics information systems toward service-developed applications within a DoD standard technical framework. We see clear vulnerabilities to logistics support of campaigns in potential adversaries' chemical biological warfare capabilities and a *potential* vulnerability in their capacity to wage information warfare. We expect that the efforts of the DSB Task Force on Information Warfare will encompass logistics as well as combat.

Lastly, we support efforts under way in the Services, Joint Staff and by the Deputy Under Secretary of Defense (Logistics) through the DoD Logistics Strategic Plan, Joint Warfare Capabilities Assessments and Service initiatives to modernize logistics processes. We believe that our recommendations will add impetus to their efforts.

For the DSB Task Force
on Logistics Modernization,

William G.T. Tuttle, Jr.
Chairman

Enclosure

CONTENTS

Executive Summary

The Defense Science Board (DSB) Task Force on Logistics Modernization was tasked to identify existing logistics-related technologies that would reduce costs while providing enhanced readiness, deployability and sustainment. Additionally, the Task Force was asked to develop investment strategies.

Weapons systems Operating and Support (O&S) costs now amount to approximately $65 billion per year. The Task Force concluded that significant opportunities exist to reduce these costs and recycle the savings into modernization, while actually enhancing readiness. Principal opportunities for saving money lie in these general areas:

- Improvements in overall logistics system processes
- Reductions in the cost of ownership for new systems and major upgrades
- Development of technologies with payoff in reducing O&S costs
- Outsourcing of significantly more logistics functions
- Reductions in O&S costs of fielded systems through reliability enhancements

The Task Force determined that substantial savings and readiness improvements can be obtained by taking advantage of available technology in two areas:

- Reliability and maintainability (R&M) improvements for fielded systems
- Logistics information systems

The Task Force recommended that DoD pursue investment strategies principally in these two spheres, but included several other areas of opportunity. The Task Force recommendations are as follows:

- Building on PBD 714, institutionalize a process that will encourage adequate investment in R&M enhancement
- Revise the process for developing logistics management information systems

- Encourage the use of simulation in planning logistics, and the inclusion of logistics constraints in combat simulations
- Expand the use of self-paced, computer-based maintenance training
- Expand the use of automated diagnostic aids
- Exploit information technology in the Joint Logistics and Battlefield Awareness Data Dissemination Advanced Concept Technology Demonstrations
- Move toward routine use of food irradiation

Each of these seven investment strategies requires funding to implement—with the possible exception of the second. We estimate not more than $300 million a year can lead to O&S cost reductions of three to four times that amount—the lion's share in the reliability improvement area. Conservatively, the Services could have at least another billion dollars a year for procurement were they to take advantage of these opportunities.

The Task Force also looked into the vulnerability of DoD logistics systems and recommended that

- CINCs' war plans and exercises deal more thoroughly with the chemical-biological threat and means for coping with it
- The Joint Program for chemical-biological defense continue to receive funding support for development and production of chemical-biological defense systems.

We concluded also that an adversary's offensive information warfare capabilities create potential vulnerabilities for logistics systems as well as combat systems. The DSB Task Force assessing information warfare includes logistics processes in its review.

Outline of Report

- **Introduction**
  - Terms of reference–objectives
  - Approach
  - Participants in Task Force activity
- **Importance of logistics modernization**
- **General opportunities for savings**
- **Issues examined**
  - Reliability and maintainability enhancement
  - Information technology
  - Other opportunities
- **Logistics vulnerabilities**
- **Conclusions and recommendations**

After reviewing the terms of reference that guided the study and discussing some of the limitations that were faced, we place the study in context. Some of the reasons for undertaking it are enumerated and broad areas for achieving logistics savings are identified. This material is followed by the main portion of the report—an extensive discussion of the areas we examined in detail, with particular emphasis on reliability and maintainability enhancement, and information technology. We end with conclusions and recommendations.

Terms of Reference--Objectives

- **Determine logistics-related technologies available that would reduce costs while providing enhanced readiness, deployability, and sustainment**
- **Develop investment strategies needed to reduce logistics costs, considering:**
  - **Effect of new weapon system technology on logistics**
  - **Logistics technologies for current systems**
  - **Information technology that would enhance logistics**
- **Assess logistics vulnerabilities**

The objective and scope of this Task Force are outlined above. Appendix A provides the complete Terms of Reference for the Task Force. At the first meeting of the Task Force, the sponsor of the study (Deputy Undersecretary of Defense, Logistics) provided the Task Force with background information on the current issues in logistics and charged the Task Force to focus on reducing the cost of logistics across DoD. This has been our main emphasis. The DSB chairman added logistics vulnerabilities and how they might be overcome as an area of review.

Approach

- **Relied on expert opinion and past DoD studies**
- **Emphasized fielded systems and processes, rather than developing new technology**
  - **DoD is buying few new systems**
  - **Plenty of existing technology; the emphasis is on getting it adopted**
- **Emphasized weapon system support, with some attention to personnel support**
- **Did not address strategic mobility**
  - **Being addressed by separate DSB Task Force**

The Task Force relied heavily on input from a variety of DoD and industry logistics experts regarding a wide range of topics related to defense logistics technology, policy, practices, and support. Appendix B lists the many briefings that were provided.

Most of our attention has been devoted to the support of already fielded weapon systems. Because few new systems will be coming on line in the near future, we did not feel that logistics for new systems was an important potential source of short-to-medium term cost savings. In the two areas we emphasized most—support for existing systems and information management—our emphasis is not so much on developing new technologies as on appropriately adopting technologies that already exist.

Strategic Mobility, an important aspect of logistics, is the focus of study by a separate DSB Task Force and was therefore not addressed by us.

Participants in Task Force Activity

MEMBERS	
GEN (USA Ret.) William Tuttle, Chairman	President, LMI
Mr. Gordon England	Lockheed-Martin (retired)
Mr. Dean Clubb	Executive Vice President, Texas Instruments
Mr. Phillip Odeen	President and CEO, BDM International Inc
Gen (USAF Ret.) Bernard Randolph	Consultant, TRW
Mr. Edwin Biggers	Hughes Aircraft (retired)
LTG (USA Ret.) Donald Babers	President and COO, Cypress International
Mr. Adolph Quilici	United Defense LP, Advisory Committee Member
MajGen (USAF Ret.) Edward Bracken	Consultant
Mr. James D. Shields	Vice President and Group Director, TASC
LtGen (USMC Ret.) Robert Winglass	Maine House of Representatives
VADM (USN Ret.) Stephen Loftus	Consultant
LTG (USA Ret.) Leo Pigaty	Vice President, Los Alamos Technical Associates
Mr. Frank W. Swofford	Former ASN(S&L), Currently Defense Consultant
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MG Charles C. Cannon	Vice Director for Logistics, Joint Staff
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RADM James L. Taylor	Director for Support, Maintenance, and Modernization (OPNAV 04)
Mr. David Borland	Deputy Director of Information Systems for C4, Army
Mr. Edward Harris	Deputy Director for Business Funds (DFAS)
Mr. Lawrence Kreitzer	Deputy Director Marine Corps Systems Command
Mr. Mark O'Konski	Director, Army Logistics Integ. Agency
OTHER SUPPORT	
Executive Secretary	COL Kerry Brown, OSD
OSD Staff	Mr. Harry Applegate
Secretariat Representative	LtCol Keith Larson
Technical Support	Institute for Defense Analyses

The Task Force was chaired by Mr. William Tuttle, President of the Logistics Management Institute. The other Task Force members and participants are listed above.

The Office of the Secretary of Defense, the Services, and the Defense Agencies were very helpful in assisting the Task Force.

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Why Logistics Modernization?

- **DoD needs funds to pay for future recapitalization**
- **DoD needs to find high-payoff opportunities for cost savings, while maintaining readiness**
- **DoD needs to improve the accuracy and timeliness of logistics information**
- **DoD now spends approximately $66 billion per year on weapon system O&S costs**

The Defense Department faces a substantial bill to replace aging equipment over the next decade. By identifying high payoff opportunities to reduce operating and support costs, the Task Force can help make the recapitalization burden less onerous. Effective provision of logistics information is a key to improving the effectiveness and efficiency of logistics support.

Weapon system Operating and Support (O&S) costs consume a substantial portion of the Defense budget, perhaps as much as $66 billion in 1995. These O&S costs include Operations and Maintenance (O&M) expenditures, as well as Military Personnel expenditures involved in the operation and support of the Services' weapons systems. While it is important to adequately support existing weapon systems, it is also important to look for ways to do it more efficiently.

Weapon System O&S Costs

	Army	Navy and Marines	Air Force	Total
Military Personnel [1]	14.6	9.1	11.0	34.7
Fuel [2]	0.1	1.1	2.5	3.7
Parts and Supplies [2]	1.6	3.1	2.7	7.4
Training Ammo, etc. [2]	0.2	0.5	0.1	0.8
Other [2]	0.1	0.3	0.3	0.7
Depot (DBOF) [2]	0.6	3.3	2.0	5.9
Central Logistics [3]	4.2	5.7	2.5	12.4
Total	21.4	23.1	21.1	65.6

Sources:
1. Total for combat and deploying support units
2. Army and Navy: VAMOSC
3. FYDP FY 1996-03

Because detailed information about the nature of O&S costs is not available in the FYDP database, it is difficult to precisely categorize them.

Combat and deploying support units spent approximately $66 billion on O&S in FY 1995. About half of this was for military personnel, the rest was for O&M. Not all these costs are closely linked to the operations and support of weapons. For example, they include some base support costs. In addition, $12 billion was devoted to centrally funded logistics. The depot entry includes unit-funded depot maintenance of equipment. The central logistics entry refers to depot maintenance and software and contractor support, funded centrally by the Services.

Various data systems oriented to the documentation of unit and equipment support costs provide a bit more information on weapon systems costs. We drew on the VAMOSC (Visibility and Management of Operating and Support Costs) data systems of the Army and Navy, and on cost factors provided in Air Force Instruction 65-503 to develop the unit-level costs presented in the above table. It documents about $19 billion in direct, unit-level, weapon system O&M costs.

If we assume that all personnel at combat and deploying support units play a role in weapon systems operations and support and add in centrally funded logistics, we get a total of around $66 billion. This may give a rough idea of the size of the universe that logistics modernization can target.

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General Opportunities for Savings

- **Improve overall logistics system processes**
- **Reduce cost of ownership for new systems and major upgrades**
- **Develop new technologies with payoff in reducing logistics costs**
- **Outsource significantly more logistics functions**
- **Reduce costs for fielded systems through reliability enhancements**

If DoD could save only a small part of the $66 billion annual expenditure on weapon system O&S, it could move substantial resources to modernization

Within the general area of weapon system support, we have identified the following major categories as providing opportunities for significant savings in ownership and logistics costs:

Logistics system processes—there is a need to institutionalize logistics process improvements as outlined in the DoD Logistics Strategic Plan, in corresponding Service initiatives, and in work being done to develop a modern Logistics Information System.

Ownership costs of new systems and major upgrades—accountability, tradeoffs, and incentives need to be developed along with a comprehensive logistics benchmarking program.

New technologies—new logistics technology development and implementation should be continued to reduce costs and the logistics "footprint." Areas include fuel efficiency, improved diagnostics, materiel tracking, and smaller/smarter munitions.

Outsourcing logistics functions—DoD should continue its initiatives to explore outsourcing opportunities in such logistics areas as contractor life-cycle support, depot maintenance, supply, and transportation.

Fielded system costs—reduced procurement funds means relying on older systems, creating significant opportunities for cost reduction. An institutionalized program to create opportunities for logistics savings for fielded systems is needed.

We expand on each of these categories in the following slides.

Improving Logistics System Processes

- Institutionalize process improvements outlined in DoD Logistics Strategic Plan and corresponding service initiatives
- Ensure responsive transportation
- Implement a modern, flexible logistics information system
- Accelerate the business process reengineering efforts in the Services and DLA to make existing infrastructure more efficient and effective and to reduce overcapacity
- Develop methodology to allow Services to plow O&S savings into modernization

These processes are largely funded through the Defense Business Operations Fund (DBOF). The major impact of these changes will be to reduce the present 10 percent surcharge rate. Continued aggressive cost-reducing goals should be sought.

The 1995 Logistics Strategic Plan established three major goals designed to provide a more responsive logistics system and a leaner infrastructure: (1) reduce logistics cycle times, (2) develop a seamless logistics system, and (3) streamline the logistics infrastructure.Where applicable, metrics are defined, quantitative goals and milestone completion dates specified, and Executive Agents identified for leading implementation in the Logistics Strategic Plan.

With respect to logistics cycle times, an ambitious plan to achieve a 72–hour logistics response time by September 1998 has been adopted. DLA has made significant progress in this area through a number of initiatives. The implementation of a DoD-wide Total Asset Visibility system and Service initiatives such as Lean Logistics (Air Force), Velocity Management (Army), and Regional Maintenance Centers (Navy) are designed to help meet this goal. A responsive transportation system must be in place to ensure that material is delivered quickly.

A seamless logistics system is one in which the impediments to effective implementation flow and function execution are removed. OSD and the Services have been tasked to develop common processes, standard definitions, and standard data elements to support the use of modern MIS and decision support technology. The integrated data environment should be developed in conjunction with such information system initiatives as the Global Combat Support System (GCSS), Continuous Acquisition and Life Cycle Support (CALS), the Joint Engineering Data Management and Information Control System (JEDMICS), and the Configuration Management Information System (CMIS). This issue is discussed in more detail in the section on Information Technology.

The desire to reduce the cost and footprint of logistics is the basis for streamlining the logistics infrastructure as the force structure reduces and the global threat changes. Ongoing initiatives include those related to inventory reduction (a goal of over $20 billion reduction by 2001 has been established), outsourcing, commercial parts, direct delivery, cross servicing, benchmarking, reliability and maintenance technology, and the Army's "Modernization Through Sparing."

The DoD needs a methodology and management structure for using the cost savings that result from logistics modernization. This methodology and structure must accomplish two somewhat contradictory goals: (1) ensuring that the Operations and Support cost savings resulting from logistics modernization are used to help meet the Services' recapitalization requirement and (2) ensuring that logisticians and operators have an incentive to seek O&S cost reductions by allowing them to devote some of the savings to investment in continuing improvements.

Reducing Ownership Costs for New Systems

- **Assign total cost-of-ownership accountability (USDA&T memo of December 4, 1995)**
- **Continue tradeoffs (performance, cost, reliability, etc.) throughout program life cycle**
  - **F-16C/D experience shows significant potential for manpower reduction through R&M improvement**
- **Apply contract incentives and terms to encourage contractor investments in reliability improvements**
  - **Demand viable warranties**
  - **Pursue value engineering programs**
    - **» Army MSE program savings > $100M**
    - **» AMRAAM program savings > $500M**
    - **» LPD 17**
    - **» F-22**
  - **Award fees for exceeding critical reliability thresholds**
  - **Cultivate long-term relationships**

Responsibility for ownership costs must be explicitly assigned as an initial step towards their reduction. This is in line with the DoD Logistics Strategy to develop a comprehensive logistics benchmarking program.

Reliability is the key to reducing the need for logistics support in a significant number of areas, such as maintenance personnel, diagnostics and repair costs, spare parts, and supply transportation. A large body of data confirms that reliability improvement pays when implemented in a timely and effective manner. To ensure that readiness is achieved at minimal life-cycle cost, a continual effort has to be made to identify the bad actors and to conduct tradeoffs between reliability, cost, and performance.

Clearly the most effective approach is to have the system designed to be reliable, but that approach is of limited value when few new systems are being bought. It also pays to give contractors a continuing interest in reliability improvement. There are a number of contractual approaches to motivate contractors in the right direction. These include contractor life-cycle support, long-term warranties with R&M controls (e.g., the Air Force F-16 program), value engineering programs (the Army MSE and the Air Force AMRAAM missile), and award fees (the Navy F-18). The goal is to have the contractor benefit from higher operational reliability, even though this may involve his own investment in the design and development phases. Such a policy reverses the old dictum that contractor profits are maximized at a reliability level that is minimally acceptable.

Developing New Technologies to Reduce Logistics Costs

- Higher fuel efficiency
- Improved diagnostics (reduces inventories and manpower)
- Dependable materiel tracking systems (reduces inventories and overbuys)
- Fewer/smaller munitions with accurate guidance
- Computer-based training for logistics personnel

Fuel costs account for approximately 20 percent of operation and maintenance costs. The Air Force spent nearly $2.5 billion in 1993 for fueling its fighters, bombers, and tankers and $6.2 billion for maintaining these aircraft. Over the long run, more efficient engines can reduce these costs when new aircraft are procured or engines are replaced or modified on older aircraft.

Improved diagnostics in the face of ever increasing equipment sophistication is still a difficult challenge. For example, despite significant improvements in the reliability of C-17 avionics, so many incorrect in-flight fault indications are being experienced that operating crews have developed workarounds to reduce unnecessary actions in response to a false alarm. Software, in some cases, may be inadequate to deal with temporary, insignificant anomalies. This is an area requiring further research.

Major initiatives to track material starting with the Total Asset Visibility (TAV) program and its integration with Corporate Information Management (CIM) migration systems is an objective of the DoD Logistics Strategic Plan. Other initiatives include the Defense Intransit Visibility Integration Plan, the Automated Manifest System, the Defense Transportation Tracking System and Automated Identification Technology such as radio frequency tagging and bar coding. Knowing what we have and where it is (and having reliable transportation) can prevent the need for the kind of over-stocking that proved extremely wasteful during the Gulf War.

Smaller and more accurate munitions result in a smaller logistics burden. Decreased weight of an airborne weapon, for example, lowers fuel costs, decreases structural stresses, and because of easier ground handling, may reduce manpower and ground equipment requirements. Increased accuracy means that fewer munitions are needed to do the job, reducing the load on the logistics system.

Training maintenance personnel is a significant logistics cost. Analysis has shown that increased reliance on computer-based training could significantly reduce the time individuals spend in training and the cost of that training.

Outsourcing Logistics Functions

- DoD 5000.2 guidance can yield large O&S savings
  - Focus on opportunities for contractor logistics support (CLS) policy for new systems and those in major modification
    - » It reduces the need for defense logistics infrastructure above the organizational level
    - » Example: Army mobile subscriber equipment, GTE is the CLS contractor
    - » Other candidates are the Navy's F/A-18E/F and V-22; the Air Force's F-22, C-17, and B-2; and the Army's Comanche
  - Armys Paladin (155mm howitzer upgrade) is first major mod program candidate.
- Pursue CLS outsourcing of remaining in-service systems
- Proceed with analysis of logistics infrastructure outsourcing
- Construct defense analogues to commercial "power by the hour" practice for engines and other major components

Outsourcing, a major initiative in the Defense Department, most recently was highlighted as a major goal by the Commission on Roles and Missions, and was the topic of a DSB Task Force. One important area for increased contractor involvement is in undertaking life-cycle contractor logistics support (CLS) for new systems. This reduces the amount of organic logistics infrastructure needed above the organizational level. A prominent example is that GTE is serving as a CLS contractor for Mobile Subscriber Equipment. Contractors are also involved in CLS for the new version of the Navy F/A-18, and the new Air Force aircraft. Decisions on CLS are pending for the new version of the F/A-18, the V-22, and the new Air Force aircraft.

The Army's Paladin system, an upgrade to the 155 mm howitzer, is under evaluation for increased privatization. We should be proceeding with analysis to determine if more logistics infrastructure can be outsourced, as the DSB Task Force on Privatization recommended. The most effective way is by outsourcing the support of whole systems. Ample precedent exists, incentives to improve readiness are available and performance metrics are simpler, than in outsourcing functions (e.g., cataloguing, depot overhaul).

We should also be looking for defense analogues to the "power by the hour" practice that private companies are using for engines and other major components. Relying more on the private sector will allow greater flexibility in reducing overcapacity. Example: recent Boeing/Allison unsolicited proposal for reengineering the B52-H through lease.)

Reduce Logistics Costs Through R&M-Enhancing Investments

- Concentrate on fielded systems
- Few new systems are entering the inventory
- Existing systems are aging
- Services have significant data on current cost drivers
- Services have significant opportunities to reduce costs
- We can institutionalize an investment program to create logistics savings for fielded systems
  - PBD 714 makes a start

As procurement funds decrease, we must rely on existing systems to perform the mission. These systems will continue to age; therefore, logistics costs can be expected to increase if no action is taken. Current data systems such as VAMOSC are adequate to identify significant weapon system support cost drivers. Currently inadequate are the funds necessary to implement high payoff proposals, including R&D in logistics modernization.

Current Service initiatives to reduce O&M costs at the module and equipment levels have shown that significant savings in a relatively short time period is possible [e.g., initiatives proposed under the Army's Operating and Support Cost Reduction (OSCR) program.] The best way to extend these kinds of gains—to larger classes of systems or to opportunities with greater leverage—is to institutionalize an investment program to attack the problems created by an aging population and rising logistics costs. Such a program must determine significant but achievable savings goals along with corresponding investment levels to meet the goals. This will involve developing and applying criteria for investment decisions based on such standard metrics as return on investment and payback period. Incentives for program and system managers must be developed to establish the needed climate for such a program. Finally, funding sources must be identified along with a management review process to provide the fuel and the direction.

In the next section, we examine in more detail this set of opportunities for applying technology to reduce O&S costs while enhancing readiness.

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Issues Examined

- **Reliability and maintainability enhancements**
  - Funding of R&M enhancements
  - Management responsibilities for R&M enhancements
- **Information technology**
  - Acquisition and management of information systems
  - Interface between logistics and modeling and simulation
  - Expansion of electronic commerce and data interchange technology
  - Other information technology opportunities
- **Other opportunities**
  - Food irradiation
  - Flexible manufacturing
  - Telemedicine

To assess logistics modernization issues, the Task Force addressed reliability and maintainability strategies and information technology, as well as several other topics related to logistics technology.

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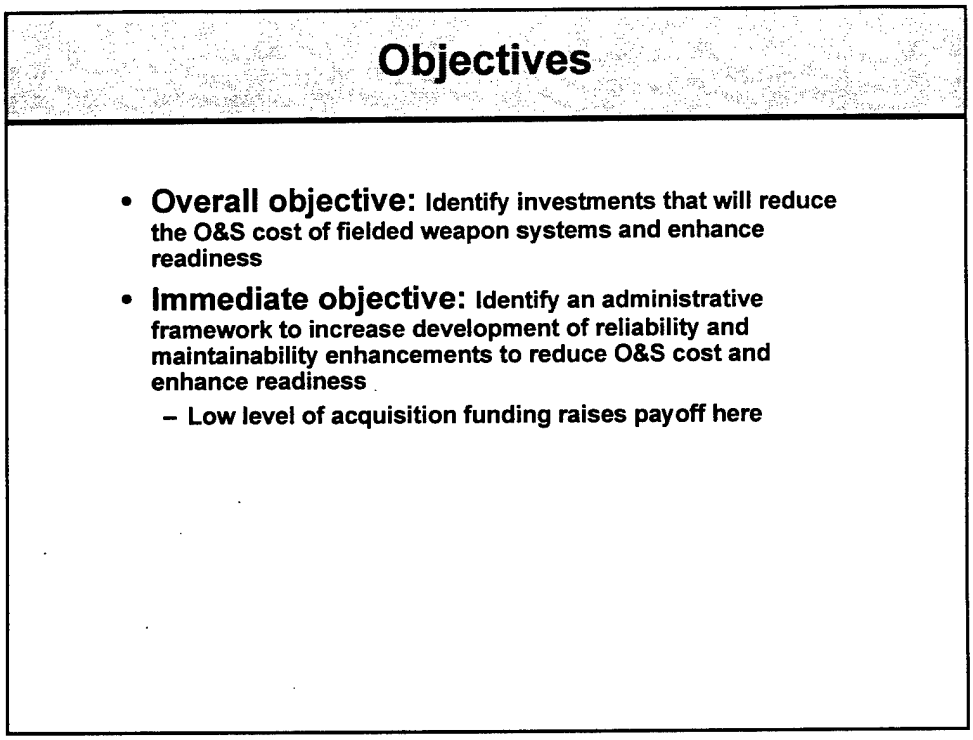
Reliability and Maintainability

- Objectives
- Background
- Examples of past successes
- Suggested initiatives
  - Funding strategies
  - Process and management strategies

The next several slides summarize our findings related to reliability and maintainability (R&M) enhancement. The objective of reducing logistics cost is first reviewed. The Task Force chose reliability enhancement of fielded systems (and to a lesser extent, maintainability enhancement) as its focus.

After reviewing the current state of R&M (and of R&M enhancement efforts), we show that investments in improved R&M have been worthwhile, but limited. We then discuss how to revitalize the R&M enhancement process by adopting effective funding and management strategies.



A major objective of the Task Force was to identify the cost-effective investments that will reduce weapons systems O&S cost while enhancing readiness. We narrowed this objective somewhat by focusing on a strategy that has global characteristics, significant leverage, and both near-term and far-term implications—namely enhancing the reliability and maintainability of fielded weapon systems.

The Task Force believed that reduced procurement funds will result in current systems being used for longer periods, thus providing attractive opportunities for cost reduction through an R&M enhancement strategy. We drew this conclusion after reviewing work by the Logistics Management Institute and other organizations. This work showed that the current investment in such actions is relatively small while the payoffs can be very high.

R&M in Today's DoD Environment

- **Avionics reliability is much improved but testability problems persist**
- **Mechanical and hydraulic items (pumps, valves, connectors) and corrosion are still significant problems**
- **Software R&M issues are becoming significant**
- **Long-term use of warranties requires more investigation**

Reliability, or lack of it, triggers the maintenance and logistics systems.

We have seen significant improvements in avionics reliability, where the mean time between failures (MTBF) is in the thousands of hours compared to values in the hundreds of hours a decade ago. However, perhaps due to the more complex demands placed on today's systems, we have not experienced a corresponding improvement in testability. False alarm rates of 30 to 50 percent and higher are still being experienced on many of our systems. Each good unit pulled from a weapons platform places a burden on the logistics system.

In non-electronic items we have not seen the reliability growth experienced by avionics. Corrosion problems, although being attacked a number of ways, still result in much money being spent on upkeep of systems operating in corrosive environments. In general, the reliability and safety problems of non-electronics items and those associated with corrosion increase with system age.

As system operational design becomes more software-intensive, software R&M issues become more significant. For some new systems like the B-2, software support will become a major element of O&S costs. These costs can be controlled by relying on contractor logistics support, which preserves the knowledge base that went into the software developments.

We have not had enough experience to assess the effects on R&M of the recent DoD policy promulgating performance specifications. One way to increase contractor involvement without resorting to past approaches of detailed "how-to" specifications is to offer contracts with long-term warranties or other forms of R&M incentives. There were some successful early experiences with such approaches in the mid-70s, but they have been difficult to manage. A more careful examination of the circumstances under which they should be pursued could be helpful. Management of warranty programs is far easier under contractor life-cycle support.

R&M Initiatives are Reducing Logistics Costs

- **Service initiatives**
  - USAF: Weapon System Cost Reduction (WSCR)
  - USN: Best Operating Support System (BOSS)
  - USA: Operating and Support Cost Reduction (OSCR)
- **Service experience**
  - High-payoff areas being identified
  - Numerous activities initiated
  - Limited funds available
  - Funding for engineering design generally not identified
- **Contractor life-cycle support**
  - Investment incentives in R&M are part of the contract
  - MSE is an example

The Services have ongoing programs to reduce O&S costs. Although these programs are not specifically directed at only R&M enhancement, they frequently involve modifications that directly or indirectly result in R&M improvements.

A review of some of the individual proposals to these offices shows potentially high payoffs--the return on investment exceeds 5 to 1 and the payback period is less than 5 years. However, the limited funding for such activities has limited the potential payoff to only a fraction of that possible and desirable.

There is also a continuing challenge of finding the funds to design and implement worthwhile enhancements that may not yield immediate returns.

Contractor logistics support can provide firms with the incentive to improve R&M. Such has been the experience of the Army with its Mobile Subscriber Equipment (MSE) system over the 7 years since it was fielded. Maintenance costs have been cut by over 50 percent (from $80 million to $33 million per year). As noted earlier, the Army is evaluating the decision to extend the contractor life-cycle support process to the Paladin, which is a major modification of the 155 mm self-propelled howitzer.

Key Issues

- **Are R&M enhancements worthwhile?**
  - ***Yes***
- **Is there a significant investment now in R&M enhancement for fielded systems?**
  - ***No***
- **Is there a management structure to identify and implement effective R&M enhancement projects?**
  - ***Not formalized***
- **What are the issues associated with R&M-enhancing investment?**
  - ***Funding and processes***

If the payoffs of R&M enhancement are small or the current investment is large, we ought to seek a different focus. Our analysis confirms what is generally believed to be true—that there is a large potential payoff to improving the reliability of fielded systems (with perhaps a lesser payoff for maintainability), especially if there is not a direct correlation between reduced maintenance requirements and reduced manpower. On the other hand, the Task Force was surprised to learn that the current annual DoD investment directed towards reliability enhancement of fielded systems is well under $100 million.

Although some efforts at formalization under the umbrella of operating system cost-reduction have been undertaken, we could not identify a formalized consistent management structure for implementing a program of fielded system reliability and maintainability enhancement. The Army has a formalized process for Defense Business Operations Fund (DBOF) and non-DBOF OSCR process management. The Air Force is working on establishing a formal process. The Navy has a Logistics Engineering Change Proposal (LECP) process.

It is the consensus of the Task Force that a structure is required that, in addition to direction and control, provides incentives, synergy, and leverage for R&M enhancement of fielded systems. Funding at a level to attract interest and provide staying power is needed.

Therefore, the overarching issues that need to be addressed are funding and process, including management structure and responsibility.

Benefits of R&M Enhancements

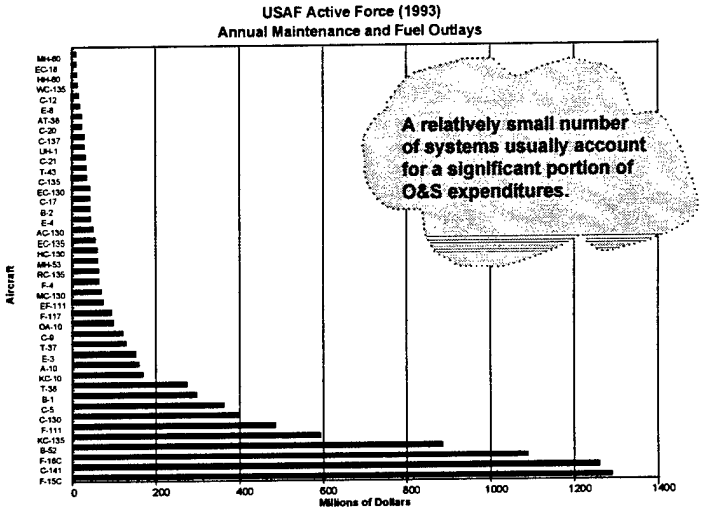
- **Investment in more reliable components**
  - Improved availability
  - Reduced failures
  - Reduced demand for replacement parts (currently $6 billion per year)
  - Reduced related management, handling, and shipping costs and eventually, related infrastructure requirements
  - Reduced requirement for organizational repairers and supply personnel
  - Reduced logistics footprint and lift requirements
- **Investment in better test and diagnostic systems**
  - Improved availability and readiness
  - Reduced incidence of "false" removals (not broken)
  - Reduced repairer-induced damage from removal of good parts
  - Reduced demands for replacements (with savings noted above)

The next two slides show the substantial effect of having more reliable and maintainable components.

An immediate fallout of more reliable components is improved system readiness and effectiveness. A reduction in the number of failures leads to reduced demand for replacements and thus lowers the current expenditure of $6 billion in this O&M cost category. Similar savings will accrue in repair, stockage, and shipping costs, eventually leading to reductions in manpower and infrastructure.

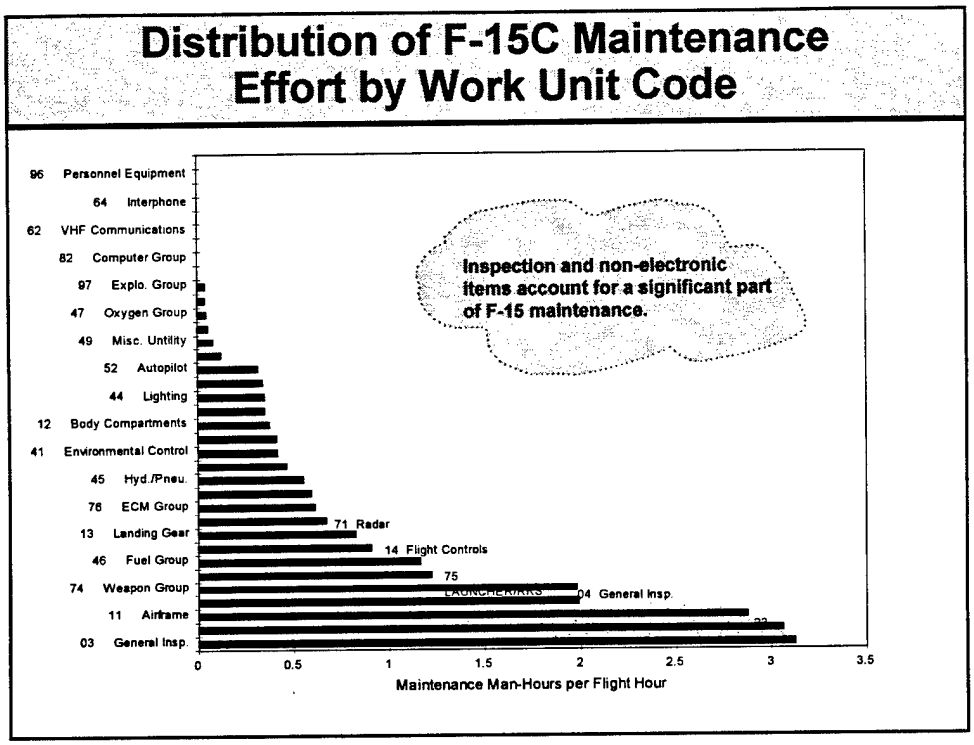
By investing in better test and diagnostic systems for deployable support organizations, we will also improve readiness and reduce costs because there will be fewer false removals and more efficient repair. This will lead to a reduction in unnecessary demands for replacements, resulting in savings in many of the same cost categories associated with improved reliability.

Distribution of USAF O&S Costs Across Aircraft



This chart shows how the Air Force O&M funds were distributed among the fleet in FY 93 in terms of maintenance and fuel outlays. The top four aircraft (F-15, C-141, F-16, B-52) accounted for about 60 percent of the total expenditure. We have no reason to believe that more recent data will show a different picture.

We see a typical Pareto phenomenon—a relatively small number of aircraft types account for a major portion of the costs. These aircraft are usually systems with one or more of the following characteristics: large populations, high operating tempos, or high unit costs. Quite obviously these systems should be the primary targets for R&M enhancements. That's where the costs are!



This chart shows how maintenance man-hours per flight hour—one surrogate for O&S expenditures—are distributed for the F-15C aircraft. Again, a significant portion of funding is concentrated in a relatively small number of systems, thereby providing a focus for initial savings opportunities.

If, for example, nontrivial reductions in inspection frequency (scheduled and phase) could be achieved, there would be a significant reduction in maintenance man-hour requirements with correspondingly lower requirements for maintenance personnel.

The inspection example also illustrates the concept of a leveraged opportunity. Suppose that to achieve a reduction in inspection frequency, the Air Force invested funds to develop a Reliability Centered Maintenance (RCM) strategy for the F-15. RCM, a commonly used strategy of the airlines and also used in some DoD systems, formalizes the concept, "if it ain't broke, don't fix it." Several years' experience of flying the F-15 under RCM, modified as necessary, could then provide the basis for adopting the strategy to other aircraft so that a fleet-wide savings could be realized.

The above example is not wholly hypothetical. The Air Force, through its Weapon System Cost Reduction office (WSCR), estimates that it could save on the order of $19 to $20 million per year by extending the periodic depot maintenance (PDM) interval of the KC-135R aircraft from 48 months to 64 months and adding some corresponding field inspections.

Recent Successes

F-14A/B inertial navigation system	$35M	5+ years
F-15A/B reliability improvement	$197M	5 years
Navy Smart Ship Program		
KC-135R rewiring	$14M	10 months
Abrams tank track and power train	Durability: Track @ 3X PT @ 1.9 X	
LAV engine improvement	$11M	4+ years
F-16 anti-skid brake controller	$11M	4+ years
Dehumidification of operational systems	good European experience	1 year

We found several examples to illustrate the benefits of R&M enhancements. Not all of the examples deal only with reliability and maintainability. Many times, modifications are undertaken to improve performance or operations, and R&M improvement is a natural fallout. Also, the amounts saved are usually seen after a number of years of operation, so that the return on investment and payback values shown are typically estimates based on limited data.

Details on each of the programs shown are presented in Appendix C.

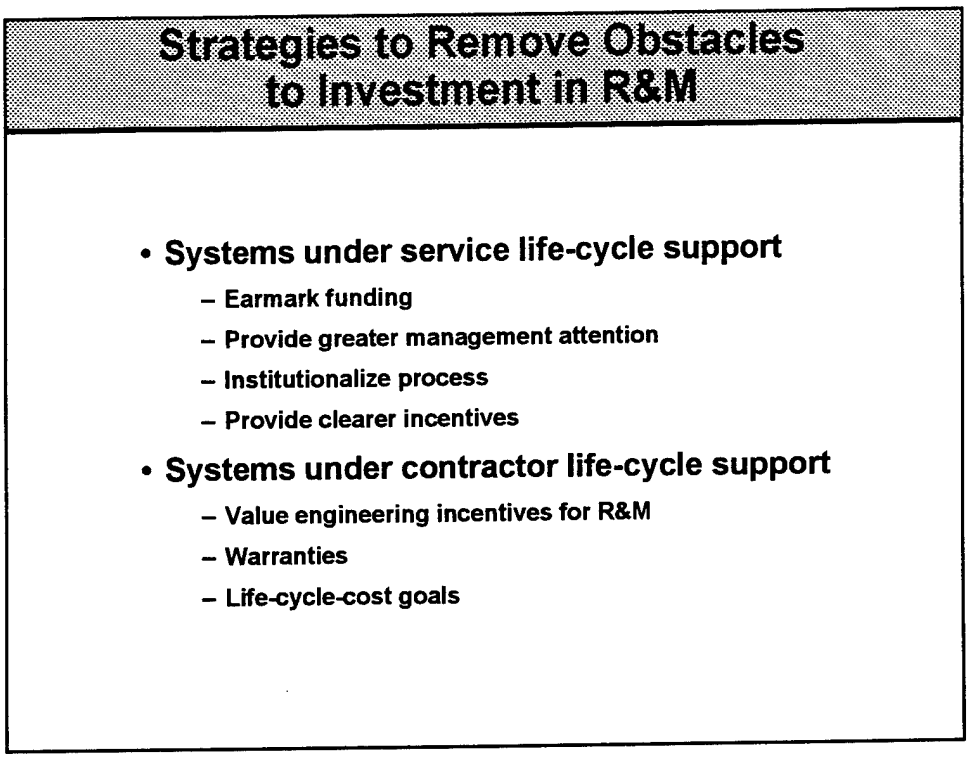
Level of Investment

- **Annual DoD investment in fielded systems' reliability improvement is well under $100 million (The recent PBD 714 will provide $90 million in FY 1997 to fund R&M enhancements)**
- **Backlog of initiatives is generally small**
- **Funding for R&M technology initiatives has declined over the past decade**

Despite the potential for enhanced reliability to reduce logistics costs, a study by the Logistics Management Institute found that the annual direct DoD investment in reliability improvement is on the order of $60 million. This dollar value does not include investments that are part of contractor life-cycle support. Nor does it include expenditures by the Naval Sea Systems Command (NAVSEA) and several other commands, but it is well under what worthy candidates can absorb. In addition, the backlog of initiatives is small, because funds have been unavailable.

However, efforts such as the WSCR and OSCR cost reduction programs are underway to improve this situation. The recent President's Budget Decision (PBD) 714 will provide a needed impetus. It includes an initiative to fund an additional $90 million for reliability improvements.

Another concern is the reduction in funding for R&M technology initiatives that may have been taking place for some time.



Impediments to R&M investments are limited targeted funding, secondary priority of R&M, lack of a formalized R&M investment process, unclear incentives related to R&M achievement, and uncertain contractor motivation. Because of the general trend to take better advantage of industry capabilities in certain areas of operations and support (e.g., the latest revision of DoD 5000.2 encourages such initiatives as contractor logistic support), we have identified strategies to overcome these impediments by considering two classes of systems: those under service life cycle support and those under contractor life cycle support.

Service Life-Cycle Support:

To ensure proper funding, DoD should establish a process that earmarks funds for R&M investment—for both developing and fielded systems. With regard to new systems, this idea may be especially important in light of the 1994 OSD decision not to mandate military specifications and standards. We cannot specify exact amounts or percentages without more detailed study, but it is believed that the current investment in improving the reliability and maintainability of fielded systems (well under $100 million annually) needs considerable augmentation.

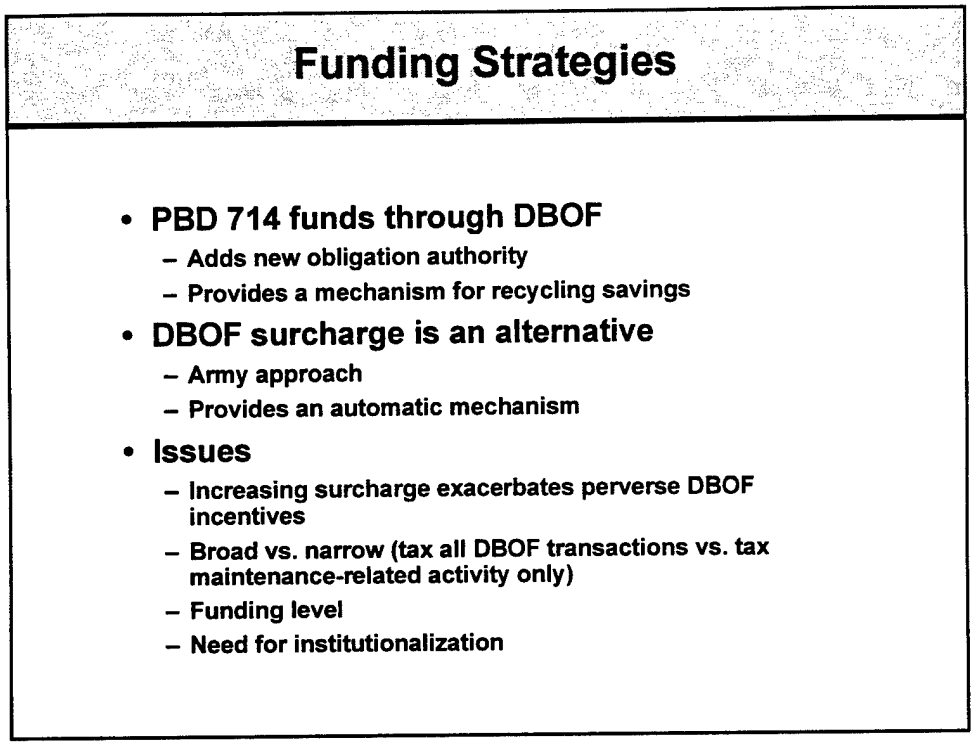
Increased funding will, by itself, generate more management attention but there can be improvements to the management structure that will further ensure achieving the appropriate level of interest, including designating R&M responsibility at a relatively high level and institutionalizing the R&M development and assurance processes.

The incentive equation has to be changed so that R&M achievement and improvement means greater rewards to the program and system managers and more business and profit to the contractor. A way for managers to keep the savings from R&M improvements should be found.

Contractor Life-Cycle Support:

Value engineering programs, warranties, and life-cycle cost goals are ways in which there can be forms of contractor life cycle support along with proper contractual structure and incentives for R&M enhancement. For fielded systems, such support generally is initiated as part of a major modification program. We have seen (through such examples as the Army MSE contractor life-cycle support initiative, the Air Force F-16 warranty program, and the Navy F-18 life-cycle cost program) how the contractor can be brought into more direct involvement in developing more reliable, maintainable, and logistically supportable systems by changing the incentive equation so that better R&M means more profit and future business.

The recently published DoD 5000.2 (para 3.3.7) strongly encourages contractor logistics support (CLS) for new systems and major modifications. CLS is probably the most effective way of providing incentives for the achievement of life-cycle cost reduction through the life of the system. The contractor's field service technicians have an incentive to feed back accurate reliability data, to instruct organizational repairers on proper diagnostic and repair procedures, and to suggest ways of improving R&M to the contractor's sustainment engineering group. Sharing value engineering benefits, coupled with warranted performance can generate additional profit for the contractor and R&M benefits for the Service.



PBD 714, Depot Maintenance Reliability Program, issued in January 1996 is designed to augment funding for R&M and safety modifications by increasing the obligational authority of the DBOF by $90 million. If these additional funds act as seed money, savings can be realized for reinvesting in further R&M enhancements. Defining an appropriate level of continuing investment and a way to institutionalize the process are challenges still to be met. (Initiatives are not confined to those modifications that can be applied in depots.)

The Army has employed DBOF funds obtained through a surcharge to pay for modifications of fielded systems. A surcharge has the advantage of providing an automatic mechanism for funding and spreading the cost over a large base. But some claim that the DBOF surcharge is already too high and the costs are not fairly distributed. The danger is that an increased surcharge may add to incentives organizations have to avoid the DBOF process entirely. Another issue to consider is whether the R&M investment surcharge should be broadly based or narrowed to reflect directly affected cost elements such as those related to maintenance.

An alternative strategy would be to directly earmark procurement funds for R&M investment. That strategy would avoid much of the criticism of the broad-based DBOF approach but could present an attractive target of opportunity to those needing additional funding for what are perceived to be higher priority requirements. Adding new obligational authority to the DBOF to fund R&M enhancement (as PBD 714 does) is vulnerable in the same way.

Who Should Be Responsible for R&M Enhancement?

	Pros	Cons
Program managers	Responsibility for system; appropriate skills	Performance oriented; lack of funds
Major commands	Control of funds; concern for readiness	Not sole owner; couldn't keep savings; funds needed for other purposes
System commanders	Access to funds; track R&M already; improved R&M would cut workload	Couldn't keep savings; funds needed to do core work
Assistant service secretaries	High-level attention; access to funds	Would have to delegate development of enhancements and allocation of funds; long-term attention not assured
DUSD (Logistics)	High-level attention; influence over funding; could assure long-term focus	Would have to delegate development of enhancements and allocation of funds; perception of micro-management
Vice Chiefs of the Services	High-level attention; access to funds	Would have to delegate development of enhancements and allocation of funds; long-term attention not assured
Separate Service agencies	Long-term focus	Funds would have to be made available; needs continuing high-level support

We list here a number of alternatives for designating responsibility for R&M enhancement—a necessary step to ensure proper attention.

In general, the lower the level of assigned responsibility, the more the direct interest and the better the available skills; however, a lower level of responsibility means less funding control and decreased long-term interest.

Responsibility at a high level, such as the Vice Chief of Staff of the Services, provides advantages in funding control and continued long-term interest, but presents challenges in allocation and delegation.

R&M Findings and Conclusions

- **Investments in R&M enhancement can have high payoff**
- **Very little has been invested**
- **Provision of incentives and a secure source of funding are critical**
- **PPBS/JROC decision process should establish the appropriate investment level**
- **Continuing high-level attention is needed**

The Task Force found that there can be a high payoff to investing in reliability and maintainability enhancement: payback periods of just 5 years or less and long-term return on investment of over 5 to 1.

Before the issuance of PBD 714 in January 1996, little had been done in recent years to reduce military logistics costs through an R&M enhancement program. The PBD decision to designate improvement funds to FY 97 with incremental financing for out-years based on savings is a good first step. The Task Force believes that it would be prudent to have a more secure and significant funding source. The level of investment should be judged on the basis of the availability of suitable investment projects, and is best decided through the PPBS/Joint Requirements Oversight Council (JROC) process.

To provide the motivation and structure needed to implement the process effectively, continuing attention from high-level management is needed. One alternative is to place DUSD (Logistics) in charge.

R&M Recommendations

- **DUSD(L), in conjunction with the Joint Logistics Commanders and Service Acquisition Executives, should develop a robust process for investment and review to include**
  - **Funding sources and investment levels**
  - **Guidelines for investment decisions**
  - **Incentives for investments**
  - **Use of savings (modernization, future investments)**
  - **Management review (results, payback, refine process)**
- **The Services should incorporate promptly the new contractor life-cycle support guidance of DOD 5000.2 into their ongoing major modifications and new system acquisitions**

The process to improve the reliability and maintainability of fielded systems needs to be institutionalized, and PBD 714 is a first step. A more significant step is to have DUSD (Logistics) in conjunction with the Joint Logistics Commanders and Service Acquisition Executives develop and implement an investment and review process.

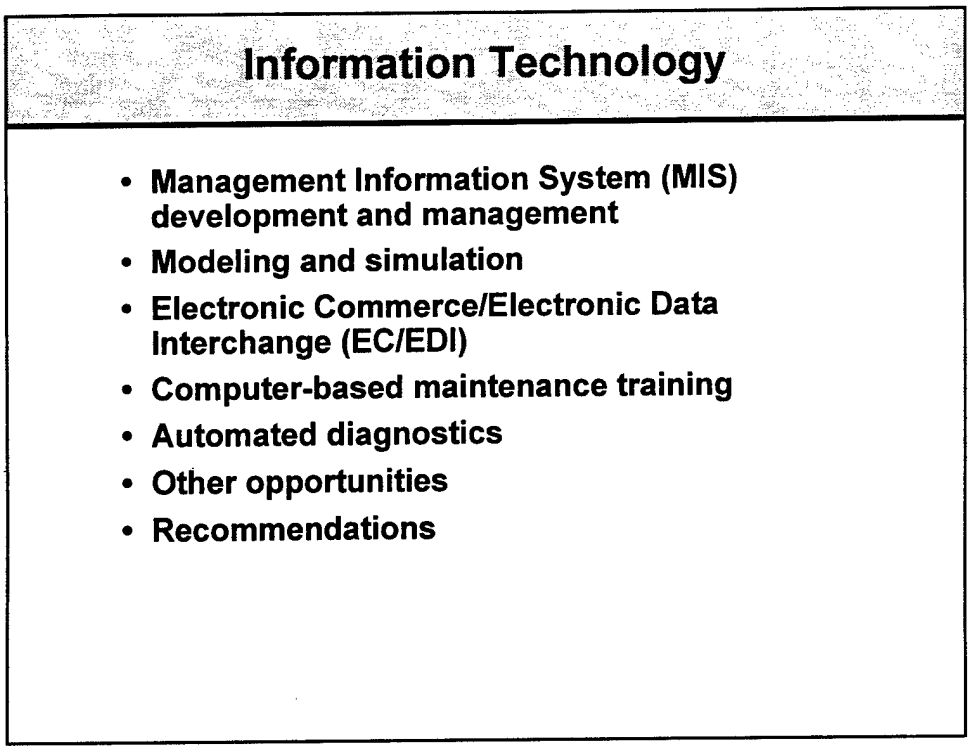
The process should include incentives to ensure appropriate levels of R&M investment. Savings should be used both to fund modernization and to finance additional investments in R&M enhancement so that the enhancement process becomes largely self-sustaining.

A tracking and review system will be needed to assess results and determine payback and return-on-investment metrics so that needed adjustments to the process can be identified and implemented. The DoD Comptroller should provide assistance to ensure proper tracking and review and to ensure that savings are, in fact, used to finance needed logistics cost reductions and procurement investment.

With the policy change in DOD 5000.2 encouraging contractor life-cycle support, the Services can institutionalize the commitment to R&M improvements throughout the life of CLS systems. The R&M investment would serve as a source of supplementary funds to the normal value engineering strategy that can be incorporated into CLS contracts.

Outline of Report

- Introduction
  - Terms of reference--objectives
  - Approach
  - Participants in Task Force activity
- Importance of logistics modernization
- General opportunities for savings
- Issues examined
  - Reliability and maintainability enhancement
  - Information technology
  - Other opportunities
- Logistics vulnerabilities
- Conclusions and recommendations



The Task Force focused on making better use of existing information technology. We proposed better approaches to developing and managing information systems, making greater use of modeling and simulation in integrating logistics into our planning and training, increasing the use of computers in commerce and data interchange, relying more on computer-based maintenance training, and improving the repair process by use of automated diagnostic aids. In addition, we examined other advanced technology opportunities and offer suggestions for incorporating them into logistics processes.

MIS Development and Management: Background

- **History of CIM**
  - DMRD 918
  - Creation of JLSC and other CIM agencies
  - Initial JLSC charter
  - Secretary Perry memos
- **Result: development of stovepiped standard systems**
- **Attempting to force-fit Services into standard systems was inappropriate**

This slide summarizes the key events that led to the current Corporate Information Management (CIM) effort to field standard application systems across the Services. The original DoD objective for the CIM effort was to move from many legacy systems to fewer migration systems and then to re-engineer business processes supported by a shared DoD enterprise database accessed by target application systems. DMRD 918 gave the Defense Information Systems Agency (DISA) responsibility for consolidating data processing into megacenters. In 1992, the JLSC and other CIM agencies were created. The Joint Logistics Systems Center (JLSC) charter was to integrate Service requirements for Wholesale Materiel Management (MM) and Depot Maintenance (DM) and to direct developmental efforts of Service Central Design Activities (CDAs) with respect to MM and DM functions.

A series of memos from Secretary Perry culminated in a 13 October 1994 memo that changed the direction of the program. Migration systems were to be fielded in 3 years and the focus shifted away from process re-engineering to fielding those systems within the 3-year period. When funding shifted from Service CDAs to industry, JLSC execution shifted from requirements management to acquisition program management. The JLSC and other CIM agencies were directed to select standard systems that were the best of breed.

The attempt to force the Services into standard systems is a misguided policy. It would lead to operational problems and sacrifices in functionality for several reasons. Each Service has different business rules that are a consequence of its unique missions. Requirements have been defined at a high level with a lack of consensus on the details. Finally, the standard systems are stovepiped by functional area—this runs counter to the basic nature of logistical support, which cuts across and integrates multiple areas. A consequence of these functional stovepipes is a lack of interoperability with a corresponding requirement for a huge number of interfaces across systems.

Although there has been some limited success with partial sharing of systems across Services (for example, tool control, hazardous materials management, etc.), this sharing has not occurred for the core systems that are the primary focus of the CIM effort. The Task Force concluded that the biggest improvements in productivity and effectiveness are affected by re-engineering processes and by keeping the user closely involved in the development of information systems, not by deploying standard systems.

Recognition of Current Technological Opportunities

- COTS
- Client-server networks
- Open system architectures
- Graphical user interfaces
- Rapid application development
- Rapid prototyping: Ensure user satisfaction
- Common operating environments
- Common data environments

This slide outlines current technological opportunities. MIS architectures built around mainframes and terminals are being replaced by client-server architectures based on networks of servers and workstations. In many cases, needed functionality can be bought off the shelf. Even when functionality must be developed, tools are available to facilitate rapid prototyping and development. With tools supporting rapid application development, applications can be developed in months rather than years. Rapid prototyping tools allow the users to have hands-on experience with the look and feel of the to-be-developed system so that they will know precisely what they are getting before a great deal of time and money has been committed. The local processing capabilities of workstations readily lend themselves to graphical user interfaces with pull-down menus and point-and-click interactions.

Open system architectures allow one to separate the application software from proprietary hardware, system software, and database management software, so one can procure these resources as individual entities based on best value, and upgrade them over time without major impacts on the application software. It is this capability that allows for separation of their management and control as well, allowing users to focus on what they understand best—the functionality required to carry out their tasks.

A common operating environment (COE) provides a standard set of utilities/system software for constructing higher level applications. This allows a diverse set of applications to run within that environment and solves the current problem in which individual applications running on different hardware platforms must be accessed through different terminals. In the final analysis, DoD could migrate to a common hardware and operating system software environment that would support a diverse set of functionally oriented applications running in a client-server environment. Integration standards are key at the COE level and they would be TAFIM/DII compliant, allowing a true plug-and-play environment analogous to the Windows 95 environment.

A common data environment (CDE) provides standard data definitions and shared databases to allow for interoperability between applications.

By following a disciplined approach in developing and maintaining a COE and CDE and making the users focus on a functionally oriented application environment, DoD can eliminate duplication, save money, and promote interoperability.

Principles of MIS Development and Management

Objectives:

- **Interoperability**
  - Seamless flow of data across applications
- **Flexibility**
  - Business rules and practices evolve rapidly
  - Changing requirements are a given
- **Plug-and-play within a common operating environment**
  - Ease of moving to new hardware
  - Not tied to specific vendors
  - Access multiple applications from a single workstation in a way that is transparent to the user
- **Data accountability, discipline, and accuracy**
  - Technology can improve accuracy

There are several key objectives for MIS development and management. In sum, they amount to taking advantage of the technological opportunities that are available. One is interoperability among applications. Current MIS systems supporting both wholesale and retail logistics require a complex web of interfaces in order to transmit and receive data. This complexity is an inevitable consequence of the lack of central data management and control. Each application defines and manages its own data. Interfaces between two applications must translate between different data definitions and formats for the same conceptual data. Interoperability requires standard data definitions and strict data configuration control.

As mentioned previously, flexibility is another key objective. Business rules and practices change rapidly. Flexibility must be designed into any given application.

A third objective is plug-and-play within a common operating environment. In addition to maintaining an open system architecture, users should be able to access multiple applications from a single workstation. Ideally, this should be done in a way that is totally transparent to the users. For the short term, this can be accomplished through middleware/mapper software. For the long term, it can be accomplished by all applications accessing common shared data consisting of standard data elements.

A final objective—and, indeed, a consistent theme throughout our discussion of information technology—is data accountability and discipline. This is critical for achieving interoperability and transparent access to different applications. Data is an enterprise-wide asset and needs to be managed as such.

The adoption of automated data collection procedures, that embed data collection in the normal work flow process, can serve to improve the accuracy of logistics data. Current procedures sometimes hinder the development and maintenance of accurate databases.

Principles of MIS Development and Management (Continued)

- **New approach needed**
  - Logistics cuts across multiple areas
  - Need to integrate information across CIM areas
- **Get in step with private sector**
  - Re-engineer process first
  - Use information engineering to construct MIS environment
  - Impose data discipline and accountability
  - COTS is the preferred solution
  - Outsourcing
- **Recognize that the logistics infrastructure will be much smaller in the future due to privatization and outsourcing**
  - Will affect the approach or size of the MIS environment

Rather than trying to save money by adopting standard application systems, the Services need to take a different approach, one that parallels the best practices from the private sector and keeps pace with advances in technology. The objectives of this approach should be to produce applications (1) quickly (months not years), (2) that are flexible in terms of their ability to change as business rules change and to support disparate users, and (3) integrate information from multiple CIM areas.

The recommended approach begins with re-engineering business processes first and then continues with constructing the MIS environment based on those re-engineered processes. Data management and accountability are critical because data is an enterprise-wide asset. Within this approach, data definitions are managed centrally; applications are either acquired off the shelf or developed within the context of an open system, client-server environment and must adhere to data standards. In general, commercial off-the-shelf (COTS) solutions are preferred and will be selected if there is a suitable (not necessarily perfect) degree of overlap between the business processes and the COTS solution. To the extent possible, when there are discrepancies between business practice and the capabilities of the COTS solution, the business process should be modified to allow use of the COTS product. Experience has shown that changing the COTS software is a recipe for disaster. Last, for application development, outsourcing is preferred to in-house central design activities.

Finally, as outsourcing of logistics processes increases, the DoD must explicitly address the requirements for MIS interfaces, interoperability, common data definitions, etc., as part of structuring outsourcing and privatization arrangements.

How Should DoD Proceed?

- **Get *out* of the business of developing standard applications across all services**
- **Get *into* the business of data management, processing, and distribution**
  - **Provide discipline and accountability in data management**
  - **DISA's GCSS environment is key**
    - » **Backbone technical architecture and building codes**
  - **Parallels private sector technology advancement**

We now turn to how the DoD should proceed to achieve the objective of fielding flexible MIS applications that are integrated across functional areas. There are two major steps. The first is to abandon the effort to develop standard applications across the Services, except in exceptional cases in which the Services have agreed that a standard system makes sense. For these instances, there is a methodology that promotes Service buy-in. This methodology is discussed later in this section. The second step is to focus on providing the infrastructure to promote interoperability. This infrastructure includes centrally managed and controlled data, and it includes a common data environment.

Another aspect of providing the infrastructure is the move to a common operating environment, allowing the user to have access to all data and applications from a single work station. This effort is already well underway in the form of DISA's Global Combat Support System (GCSS), which will provide a common hardware and system software environment across applications in the context of an open system, client-server architecture.

How Should DoD Proceed?
(Continued)

Services develop functional applications:

- **Return application dollars to the Services**
- **JLSC should baseline and complete deployment of centrally developed applications and transfer maintenance responsibility to the Services**
- **Re-engineer processes first, then information engineering to define MIS environment**
- **Build functional applications to the GCSS operating environment**
- **Do not recreate large organic Service CDA's**
  - **Redefine role of CDAs to functional application centers**
  - **CDAs manage rather than develop**
- **Buy COTS**

The Services should be given the responsibility of meeting their own functional requirements within the infrastructure provided by GCSS. The place to begin is with re-engineering the business processes and only then defining the MIS environment to support those processes. In this approach, applications will no longer drive data requirements; rather they must adhere to data standards.

COTS solutions should be implemented where it makes sense. The bias should be to adopt COTS solutions even if minor changes to business rules are required. The Services' central design activities should be primarily given the responsibility of managing requirements, but they should not be responsible for actual software development, except in those rare instances where a COTS solution is not available. Even in these cases, they should outsource the development.

How Should DoD Proceed?
(Continued)

Recognize continuing need for *some* organization to perform central DoD functions:

- **Standardize logistics data and control configuration**
- **Integrate logistics with other core applications (e.g., financial management, procurement, JCALS)**
- **Create Joint Service review group to act as clearinghouse for COTS/application sharing**
- **Encourage use of existing code**

A central organization should be made responsible for defining standard data elements for the Services to use in developing their own applications. The organization should also serve as the configuration control agency for data. If users want to add new data elements, this would only be done through the organization's configuration control process.

To promote application sharing, a Joint Service review group should be put in place to serve as a clearinghouse. In this role, it would be able to direct the reuse of existing code to avoid costly new development efforts.

How Should DoD Proceed?
(Continued)

- **Determine approach to the development of standard system applications for those cases where warranted (e.g., LSA/LSAR, electronic Commercial cataloging)**
- **Consider approach sponsored by USD(A&T)**
  - **Lead Service/DLA**
  - **Joint functional requirements**
  - **Utilize DoD enterprise model**
  - **Streamline requirements documentation**
  - **Financed by DoD**
  - **Joint Logistics ACTD for accelerated introduction**

For those cases in which the Services agree that a standard system makes sense, the approach sponsored by the Under Secretary of Defense (Acquisition and Technology) [USD (A&T)] should be considered. The key features of this approach are noted above.

How Should DoD Proceed? (Continued)

- **Adapt acquisition and oversight to new realities**
  - To keep pace with advances in technology
  - To meet needs quickly
- **Revise current MAISRC process**
  - Current MAISRC process for information systems out of step with modern development practices
    - » Detriment to information systems modernization particularly for logistics
    - » Barrier to acquisition reform for information systems
  - Nature of information technology requires incremental improvement
  - Need to accommodate rapid prototyping, COTS solutions

To build an MIS that supports continuous improvement in business processes, the architecture must be flexible: it must accommodate changes in hardware platforms, system software, and in database and communications technology. The need to accommodate continuously changing requirements requires a development process that incorporates rapid prototyping and the development and fielding of incremental improvements. DISA calls this new process, "build a little, test a little, field a lot."

Said another way, the private sector is on an accelerated information systems technology path. If DoD is to benefit from this fast-paced technology growth, it must adapt its acquisition practices to these new realities.

A corresponding change in oversight in needed. The Major Automated Information System Review Council (MAISRC) milestones follow the outdated process of specifying requirements up front, developing a complete application over a period of years, and then fielding the system. This inflexible approach guarantees the fielding of an obsolete system.

The milestone approach is irrelevant. It hampers adjustment to changing requirements and is inconsistent with best commercial practices, which involve rapid prototyping. Delays have commonly occurred in the development and fielding of required information handling capability under the current system.

Finally, in the Task Force's view, the MAISRC system is a barrier to acquisition reform being embraced by the Services, DoD, and Congress.

Impact of MIS Strategy

- **Stop unproductive developments of core applications reducing DBOF requirement (and prices)**
- **Speed incorporation of process improvements into Services/DLA core systems for more accurate/timely information and further reduced costs**
- **Allow focus on meeting the common/joint information needs**

By adopting our recommended strategy for the development and management of logistics management information systems and databases, DoD would end the waste that has been associated with the centralized development of core computer applications, permitting the overhead costs reflected in DBOF surcharges to decrease.

The greater flexibility associated with the new management approach would allow management information systems to be improved more quickly as the state of the art advances.

By allowing users to meet their own unique needs, central management will be better able to focus on information needs that cut across users. They will be done by maintaining control of data definitions and by appropriately coordinating the use of COTS and the reuse of software.

Modeling and Simulation

- **Integrate operations and logistics**
  - Logisticians and warfighters act as team rather than stovepipes
- **Models should be developed to facilitate:**
  - War planning
    - » Requirements determination
    - » Transportation planning
    - » Support to execution and real-time re-planning
  - Training and war gaming
    - » Train as you fight
  - Force assessment and planning/programming
    - » Relate policy choices to prospect of wartime success
  - Funding should first be sought through restructuring existing M&S program. J4-J7 team can oversee.
- **Applies to both Service and Joint operations**

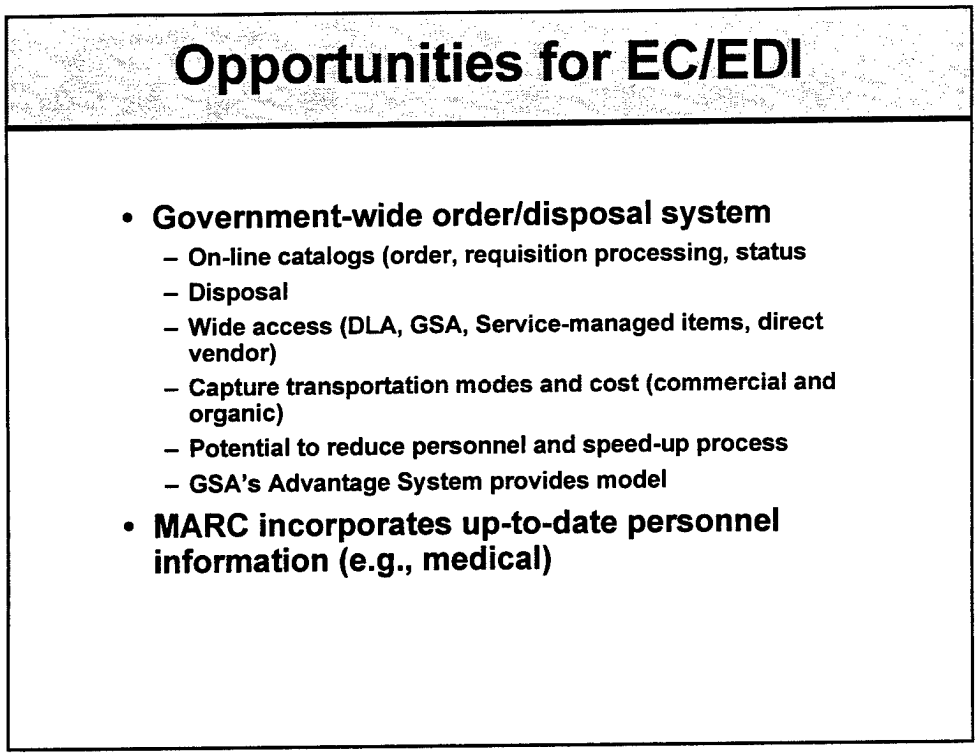
Recent advances in information technology enable us to make substantial improvements in modeling and simulation. Making modern logistics strategies such as lean logistics work requires tight integration of operations and logistics. Logisticians must understand the needs of warfighters and warfighters must be confident that logisticians will be able to support them. Improved modeling and simulation is needed to make this happen.

Better logistics simulations are needed to improve planning for war. We must be better able to calculate overall requirements, coherently plan transportation to move items from their points of origin to the final user, and have the ability to rapidly cope with changed situations.

Logistics must be realistically incorporated into war games and training exercises. Operators must come to understand the constraints that logistics provide in the real world. Assuming the adequacy of logistics during training exercises does not encourage the proper attention to logistics in planning for war.

Tools are needed to allow programmers to measure the value of logistics assets using the same yardstick used for combat assets. Today's analytic models (like those used in the Army's Total Army Analysis) do not permit this. Logistics "requirements" are calculated, but the implications of failing to meet the requirements are never identified. This makes logistics look like less than what it is: a full partner in the production of combat success.

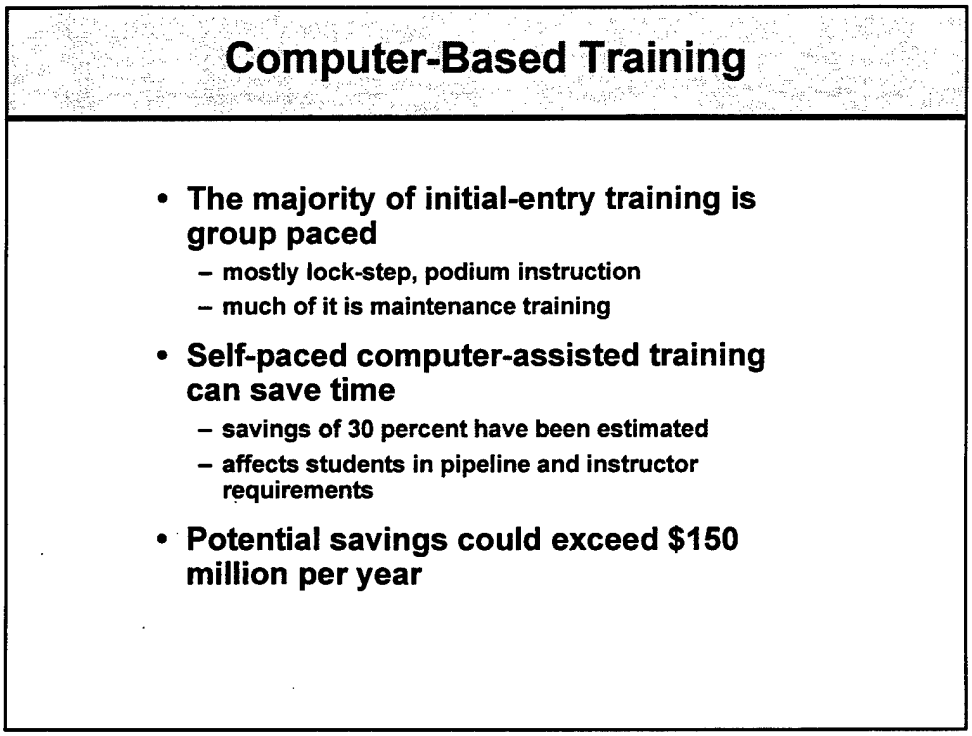
There is a particular shortage of relevant modeling and simulation in the Joint arena.



Electronic Commerce/Electronic Data Interchange (EC/EDI) involves using computers for normal housing and data functions that used to be done by hand. One application is a government-wide system for ordering and disposing of materiel, using such mechanisms as on-line catalogs. Computerized systems can give the consumer wide access to items controlled by Defense Logistics Agency (DLA), Government Services Administration (GSA), and the Services, and they can even permit users to deal directly with vendors.

The Advantage System being developed by GSA is an example of a government-wide order and disposal system.

Another example of EC/EDI is the Multi-Technology Automated Reader Card (MARC), which contains medical and other updatable personnel information that military personnel could carry around with them. It is the size of a credit card and contains a 2K computer chip along with a bar code, a magnetic stripe, a photo, and printed information.



A strong case can be made that interactive, self-paced training (often called computer-based training) offers a way to save money on training in general, and maintenance training in particular. These savings are possible due to the development of interactive courseware (ICW) made cost-effective by continuing decreases in the price of computer hardware and software. The two questions to be answered are (1) can ICW save money in training and (2) do the opportunities for such savings exist in current military training procedures?

Several studies of military and civilian training have reported significant savings through self-paced, computer-assisted training. Although savings estimates vary, 30 percent is representative. Some of these savings accrue in the process of course development, production, and delivery. However, one of the main source of savings is in student time. This turns out to be a dominant factor in military training, where the students are being paid for their time and are unavailable to perform their normal duties while in training.

Will it save money for military maintenance training? We believe so. A few years ago, IDA examined whether the current approach to military training could take greater advantage of self-pacing and interactive courseware.[1] An analysis of 1989 Navy data on initial skill training found that the majority of students go through courses that are lock-step as opposed to self-paced, and a majority of those courses involve mostly standard podium instruction. Also, a large proportion of student time is spent in a relatively small number of courses, (e.g., one-third of Navy initial skill training load was concentrated in 27 identifiable courses) and half of those were maintenance related.

Based on conservative assumptions (that only 20 percent of the student load would be affected, and that savings would only be 20 percent), IDA estimated that DoD-wide savings could be $150 million per year, and that a given enlisted endstrength in operational units could be maintained with 10,000 fewer enlisted personnel.

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[1] Angier, Bruce N., John D. Fletcher and Stanley A. Horowitz, "Interactive Courseware (ICW) and the Cost of Individual Training," Institute for Edefense Analyses, Paper P-2567, November 1992.

Automated Diagnostics Aids

- **Technology can combine digitized technical manuals with artificial intelligence**
  - Uses information on the nature of the failure to help isolate faults
    - » Guides repair process
    - » Updates advice as new information is gathered
    - » IMIS is a working example
  - Can add "point-and-click" replacement ordering
- **Results of IMIS test on F-16**
  - Solved 23 percent more problems
  - Used 31 percent fewer parts
  - Reduced repair time 23 percent
  - Reduced major errors 70 percent
  - Reduced requirement for skilled specialists
- **Conclusions**
  - Opportunity for substantial manpower reductions
  - Reduction in good parts sent for repair can help new logistics paradigm work

Automated diagnostic aids, sometimes called job performance aids, provide a branching logic (try this, observe the result, and decide what to do next) to help maintainers troubleshoot and isolate problems. Research on a computer-based information system that a technician could use to support maintenance in a field environment has been going on at least since 1980. The Integrated Maintenance Information System (IMIS) uses this kind of approach. It was prototyped on the F/A-18 and then adapted to the F-16. A controlled field test of the system at Luke Air Force Base in 1994 yielded excellent results.

The success of two groups of maintainers, one with IMIS and one without, were compared. Use of IMIS allowed maintainers to complete 23 percent more repairs, using 31 percent fewer parts. Repair time was cut an average of 23 percent and major errors were reduced 70 percent. Journeymen were usually able to do work that typically requires skilled specialists.

The reductions in hands-on repair time and in time wasted trying to fix unbroken components provide an opportunity for cutting the number of maintenance personnel. In addition, sending fewer good parts to the depot for repair can play an important role in making "lean logistics" work, by taking some of the pressure off the depots and the transportation system. Note: an Army prototype has added point-and-click ordering of the needed replacement parts.

IMIS can save the F-16 community at least $38 million per year. The total development costs were $81 million, so the system pays for itself within a couple of years after fielding.

Other Opportunities

Exploit information technology developments that benefit logistics:

- **Include in Global Broadcast System (direct broadcast) ACTD status information**
- **Orient Joint Total Asset Visibility (JTAV) as the logistics data fusion process for the Joint Logistics ACTD "Logistics Anchor Desk"(LAD) theater logistics C^2 platform, using the Battlefield Awareness and Data Dissemination (BADD) ACTD (GBS) communications architecture**
- **Develop Joint logistics command and control systems through linked evolution of Service systems, Joint Logistics ACTD (LAD), and JTAV technologies**
- **Expand Joint, Service and OSD involvement in DARPA "Advanced Logistics Program"**
  - **More timely and accurate logistics information**
  - **Dynamic replanning capability**

Other ongoing improvements in information technology should be harnessed to improve logistics.

The Global Broadcast System Advanced Concept Technology Demonstration (ACTD) should incorporate inventory, requisition, and shipment information, to complement and facilitate real-time inventory processing.

The Joint Total Asset Visibility (JTAV) Program should facilitate the improvement of logistics command and control through linked evolution of the Services' systems.

DARPA's work in support of logistics simulation deserves support. It will allow more complete logistics planning and provide a better capability to adapt logistics to changed circumstances. Funding appears adequate.

Information Technology Recommendations

- **MIS Development and Management**
  - Abandon CIM stovepipe application development for DoD-wide use
  - Adopt a data-focused approach with DoD-wide data standards
  - Streamline acquisition policy
- **Modeling and Simulation**
  - Develop end-to-end logistics simulations
  - Incorporate logistics realistically into all war games
  - Integrate logistics elements into combat models used to support force assessment and planning
  - Fund through restructuring program
- **EC/EDI**
  - Develop a government-wide order/disposal system
  - Consider greater use of smart cards (like MARC) for data interchange

This viewgraph summarizes the overall recommendations for information technology. The CIM standard system approach should be abandoned. The JLSC should be disestablished and the dollars returned to the Services to develop their own applications under the GCSS architecture. In addition, DISA should be given the responsibility for defining and controlling standard data elements. Acquisition policy should be streamlined, including the MAISRC oversight process.

Logistics should be an integral part of war games and combat models. Funding for this effort most likely can be handled in the yearly program development.

Finally, a government-wide order/disposal system — perhaps GSA Advantage — should be developed. Smart cards, which offer potential for a portable means of data interchange that can be updated, should be evaluated for early adoption. Paybacks in reduced infrastructure make these systems practically self-financing in the same year since technology already exists in the commercial world.

Information Technology Recommendations (continued)

- **Computer-based training**
  - encourage conversion of high-volume maintenance training pipelines to self-paced computer-based training
- **Maintenance aids**
  - integrate deployable electronic tech manuals and diagnostics with maintenance and parts' supply MIS
- **Exploit other information-technology-related activities**
  - Global Broadcast Service, Joint Total Asset Visibility, DARPA program

Computer-based training uses a mature technology of proven value. It should be broadly applied to high-volume maintenance training pipelines.

IMIS has shown that artificial intelligence can make the job of maintenance easier. Not only can this kind of technology reduce personnel and training costs, it can also reduce parts and transportation costs by reducing the number of good parts mistakenly sent to depots for repair.

Efforts to improve logistics command and control, including better communications, better information on the location of assets, and a better planning capability, should be encouraged.

Outline of Report

- Introduction
  - Terms of reference--objectives
  - Approach
  - Participants in Task Force activity
- Importance of logistics modernization
- General opportunities for savings
- Issues examined
  - Reliability and maintainability enhancement
  - Information technology
  - Other opportunities
- Logistics vulnerabilities
- Conclusions and recommendations

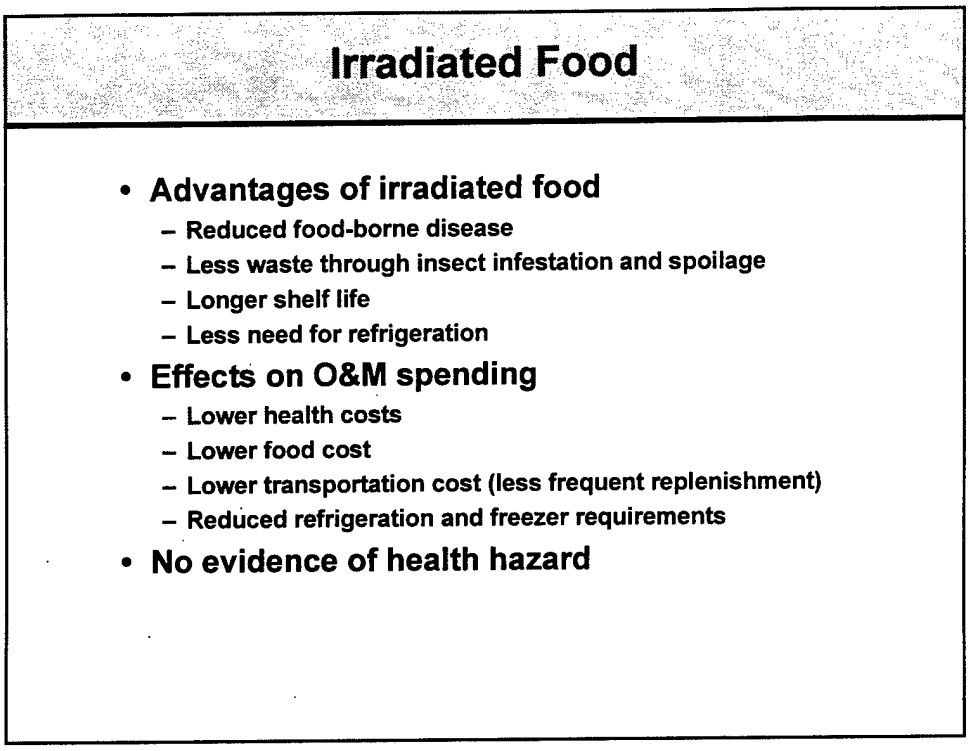
Other Logistics Technology Opportunities

- Food irradiation
- Flexible manufacturing
- Telemedicine

In our search for opportunities for logistics modernization, we have found several other topics that deserve more attention.

We were able to gather a moderate amount of information supporting the greater use of food irradiation as a means of preservation.

Flexible manufacturing and Telemedicine seem like worthwhile concepts to pursue. The Task Force did not examine them in detail, but recommends that DoD continue its pursuit of both.



NASA has been using irradiation to preserve food for its astronauts for over 20 years. It reduces food-borne disease, leads to less waste, and greatly extends shelf life. Irradiated food needs less refrigeration. A proven, safe technology, it leads to lower O&S spending.

Savings from Food Irradiation

Cost savings from reduced spoilage and delayed ripening of fruit

	Spending 1994	Estimated Savings
Fresh fruit and vegetables	$ 313 million	$ 31.3 million
Chilled and frozen foods		
Poultry and ground beef	56	5.6
Other	265	—
Semi-perishable (canned, dry)	156	—
Operational rations	234	—
Total	$1,024 million	$ 36.9 million

Source: U.S. Army Natick Research, Development and Engineering Center

The Army Research, Development and Engineering facility at Natick estimates that reduced spoilage could save approximately $37 million per year. In addition, irradiation would result in improved health of military personnel, tastier food than MREs, and reduced spending for food, health, refrigeration, and transportation. The true savings could be many times as large.

DoD should join with the growing commercial trend in irradiation of food so as to take early advantage of the benefits noted above.

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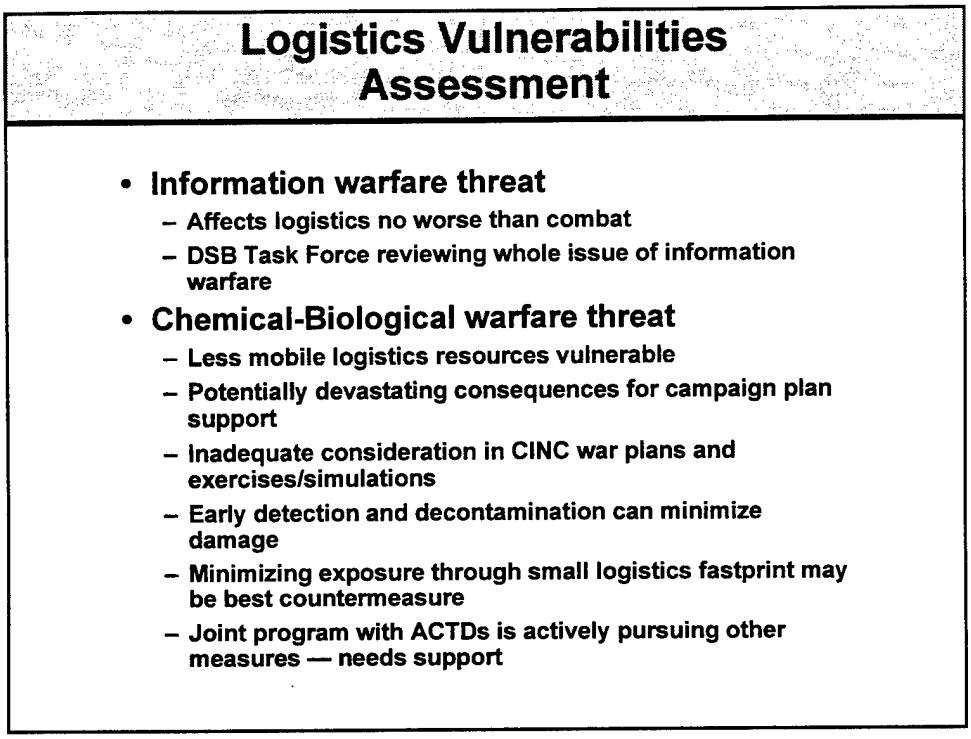

At the Chairman, DSB's request, the Task Force on Logistics Modernization studied the area of logistics vulnerability in addition to the topics included in the Terms of Reference. We found two issues of paramount concern:

Information warfare

Chemical-Biological warfare

We concluded that information warfare will subject logistics processes to the same types of disruptions as it will combat operations and decided to defer further exploration to the DSB Task Force already working on this threat.

Regarding the chemical-biological warfare threats, we concluded the following:

Logistics resources are particularly vulnerable because of their reduced mobility and lack of dedicated defenses. Support equipment and entry airfields, ports, and storage areas can be rendered unusable, with major disruptive consequences for combat operations. Early detection and decontamination can help to minimize the damage, but both are problematic.

Although the results of chemical-biological attack are potentially devastating, the threat to logistics resources does not appear to be adequately considered in the CINCs' war plans or in training exercises.

Logistics Vulnerabilities Recommendations

- **CINCs and JCS should:**
  - **Modify war plans, simulations, and exercises to include courses of action to deal with the chemical-biological threat**
  - **Consider ways to reduce the in-theater logistics footprint to minimize exposure to chemical-biological threats**
- **DoD leadership should**
  - **Support the Joint Program for chemical-biological defense with adequate RDA funding for such improvements as "hardened" materials, overpressure shelters, and detection systems**

Remedial steps can bring chemical-biological considerations into our planning:

CINC war plans should include courses of action to respond to adversary use of chemical and biological agents.

Simulations should be developed to bring chemical-biological considerations into studying courses of action, conducting exercises, and analyzing logistics support options.

In addition to planning, we can take concrete steps to minimize the effects of chemical and biological attack:

Continue efforts such as the Air Base/Port Biological ACTD that are developing an automatic detection system to improve early warning.

Although leaders must make judgments regarding affordability vs. risk, we should be spending at least some RDA funds on "hardening" approaches, such as using resistant materials in acquiring new systems and modifications. Additionally, logistics forces that would be exposed to the threat should be equipped with hardened (overpressure) shelters to protect people, command and control systems, and other critical equipment.

Given that reducing the exposure of our logistics forces will lessen their vulnerability to chemical-biological attack, DoD should consider ways to reduce the footprint of in-theater logistics.

In order to make efficient use of scarce funds, DoD has organized a joint program to coordinate the Services' efforts to cope with the chemical-biological threat. The Task Force was impressed with the efforts of Major General George Friel, who oversees this joint program.

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Conclusions and Recommendations

To reduce weapons systems O&S costs while enhancing readiness, DoD should:

- **Build on PBD 714 to encourage investment in R&M-enhancing technology**
  - DUSD(L) should lead the effort
  - Outsourcing logistics support of weapons systems creates best incentives
- **Revise the process for developing logistics management information systems**
  - Return application development to Services
  - Eliminate the MAISRC process
  - Centrally manage data definitions; encourage use of COTS and reuse of code
- **Encourage the use of simulations in logistics and of logistics in simulations**
- **Expand use of self-paced computer-based maintenance training**
- **Expand the use of automated diagnostic aids like IMIS**
- **Move toward routine use of food irradiation**
- **Exploit information technology in JLOG, BADD ACTDs**
- **Recognize and act upon the potentially devastating vulnerability of theater logistics to the chemical-biological threat**

To summarize the key features of this report:

There have been inadequate investments in improving the reliability and maintainability of fielded systems because it has been a low priority of the Services. An institutionalized process to encourage R&M enhancement, managed by OSD, should be implemented. Greater use of contractor logistics support, coupled with appropriate contractual incentives offers the best incentives for making R&M modifications and realizing O&S savings.

Recent efforts to centralize the development of logistics MIS applications should be terminated. Responsibility for applications should be closer to the user. Central responsibility should be confined to defining system and data architectures and to acting as a clearinghouse for Service-run application developments. The current MAISRC process is an impediment to expeditious fielding of computer applications and is contrary to the commercial practice of rapid prototyping. It should be abolished.

End-to-end simulations of the logistics pipeline should be developed to facilitate operational logistics planning. In addition, logistics should be realistically incorporated into both training simulations (to add a key element of realism) and simulations used to support the programming process (to promote balance between spending on logistics and spending in other areas).

Greater use of computer-based maintenance training, automated diagnostic aids, and irradiated food can all save a fair amount of money in the reasonably short run and contribute to enhanced readiness.

In the longer term, the information technologies being demonstrated in several ACTDs offer additional potential. (BADD stands for Battlefield Awareness and Data Dissemination.)

Appendix A

Terms of Reference

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION AND
TECHNOLOGY

JUN 0 2 1995

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Terms of Reference--Defense Science Board Task Force on Logistics Modernization

You are requested to establish a Defense Science Board (DSB) Task Force to address the technologies that will affect the cost of ownership for current and future weapon systems. Work should begin as soon as possible, with the Task Force providing an interim report by December 1, 1995, and a final report by March 1, 1996.

The Task Force should address the following questions related to reducing logistics costs through modernization:

- What logistics related technology opportunities are available to reduce costs while providing enhanced readiness, deployability and sustainment?
- What investment strategy is required to achieve the desired level of logistics cost reduction? Consider the following areas:

New Weapon Systems Technology's Effect on Logistics - Implications of new weapon system technologies on the logistics system; impact of smart munitions on lift requirements and the logistics support; impact of other technologies, such as much higher fuel efficiency, solid fuels, greatly improved diagnostics, much smaller munitions, self-repairing circuits, composite materials, and reduced amounts of communications equipment that would significantly change the deployment footprint and have a significant impact on modernizing the logistics system.

Information Technology Enhancing Logistics - Implication of logistics information system initiatives, such as total asset visibility and low earth orbit satellites, on battlefield information systems; implications of automatic "diagnostics" such as tanks that report they need more ammunition based on the firing rate or aircraft that report they need engine overhaul based on turbine revolutions; impact on the C3I infrastructure to support requirements for these and other initiatives such as "lean logistics" or "velocity management" that depend on immediate information; other logistics information system activities that would enhance warfighting capabilities.

Logistics Technologies for Current Systems - Initiatives that would influence the future cost of logistics for existing systems, possibly including flexible manufacturing, artificial intelligence, digital training and technical manuals, technology insertion that impact reliability and supportability, negotiating changes to weapon system contracts to include logistics support, life extension, etc.

The Task Force will portray the totality of the value of logistics modernization to the DoD. The Deputy Under Secretary of Defense (Logistics) will sponsor this Task Force. Mrs. Joan Habermann will serve as Chairman of the Task Force. Lieutenant Colenel Kerry M. Brown, USA, of the Office of the DUSD (Logistics) will serve as Executive Secretary. Lieutenant Colonel Keith Larson, USAF, will be the Defense Science Board Secretariat representative. The office of the USD (A&T) will provide funding and other support as may be necessary. It is not anticipated that the work assigned to this Task Force will cause any member to be placed in the position of acting as a procurement official.

Paul G. Kaminski

Appendix B

Briefings Received by the Task Force

Briefings Received by the Task Force

"Commercial Practices on Iridium," Mr. Darrell Blackburn, Motorola, 26 July 1995.

"Logistics Research and Development," LTC Doyle Weishar, ARPA, 26 July 1995.

"Army Modernization Initiatives Impacting Logistics," Mr. Alan Estevez, Army, 26 July 1995.

"Navy Logistics Modernization Projects," CDR Ted Brown, Navy, 26 July 1995.

"Logistics Management Information Systems," COL Collings, Air Force, 26 July 1995.

"Pollution Prevention," 26 July 1995.

"Advanced Expeditionary Combat Service Support," COL Bloomer, Marine Corps, 26 July 1995.

"Revolution in Military Affairs & Logistics," Mr. Dan Fox, RAND, 25 September 1995.

"ITV, GTN & Security," COL Victor Wald, TRANSCOM, 25 September 1995.

Briefings Received by the Task Force

"J-4 Logistics Support," COL Ed Fellers, 25 September 1995.

UPS Briefing, Mr. Steve Smith, 25 September 1995.

Lockheed Briefing, Mr. Jerry Sills, 25 September 1995.

"Reducing Logistics Related Cost of Ownership," Mr. Dennis Wightman, LMI, 25 September 1995.

Boeing Briefing, Mr Thomas Schick, 26 September 1995.

"Privatization & the Reinvented DLA," MG William Hallin, 26 September 1995.

"OSD Privatization," Mr. Joshua Gotbaum, 26 September 1995.

JLSC Briefing, Mrs. Glasgow, 30 October 1995.

"Infusing Logistics into Modeling and Simulation," Mr. Fred Czerner, Synergy, 30 October 1995.

"Chemical Vulnerability," MG Friel, 7 November 1995.

Briefings Received by the Task Force

"Reviewing Joint War Plans," COL Mongeon, 7 November 1995.

"Information Warfare," Dr. William Neal, 7 November 1995.

MSE Brief, Mr. Madnick, 8 November 1995

"Technology Insertion," Mr. Stanley Horowitz, IDA, 8 November 1995.

"Global Combat Support System (GCSS)," ADM Gaus, DISA, 16 November 1995.

"TRANSTAC," Mr. Brian Sharkey, ARPA, 17 November 1995.

"DTAV," Mr. Brian Shortell, 17 November 1995.

"TRANSTECH," Mr. Brian Sharkey, ARPA, 6 December 1995.

Air Force Briefing, LTG Babbit, 6 December 1995.

"Multi-Technology Automated Reader Cards (MARC)," Mr. Mike Noll, 5 February 1996.

"Food Irradiation," Ms. Vicki Loveridge, 5 February 1996.

Briefings Received by the Task Force

"Logistics Vulnerability," Mr. William Tuttle, 5 February 1996.

"Information Technology," Mr. Stephen Loftus, 5 February 1996.

GSA Advantage Briefing, Mrs. Kathleen Carson, 6 February 1996.

"Status of Life Cycle Reduction, Mr. Royce Kneece, 6 February 1996.

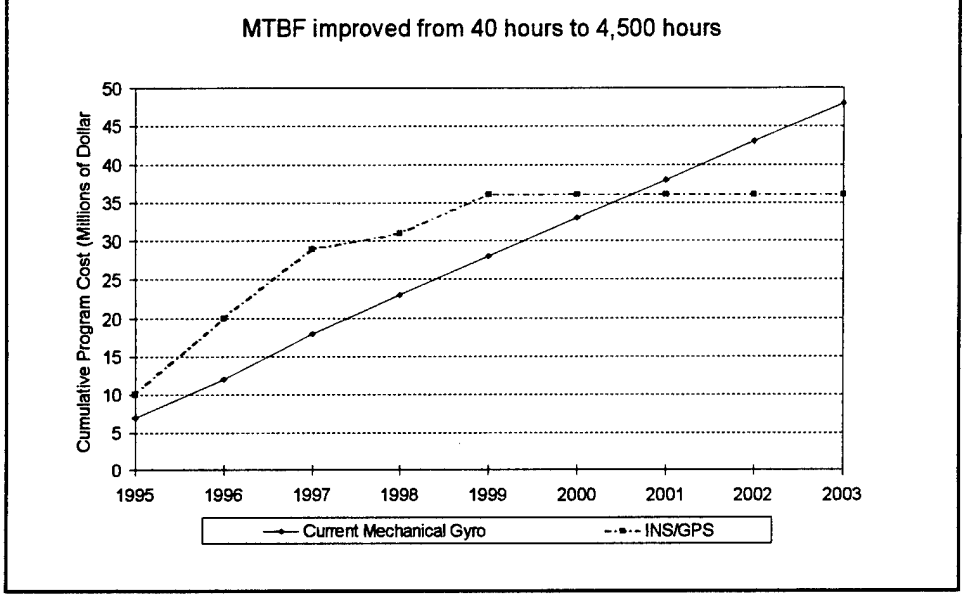
"BADD-Battlefield Awareness Data Dissemination," Mr. Crites, 19 March 1996.

"Logistics Joint Technical Architecture," Dr. Kaplan, 19 March 1996.

Appendix C

Examples of Benefits of Reliability and Maintainability Enhancements

F-14A/B Inertial Navigation System



This example of technology insertion for reliability enhancement involves the inertial system on the Navy F-14A/B aircraft. It is based on data provided by the Navy Aviation Supply Office BOSS III program.

The original unit was a mechanical gyro with a mean time between failure (MTBF) of about 40 hours. This low reliability results in an expectation of about 7 or 8 annual failures per aircraft. In addition, such sensitive mechanical devices usually require periodic calibration and expensive refurbishing.

The replacement, a modern computer-based inertial system using GPS technology, is expected to have a MTBF on the order of 4,500 hours. Bringing the new system on board will increase costs over the current system until about the middle of 2000, at which time the break-even point is reached. After that, the new system will accumulate very little annual cost since the MTBF is greater than the yearly flying hours per aircraft by much more than a factor of 10.

In this case, we have an example of new technology providing payback in less than 6 years and, at the same time, providing better performance and significantly enhanced readiness.

Benefits of F-15A/B Reliability Improvements

- **MTBM improves from 2.22 hours to 2.46 hours (A/B aircraft, 10 mods)**
- **Modification cost: $197 million for 625 aircraft**
- **Successful sortie rate in combat up over 10 percent for 10 mods, 22.1 percent for 30 mods**
- **Savings over 20 years: $870 million *plus enhanced performance and readiness***
- **Break even in 5 years**

Note: Air Force estimates based on a set of R&M subsystem modifications to the aircraft

The Air Staff evaluated a series of improvements for the F-15 aircraft fleet that involved various R&M modifications, a number of which have been funded. These improvements range from changes to the anti-g hose disconnect at a cost of $1.3 million, to an improvement in the APG-63 antenna at a total cost of $67 million. The Air Staff concluded that an investment of $197 million over 625 A/B aircraft would improve aircraft mean time between maintenance (MTBM) by about 10 percent. The total MTBM improvement to the units being modified is better than 3 to 1. The allocated modification cost per aircraft is about $325,000, equivalent to about 1.2 percent of the flyaway costs.

The above results translate to an improvement in combat sortie rate capability of better than 10 percent and a projected ownership cost savings of $870 million over 20 years. This corresponds to a payback period of about 5 years.

Navy Smart Ship Program

- **Program designed to reduce ship operating costs through**
  - **Technological innovation**
  - **Re-examining age-old standard procedures**
- **Primary focus is reduction in crew size**
- **R&M initiatives include**
  - **Integrated Condition Assessment (ICAS)**
  - **New corrosion control procedures**

To achieve the goal of a leaner Navy, the cruiser USS *Yorktown* and the destroyer USS *Harry W. Hill* are being outfitted as operational test beds for the SMART ship concept advocated by Navy Chief of Operations, Admiral Mike Boorda.

The program is designed to reduce ship operating costs through better technology and re-examining age-old practices and standards that may no longer be cost-effective.

The primary focus of the inititiative is to reduce crew size. The annual payroll for *Yorktown*'s 360 man crew is $9 million. Technological insertions to achieve an "integrated bridge" will reduce the bridge manning from 12 to 5, and there are possibilities for even further reductions.

The major R&M-related inititiatives are in the area of diagnostics. Sensors will be installed on many ship systems, including pumps, engines, and compressors, and be tied into an Integrated Condition Assessment System (ICAS). New corrosion control material and processes are also being implemented to significantly reduce maintenance manpower requirements.

The KC-135R Rewiring

	Costs in Millions of Then-Year Dollars					
	FY96	FY97	FY98	FY99	FY00	Total
Investment	13.7	—	—	—	—	13.7
Savings	15.8	21.0	21.7	22.5	23.3	104.3
Net savings	2.1	21.0	21.7	22.5	23.3	90.6

Involves replacement of wiring in 25 mission-essential/flight-safety systems that deteriorated due to effects of age and the operating environment

The Air Force Weapon System Cost Reduction office has sponsored a program to rewire the KC-135R aircraft. The program involves 25 deteriorating mission-essential/flight-safety systems. For an investment of $13.7 million, a total savings of over $90 million (then-year dollars) over 5 years is expected. This is equivalent to a savings in cost per flying hour on the order of $200. Presumably, additional cost and effectiveness benefits would result from the reduced maintenance demand. The Air Force has characterized this initiative to have zero risk. The program is now over half complete.

Abrams Tank Track and Power Train

- **Track durability**
  - Requirement for 2,000 miles between maintenance
  - Original design achieved 736 miles
  - New design getting 2,100 miles
- **Power train durability**
  - Requirement for 50 percent of power trains to last 4,000 miles
  - Original design achieved 37 percent
  - New design getting 66 percent

Since its inception in 1973, the R&M improvement process in the Army's Abrams tank program has been continuous. An extensive RAM data collection and analysis system that has been supported by the Army Material System Analysis Activity (which supplied the information shown on the slide) has been in force throughout all phases.

In addition, there have been specialized RAM/durability testing programs to uncover problems and to test proposed solutions. To meet an upgraded 2,000 miles between maintenance requirement for the track system, two alternatives were tested for over 12,000 miles each. The selected system met the goal, resulting in nearly a 3 to 1 improvement over the current system.

To improve power train durability, seven tanks were tested for over 42,000 miles, equivalent to over 6 years of operation for each tank. As a result of improvements made, the Army estimates that the probability that the life of a powertrain exceeding 4,000 miles is 66 percent. This compares favorably with a goal of 50 percent, and a current value of 37 percent.

Note that in both of these examples, we are dealing with durability issues: a durability "failure" involves replacement with a new item or else an extensive overhaul. Thus, improvements of the types indicated here will result in significant cost of ownership savings.

Light Armored Vehicle (LAV) Engine Improvement

- **Program Objective: Improve sustainability and lower life-cycle costs**
- **Upgrades**
  - Silver Series Engines (remanufacture of current engines)
  - ECP-type improvements (shields, covers, brake upgrade, tire demounters, etc.)
- **Engine Program Projections**
  - Investment $10.9 million
  - Payback 4.25 years
  - 10-year gross savings $18.5 million

The U.S. Marine Corps has embarked on a program to upgrade its fleet of Light Armored Vehicles (LAVs) to improve sustainability and reduce life-cycle costs.

The major effort is a remanufacture of the current "Green" series engines to "Silver" series engines with glow plugs. This will be the first major upgrade of the LAV fleet. In addition, there are a number of ECP-type improvements such as shielded periscopes, engine grill covers, portable tire demounters, and brake system upgrades.

The Marine Corps estimates a total investment of $10.9 million (FY 96 and FY97) that will be recouped in about 4.25 years and a total 10-year gross savings of $18.5 million. The savings breakdown (prior to subtracting the investment cost) is $2.4 million in part utilization, $6.6 million in depot operations, $9.2 million in engine replacements, and $0.3 million in fuel.

F-16 Antiskid-Brake Controller

- **Program Objective: Replace current brake control box and anti-skid controller with single digital unit**
- **Advantages**
  - Full BIT with self-powered fault storage and data extraction
  - Reduced skid cycling, 15 percent better stopping and reduced brake and tire wear
  - Improvement in MTBF by a factor of 5
  - Redundant control channels
- **Projected Savings (1,255 aircraft)**
  - Total cost $8.785 million
  - Savings per year = $5.9 million
  - Payback period = 18 months
  - Life-cycle savings (20 years) > $100 million

A new anti-skid system design to be implemented on the F-16 fleet of aircraft offers significant performance, safety, and life-cycle cost improvements:

Performance—better stopping distance

Safety—redundant control channels, reduced skid cycling

Life-Cycle Cost—greater reliability, full built-in testing (BIT), reduced tire and brake wear

The Air Force estimates that the cost to retrofit is $7,000 per aircraft leading to a yearly savings of about $4,700 per aircraft. This translates to a yearly savings of over $5.9 million annually, once the investment is recouped, which should take about 18 months.

Flight tests were scheduled for late 1995 with expected contract award in June 1996.

Dehumidification of Operational Systems

- **Services incur $3-12 billion in moisture-related costs annually**
  - Moisture leads to corrosion, fatigue, and failure of metal surfaces and electronics
    - » Over 50% reduction in life of structural components
    - » Increased corrosion of connectors and fluctuation in resistance of electronic components
  - Humidity over 50% causes exponential increase in corrosion
    - » Factor of 20 on "humid" KC-135s
- **Preservation yields rapid payback**
  - Used by most European countries and validated for many US systems
  - Increases readiness and sustainability
    - » 21% fewer failures in A-6Es
    - » 18% fewer failures in NATO AWACS
  - Reduces O&S spending
    - » By extending aircraft overhaul intervals
    - » By saving money devoted to repairing damage due to corrosion

Dehumidification is another way to improve reliability. According to various estimates, the Services pay up to $12 billion annually to counter the effects of moisture. Moisture leads to corrosion, fatigue, and failure of metal surfaces and electronics. Some of the results are reduced life of structural components and increased resistance of electronic components. Humidity over 50 percent causes an exponential increase in corrosion, and high humidity has been found to lead to increased corrosion of KC-135s by a factor of 20.

The situation is far from hopeless, however. Preservation is already used in most European defense systems, and has been validated for US systems. It has led to large increases in readiness and sustainability by reducing failure rates on A-6Es and NATO AWACS planes. And it can save O&S spending by lengthening the time between overhauls and reducing costs to repair damage from corrosion.