REPORT OF THE

Defense Science Board Task Force

ON

Acquisition Reform Phase IV

Subpanel on Research and Development

July 1999

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

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This report is unclassified.

OFFICE OF THE SECRETARY OF DEFENSE
3 140 DEFENSE PENTAGON
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MEMORANDUM FOR THE UNDER SECRETARY OF DEFENSE (ACQUISITION AND TECHNOLOGY)

SUBJECT: Final Report of the Defense Science Board (DSB) Task Force on Defense Acquisition Reform, Phase IV, Subpanel on Research and Development

I am pleased to forward the Final Report of the Defense Science Board (DSB) Task Force on Defense Acquisition Reform, Phase IV, Subpanel on Research and Development.

This report provides the Research and Development Subpanel's assessment of Acquisition Reform Initiatives, Advanced Concept Technology Demonstration Programs, a number of acquisition process models, specific Research and Development (R&D) programs, and the acquisition education and training programs.

The Subpanel's recommendations stress the importance of implementing Price Based Acquisition as a major reform initiative for the Department. It also offers specific recommendations for the Joint Strike Fighter, shipbuilding, space, Joint Tactical Radio System, and education and training programs of the Department.

I concur with the recommendations and recommend that you review the report, and forward the study to the SECDEF.

Dr. Craig I. Fields
Chairman,
Defense Science Board

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JUN 10 1999

MEMORANDUM FOR THE CHAIRMAN, DEFENSE SCIENCE BOARD

THROUGH: Dr Robert J Hermann, Chair, Defense Acquisition Reform, Phase IV

SUBJECT: Final Report of the Defense Science Board (DSB) Task Force on Defense Acquisition Reform, Phase IV, Sub-panel on Research and Development

Attached is the Final Report of the Defense Science Board (DSB) Task Force on Defense Acquisition Reform, Phase IV. It is the Report of the Sub-panel on Research and Development. The Task Force was chartered to examine how acquisition reform was being applied to weapons systems research, development, and acquisition. Specifically, this Task Force was to focus on DOD implementation activities by assessing the progress that was being made in acquisition reform initiatives, and to make recommendations as to where further action and significant progress needed to occur.

The Task Force has assessed the Acquisition Reform Initiatives, the Advanced Concept Technology Demonstration (ACTD) Programs, a number of acquisition process models, specific research and development (R&D) programs, and the acquisition education and training program. The Task Force reached a number of conclusions for improvements in each specific area and program. Finally, the Task Force offers specific recommendations for Price Based Acquisition, and in five specific program areas.

Recommendation — The Price Based Acquisition (PBA) Model

The Task Force believes the proposal to incorporate PBA is the most significant of the Acquisition Reform Initiatives advanced in the past two years, since it emphasizes the concept of "price to the Government" and "value to the user." This must be accompanied or complemented with commercial-like innovative product support. This is fundamental to true acquisition reform.

The Task Force, therefore, has constructed the Price Based Acquisition Process, which includes the significant elements of reform. The Task Force recommends the USD(A&T) designate this process as the principle direction for development and procurement of DOD systems, and insure its timely implementation.

Recommendations — Specific Programs

Joint Strike Fighter (JSF) Program: The USD(A&T) should: structure the JSF contract to insure that there is continuous competition throughout the procurement and sustainment cycle for the JSF primary airframe and supporting subsystems; structure the contract consistent with price based acquisition; expand the authorities of the JSFPO to include actual weapon interfaces, dimensions and protocols for the intended stores and armaments; and, designate the JSF as the model for an open systems architecture program. The systems "open architecture" should be a fundamental pass or fail JSF procurement contract condition.

Shipbuilding Programs: The USD(A&T) should insure that sufficient development funding is designated for each new class of ship to insure inclusion of cost effective innovations that reduce ownership cost without unacceptable reductions in performance. Some candidate innovations should be identified and analyzed prior to formal initiation of each new program. The DD-21 should be designated as the model for this and other acquisition reform initiatives.

Space Programs: To provide for the expanding space system needs, and in light of the large commercial investment in space, the DOD should concentrate its limited resources on the high leverage military-unique technologies in those areas that have no commercial equivalent application, as in survivability protection and data encryption. Through the use of space architecture studies the DOD should capitalize on commercial space capabilities wherever practical. The USD(A&T) should insure the use of competitive commercial practices in acquiring space systems, and in contracting for the operation of the space infrastructure.

Joint Tactical Radio System (JTRS): The JTRS initiative offers great potential in satisfying the long-term communication needs of the DOD. The ASD(C3I) with the support of the Services, and industry must complete the effort to define an acceptable technical architecture, which will continuously encourage competition at the functional module, as well as the communication system level. The USD(A&T) must insure adequate budget to support a timely schedule, and insure that all Service priorities are consistent with this program's importance.

Education and Training: Responsibility for acquisition E&T should be clarified and strengthened to provide necessary leadership and management authority, but above all to provide accountability for the entire program and its outcome.

Robert A. Fuhrman
Chair

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Executive Summary

March 1998

In May 1996, the DSB Task Force on Acquisition Reform, Phase III made the following comments in its final report:

> **"As has been stated many times, America's warfighters have entered an era of new geo-political and economic realities in which they must identify and react to emerging or new missions under the constraints of a much reduced defense budget. This means that the DOD must develop and acquire weapons systems faster and better at lower costs.**
>
> **The present DOD process for developing and buying major weapon systems has serious failing. The process is generally acknowledged to be expensive and lengthy averaging 16-18 years to field a system. Commercial products are often better, more reliable and less expensive than comparable military specific products. However, DOD does not have effective access to the best practices of the commercial market. Costly and inefficient oversight processes isolate the defense industrial base from the general commercial industrial base. If current practices continue, DOD will be forced to depend on an isolated defense industrial base that has been greatly reduced, both in overall size and in number of competing firms. As a result, there is risk that the Department will be slow to respond, inefficient, and – most important – less than state-of-the-art."**

Terms of Reference

Although some progress has been made it is insufficient for true Acquisition Reform. Because of this the DSB was tasked to continue its examination by the Terms of Reference (TOR), Appendix A. A special Sub-panel on Research and Development was chartered to examine how acquisition reform was being applied to weapons systems research, development, and acquisition. Specifically, this Task Force was to focus on DOD implementation activities by assessing the progress that was being made in acquisition reform initiatives, and to make recommendations as to where further action and significant progress needed to occur.

The Task Force was convened on November12,1997 . At that meeting the USD(A&T) discussed his support and further chartered the Task Force effort. Appendix C further delineates the specific programs and subjects that were reviewed by the Task Force between November 1997 and September 1998. The Task Force has assessed the Acquisition Reform Initiatives, the Advanced Concept Technology Demonstration (ACTD) Programs, a number of acquisition process models, specific research and development (R&D) programs, and the acquisition education and training program. The Task Force reached a number of conclusions for improvements in each specific areas and programs. Finally, the Task Force offers specific major recommendations in two areas.

Assessments — Acquisition Reform Initiatives

There have been many individual efforts that can be equated as Acquisition Reform Initiatives. Their implementation has been limited. Some initiatives have increased efficiency and decreased cost, some have not. All need continued emphasis. Among the most important initiatives being worked are the

improvement of the requirements process by increasing involvement of the Commanders-in-Chief (CINCs) in the mission needs process during the entire development process, and efforts to reduced cycle time, broadened forms of competition, encouragement of commercial vendors by accepting commercial practices and standards within the DOD, making greater use of Commercial and Non-Developmental Items (CaNDI), and encouraging open systems. DOD must continue to encourage using cost as an independent variable, implementing lean enterprise initiatives, using acquisition simulation models, using total ownership cost instead of production cost for decision making, using ACTD-like processes, implementing commercial-like innovative product support, and basing acquisition on price instead of cost -- Price Based Acquisition (PBA).

The Task Force comments on ten initiatives in the report. The most compelling reform initiative currently under way is Price Based Acquisition. The Task Force, as a further expansion of the work accomplished in Phase III, has incorporated PBA into its New DOD Acquisition Model for conducting research and development.

New Price Based Competition Model

Broadening the forms of competition requires finding new ways to open the acquisition system to new and non-traditional suppliers as well as implementing the acquisition reform initiatives already underway. To buy these commercial items the DOD must emulate a commercial buyer. This in turn requires a cultural change in the acquisition system that is accompanied by an attitude change in the government personnel.

The Task Force believes that **price based acquisition** is the best approach to conducting these competitions. Price based acquisition has been defined as the establishment of a contract price by means other than recourse to costs actually incurred, or costs expected to be incurred. Fixed-price contracts may be either cost-based or price based, depending upon the methodology used to establish the contract price. When a fixed price is established on the basis of cost proposals and cost analysis, the contract price is cost-based.

Cost analysis focuses on whether or not the supplier has correctly estimated and tabulated his costs and not what the product or service should cost. Commercial companies do not have cost accounting systems designed for the Government's cost-based acquisition approach. This does not mean they do not have cost accounting systems for tracking and controlling costs. These commercial suppliers are just not using a Government-prescribed system. The key to price based acquisition is using short, relatively risk free periods of fixed-price contract performance.

The switch to price based acquisition is essential to break out of the cost plus culture and attract new commercial suppliers. In the present DOD cost-based system the contractor's profits are based on costs. Additionally, cost systems and

personnel are added to track costs. These Government-prescribed cost accounting systems are uniquely governmental and require an otherwise commercial supplier to overlay costly processes just for a Government contract. The Government can avoid these higher costs by using the contractor's existing system to track cost against performance when necessary, and using cost as an independent variable (CAIV) as a tool to insure the best value is being received so long as there exists adequate competition for satisfying the basic government need.

Using this system, milestone payments are the best payment system to motivate the contractors and avoid costly cost accounting administration. This payment procedure creates incentives on cost control, schedule, and performance.

Assessment — Advanced Capability Technology Demonstrations (ACTDs)

The Advanced Concept Technology Demonstration (ACTD) Program was initiated in 1994 in response to recommendations of the Packard Commission in 1986 and the Defense Science Board recommendations in 1987,1990, and 1991. The recommendation of the Packard Commission was to build and evaluate prototype systems to assess improvements in military capability and provide a basis for cost estimates before making acquisition decisions. This recommendation was intended to address the problem frequently encountered in DOD, deciding to acquire new military capabilities before it has a good understanding of either the value or the price of those capabilities. In the five years since the program began, the process has evolved significantly, but the two primary objectives of the process have remained unchanged:

- Develop prototype versions of new military capabilities, hardware and/or software, and provide those prototypes to operational units for employment in realistic military exercises for assessment of sufficient military utility. The rapid changes occurring in the threat and in key technologies employed in our military systems are having an accelerating military utility.
- Expedite the fielding of those capabilities that demonstrate a significant positive effect on the nature of warfighting.

In this environment, an operational evaluation of proposed new capabilities is a crucial element of informed acquisition decisions. It is equally important that this evaluation be accomplished without contributing to an already excessive acquisition cycle time. The ACTD process is clearly succeeding in this regard. For the 46 ACTDs that have been initiated since the program began, the average time from approval to planned completion of the demonstration phase and fielding of the residual capability is approximately three years. The actual duration for the nine ACTDs that have been completed has averaged just less than 37 months.

The Task Force strongly endorses the ACTD process, including the refinements to that process in the areas or determining readiness to transition, determining affordability, and funding of follow-on activity.

Review and Assessment- Selected R&D programs

As requested in the TOR, the Task Force examined and re-examined acquisition initiatives in many acquisition programs. In its examination, the Task Force studied the JSF, various ship building programs, land programs, space programs, the Joint Tactical Radio System and product support and sustainment. Conclusions are presented for each of these areas in the report.

The four most significant areas that are, or could, implement significant acquisition reform initiatives are the Joint Strike Fighter Program (JSF), Navy shipbuilding programs, space programs, and the Joint Tactical Radio Program. Major recommendations are presented later for these programs.

Assessment — Product Support and Sustainment

The Task Force strongly believes that to reverse the trend toward increasing amounts of DOD funding being diverted from weapon system investment, to the operational support of the deployed systems, action is needed. Commercial aviation provides an example of the characteristics of product support the DOD should consider for at least its flying systems. Specifically, commercial-like supply chain management and a modernized information support system are parts of a revised DOD logistics system that should be considered. They should not only be considered for new developing systems, but be given consideration for existing, deployed DOD systems.

Assessment — Acquisition Education and Training (E&T)

In performing its assessments of the various programs, it became apparent to the Task Force that there was a decided difference in the education and training of the persons briefing the Task Force regarding acquisition reform. Some were totally aware of current developments and some had little awareness. As a result, the Task Force sought out and received a number of presentations from those responsible for the training of the DOD acquisition workforce. Findings and conclusions are presented in the report in the areas of accountability, metrics for program evaluation, use of civilian institutions, DOD/industry relationships in E&T, distance learning, military student policy, student prerequisites, and the establishment of mentor teams.

Major Recommendations

Recommendation — The Price Based Acquisition (PBA)

The Task Force believes the proposal to incorporate PBA is the most significant of the Acquisition Reform Initiatives advanced in the past two years,

since it emphasizes the concept of "price to the Government" and "value to the user." This must be accompanied or complemented with commercial-like innovative product support. This is fundamental to true acquisition reform.

The Task Force, therefore, has constructed the Price Based Acquisition Process, which includes the significant elements of reform. The Task Force recommends the USD(A&T) designate this process as the principle direction for development and procurement of DOD systems, and insure its timely implementation.

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Joint Strike Fighter (JSF) Program

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Joint Tactical Radio System (JTRS)

The JTRS initiative offers great potential in satisfying the long-term communication needs of the DOD. The ASD(C3I), with the support of the Services, and industry must complete the effort to define an acceptable technical architecture based on commercial specifications, which will continuously encourage competition

at the functional module, as well as the communication system level. The USD(A&T) must insure adequate budget to support a timely schedule, and insure that all Service priorities are consistent with this program's importance.

Education and Training

Responsibility for acquisition E&T should be clarified and strengthened to provide necessary leadership and management authority, but above all to provide accountability for the entire program and its outcome.

I. Introduction

In accordance with the Terms of Reference (TOR), included at Appendix A, the Defense Science Board Task Force on Defense Acquisition Reform, Phase IV, convened a special Task Force on Research and Development to examine how acquisition reform was being applied to weapons systems research, development, and acquisition. This Task Force was to be a follow-on effort to the Phase III Task Force, "A Streamlined Approach to Weapons Systems Research, Development and Acquisition . . . The Application of Commercial Practices," dated May 1996. Specifically, this Task Force was to focus on DOD implementation activities by assessing the progress that was being made in acquisition reform initiatives, and to make recommendations as to where further action and significant progress needed to occur.

The Terms of Reference also recommended specific programs that should be reviewed. The Task Force was convened on November 12,1997 with the membership shown in Appendix B. At that meeting the USD(A&T) further established the charter for the effort. Appendix C delineates the specific programs and subjects that were reviewed by the Task Force between November 1997 and September 1998. In addition to the specific research and development (R&D) programs, the Task Force assessed the acquisition reform initiatives, the Advanced Concept Technology Demonstration (ACTD) Programs, a number of acquisition process models, and the acquisition education and training program. The Task Force made a number of recommendations for improvements in specific areas and programs; they also concluded with three major conclusions and recommendations.

This report presents the findings, conclusions and recommendations in the following format:

II. Assessment of Acquisition Reform Initiatives;

III. Advanced Concept Technology Demonstrations (ACTDs);

Iv. Acquisition Process Model;

V. Selected R&D Programs - Review and Assessment;

VI. Education and Training; and

VII. Major Conclusions and Recommendations.

II.Assessments of Acquisition Reform Initiatives

A. *Requirements Process*

The DSB Task Force on Acquisition Reform addressed the DOD military requirements process in the Phase I, Phase II, and Phase III reports to the USD(A&T). These reports recommended :

- Increasing the role of CINCs, working with the CJCS, in the overall requirements process.
- Providing the Joint Staff with improved capability to permit the Chairman and the CINCs to prioritize requirements. The improved capability would include that related to technology and available resource management.
- Developing a procurement model allowing the Vice Chairman of the JCS and the USD(A&T) to work together to determine the best approach to satisfy mission needs, continuously evaluate competitive alternatives, and jointly make or buy decision when a satisfactory combination of value, performance, and schedule existed.

One objective of these recommendations was to provide as much user experience as possible in identifying and forecasting mission needs, using the judgment and experience of those who are responsible for warfighting. A second objective was to define solution sets that could match available resources, schedule requirements, proven technology capability, and value assessments while taking full advantage of alternate solution analyses (analyzing different solutions to the same problem).

In the "front end" or conceptual phase of a program, real mission needs (requirements) may be fuzzy, as the program fielding date remains some years in the future. This demands that the requirements definition, although based on good fundamental judgment, be flexible enough to permit managed change in the incremental processes of R&D that are directed to satisfy the requirement. This environment forces, trade-offs between current system upgrades versus next generation systems, emphasizes open-system architectures that can accommodate incremental modifications, and requires full support of acquisition cycle time improvements to minimize "uncertainty" penalties.

While recognizing that continuous involvement of the user community is critical in the early phases of a weapon system program, it is also important that this involvement continue through all phases of a procurement. This implies the implementation of a formal and effective IPT process. The proper trade-offs of schedule, performance, and total operating costs can be conducted with all DOD communities of interest involved. The user participants can provide the critical inputs regarding field operational and inter-operational needs, the field evaluation processes, the doctrinal issues, and the threat evolution.

This Task Force concludes that the Requirements Process IPT, established jointly by the by the USD(A&T), and Vice Chief, Joint Chiefs of Staff, be fully supported to continue its work.

B. Cycle Time Initiatives

The issue of defense system acquisition cycle **time has received intermittent** attention from DOD since the Packard Commission introduced "A Formula for Action" in 1986. The Packard Commission stated that "an unreasonably long acquisition cycle of 10 to 15 years for major weapons systems is a central problem from which most other acquisition problems stem." These other problems include cost, obsolete technology in the field, and "gold plated" defense systems. The Commission believed it was possible to cut the acquisition cycle by 50 percent. Eight years later, in 1994, Secretary of Defense Perry challenged the defense services and agencies to reduce cycle time by 50 percent by the year 2000. This resulted in the following "goal" initiatives:

- Federal Acquisition Streamlining Act (FASA) in 1994 — Deliver emerging technology to the troops in 50 percent less time;
- DOD's National Performance Review (NPR) goal — Reduce cycle time Major defense Acquisition Programs (MDAP) by 25 percent by the year 2000; and
- Defense System Affordability Council (DSAC) Direction in 1997 — Aim for 50 percent reduction in acquisition cycle time; Institutionalize changes in 5000.2-R policy.

Acquisition cycle time is defined in Figure II-A, below. The time to develop and field new technology is shown as the Acquisition Response Time. This is obviously a dimension of great importance, and requires cycle time reduction in both industry and DOD.

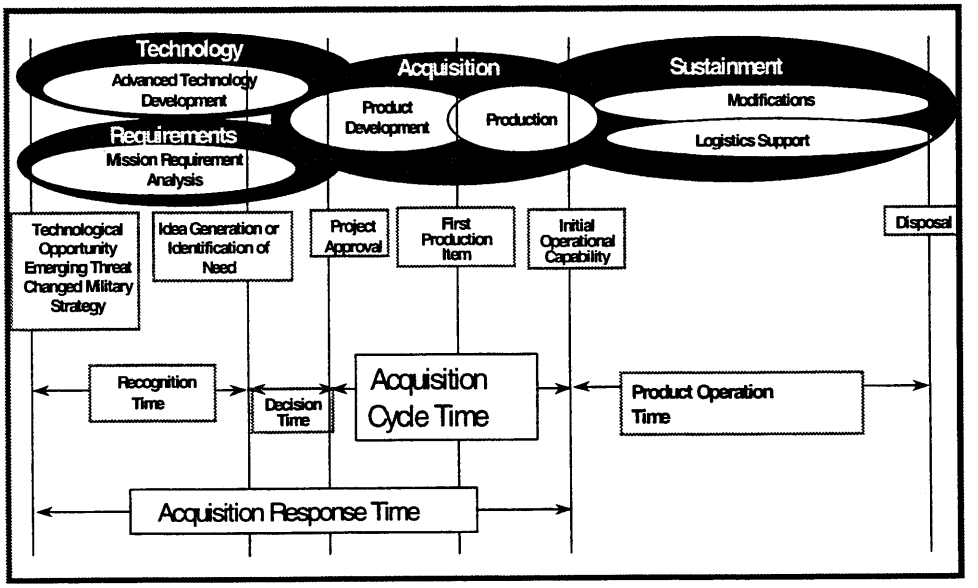

Figure II-A -Acquisition Cycle Time

The progress in cycle time reduction in American industry over the last ten years has been significant. The automotive industry, commercial aircraft industry, commercial spacecraft industry, commercial avionics industry, and consumer electronics industry have reduced total product cycle time by ***50*** percent. The methodologies used to achieve these results were many, however, a few-key approaches stand out. Effective change management, with active leadership from the top, was critical. The objective was the complete characterization of all processes within engineering, manufacturing, finance, and administration. This allowed non-value-added processes to be eliminated. It also allowed those that were necessary, to be "streamlined." Extensive and appropriate use of modeling and simulation in engineering and manufacturing permitted first-time design successes, eliminating reiterative time losses. Attention to product and system requirements eliminated cost and avoided timely downstream modifications. The incentive was to "do the right thing and do the thing right." The application of open system architecture approaches, although not perfect or complete, allowed a significant amount of hardware and software reuse in extended product lines. This promoted a significant compression of cycle time. The attention to agility, as well as speed, combined with other "lean" approaches, considerably reduced manufacturing cycle times.

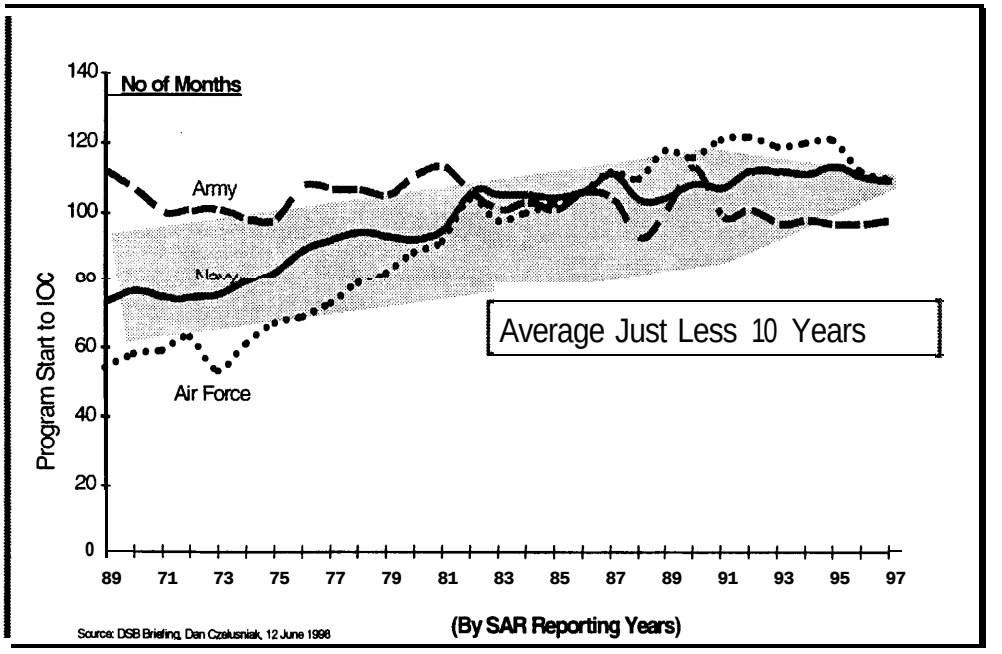

Figure II-B — Average Cycle Times

A DSB study in 1998 showed little cycle time reduction in major DOD systems as shown in Figure II-B, above. Further, the programs reviewed by this Task Force did not convey plans or actions that could help reduce cycle time by 25 to50 percent. In this regard, an OSD briefing to this Task Force highlighted the consequences to DOD of long acquisition response times. Average program cost growth was over 40 percent in programs with over 14 years to first operational delivery; average schedule growth in a planned ten-year program was over 22 percent; and the probability of cancellation of a ten-year program approached 40 percent. This is a tremendous waste of resources. Further, the probability of a 15 to 20-year program providing the capability to counter the real threats existing at the time of fielding was extremely low. The impact of long cycle times on sustainment is also significant. Obsolete technology is costly to maintain and replicate, the manufacturing base can erode or diminish earlier in a long program life cycle, and new systems in development preclude use of resources for upgrades and modifications in the older programs.

The OSD briefing also described some of the drivers of cycle time in DOD. In particular, the priorities of the PEMs and SPOs that favored superior system performance over other requirements (Packard Commission "gold plating") are a significant factor as shown in Figure II-3 below. The high turnover of acquisition and program executives during a 10 to15–year program results in a critical lack of accountability for cycle time reduction. Combine this with the sub-optimization of manufacturing, test, laboratory capabilities, and an inconsistent mix of cycle time metrics, and one will experience slowed progress. Further, if the technology proposed for a program has not matured, DOD then needs to pursue that technology maturity before starting the actual program.

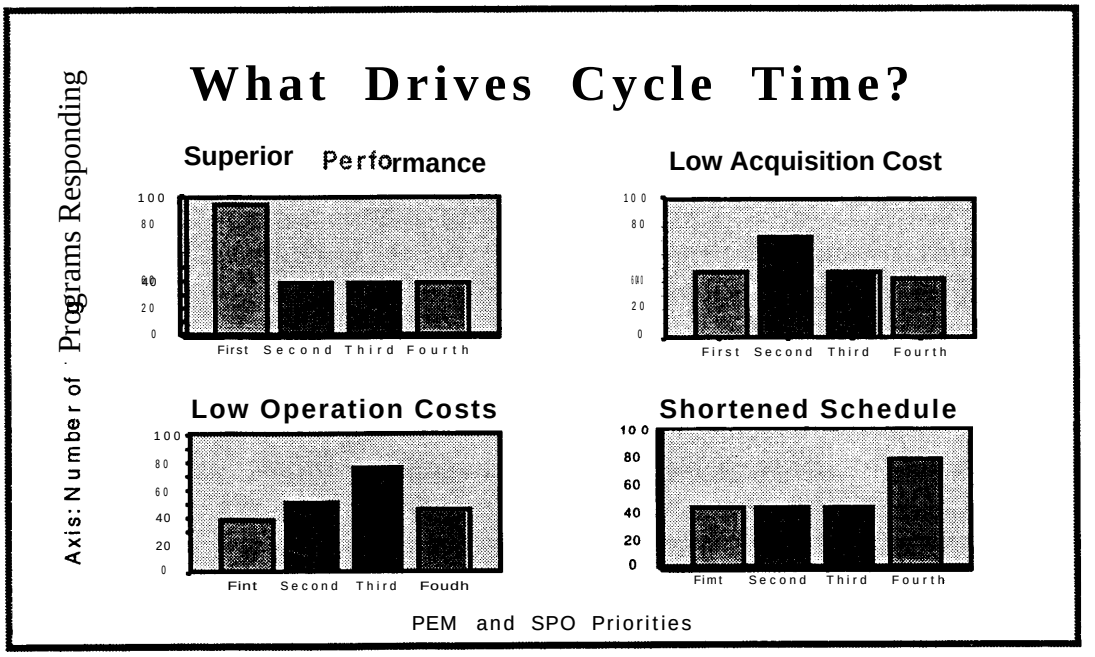

Figure II-C — What Drives Cycle Time

This Task Force recognizes that an overarching driver of acquisition cycle time is that related to program funding stability. The dynamic uncertainties and instabilities of program funding will continue to limit the progress that could be made in cycle time reduction. Nevertheless, significant and high payoff cycle time process improvements can be identified and implemented within DOD and in industry. Technology risks should be understood and minimized before system acquisition is initiated. Requirements should be matched to available technology and with proposed systems using an open system architecture that allows upgrading based on new threats and new technology. Following technology demonstrations, development should be a single-phase activity, schedule-driven, and fully funded with a plan for evolution of performance as needed. Total ownership costs must be considered and managed throughout the program.

This Task Force concludes the following:

1. The Deputy Secretary of Defense should direct that all weapon system integrated product teams (existing and new) include cycle time management as a critical consideration in the development of the system acquisition strategy. Initiatives such as the Army's "Fast Track" activity should continue.

2. USD (A&T) should establish a consistent set of cycle time metrics, that to the extent practical, are common to both military and industrial sectors.

C. The New Competition Model — Price Based Acquisition

The goal of competition is to insure that the Government gets the best alternative to meet the mission requirements at the most affordable price. Traditional competitions have been based on all competitors bidding to supply a Government-prescribed solution. While there may exist some latitude in what is proposed, seldom is there an advantage gained from offering a radically different answer. When several good suppliers respond, it is often very difficult for the evaluators to choose between the proposals. The technical, management, and cost proposals are all basically in the same format and often contain the same or very similar responses. In order to obtain innovative and commercial solutions, the form of competitions needs to be broadened to be open to all possible alternatives.

We must change our approach as threats change. We must deal with the new asymmetric threats such as biological warfare and rogue nation ballistic missiles. Buying more traditional weapon platforms (like ships, planes, and tanks) will not be sufficient and may be the wrong response. We must be able to take advantage of the rapid improvements in technology, the majority of which are coming from non-traditional defense suppliers who are developing technology for strictly commercial markets. We will likely find many of our solutions in markets that are both purely commercial and global.

The new broader competitions must allow totally different approaches. The requirements must be stated in terms that identify the need or threat but do not suggest that there is only one acceptable approach. The solution may be found in a new platform but as likely it will be improvements to existing systems. However, the solution may come from a very indirect source such as improving C^3I or changing the logistics support concept.

Traditional competitions have tended to be Service specific. The new threats require mission planning that emphasize joint operations. If all approaches to satisfying the mission requirements are to be considered, the acquisition strategy must take into account the roles of all Services in the mission. The joint commanders' inputs will be particularly important. In addition such broader competitions will require a maximum of cooperation and communication with the users, primarily the CINCs. Because one of the principle objectives of reform is to reduce cycle time, it is critical that the users and acquisition community establishes very close ties. This will require a special emphasis on finding and applying efficient mechanisms for dealing with the Joint warfighting requirements.

The use of Integrated Process Teams (IPTs) is important to organizing the response to the threat. These teams should consist of representatives of key organizations that have interest in the solution. This should include both operators/CINCs, and logisticians. These IPTs must to be empowered to make changes where needed and make tradeoffs between cost, schedules, and performance. Affordability must be recognized as a decisive factor in making trade-offs. Where affordability has been exceeded the IPT needs to either adjust the response or recommend termination.

Broadening the forms of competition requires finding new ways to open the acquisition system to new and non-traditional suppliers as well as implementing the acquisition reform initiatives already underway. It will be particularly important to access the new technologies originating in the purely commercial markets both domestic and foreign. To buy these commercial items the DOD must emulate a commercial buyer. This requires more than a few changes to the regulations. A cultural change must occur in the acquisition system that is accompanied by an attitude change in the government personnel. The suppliers need to perceive the system is fair and they will receive the same treatment as if the sale was made to a commercial customer. Very few of the suppliers will agree to set up a separate system just to deal with the government customers. These commercial suppliers do not want to deal with Government unique requirements such as Cost Accounting Standards (CAS), the Truth in Negotiations Act (TINA) and the Civil False Claims Act. The laws and regulations and the treatment by the Government buyers must be comparable as that received from commercial buyers.

The broader competitions have to recognize there exist significant differences between new potential commercial suppliers and its traditional Government ones. For example, commercial suppliers generally develop their own technology and

retain all intellectual property rights. The only way they share their intellectual property with their customers is through license agreements. The Government often pays its traditional suppliers for the development of its systems. With the notable exception of Independent Research and Development, where the Government pays, it generally owns the right to use any intellectual property that is developed. It also has the right to the technical data to use for its purposes. Where both types of suppliers are bidding on the same requirements, the Government solicitation must be sufficiently flexible to take into account this difference.

The Task Force believes that **price based acquisition** is the best approach to conducting these competitions. Price based acquisition has been defined as the establishment of a contract price by means other than recourse to costs actually incurred or costs expected to be incurred. Fixed-price contracts may be either cost-based or price based, depending upon the methodology used to establish the contract price. When a fixed price is established on the basis of cost proposals and cost analysis, the contract price is cost-based.

The Government has come to rely much too heavily on cost analysis. Cost analysis focuses on whether or not the supplier has correctly estimated and tabulated his costs and not what the product or service should cost. The Government is seldom in a position to be able to judge which of the cost proposals correctly states the actual cost. This is particularly true where the form of the contract is such that the Government absorbs all or at least most of the cost risk. In the present evaluation process, there exists little or no penalty for understating the costs. However "overstating" the cost not only is penalized but also often results in losing the competition.

Price based Acquisition is the normal manner by which products are acquired in the commercial sector. Commercial companies do not have cost accounting systems designed for the Government's cost-based acquisition approach. This does not mean they do not have cost accounting systems for tracking and controlling costs. These commercial suppliers are just not using a Government-prescribed system. However if the DOD is to eliminate or reduce the distinctions in the way it buys compared to those used by commercial buyers, it must change its focus from determining value based upon inputs, i.e., costs, to determining value based on outcomes, i.e., performance and the value, expressed in terms of price.

The implementation of price based acquisition is not a return to the fixed-price development approach or total package procurement that has failed previously. The key to price based acquisition is using short periods of fixed-price contract performance. If progress towards desired performance proves too costly to the contractor, or inadequate to the government, the contract for the next phase would either be re-priced to continue or declined in favor of an alternative solution. In such cases, hard decisions will have to be made on whether or not to terminate the contract. The contractor's cost risk will be limited unless he chooses to proceed

on his own funding. It will be important to have competitive alternatives to place competitive pressure on the suppliers.

The switch to price based acquisition is essential to break out of the cost plus culture and attract new commercial suppliers. Traditional cost-based contracting discourages efficiency and often is a disincentive to reduce R&D, production or O&S costs. Typically the only pressure the contractor has to reduce costs after winning the contract is budget constraints. The contractor's profits are based on costs. Therefore, the higher the cost estimate at the outset the higher the profits. This is a very inefficient system. Additionally, costs systems and personnel are added to track costs. These Government prescribed cost accounting systems are uniquely governmental and require an otherwise commercial supplier to overlay costly processes just for a Government contract. The Government can avoid these higher costs by using the contractor's existing system to track cost against performance when necessary, and using CAIV as a tool to insure the best value is being received as long as there exists adequate protection for satisfying the basic Government need.

Along with using price based acquisition the DOD needs to change the way it reimburses its suppliers. The current practice is to use cost-based progress payments for fixed price contracts as a form of financing. Under this system the contractor receives a percentage of his costs with no markup or profit. The contractor does not receive full payment until he delivers the items that are separately priced. This is a cost-based practice with no incentives that again requires a Government prescribed cost accumulation system. This procedure needs to be changed to attract commercial suppliers, avoid costly paperwork, and motivate performance and obtaining best value.

Milestone payments are the best payment system to motivate the contractors and avoid costly cost accounting administration. At the outset, the Government and contractor establish a series of milestones or measurable events. The contractors' price is broken up in approximate relationship to the portion of the price allocated to the milestone. As an example, the price for the first milestone could be paid on day one. No additional payments are made until milestone one is completed. At completion of each additional milestone the contractor receives payment for the next one. Thus, the contractor is being financed until he exhausts his current payment through incurred costs (measured by him not the Government). He is highly incentivized to complete the milestone in order to receive the next payment. This payment procedure creates both incentives on cost control and performance. It is also a common commercial practice that would help attract commercial suppliers.

The USD(A&T) has a proposed policy change directing use of Price Based Acquisition being staffed in the Pentagon. As a result of the "Report of the DSB Acquisition Workforce Sub-Panel of the Defense Acquisition Reform Task Force," response to Section 912 of the 1997 Defense Authorization Act, a study group has been formed to research and propose implementation of PBA. The USD(A&T) has

signed the charter of that study. This Task Force looks forward to the studies report. The draft policy and charter are at Appendix F.

The Task Force concludes the following:

1. In order to improve the requirements process IPTs must continue to be used to incorporate CINC users and suppliers in the process. The real users must be involved in the trade off of cost, schedule, risk, and performance.

2. Requirements need to be stated in broadest possible terms to allow consideration of a broad array of solutions including commercial solutions.

3. The search for solutions needs to be conducted before narrowing to a service specific solution.

4. Request for Proposal (RFP) terms and conditions must avoid non-commercial provisions.

5. The Government must respect the ownership of intellectual property and technical data rights by commercial suppliers and both restrict its demands and protect these highly valuable proprietary properties.

6. Make price based acquisition the rule rather than the exception by changing the directives and regulations to require a high-level exception determination to use cost-based contracting.

D. Incentives

The objective of all acquisition reform must be to reduce Total Ownership Costs (TOC). All too often all the incentives have been focused on reducing acquisition costs without concern for the impact on TOC. New systems being acquired today and into the foreseeable future will likely have a service life of at least 30 and maybe as much as 50 years. These systems will be upgraded several times over their useful life, in addition O&S costs will, in most cases, comprise significantly more than 50 percent of the TOC. As we reduce cycle times and acquisition costs these percentages will grow even larger. Therefore, new incentive schemes must be employed that will tie operations and support (O&S) cost reduction into the R&D and procurement phases.

Provisions that provide cash rewards to the contractor have proved effective in commercial markets. Limited attempts by the Government have been successful but have lost momentum over time. For example Reliability Improvement Warranties (RIW) and performance on orbit incentives for satellites have been successful in improving reliability and reducing support costs.

The transition from the development phase to production has always proved to be difficult. It is very important that production, operating and support costs be

included in the development process considerations. Under the current emphasis on containing development costs, little attention is given to embedded diagnostics and training, and manufacturing technology and processes. Contractors need to be incentivized to include manufacturing, and O&S cost reduction in their product development phase.

The commercial model is to keep the supplier providing direct support and tied to the total operating cost (TOC) through techniques such as warranties. The Government has traditionally opened the O&S contracts to all bidders. The commercial model has generally been shown to be the most cost effective. One key is to connect the supplier's ultimate profits to the TOC wherein the supplier gets to keep a significant share of the saving in projected O&S costs. Under this model the successful supplier will make sure the appropriate trade-offs are made in R&D and production to minimize O&S costs. The other key is to outsource as much of the O&S function as possible. Shifting the O&S burden from the supplier to Government in-house takes away critical incentives and places the work in a non-competitive environment where at a minimum there has to occur a technology transfer in order for the government facility to maintain the system.

The Task Force concludes the following:

1. The acquisition strategy must encompass Total Ownership Costs. This requires consideration be given during the development to manufacturing, and operating and support costs. The contracts must include incentives that will reward the contractor for reduced costs during manufacturing, deployment, and operation.

2. Whenever possible, it is important to keep the contractor involved throughout the program. This will provide for continued incentives that reward the contractor throughout the useful life of the product.

E. *Open Systems*

The desire to reuse technology (in both a basic and combinational/modular form), along with the need to upgrade products and systems on an incremental basis led to the DOD drive for open system architecture. The success achieved in the personal computer industry with this approach fueled that drive. Currently there are a multitude of views as to what constitutes an open system. Most visualize standardized hardware and software interfaces that are "available" to all of industry at no cost or low cost. Other essential attributes generally associated with open systems include:

- Scalable – from small to large.
- Extensible – able to adapt to changing user requirements and technology advances.
- Low cost – increased use of CaNDI.

- Software reprogrammable – ability to add new functionality through software upgrades.

The DOD's Joint Technical Architecture (JTA) Committee was established by the DSAC. This committee has the task to provide a consistent definition of an "open system" across all services, provide open system design approaches for various system categories (e.g., aircraft, ship, command/control communication systems, etc.), work with industry/government groups to provide an open system maturity model, and to include open system approaches and processes in appropriate DOD training courses.

Currently, there are various industry and DOD efforts to define reference models that can be used to create "open" communications systems architectures. The two most prominent are the Programmable Modular Communication System (PMCS) and the Modular Multifunction Information Transfer System (MMITS) which was spawned by the DOD Speakeasy program. In addition the ASD(C3I) has developed the Generic Open Architecture (GOA) reference model for the development of Open Avionics systems. In general, these models follow the lead set by the DOD Joint Technical Architecture Committee.

The actual progress in implementing open systems architecture in the programs reviewed by this Task Force was minimal, as the guidelines for open system design are in the process of formulation. The program giving most attention to an open system approach is the Joint Tactical Radio System (JTRS) which is discussed in another section of this report. The Task Force believes that of the programs reviewed, the Joint Strike Fighter program is a primary candidate for an open system design approach, and that the program office should make JSF the model for open systems.

The problems evident in current open system design approaches are those relating to the hierarchical system level at which "standard" interfaces (or functional "object" definitions) should be established – the level at which open system design goals can be achieved while still maintaining effective procurement competition at the system and replaceable subsystem level. Many of the system approaches lean toward a "bottoms up" strategy, with emphasis on defining subsystems that can be "integrated" into a top level system rather than addressing a top level architecture that can be structured with logical functional interfaces and subsystems that stand the test of reuse and "upgradability".

An important set of open-system issues appears at the higher levels of system design. The need to maintain major system interoperability in the field (and under stress) is essential. This extends the dimensions of an open system architecture to include operating doctrine, training, and inter-system configuration control. The concept, in the ultimate, can reach from plug and play modules to plug and fight systems.

While the concept of open systems in the commercial environment has been around for quite sometime, the standards that permit effective implementation are only now approaching maturity. The open system activities in DOD should take advantage of this experience, and should proceed at a pace that permits practical, "semi" open system approaches to design with evolutionary progress to extended "openness."

The Task Force concludes the following:

1. The USD(A&T) should make open systems a key element of all programs. The Joint Technical Architecture Committee should continue to function as the coordinating body for open systems architecture definition and implementation approaches. Priority should be given to the definition task.

2. Open system approaches should be incorporated in new ACTD's, and that these ACTD's be used as the early proving ground for open system effectiveness.

3. It is further concluded that an open system architecture evaluation be included in the source selection criteria for all new weapon system procurement. For example, the Joint Strike Fighter should be made the model program to follow. The JSF "open architecture" should be a fundamental pass or fail JSF procurement contract condition.

F. Single Process Initiative

On December 8,1995, the Secretary of Defense and Under Secretary of Defense for Acquisition and Technology announced implementation of the Single Process Initiative (SPI). SPI encourages transitions of contractor facilities from multiple government-unique management and manufacturing systems to the use of common, facility-wide processes. Using a "block change" modification approach, SPI is intended to unify requirements in existing contracts on a facility-wide basis, rather than on a contract-by-contract basis.

Implementation of SPI was assigned to Defense Contract Management Command (DCMC) and its Administrative Contracting Officers (ACOs). The ACO assigned to a facility is the single point of contact for the SPI effort. ACOs lead the coordination and negotiation of contract modifications (block changes) to existing contracts fin response to contractor concept papers/proposals. The contractor must propose and substantiate SPI common processes. Industry, the military services, the Defense Contract Audit Agency (DCAA), and DCMC were intended to work together and work quickly to take advantage of this initiative.

SPI was and is envisioned as a key to DOD Acquisition Reform efforts; as it provides a method to implement acquisition reform goals in contracts today. It is intended to reduce contractor operating costs and achieve cost, schedule, and

performance benefits for the government. The benefits of SPI are to be more efficient, consistent, stable processes with greater ease of contract administration for both contractor and government and savings for the taxpayer. It also has the potential for promoting civil-military integration by reducing the disparity between processes used on government contracts and those used for non-DOD customers.

The Task Force found the effort to be truncated and not living up to its original expectations. The approval paper work bureaucracy has literally stymied any real improvements. The need to conduct a cost analysis on each SPI in order for the government to be able to negotiate a lower price for the ongoing programs that will be affected by the SPI has proven detrimental. Demanding "consideration" on existing contracts has been a contentious issue and has inhibited SPI implementation. It causes the expenditure of more dollars analyzing savings than is warranted in most cases. Flow down of SPI to subcontractors also continues to be a problem.

Plant wide SPI's are few and far between, and industry-wide examples of success are non-existent. With a substantial fraction of defense acquisition contracts being cost-based, contractors are not highly motivated to propose changes that may reduce their profits.

Despite its truncated nature, SPI has had some significant results, including the conversion of more than 200 facilities to IS0 9000 and 9001 standards (replacing government unique quality requirements) and savings/cost avoidance's in excess of $500 million (source: DCMC). In another example, Raytheon worked with a tri-service team headed by the Army's Tactical Missile PEO, and standardized a number of manufacturing processes that resulted in Raytheon agreeing to provide extra missiles at no extra cost to the Army. The most successful example that the Task Force found is the Rockwell-Collins Avionics and Communications case study discussed in Section II H, of this report under civil military integration.

Recently the USD(A&T) has made two changes that hold promise. First, the SPI focus has been altered away from a single process/single facility approach to a corporate wide approach. Most major contractors now have corporate management councils (the membership on which includes the company, its customers, DCMC, DCAA, AR, etc). Moreover, the initiatives being proposed through these councils, because they are much broader than the earlier, more discreet proposals, offer even greater opportunity for savings. The key to this change should be to not generate more bureaucratic process but to concentrate on output. The Task Force's believes the emphasis should be on less process and more output.

Second, the USD(A&T) has recently formed an SPI Executive Council, chaired by the Principal Deputy Under Secretary/Acquisition & Technology, the specific purpose of which is facilitate the movement of proposals through the process. The Council, which first met this past Fall, recently approved a pilot

program proposal in which two major suppliers (General Electric and Allied-Signal) will use commercial packaging standards in place of military unique requirements.

The Task Force concludes the following:

1. The role of the Government in promoting the SPI need to be substantially increased. Instead of relying solely on voluntary industry proposals, the ACO's should be tasked to identify potential SPIs that would be in the government's interest and aggressively negotiate the appropriate contract changes.

2. The team headed up by Principal Deputy USD(A&T) is a positive step to keep senior leadership drive and focus on SPI. Industry wide applications need to be stressed and expanded. All contractors should work with DCMC and the services to standardize their processes.

3. There should be incentives for contractors who create meaningful SPI projects rather than demanding "consideration" on existing contracts which has been a contentious issue during the early stages of SPI. The need to conduct a cost analysis on each SPI in order for the government to be able to negotiate a lower price for the ongoing programs that will be affected by the SPI inhibits SPI and causes the expenditure of more dollars analyzing savings than is warranted in most cases.

G. Procurement Initiatives

Multiple procurement initiatives have been pursued as acquisition reform. Three of the most interesting and successful are the limited use of Section 845 "Other Transactions," the new Part 12 of the Federal Acquisition Regulations (FAR) for commercial items, and changes in Independent Research and Development (IR&D).

1. Section 845

Section 845 is available only at the R&D phase and had seen limited use primarily by DARPA and the Navy, until 1997 when the Air Force and Army increased their usage of the authority (Table A, Section 845 Agreements). Where used it was found to be more efficient, more effective, and more affordable. The key areas where flexibility is available include "cost accounting standards, cost principles, government property management and protest procedures." Flexibility in these areas makes it easier to pursue activities with predominantly commercial companies and significantly expands the ability to use commercial products and processes. Where it has been used, it has provided more system for less money. Its primary advantages have been increased industry freedom in design and technical innovation and it facilitates incorporation of innovation in process and product development and in manufacturing and construction.

Agency	FY95	FY 96	FY97
Army	0	0	10
Navy	0	0	20
Air Force	0	0	8
DARPA	6	8	4
NOMA	0	0	3
Total	6	8	45

Table A Section 845 Agreements

The problem with this important enabling legislation is that it is limited to research and development contracts. Should the 845-project lead toward an acquisition decision, it is necessary under the current law for the project to transition to a Federal Acquisition Regulation (FAR) contract. The DOD tried to extend 845 authority last year to the procurement phase and failed but there is another attempt at a legislative initiative for 1999.

The Task Force strongly supports the use of section 845 agreements and the expansion of their use by the services. However, it is necessary to expand the authority further to include application to procurement as well as prototyping. Otherwise all the momentum and savings that accrue to such transactions will be lost in the transition to the "normal" acquisition. Also the ability to continue to take advantage of those commercial contractors who did not previously do work for the DOD may also be lost.

2. Federal Acquisition Regulation (FAR), Part 12

FAR Part 12, is the implementation of Title VIII of FASA, Part 12 allows for a significant exercise of business judgment in the contracting officers and provides them with broad authority for procuring commercial products in a manner determined to be consistent with commercial practices. Part 12 allows the commercial industry to apply standard practices and to supply innovative solutions to defense requirements.

FASA was a bold move by the DOD and Congress to address the need to apply commercial practices to attract the best suppliers to DOD needs. The problem to date is that it is being applied in far too few contracts. Part 12 would appear to be a reform that requires a cultural change before implementation. The first step is an extensive training program to convince the acquisition work force of both the improvement in products and cost savings that are available through applying this important acquisition tool.

3. IR&D

The Government has received great benefits from allowing their contractors to pursue research and development that is perceived by the contractors, but not necessarily the Government, to give them a competitive edge. The Government indirectly compensates the contractor through the General and Administrative (G&A) expenses allocated to contracts. In recent years the separate cost categories for bids and proposals and independent research and development (IR&D) in the G&A accounts have been combined into one account. The two constraints on IR&D expenditures have been reasonableness and the need to keep G&A costs down for competitive reasons.

The recent trend toward consolidation of the major suppliers into four huge companies likewise causes the IR&D dollars to be concentrated. This concentration has the potential to create a dependency on far fewer sources for new and creative technology breakthroughs. Additionally, there exists the potential for the IR&D expenditures to be biased towards bid and proposal costs rather than research and development. The question is how to address these concerns in a way that preserves the "I" portion of IR&D. A companion issue is how to make sure sufficient G&A expenses are devoted to IR&D.

This is a difficult policy issue wherein the Government needs to encourage IR&D but not proscribe on what or how the expenses are incurred. In particular the larger prime contractors need to encourage their subcontractors to spend IR&D dollars. Additionally they need to consider allocating some of the prime's IR&D dollars to directly contracting with the subs for research and development. (Price Based acquisition will leave IR&D decisions to the contractors because it will eliminate the need for a review of G&A expenses.) The policies should encourage and reward those contractors who emphasize expenditures for research and development rather than proposal costs.

The Task Force concludes the following:

1. DOD should expand the use of Section 845 to more programs and seek its application to procurement funding.

2. DOD should encourage broader use of Part 12 of the FAR by making its use a presumption where commercial items can meet the requirement and through education and training.

3. DOD should create positive incentives for contractors to emphasize the IR&D portion of their IR&D/ bid and proposal (B&P) G&A accounts. (Note that in a pure PBA environment, IR&D is no longer an issue.)

4. DOD should encourage major prime contractors to contract with innovative subcontractors for IR&D with the majors' IR&D funds.

H. Civil-Military Integration

One of the priorities of DOD leadership is to take full advantage of the commercial industrial base in military procurements. This permits access to new technologies, can lead to higher product and system quality levels, and can contribute to lower total ownership costs of weapon systems and services. Importantly, this approach can also be a significant factor in reducing the cycle times required to field new or upgraded weapon systems.

The DOD initiatives that support commercial cost accounting standards — MIL-Spec Reduction, FAR part 12, Sec. 804 or "Other Transactions" contracting methodologies, Commercial Operations and Support Savings Initiative (COSSI), Single Process Initiatives (SPI), and contractor ownership of certain proprietary information (cost, intellectual property) — have resulted in real progress in leveraging the commercial base.

This Task Force reviewed a case study involving the Rockwell Collins Avionics and Communications business that clearly illustrates a successful integration of military and commercial business functions within a company. Collins is a leading designer and producer of avionics for the Commercial Air Transport market airlines, and airframes. Collins is also a major supplier of military avionics and communications products and systems to the military services and to the prime contractors for large military weapon systems.

Prior to 1995, the commercial and government divisions were clearly separated, each with it's own marketing, engineering, manufacturing, information management, finance, accounting, and administrative functions. In 1995, after careful considerations of commercial and government business conditions and of the positive trends in the DOD acquisition environment, the commercial and government businesses were integrated into a single operating entity. The combined business had annual revenues of about $2 billion, employed approximately 9,000 workers, manufactured 700 product types of low quantity and high mix production, while managing over 250 key suppliers.

The new, integrated organization has a single manufacturing function that produces military and commercial products using the same Single Process Initiative process.. For example, there is a single quality system, a single soldering system, a single assembly and test system for all products, even though there are several factories that are geographically separated. Additionally, the contractor is implementing an Enterprise Resource Planning (ERP) system that will insure consistency in business systems, accounting practices, and manufacturing requirements planning. The net result of this will be an ability to build any product at any plant at any time, and ultimately eliminate the distinction between "commercial" and "military." Throughout this evolution, overall focus remains on quality, cycle time, delivery time, agility, advanced processes, and Cost as an

Independent Variable (CAIV). It should be noted that the Bargaining Unit was an active and involved partner in the integration team.

In the Collins organization, marketing and sales, program management, and customer specific product design and engineering are structured to match the customers they serve and to facilitate effective up-front IPT's. The advanced technology function, engineering process management function, and information technology and management function are common to all business areas.

As a result of this business integration and the related sharing of Best Practices from the commercial and government sectors, the following two-year results were reported:

- On-Time Delivery – improved by 20 percent
- Total Manufacturing Cost – reduced by 30 percent
- Cost of Quality – reduced by 30 percent
- Material Costs – reduced by 23 percent
- Manufacturing Support Costs – reduced by 35 percent

In addition to improving cost, quality, and delivery performance for both commercial and defense customers, the integrated business offers Collins and others effective access to commercial avionics and communications products for its military customer base.

Several key "enablers" to this business integration are worth mentioning:

- DCMC was an important member of the integration team from the start. Although DCMC headcount at Collins was reduced by 50 percent, this organization provided critical support;
- An OSD team, in conjunction with DCAA, DCMC, and Collins Finance Executives defined the financial system and related commercial controls that would be accepted by Collins and it's customers;
- The Single Process Initiative (SPI) permitted single, effective processes to be implemented;
- Change management leadership came from top management;
- The IPPD and IPT processes were effectively implemented and motivated; and,
- Management of the supplier relationships and involvement of key suppliers was a key success ingredient.

This Task Force believes that civil-military integration is practical and workable in the current acquisition environment, and that the DOD should encourage and facilitate such initiatives, like Rockwell Collins, as they arise.

I. Lean Enterprise Initiative

A lean and agile integrated industrial enterprise can be characterized by high quality, short cycle time, and cost effective processes and products that can meet the needs of customers on a timely basis. In this context, the enterprise must address a total dynamic system that tightly integrates people, processes, and technology within the enterprise and with the customer and supply base.

The concept of "lean" originated with just-in-time initiatives, was refined in MIT's lean-production programs, and documented in the books "The Machine That Changed The World" by Womack, Jones and Roos, and "Lean Thinking" by Womack and Jones. Common benefits associated with the implementations of lean concepts follow:

- 40-60 percent improvements in productivity
- 60-80 percent reductions in lead time and inventory
- 30-50 percent reduction in floor space

A lean enterprise focuses on identifying value and eliminating non-value added activities or waste. This Task Force did not address activities within the DOD which are directed toward making that organization lean. It did, however, address some of the DOD initiatives that can enhance leanness in its supplier base. From an acquisition perspective, there are a group of enablers that deserve attention.

One of the most effective enablers for Lean Enterprise would be the Single Process Initiative (SPI) if it were properly applied. Requirements to implement, maintain, and control multiple processes that address a single R&D, and/or, manufacturing function result in increased cost and lengthened delivery times. Convergence to a single process per function — a single quality process, a single soldering or fastening process, a single test process — that will be accepted by all of the Service buying agencies can contribute significantly to the lean performance of an industrial organization.

Another important enabler is the allocation of acquisition funds early in a development program that will permit concurrent engineering/manufacturing contributions focused on manufacturability — e.g., design for production. The cost and manufacturing complexity related to a product is determined relatively early in the design cycle. Consideration to lean manufacturing processes should be a requirement in ACTD programs where manufacturing maturity should be as important as technology maturity. It should be noted that in the typical DOD acquisition, with competition at both the development and manufacturing phases of

a program, there is little incentive to invest in manufacturing process improvements in the early phase. Manufacturing is treated as a 'following' activity, and leanness is often compromised because of tight delivery schedules.

The actions to encourage and support IPT's and IPPD's, in every major procurement, is another enabler to industrial leanness. As these teams solidify requirements, improve the efficiency of engineering and manufacturing processes, improve quality, reduce cycle time, and push for open system design and related reuse, the results to the customer can only improve.

Another "lean" enabler under DOD's control relates to the unnecessary flowdown of defense acquisition requirements from primes to lower tier suppliers. The extent of this flowdown can, to a large extent, be controlled by the acquisition community, and can be managed to maintain performance without penalizing cost, delivery, or parts availability. Effective supplier base management is a key to lean manufacturing. In fact, the majority of the industries that we want to be lean are in the supplier base.

As described in another section of this report, the initiatives to utilize the commercial industrial base in defense procurements will result in increased access to lean enterprises that operate in a highly competitive marketplace and are forced to be lean in order to survive. These initiatives which include commercial accounting standards, intellectual property management, Mil Spec reductions, and price based acquisition will all contribute to leanness and bring high pay off.

J. Simulation Based Acquisition

The topic of Simulation Based Acquisition (SBA) has been the subject of numerous studies conducted by OSD, the Services, and joint DOD/industry groups. Although there is general agreement of a top-level definition of SBA, there is no definitive strategy that has been jointly developed to effectively implement SBA. Perhaps the best definition of SBA is provided in a 1996 report by the Director of Test System Engineering and Evaluation (DTSE&E):

> "Simulation Based Acquisition is the process by which simulation is incorporated and integrated throughout the functions of the acquisition of a weapon system, from concept exploration, through prototyping and design, test and evaluation, fabrication and production, to deployment and finally operations and sustainment."

The report went on to say:

> "Using modeling and simulation in acquisition is not a new idea. Simulation is already being successfully incorporated in each function in individual weapon system acquisition programs in each of the Services. What is new in Simulation Based Acquisition is the integration of technologies across functions, phases, and programs."

The report pointed out that the study did not include Requirements Definition and Training, although both areas benefit from the use of modeling and simulation. Most agree that these functions should be included in the general definition of SBA.

Most of the SBA information routinely circulated focuses on the application and benefits of specific modeling and simulation tools in individual phases of the acquisition process, e.g., design, manufacturing, or test etc. Very few reports or presentations focus on the systemic, across function and across phase use of modeling and simulation. Those that do are very generic and academic, although they do portray a vision or "ultimate goal" for SBA.

A National Defense Industrial Association (NDIA) study highlighted some of the significant issues of a systemic implementation of SBA. One of the simply stated but very complex issues is the requirement for a "compatible acquisition environment and system architectures to support SBA."

The system architecture issue relates in large part to the need for open system architectures that are logically structured with functional elements or modules that can be modeled and cataloged for use in various simulation activities. The acquisition environment issue pertains to, among other things, a single DOD approach to SBA, one set of acquisition policies, and a DOD organization that can manage the evolving modeling and simulation processes, and maintain the DOD model library or repository.

The NDIA report stated that the "heart of SBA is the sharing of models and data among industry, and between industry and government." It should be noted that the industrial "models" are not just weapon system/product models. They also include cost models, manufacturing process models, test models, etc. The attendant problems are formidable. To compound this, the related DOD, or user models will include full operational, and system interoperational models, changing threat models, and training models. It must be recognized that all of these models come in many formats, degrees of completeness, plug-in standards, and often will work with only one or a small set of simulators. Further, the quality of models varies across a wide spectrum, and quality assessment metrics vary just as widely. Model standards would need to be set for all categories of models, at all system levels, to allow model designs that could be shared by the Services and industry, and to fit with the proper set of simulators – no easy task.

Also, the important issue of intellectual property arises. The prospect of sharing company proprietary models must be considered. This may be the toughest hurdle to overcome, as it flies in the face of market competition.

The management of a DOD repository for models, along with the task of properly communicating the contents of the repository to potential users, and the configuration management task related to ever-changing model versions are non-trivial issues.

The Task Force concludes the following:

1. Modeling and simulation should be emphasized and encouraged even in the light of these SBA barriers. The Task Force believes that a systemic, top level joint strategy for SBA should be developed, so that progress in the individual functional areas can be directed within a total SBA context. Although the ultimate goal for SBA may be a long way out, incremental improvements in the continued development and use of modeling and simulation can have a great payoff.

2. The USD(A&T), through DDR&E, should continue the activities of the Executive Committee on Modeling and Simulation(EXCIMS), and charge the Acquisition Council of that committee to increase interaction with industry(NDIA, NCAT, etc.) to allow coordinated progress to be made in defining and implementing a SBA strategy. Interaction with the Open Systems steering group should be encouraged.

III. Advanced Concept Technology Demonstrations (ACTDs)

The Advanced Concept Technology Demonstration (ACTD) program was initiated in 1994 in response to recommendations of the Packard Commission in 1986 and the Defense Science Board recommendations in 1987, 1990, and 1991. The recommendation of the Packard Commission was to build and evaluate prototype systems to assess improvements in military capability and provide a basis for cost estimates before making acquisition decisions. This recommendation was intended to address the problem frequently encountered in DOD, deciding to acquire new military capabilities before it has a good understanding of either the value or the price of those capabilities. In the five years since the program began, the process has evolved significantly, but the two primary objectives of the process have remained unchanged: a) to develop prototype versions of new military capabilities (hardware and/or software), and to provide those prototypes to operational units for employment in realistic military exercises for assessment of their military utility; and b) to expedite the fielding of those capabilities that demonstrate sufficient military utility.

The rapid changes occurring in the threat and in key technologies employed in our military systems are having an accelerating effect on the nature of warfighting. In this environment, an operational evaluation of proposed new capabilities is a crucial element of informed acquisition decisions. It is equally important that this evaluation be accomplished without contributing to an already excessive acquisition cycle time of 10 to 15 years. The ACTD process is clearly succeeding in this regard. For the 46 ACTDs that have been initiated since the program began, the average time from approval to planned completion of the demonstration phase and fielding of the residual capability is approximately three

years. The actual duration for the nine ACTDs that have been completed has averaged just less than 37 months.

The Task Force spent several hours reviewing the status of the program, including lessons learned from the initial ACTDs. It also reviewed two specific ACTDs, the Miniature Air Launched Decoy, and the Tactical Unmanned Aerial Vehicle called Outrider. The Task Force strongly endorses the ACTD process, including the refinements to that process that are described below in the paragraphs to follow.

A. Lessons Learned

To achieve the two objectives of the program, ACTDs are structured to build fieldable prototype systems that are capable of being employed in a series of operational exercises to assess their value. If they are judged to have sufficient utility, they remain with the operational unit, providing a limited operational capability. If additional units are required to fully satisfy the operational need, the program then enters the formal acquisition process. It normally enters the acquisition process as far downstream as practical to allow early fielding of the additional units.

As the first set of ACTDs, which started in 1995, neared completion, it became apparent that during the design of these early prototype systems insufficient attention had been given to post-ACTD considerations, such as interoperability and sustainment. An example is the Advanced Joint Planning ACTD that provided a critically needed capability to integrate joint readiness data for all CONUS-based forces. However, when the effort was initiated, no requirement was imposed to make the prototype system compliant with the Defense Information Infrastructure (DII) and the Common Operating Environment (COE). Significant effort has been required to revise the capability to bring it into compliance and to allow it to be hosted on the Global Command and Control System (GCCS). Guidelines for ACTD formulation have subsequently been published, requiring that information exchange requirements be identified during ACTD formulation and that appropriate standards be applied during the design of the ACTD.

The Predator ACTD showed that vital new capabilities can be developed, evaluated and introduced into service significantly faster than is possible under the normal acquisition approach. The system was in operational service 19 months after program initiation, and the ACTD was completed in 30 months. However, Predator also showed that sufficient attention must be given to planning and preparing for the transition. This includes such areas as manning, sustainment, interoperability, and the development of operational requirements that reflect the experience gained during the ACTD. As a result of this ACTD, a requirement was established in 1997 that a Lead Service/Agency must be designated prior to the initiation of an ACTD. The Lead Service/Agency will be responsible for planning

and preparing for the transition of the residuals to the user and, where required, for transition into the acquisition process.

To provide near-term capability to the warfighter, only mature technologies are permitted in the prototypes. This allows technology development to be avoided, risk and uncertainty to be reduced, and shorter schedules to be established. In the High Altitude Endurance UAV, particularly in the case of the Darkstar UAV, the maturity of several key technologies was overestimated. This problem was confirmed by the DOD Inspector General in 1997 as a much more specific definition of mature technology was being established. That definition requires that technologies must be demonstrated at the required performance level and in the operational environment. The penalty of limiting consideration to demonstrated technologies is a slightly lower performance that might otherwise be available. However, the ACTD formulation guidelines stress the use of open system design practices that reduce both the cost and the design impact of upgrades during the life of the system. This approach enables the design to evolve as necessary to accommodate changes in technology and/or threat.

B. Task Force Findings

1. Readiness to Transition

When ACTDs involve hardware systems that may ultimately involve production quantities, it is important to establish the proper transition strategy early in the ACTD. Two alternatives exist. One is to transition into the acquisition process at Milestone II, planning to complete development prior to starting LRIP. This would appear to allow all effort on the "illities" to be deferred, thus reducing the scope of the ACTD. However, if the ACTD is to field the residuals at the completion of the demonstration phase, those residuals must be designed to withstand the rigors of the operational environment for an extended period. They must be reliable, sustainable, interoperable, and affordable. Deferring all "illities" which would necessitate a redesign, additional development, and increased testing prior to entering efforts on LRIP would certainly extend the schedule. This would result in a development timeline comparable to the timeline for the normal acquisition process. This approach would run counter to the objective of expedited fielding. Barring unusual circumstances, the transition strategy should be to include within the prototype development process sufficient system engineering to provide an acceptable quality product that is suitable for entry into LRIP. The key to success under this approach is finding the proper balance during the design, development, and testing that will qualify the system to enter LRIP, and to do so without encumbering the ACTD process with the extensive process and paperwork that have evolved under the formal acquisition process. The policy of employing only those technologies that have already been demonstrated will simplify this task, but the importance of finding the proper balance should not be underestimated. This approach will avoid one complete development cycle and would reduce time to fielding by an estimated three to five years. Similarly, software intensive ACTDs

should strive for products ready for hosting on GCCS or GCSS where appropriate, or for immediate fielding to the required units. These factors did not receive sufficient emphasis in the early ACTDs, but in the ACTD management guidelines published in 1997 and 1998, emphasis was added in each of these areas. The selection process has also been refined to insure that adequate attention to system engineering, manufacturing and sustainment is included. The Task Force fully supports this added emphasis.

2. Affordability

The Miniature Air-Launched Decoy (MALD) ACTD provides clear evidence that emphasis on cost control can produce significant results. That program has shown true innovation in its search for low cost approaches to satisfying military requirements. The real proof is still contingent on a successful flight demonstration program, but the approach looks promising to this point. Since MALD is designed to be a wooden round, it is reasonable to concentrate on unit flyaway price (UFP) as the objective. However, the Committee is concerned that on programs such as Global Hawk, the emphasis on UFP could lead to improper trades against the total cost of ownership (TOC). We encourage focusing the emphasis on affordability and cost control on TOC to insure that cost trades remain sensitive to the total cost equation, and not just a single element of cost.

3. Funding

The funding philosophy for ACTDs requires that all funding required to conduct the ACTD, including the funds for technical support of the residuals during the first two years in the field, must be identified and committed prior to approval of the ACTD. Funding for a potential follow-on acquisition is not required to be identified because there is no implied commitment to acquire the capability at the time the ACTD is initiated. The purpose of the ACTD is to determine the military value of the capability before making an acquisition decision.

However, planning and preparing for transition into acquisition without programming the required procurement funding creates a significant transition challenge. Under the current procedures, if programming of funds occurs immediately after the assessment of military utility, it will create a delay of at least two years in the follow-on procurement. To provide the resources promptly for a follow-on procurement, and to do so without diverting them from other programs and thus exacerbating the problems of funding instability, requires a change in the current process,

The Task Force concludes the following:

1. Funding for follow-on procurement must be programmed. This relates to funding for follow-on procurement of a capability that demonstrates high utility during the ACTD. The Army has addressed a similar problem when it created the Force XXI PE as a wedge to fund procurement of

capabilities tested and proven effective in the Task Force XXI exercises. The creation of such a wedge for ACTDs poses several questions. First, how large should the wedge be? The Committee believes the wedge should be sized to support the first two years of procurement for no more than 60 to 70 percent of the ACTDs that, if successful, would require follow-on production. This retains a measure of competition for these resources and insures that there is always a high priority for them, giving some measure of protection against reallocation during budget reviews. The second question, who should program for these funds? Since there are typically around four to six ACTDs each year for which follow-on production would be appropriate, 60 to 70 percent would translate into approximately two to four ACTDs per year being funded for production. This number is too small to make a Services-level wedge practical. Also, the Committee believes that the funds should be held at the OSD level and allocated to the appropriate Service, once out-year procurement budgets were committed by the Services. This source of initial procurement funding would also provide additional incentives to the Services to support the ACTD process, which is an important consideration given the emphasis on development of joint capabilities.

IV. Acquisition Process Model

The "1986 DSB Summer Study on Practical Functional Performance Requirements," produced two general models of the acquisition process, one of which characterized the commercial process, at least for the successful programs studied, and one which characterized the DOD process, at least for the unsuccessful programs studied. The Task Force did not mean to imply that all commercial programs are alike or are successful, or that all DOD programs are alike or unsuccessful. The group did see certain fundamental differences and believed that the closer a program was to the "Commercial Model", the more likely it was to succeed, and the closer it was to the "Government Model" the more likely it was to fail.

Although some of the recommendations made in the 1986 study have been followed, not much has changed in the processes by which the DOD decides what to develop and buy. Recently, however, under the pressure of limited resources, much greater attention has been paid to reform of the DOD's acquisition system. The DSB Task Force on Acquisition Reform has urged a number of major changes, and therefore, it is appropriate to describe a new acquisition model that might be called the "New DOD Model" which embodies these changes.

This section has two parts. **Part A** is taken from the 1986 report and describes the Commercial and DOD Models. **Part B** describes the Proposed New DOD Model that includes a description of how Price Based Acquisition can be incorporated.

A. *Commercial Model and DOD Model*

The **Commercial Model** is shown in Figure IV-A. There are three major participants: a Program Manager (PM) who does the work, a Chief Executive Officer (CEO) who makes the major decisions, and a user or group of users who decide the ultimate success or failure of the program. There are many minor players, of course, including inside support staffs, government regulators, consumerists, and the like. But, one of the major advantages of the Commercial Model is that the minor players play a minor role.

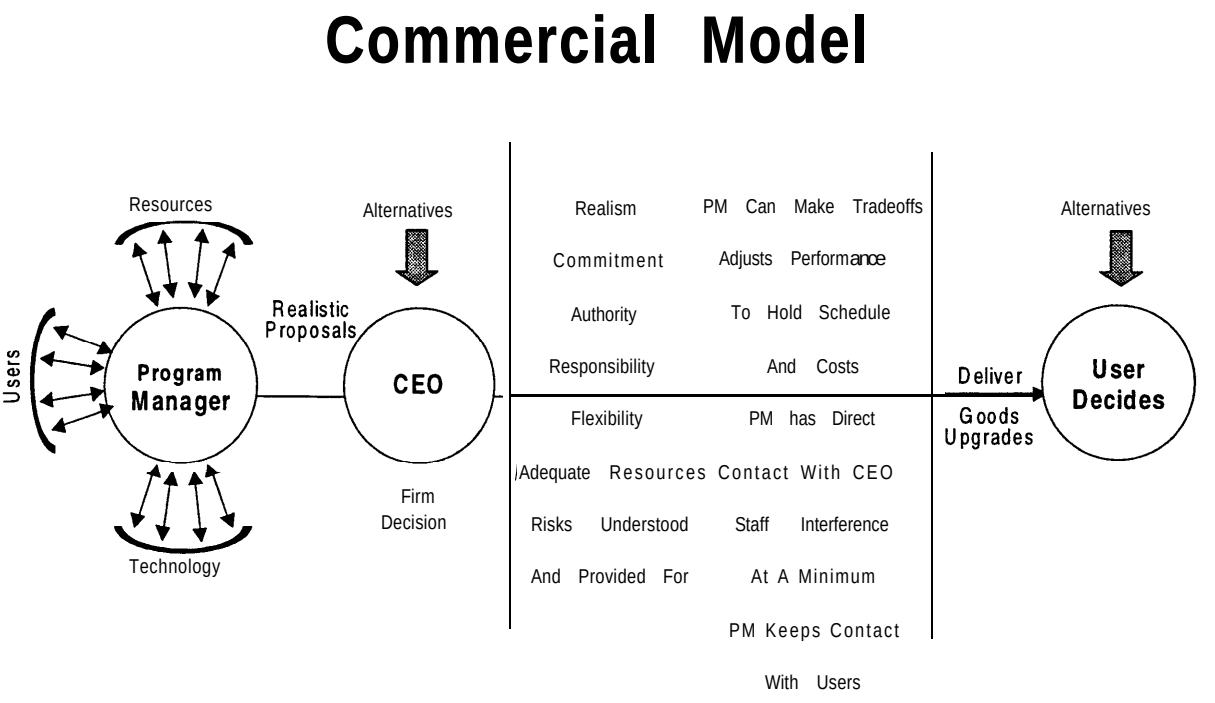

Figure IV-A -- The Commercial Model

The first step in the model is for the CEO to consider alternative proposals. The PM knows what resources and technologies are available, backed where necessary with company R&D funds. The PM pays a lot of attention to the users wants and needs, because he knows that they will eventually decide whether or not to buy his product. How he involves the users is up to him. But, involve them he must, if he is to succeed. The PM is motivated to be realistic about performance, cost and schedule, both because he will have to carry out the program if it is approved, and because his job is dependent on the merits of his proposal.

The CEO has clear decision authority. He may have to deal with Boards of Directors, banks, and the like, but they are just elements of his concerns. He must decide whether or not to proceed, and his decision must stick. The CEO has alternatives to proceeding: he can send the proposal back to be re-accomplished, or

he can cancel the program and put his resources somewhere else. His future as CEO depends on whether programs he approves are ultimately successful, not on whether or not the company proceeds with the program.

The CEO and the PM must have a close working relationship, direct access to each other, and mutual trust. The CEO can have, and probably will have, advice from many others, which he can use as he wishes.

A decision to proceed is a firm decision, based on a realistic commitment on the part of both the CEO and PM. This commitment involves a clear agreement on authority, responsibility and flexibility, an understanding of the risks involved, and an agreement on the resources to be made available, including adequate resources to cope with contingencies. In turn, the PM commits himself to performance, cost and schedule. Note that the process of reaching this decision is really a single step although it may be lengthy, expensive, and go through many iterations.

The acquisition of a complex system involves many uncertainties. The PM copes with these in two ways. First, he has some flexibility in performance goals, and second, he has some resources to reduce these uncertainties and to cover contingencies. In general, he holds schedule and relaxes performance if he must, both because timing is important in a competitive market and because holding schedule tends to hold cost. If the PM gets in trouble, he goes back to the CEO, who can grant additional resources of time or money, or can adjust performance goals. If the program reaches too far beyond nominal, the CEO can decide the program no longer makes sense. He can cancel.

Once again the CEO and the PM must have a close working relationship. The CEO must be kept informed, and the PM must be able to get help rapidly and reliably if he needs it. The principle is one of a joint activity toward a common goal. A program failure is a failure of both CEO and PM.

The staffs and inspectors, test groups and **illities** groups exist, but are insulated from the PM by the CEO. The staffs can talk to the PM, and comment, and advise, but cannot direct the PM without going through the CEO. Only the PM and the CEO can make decisions. They have the responsibility and, therefore, the authority.

When the development is complete, the product is produced and delivered to the users. It is fundamental to the model that the users have alternatives to buying this product. This user choice, or competitive market, is what really makes the system work. The CEO and PM combination must seriously consider the users wants and needs, must make realistic plans and commitments, must hold to costs and schedules, must fend off the detractors and keep the program under control, or they cannot hope to sell it in the end. With that, contrast this commercial model with the historical DOD model.

The **DOD Model** is shown in Figure IV-B. There are many more people involved; they have far less continuity of position; and they have different and sometimes conflicting degrees of authority, responsibility, and interests.

The DOD process for reaching agreement on what is to be acquired really involves two steps. The first step begins with a competition for funds, carried out in a highly political environment involving the Services, OSD, OMB, and the Congress. There are many alternative uses for the funds proposed by both Government and industry for similar and different products. There are great pressures to over-promise in order to survive the competition. Since the decisions are made by political processes, among a large and diverse group of people, there is little pressure to discipline the process and to enforce realism. Clear-cut designs to meet the requirements are not allowed because they would interfere with the next step – competitive source selection. The result is a firmly over-stated requirement that too frequently can neither be met, nor changed.

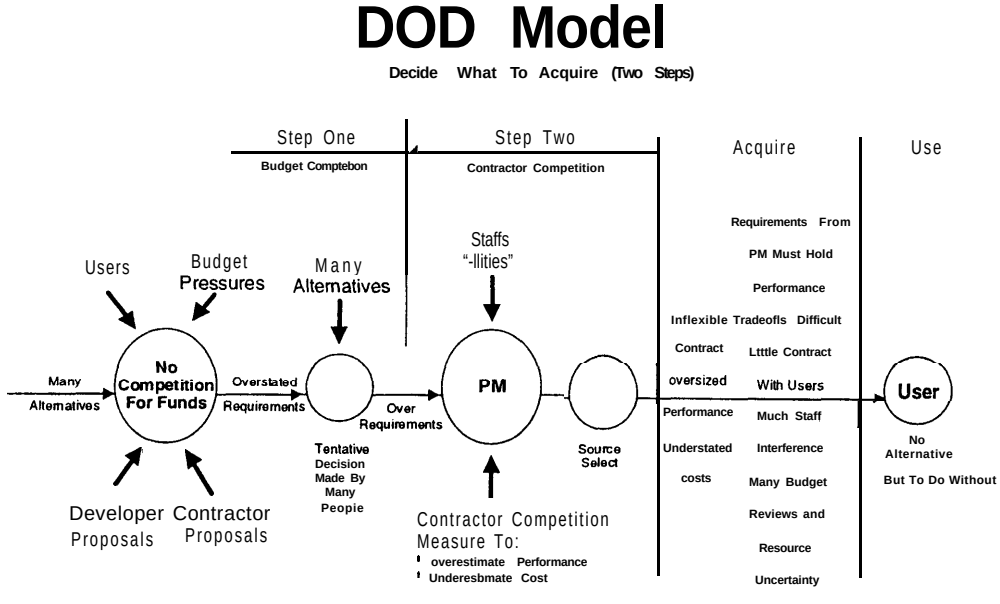

Figure IV B -- The DOD Model

Note that in this second model there is no equivalent to the commercial CEO. Although the DOD is nominally a hierarchical authoritative organization, it is very difficult in a democracy for anyone to implement a controversial decision. The successful commercial programs the Task Force considered were of great importance to the companies involved, and therefore, to the CEO. There is hardly any single program in DOD of equivalent importance to Service Secretaries, let

alone to the Secretary of Defense. DOD has too many important programs for such officials to keep track of them in detail.

The second step begins with a competition among potential suppliers. The requirement is firm and difficult or impossible to meet, and the contractors are under great pressure to overestimate what they can do, and to underestimate what it will cost. Although the requirement is firm, the decision to proceed with the program is not. The losing participants in the first step remain around hoping for another chance. It is difficult for the PM to be realistic, and he has no CEO to help him.

The result is an inflexible contract with inadequate resources, overstated performance goals, and concealed risks. The PM has little ability to cope with the inevitable troubles. He tends to keep these to himself because reporting them begets more attention, but little help. By the time the program troubles get so bad that they are quite apparent, they are extremely expensive to fix.

Staffs and ilities groups are numerous and continually harass the PM. He has little protection from them. Many of these oversight groups were established in the hope of preventing past troubles. They have authority to interfere, but no responsibility for producing the system. Although the PM's commitments up the chain are firm, his commitments down the chain are not. Changes in funding are common. The PM is usually forced to hold performance constant, so trouble results with the inevitable slipping schedules and rising costs.

Eventually, after much difficulty, the product reaches the user. The situation is now reversed; the PM has the advantage, as the user has no alternative but to accept it, or do without. The more fuss the user makes about the product, the longer it will take to fix it, the more it will cost and the fewer systems he will acquire. The user's ability to influence the design is limited throughout the process. His influence is probably greatest in the first stage, depending on how much political influence he has, and is willing to expend. His influence gets less as time proceeds.

We would hardly claim that all DOD programs go according to this model. We all know of successful high priority programs that have avoided many of these difficulties. Yet, it is obvious that successful programs tend to be like Commercial Model, which is driven by marketing forces, rather than like the Government Model, which is not. Some improvements are being made, but too few and too slowly. To further improve the DOD process, we should move it more rapidly toward the Commercial Model.

Unfortunately, normal human reactions are in the opposite direction. Bad prior decisions lead to adding more people to the decision process, which is exactly the wrong thing to do. As a general rule, the more people involved, the worse the decision. Any person or group added to the current process, no matter how able and

motivated, will make things worse. We need fewer people in the decision process, not more.

Inefficiencies and high costs lead to demands for more competitions; more promises do not help. This two-step process has a separation between the funding decision, and the source-selection or design decision. This makes it extremely difficult to get a realistic match between requirements, costs, and schedules. In many cases, less formal, but no less real competitions, conducted earlier in the process would help. As goals are missed there are demands for firmer contracts inside DOD, and between DOD and industry, but, by now there is little flexibility to cope with problems. Less flexibility only makes matters worse.

Finally, unsatisfactory performance in the field leads to demands for more operational test and evaluation, but failed OT&E without a clear fix will not help the user if he has no alternatives. The lack of user alternatives leads to a lack of user influence, and ultimately reflects the lack of realism throughout the whole DOD model process.

B. Proposed New DOD model

A Proposed New DOD Model, shown in Figure IV-C and a price based acquisition process shown in Figure IV-D, portray a process of events, that approaches the Commercial Model by imbedding the DOD process in an approximation of the free market, the distinguishing characteristic being the price based way of conducting business and reduced cycle time. The Price based process is a refinement of the New Weapon System Development Model advanced in the "Defense Acquisition Reform, Phase III Report," dated May 1996.

The DOD Model began by generating a formal approved requirement, which then passed through serial stages of approval, contracting, development, production, and delivery to the user. Each stage was assumed to be inevitable. Because, by definition, "requirements" must be met. The new DOD model assumes that there are few essential requirements, but many needs. The new model assumes the users live in a changing world of limited resources but many possibilities, and that they must participate continuously in the acquisition processes that provide the systems with which they must fight.

New DOD Model

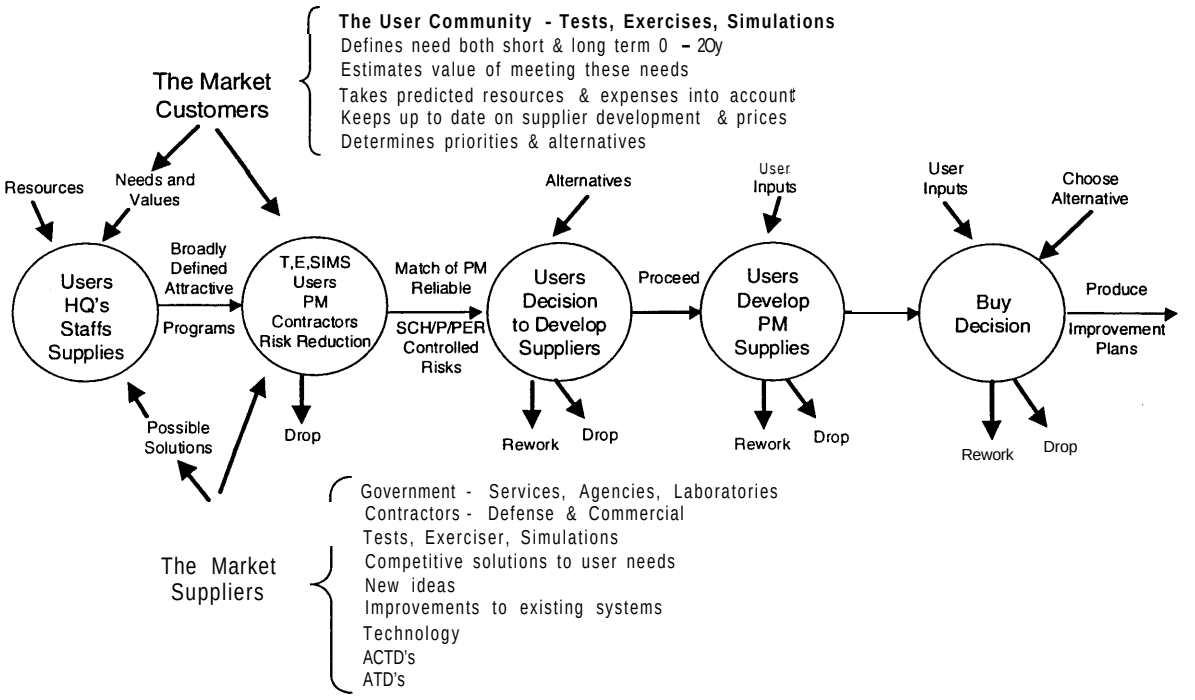

Figure IV C -- New DOD Model

The suppliers, likewise, must live in a world where their products compete throughout the acquisition process, not just at the beginning. Furthermore, they must compete on the basis of both price and value. Price and value, not cost, become the key determinants of a solution that will meet a need.

1. The Market

The top of Figure IV-C describes the Market, which consists of the user community, broadly defined to include the Chairman, the CINCs, and other war fighters, as appropriate. The users have the responsibility for building a war fighting capability including people, tactics, and equipment. They must have a time horizon comparable to the length of time it takes to acquire new systems, integrate them into their existing operations, and then learn how to use them. They must define their needs and estimate the value to them of meeting those needs. They must make sensible tradeoffs among their needs in light of the limited resources available. They must keep up-to-date on what the suppliers are developing, what new systems are likely to cost, and how long it will take to provide them. They must have an idea of the alternatives available to them if the situation changes. This does not mean that the users generate all this information. It does mean that they must have developmental situational awareness if they are to participate in

making reasonable decisions about where and how to invest the DOD's limited resources.

2. The Suppliers

The lower part of the figure describes the suppliers. The Government organizations include the Services, Agencies and Laboratories. The contractors include the defense industry, but also commercial organizations that can supply commercial products of value to DOD. The contractors are sometimes independent, but are often partnered with Government organizations to offer jointly developed equipment.

Industry teams may offer solutions to user's stated needs or new ideas of their own devising, improvements to existing systems, and technology that creates new possibilities for improved performance, greater reliability, or lower costs. The supplier base must not be restricted to user wants, but must have freedom to pursue their own perceptions of user needs. ACTDs, ATDs, participation in CINC exercises, and the suppliers' own tests and simulations, all form a part of an active, forward-thinking information base.

3. The Process

The process in the new DOD Model begins with a mechanism that puts together the needs and values that come from the users, the possible solutions that come from the suppliers, and the available resources. It is important that there is not just one user or one organization that speaks for all users, nor is there just one or a few suppliers that speak for all suppliers. Nor, indeed, is there one source of resources. In a free market there are many of each. From this process come broadly-defined, attractive potential programs along the proposition: "we believe we can develop something like the following thing, with something like the following performance, at something like the following price (to buy and to own), on something like the following schedule. We believe it has sufficient value to warrant a high priority, and it should be well worth its likely price." The decision asked for is to be funded to pursue the idea. There is no agreement to buy it, nor is there a firm requirement. Yet, there is a need.

The next step is to appoint a Program Manager who, working with users and suppliers adds definition to the idea. Several contractors may be involved. Investment is limited. Part of the effort goes into risk reduction, part into simulation and experiments to better understand use and value. From this step may emerge a more clearly defined program, including an attractive match of price, and value, reliable estimates of schedule, price, total ownership cost, and performance, controlled risks, and perhaps a source selection. In the absence of these, the program should be cancelled. Note that canceling the program is an option at every step, if the program gets into trouble, if the user's needs change, or if the resources are no longer available.

Next a decision is made whether or not to proceed to development. This requires a much larger investment. The decision-makers are at a higher level of authority than in the preceding step, more money is involved, and other alternatives must be considered. The program may go ahead, or be dropped, or, if there are sufficient funds and interest, sent back for further work.

If approved, the development goes forward, on a piecewise interruptible milestone basis with frequent opportunities to renegotiate or terminate, once again with the participation of the users. The PM can make further tradeoffs to meet schedule or reduce costs to the government. He has the users to help him decide what makes the best price and value package. If the value drops too low, the program can be cancelled or restructured.

At last, the product is ready with value determined. Now, the buy decision takes place. Most of the money is yet to be spent. The users have a chance to say whether they want the program. Price and value are reexamined. Alternatives are considered. The program can still be cancelled if some better way to meet the need is available. If the system is not all the users want, an improvement program should be considered, block changes planned, and the like. The buy decision is close to delivery and, therefore, less likely to be disturbed by unforeseen changes between the decision and when the user gets the capability in the field.

Note, the program in this model is always in competition and always subject to cancellation as a normal occurrence. As the program proceeds through the various steps, more and more money will have been invested. Therefore, more and more will be known.

Finally, the development process should include the introduction of production representative hardware at the earliest practical stage in the integrated development phase, or Phase I, which will be discussed in the next section. At that point Operational Test and Evaluation (OT&E) should begin, avoiding the need for E&MD, and a separate Low Rate Initial production (LRIP) OT&E phase.

The Price Based Acquisition (PBA) Process

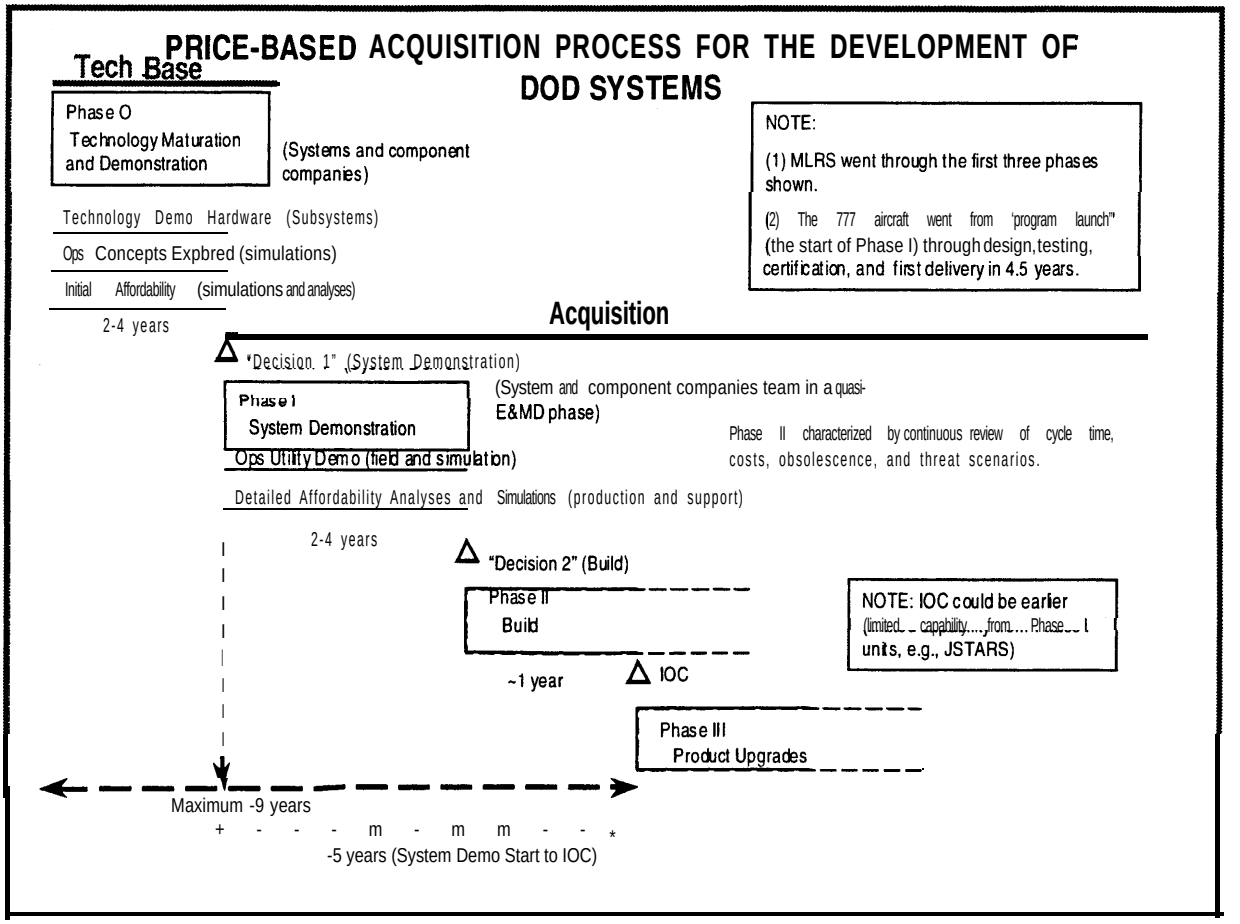

Figure IV D -- Price Based Acquisition Process

The Price Based Acquisition process is a major departure from today's process. The change to price based contracts will have profound implications. This process presumes the incorporation of reduced cycle time, broadened forms of competition, encouragement of commercial vendors by accepting commercial practices and standards within the DOD, making greater use of Commercial and Non-Developmental Items (CaNDI), and encouraging open systems.

Figure IV-D is a refinement of a chart from the Defense Acquisition Reform Phase III report. It envisions an acquisition process with Three Phases: System Demonstration, Build, and Product Upgrade. Preceding Phase I, is a technology maturation and demonstration period called Phase 0 in which component portions are developed and proven. Development risk of a technology must be driven below some metric before any consideration is given to including it in the configuration of Phase I. In Phase 0, both Users and Suppliers must discipline themselves to remain aware of what is in the realm of the possible for the future and what is immediately available.

1. Phase 0 -- Technology Maturation and Demonstration

In this "pre" Phase, Military need is identified with mission need statements. Technology solutions are developed and refined through a series of low risk, price based, contracts. Technology challenges are broken into manageable segments, and a program does not advance until the segments are developed. Two or more teams may conduct risk reduction, if necessary; critical subsystems are defined and developed using price based contracts, hardware from technology demonstrations, ACTD's, ATD's are potential sources of sub-systems or entire systems. Operations concepts are explored using modeling and simulations, and affordability is determined using simulations.

2. Phase I – System Demonstration

This phase serves to demonstrate the system using a price based contract with billing on milestone achievement. Requirements are stated in terms of mission needs. Requirements are stated, but are also continuously re-assessed. The phase is schedule-driven. Products are affordable prototypes, fielded and supported in the hands of users and warfighters. Open systems and interoperability are promoted, as well as the use of appropriate modeling and simulation. Finally, the Phase builds production-representative hardware and initiates OT&E. An ACTD may be this system development phase of a program, with the ACTD translating directly into the build phase without additional development.

3. Phase II -- Build

The build phase features a single prime, but it can include the addition of super-subcontractor participation after reevaluation of user needs, validation of utility demonstrations, and analyses of production and support affordability. Price based acquisition and milestone billing are the absolute norm during this phase.

4. Phase III – Product Upgrade

The product upgrade phase capitalizes on designed-in system flexibility and transparency to new technology during the upgrade process. Product improvement capacity is critical. Continuous competition is maintained.

The Task Force found that the Special Operations Command with its own acquisition authority and procurement budget, separate from the Services, incorporated many of the procedures discussed. It specializes in the creation and procurement of items unique to its multi-missions. Items are usually bought in low rate production lots. The Task Force views with favor the close coordination of user and procurer in this Command.

V. Selected R&D programs - Review and Assessment

As requested in the Terms of Reference, the Task Force examined and re-examined many acquisition programs, some in more depth than others. Following is a summary of that information. Added details are provided on the Joint Strike Fighter program in Appendix F.

A. *Joint Strike Fighter (JSF)*

(A more in depth examination of the JSF program is provided at Appendix E.)

1. General Observations

There has been a conscious decision to move to a single airframe (JSF) to meet a spectrum of tactical requirements of the USAF, USN, USMC and RAN. This decision has been taken in the face of a Departmental challenge to try to increase competition to improve capability and reduce dollar outlay. While competition and procurement of two or more airframes might be operationally preferable, that decision has now been foreclosed.

Single procurements to meet a general military requirement present attractive cost opportunities but also have their own set of risks. The Army's "Comanche" experience is germane. Several years ago, the original competition for the next Army helicopter involved four vendors. A decision was taken to inform the vendors that the Army intended to buy only one helicopter for the next several decades, aiming at bringing about the best solution. The net effect has been to largely eliminate competition in helicopter development and, at the same time, commit to a Comanche program that is not meeting the Army's performance or cost goals.

The Task Force concludes the following:

The JSF program must be fashioned to maintain continuous competition in all phases, including production. The Task Force urges USD(A&T) to alter the envisioned contract vehicle such that at contract award, a winning design is designated but insure that:

- two vendors are designated to produce the airframe. Block procurements would be apportioned to the two vendors based on a periodic price competition, with production numbers apportioned within a band (40 percent to 60 percent of the block) . . . .similar in concept to AMRAAM procurement practices.
- multi vendors compete to provide functional components, such as avionics, systems (EW, etc) and engines, in a competition framework similar to the F-16 Block X0, Pratt and Whitney/General Electric, engine competition,

and on-going commercial aircraft avionics competitions (Honeywell, Litton, Collins, etc.).

This approach compensates positively, to the extent that it can, the loss of ongoing direct competition between two or more discrete systems to fulfill the same or similar military mission need. The recommended approach encourages airframe and functional system industry vendors to continuously undertake, throughout the contract period, innovation and best value approaches in pursuit of the larger share of periodic contract awards. Finally, it maintains a larger competition and production base.

2. Specific JSF Program Observations

Price Based Acquisition: Since this program has been in competition, the Task Force is not aware of any steps to use R&D price based acquisition or price based acquisition (PBA). However, the Task Force and JSFPO Leadership have had a long discussion on the merits of price based acquisition and its potential use in the JSF procurement. The JSF is undergoing an extensive risk reduction development phase and a head-to-head fly-off phase using production design concepts. The JSFPO should consider the JSF acquisition as a candidate for a price based acquisition program consistent with the Task Force letter forwarded to the USD(A&T) earlier in Phase IV of this Task Force. The letter recommended adoption of price based acquisition as the rule for DOD developments and procurements.

The Failure to Consider the JSF a Weapons System: JSF Program requirements have been stated in terms of mission needs, but there is a serious limit on flexibility. The program "boundary" within which the JSFPO Director is obliged to operate is limited to the weapons platform, excluding the weapons aboard the platform. This boundary exclusion results in legacy weapons being a major drive and determinant in both airframe sizing decisions, as well as determining, and limiting, 21st century capability. This approach also provides no incentive to improved weapons development - the critical output function of the fighter.

Open Architecture: Of all the concepts and issues addressed by the Task Force, open architecture appears to have the potential for significant long term impact but is the least defined and most contentious. It is amply clear that this important concept is still in the earliest stages of definition, with considerable variance as to what it means, as well as how broad are its bounds. Definition on this topic needs to be resolved by the DOD at the earliest opportunity, not only for JSF, for all emerging weapons systems. The JSF system "open architecture" should be a fundamental pass or fail procurement contract option.

Maintenance Concepts: The Task Force believes that all US users of the JSF should adopt an "all up" common maintenance and sustainment concept -joint training for all JSF maintenance and logistics personnel, a common maintenance concept (transition from a periodic depot maintenance paradigm to a condition

based maintenance approach), and common maintenance practices — how an aircraft is daily maintained. A joint approach to developing common standards and practices in training, flight line maintenance and tertiary level repair hold enormous life cycle savings potential that need to be addressed and agreed now. There should be a DOD mandate to use common ground equipment packages, training concepts, spares, etc. Where exceptions are considered necessary, waivers should be submitted to a very senior Board (secretarial level) to strongly discourage dissimilarities unless absolutely operationally necessary.

The ultimate goal for all types of aircraft maintenance should be Conditioned-Based Maintenance (CBM), which is a strategy for performing maintenance in response to the development of specific deleterious conditions. With such a strategy it is believed that the operational maintenance costs will be minimized and operational readiness improved.

Operational Test Disconnect: The JSF timeline needs have been established and linked to the expiring operational life limits of existing systems. However, recent actions by the Quadrennial Defense Review (QDR) have inadvertently stymied the operational test program of the JSFPO. This error should be remedied by DOD, directing simultaneous service procurement of JSF OT&E aircraft in order to conduct a simultaneous, rather than sequential, OT&E program.

The Task Force believes the JSF Program Office is executing its responsibilities in full accordance with its terms of reference. The program enjoys excellent leadership and is performing very well. However, this Task Force believes the JSF program guidance is too inflexible. A unique opportunity exists to implement acquisition innovation and reform. Substantial public trust benefits and taxpayer savings can be realized. Accordingly, the Task Force recommends that DOD exercise prompt action to provide revised DOD emphasis, support and direction to the JSF program, and commit to pursue opportunities to implement new acquisition reforms in the JSF program execution. This unusual opportunity probably will not reoccur in the next decade, and DOD Leadership is urged to seize the moment.

The Task Force concludes the following:

- The JSF contract should be structured and maintained throughout the program as a price based acquisition and the contractor payment schedule should be geared to definable output metrics (specific program accomplishment milestones rather than calendar points or cost accumulation points). Standard commercial accounting practices should be used, and defense-mandated accounting eliminated. (see Appendix E, Section II, Para. A, page E 1)

- Direction to the JSF Program Director should be amended to require development and procurement of the JSF as a weapons system rather than as just an aerial vehicle. The weapons suite should command an interest equal to that of the aircraft. (see Appendix E, Section II, Para. B, page E 2)

- JSF should be designated as the model for an open architecture program. The agreement on the definition of open architecture should be expedited, insuring that a "plug and play" philosophy is incorporated and that appropriate systems are interoperable (as compared to compatible or similar systems). The JSF system "open architecture" should be a fundamental pass or fail procurement contract option. (see Appendix E, Section II, Para. C, page E 3)

- A common, cross-service maintenance concept should be developed and implemented to include maintenance training and standardized on-aircraft maintenance procedures and processes, and standard information gathering and tracking for major maintenance events and tertiary level repair. The ultimate goal for all types of JSF aircraft maintenance should be Conditioned-Based Maintenance (CBM). (see Appendix E, Section II, Para. D, page E 5)

- Direction to the Services procuring the JSF aircraft should be amended to return to the original OT&E airframe procurement program to once again allow conduct of a simultaneous, rather than a duplicative sequential, OT&E Program. (see Appendix E, Section II, Para. E, page E 6)

B. *Ship Building Programs*

The Task Force notes that the Navy has embraced many elements of acquisition reform and that much progress has been made in many areas of reform. Particular attention is being given to reducing operating and support costs by implementing many of the changes demonstrated in the "Smart Ship" testing program.

1. Arsenal Ship

The Arsenal Ship Program was one of DOD's most innovative attempts to truly revolutionize the development process for the next generation of surface combatants. This program produced many lessons applicable to future programs. Its cancellation also reconfirmed the importance of having strong Service support to keep a program viable and funded.

The Arsenal Ship was planned as a Section 845 "Other Transaction," not as a normal FAR contract. It was an excellent attempt for the Navy to "reinvent the way it developed new ships," employing Section 845 legislation. This allowed the nine-person, Program Management Team, to bypass a number of statutes that would otherwise limit flexibility. DARPA, the Navy Program Manager, and the industry teams each briefed the Task Force on the lessons they learned.

This was a "Price As An Independent Variable" program, and requirement flexibility was a critical aspect of the program. Design was the responsibility of industry. Price was the dominant factor in source selection followed by technical merit and schedule.

Because this program was canceled, we will not know whether this new approach would have yielded the innovation and total ownership cost savings that were expected. The innovations were to be made available to the next generation surface combatant, DD-21/SC-21. The cancellation of Arsenal Ship has reduced this opportunity, and the Navy will therefore have fewer proven technologies and innovative design concepts from which to chose as they go forward with DD-21.

One lesson learned from Arsenal Ship is a repeat of the lessons learned in every Navy surface ship development that the DSB Task Force reviewed. Insufficient funds were planned for the development phase. The Task Force has also observed this on LPD-17 and CVX. The Navy will be unable to achieve the planned dramatic innovations in design and reductions in total ownership costs if it is unwilling to fund the needed developments.

There have been few revolutionary programs in the past, that have succeeded without the strong support of the owning Service. Major change almost always involves some leadership group who perceives a pending crisis. If the DOD wants to make change, it must recognize the difficulty of sustaining funding support for revolutionary changes, and then provide the leadership for giving such programs funding stability.

2. SC-21/DD-21

This program is just getting started and has recently been re-structured to insure competition for the development phase. The primary emphasis for this class of ship is to reduce the total ownership cost, primarily by dramatically reducing ship manning from the current classes of surface combatants.

This program had initially been planned with the expectation of using the technologies and concepts developed in the Section 845 Arsenal Ship Program. The cancellation of the Arsenal Ship Program has increased the risk to the SC-21/DD-21 Program.

The SC-21/DD-21 Program appears to be taking full advantage of acquisition reform. Unlike previous combat ship designs, the Navy will be depending primarily upon industry to design the total ship system, and not the Naval Sea Systems Command (NAVSEA). This is a recognized risk by the Navy, but the need to design, develop and build a ship for significantly lower costs requires this change. The challenge to the Navy is to find a way to share the lessons learned that are resident within NAVSEA while keeping full design responsibility with the contractor(s).

In general the Task Force supports the Navy's approach to DD-21/SC-21. Unfortunately, the performance requirements for this ship class appear to be drifting toward, traditional design specificity rather than being stated in terms of mission needs. The Navy needs to provide greater flexibility in the performance requirements for DD-21 to industry

3. LPD 17

This program was competitively awarded to Avondale Shipyard in 1996. The systems integrator for the ship is Raytheon, who is a subcontractor to Avondale. The other major subcontractors are Bath and Intergraphics.

This was one of the Navy's first major development programs that was required to release its request for proposal (RFP) without using MILSPECS. This was a significant change from the program that had been planned by the Navy up until the RFP was ready to be released. However, the program team should be commended for rapidly making the needed program changes that allowed releasing the RFP without requiring any MILSPECS.

A highlight of the LPD-17 program is its strong focus on reducing the total ownership cost in comparison to current comparable ships. The basic design of this ship will enable the Navy to replace 41 existing amphibious ships with 12 LPD-17s. In addition, the source selection and the award structure of the contract put strong emphasis on total ownership costs. Therefore, total ownership cost reduction needs to become a recognized requirement for this program.

The program is to be commended for the strong emphasis that is being placed on reducing ship manning, the largest contributor to life cycle support costs. However, only $7.5 million in R&D dollars was provided for critical development prior to issuing the RFP to build the first LPD-17. As a result, very little "new technology" or new developments for reducing total ownership cost are available to the program. The Task Force believes that significantly greater reductions to ship manning would be possible if more effort had been invested initially to develop manpower reducing capabilities that would have been applicable to this class of surface ship.

4. New Attack Submarine (NSSN)

The New Attack Submarine (NSSN) Program, is innovatively displaying the following:

- Strong operator involvement in the program definition process;
- The use of CAIV primarily to make significant performance-cost trades;
- Designing the combat system using an open system architecture with a planned technology refresh prior to the first deployment;
- The use of technology to open the trade space in the ship design, like the non-penetrating photonics mast; and
- Putting all acquisition funding for the ship, including the combat system under the ship program manager (SPM), vice funding the combat system

and the ship separately with neither the ship nor the combat system program manager having the final vote.

The Task Force concludes the following:

1. This program has not embraced the elimination of MILSPECS nor has it put an emphasis on reducing total ownership costs. The major program focus has been the reduction of procurement cost, which is projected to be 28 percent lower than its predecessor, the Seawolf Class.

2. The use of nuclear propulsion and the submarine community's desire to maintain a very hands-on involvement have not allowed this program to embrace acquisition reform as broadly as other shipbuilding programs.

5. CVX

Since this program was briefed to the Task Force the Navy has changed its strategy to acquire this capability. Instead of funding a full development program for a CVX, the Navy will incrementally upgrade the current CVN design. The expectation is that the full CVX capability will be achieved after several incremental upgrades of the CVN.

The Task Force views this change of strategy with concern. This could be a watershed decision for the Department. It once again shows that R&D investments for major new ships, could have significantly lower total ownership costs are not being supported. Although significant changes can be incorporated into the current CVN design by accomplishing three incremental upgrades, it is an inefficient way to proceed.

The CVX team has taken an innovative approach to the design of a new aircraft carrier. The Program is to be complimented on the excellent work completed on their system trade offs starting with their use of quality function deployment (QFD). They are building the Operational Requirement Document (ORD) at the same time as they are creating the performance specifications. Considerable time and effort is being put into the Analysis of Alternatives (AOA). However, more tests could and probably should have been conducted to prove certain of the assumptions in the AOA process.

A strong emphasis is being placed on reducing the total ownership costs of this new aircraft carrier system. The CV innovation center is enabling the design team to think innovatively, albeit the relatively small $12 million per year budget for this activity is not likely to generate any revolutionary new ideas. An example of radical change is the electro-magnetic catapult, which has not had sufficient investment in its development for it to meet the old schedule of the CVX or now, for the first CV after CVN-77.

Designing the CVX to be a total system has increased the program's need to include a systems integrating contractor. The shipbuilder, Newport News, has not

had this kind of experience, and it is correctly believed that this next generation aircraft carrier should take advantage of the systems integration expertise that exists within the aerospace industry. This had been the plan, but unfortunately with the change in the CVX Program from one large design effort to three incremental efforts, it will be more difficult to down-select to a single systems integrating contractor. As smart as down selecting may be, this decision needs to be weighed against the loss of competition that would result.

6. Charter and Build

The Navy has structured a program to replace its ammunition, stores and dry cargo ships, i.e., the AE and AF classes, with a new class of auxiliary ship, the ADCX. The Navy needs ten to twelve ADCX ships. This capability should provide the Navy with significant total ownership cost savings since they will be replacing the current cargo ships on a two for one basis.

Instead of procuring, and then operating these ships, the Navy is trying to "buy the service." The Navy wants to obtain long term, approximately 20 years, leases through an industry competition. Industry would provide the financing, and once each ship has been constructed and available for service, the Navy lease would begin.

This has been accomplished successfully before with tankers and ready reserve fleet (RRF) ships. However, a lesson was learned regarding inflation adjustments, and this knowledge must be applied for the "charter and build" of the ADCX class of ships. Specifically, inflation was planned to continue to occur, and the price continued to escalate in the out years, even though inflation had been greatly reduced from that which it had been when the initial leases were signed. Some adjustment for higher and lower than expected inflation is required.

The Task Force fully supports the Navy charter and build initiative. This approach will give industry the right incentives to continuously take actions to reduce cost, yet still provide the contacted service.

7. MARITECH

MARITECH has been a DARPA program to improve the shipbuilding capabilities in the United States, and to help make the United States competitive in commercial shipbuilding. DARPA does not believe that it should continue to manage MARITECH, since it is not a high technology initiative.

In 1999 the MARITECH Program will transition to Navy management, and the funding is planned to remain at $20 million per year, which is only half of what previously had been provided by DARPA. Nine U.S. shipyards have established articles of "Collaboration for Consortium" and have agreed to invest equal amounts to that provided by MARITECH.

The Task Force concludes the following:

1. The Nation should continue this program. As long as our Nation requires a Navy, the U.S. will remain in the shipbuilding business.

2. In order to build ships efficiently for the Navy the shipbuilders must also have the ability to compete worldwide in commercial shipbuilding. MARITECH is a vital step, albeit a small one, to this end.

3. With the Navy taking over the management of MARITECH, the Task Force recommends that these efforts be linked to acquisition reform.

C. *Land Programs*

1. Secure Mobile Anti-jam reliable Tactical Terminal (SMART T)

The SMART-T program meets a critical need for equipment for tactical ground forces to communicate with secure voice and medium rate data (up to 1.544 mbs) over the MILSTAR satellite system. It will provide a range extension capability for Mobile Subscriber Equipment (MSE), to provide a satellite interface to permit uninterrupted communications as advancing forces move beyond line-of-sight MSE.

The acquisition program, aimed toward volume procurement, began in 1992 with a competitive request for Proposal (RFP) for an Engineering/Manufacturing Development (EMD) phase. Two cost plus incentive fee (CPIF) contracts were awarded in November 1992. The two selected contractors were to develop and deliver six terminals each. The acquisition strategy called for a down-select to one of the two EMD contractors based on performance during the EMD phase and their proposal for the next phase, a Low Rate Initial Production (LRIP) contract.

The acquisition strategy was revalidated by the Army Acquisition Executive (AAE) in October 1994 with the proviso that acquisition streamlining be incorporated into the program to the maximum extent possible during the remainder of the EMD phase and be incorporated fully onto the LRIP phase. The SMART-T Army Team (who are part of the same overall program management organization as SCAMP) fully accepted the guidance acquisition strategy. This team had introduced some “non-controversial” innovations and streamlining into the EMD solicitation in 1992, but the freedom to really go for major reform did not come along until 1994.

An Integrated Product Team (IPT) was chartered by the AAE. This team consisted of staff personnel from the AAE office, the Program Executive office, and the program manager. The team was fully empowered to approve the RFP for the LRIP; serve as the source selection advisory council; conduct contract reviews; and, conduct the program in concurrent (consolidated) phases.

The RFP for the LRIP program was performance-based. Design details were the prerogative of the contractors, who were free to propose their “just right”

designs, and be held accountable for performance specs only. Use of commercial business practices commercial parts, and commercial standards was encouraged.

Elimination of Military Specifications (MILSPECS) and standards was defined in the RFP and the subsequent contract, unless they were wavered in." Eighty-two MILSPECS originally included in the program were reduced to five, wavered in by the AAE. The original EMD contract statement of work of over 250 pages was reduced to 50 pages in the LRIP contract. Over 200 contract data requirement list (CDRL) items were reduced to thirty. A five-year "bumper-to-bumper" warranty was included in the contract.

The contract is a firm fixed price contract. The LRIP and Full Scale Production were incorporated into one RFP/Contract.

At the beginning of EMD, the LRIP and Full Scale Production (FSP) costs were estimated to be $800 million to buy the quantities needed to equip the force. After acquisition streamlining was introduced into the LRIP/FSP, the estimate was reduced to $250 million, which was validated by independent cost estimates. To date, the LRIP/FSP program is on schedule, units meet performance specifications, and costs are holding steady.

For its efforts the program has received a Packard award for acquisition excellence.

The Task Force concludes the following:

1. This program demonstrates that commercial business practices and commercial hardware and software standards can lead to quality military systems at significantly reduced prices.

2. This program demonstrates the efficacy of intelligent price based acquisition.

2. Single Channel Anti-jam Manportable Program (SCAMP)

The Single Channel Anti-jam Manportable Program (SCAMP) program meets a critical requirement for tactical ground forces to communicate with secure voice and low data rate (2400 bps) over the MILSTAR satellite system. SCAMP is essentially a re-started program.

The original program, after much technology-based R&D, began in September 1992 with the award of two competitive Engineering/Manufacturing Development contracts. They were cost based contracts, laden with mil specs, voluminous terms and conditions, and voluminous Contract Line Items (CLINs). The contracts were terminated after two years because of poor performance, 63 percent cost growth, high technical risk in custom development of K band transmitter components, and other assorted problems. The requirement still remained for a single channel terminal for tactical forces to operate with MILSTAR.

At the time of termination on October 1994, the initial set of acquisition reform initiatives (laws, directives, regulations, and rules) were being put in place and were beginning to be institutionalized.

The three significant initiatives that drove the SCAMP re-start were streamlining the phases and milestones of the acquisition process; elimination of MILSPECS and standard, unless "wavered" into the program; and, adoption of commercial standards, processes, and parts, including CaNDI software.

The SCAMP program team revised its acquisition strategy in accordance with these initiatives. A technical market survey was conducted including white papers from interested industry parties. This survey established that the system could be realized with almost all-commercial practices and parts of the maximum weight requirements were relaxed modestly and the communications link margins were relaxed modestly. It also established that, with these commercial ground rules and the modestly relaxed performance specs, that qualified companies would be willing to demonstrate "breadboards" as part of the competition. As a result, a demo phase was held in which companies were invited to demonstrate a breadboard system. Several companies did so and proved the systems performance requirements could be met.

As a result, a new request for proposal was issued, based on key performance specifications. It left the design solution up to the bidders. It eliminated 45 of 47 MILSPECS, and reduced the page count from 82 to 32 pages. It specified that commercial standards, parts and processes were preferred. It established a best value criteria for evaluation. It combined development prototyping, and initial production into one contract phase. It called for a five – year "bumper-to-bumper" warranty and called for contractor life cycle support for 5 years. Initial delivery under the on-phases contract was for 312 terminals with an option for several hundred additional terminals. Lastly, it called for a firm-fixed price contract with minimal pricing back-up data. After demos, proposals, and evaluations, a firm fixed price contract was awarded in February 1996.

The commitment to Integrated Product Teams paid real dividends, with full and open communications, and problem solving and systems tradeoffs being shared between the government teams and the contractor teams. The government Program Manager headed the management IPT in which the Contractor PM was a member.

Virtually all approval authority was delegated to the Program Executive Officer by the Army Acquisition Executive (AAE), because there were no intervening milestones within the one-phase contract, In essence, the next milestone decision from the AAE was the decision to buy quantities beyond the original 312 terminals. This true delegation of authority and accountability speeds up cycle time considerably.

The streamlining of the contract structure contributed greatly to a better system at extraordinary cost savings. The price based contract, in this case fixed price, eliminated volumes of cost back-up data, auditor time, and other administrative processes that would have added to program schedule and costs.

At the time of program restart, it was clear that classical phasing of the program into EMD, Low Rate Initial Production (LRIP), and Full Scale Production (FSP) milestones were not required, and would be a schedule and a cost detriment. A single contract requirement delivery of 312 terminals, fielded and tested to performance specs, coupled with a five year warranty, was clearly the high quality, low cost approach.

The results to date are impressive. Average Unit Production Cost (AUPC) for the initial production lot is $267,658. At the time of termination of the original contracts, they were estimated to be over $450,000. Option 1 for 200 additional units is bid, fixed price, at $102,000 each, whereas in the original contract, added units in these quantities were estimated to be well over $200,000. Deliveries are on schedule and the terminals meet their performance specifications (i.e., they are within the allowable weight, they communicate with MILSTAR at the required data rates, and they meet the link margin requirements).

There are clearly some steps toward commercialism and streamlining that could have been adopted by the SCAMP team. However, considering it was one of the earliest programs to start under the new culture of acquisition reform, performance is excellent.

The Task Force concludes the following:

1. SCAMP clearly demonstrate that acquiring military systems using commercial competitive practices used in the business world and using commercial parts results in better military products at significantly lower coasts.

2. SCAMP demonstrates that intelligent management, using price based acquisition can produce excellent results, even when there is R&D content in a program.

3. Joint Land-Attack Elevated Netted Sensor (JLENS)

The Joint Land-Attack Elevated Netted Sensor (JLENS) program has made a concerted effort to implement streamlined acquisition reform initiatives. The commitment to integrated product teams is good and the IPTs "within the program" are well defined: cost and management IPT, systems integration IPT, Test and Evaluation IPT and the program management council.

JLENS is an Applied Technology Demonstration (ADT) program, and has both an overarching IPT and a milestone decision Authority. It does not need both. Periodic briefing to senior levels of DOD should suffice. The program manager

should be the chief of the integrating IPT and have full authority to execute the program. The Deputy Commander of Space and Missile Defense Command should be the executive review authority.

It is unclear who the user/operator authority is for the program. Both the Joint Theater Air and Missile Defense Office (JTAMDO) and the Army missile defense establishment within the Training and Doctrine Command (TRADOC) appear to be that authority. A user/operator, analogous to the TRADOC Systems Manger (TSM) should be identified and participate fully in the integrating IPT, and be empowered to approve tradeoffs arising from Cost As an Independent Variable (CAIV). Formal training of IPT members is commended.

The overall contract structure is very simplified — there are just four, time-phased Contract Line Items (CLINs). The focus of the program output is the deliverables. There should be an intense review of the cost-based contract structure with the notion of adapting a price based contract after the design CLIN is delivered and approved. At that time, most of the risks will have been identified and solutions to reduce risk should have been adopted. Moving to a price based contract at that time would reduce the red tape, auditor and administrative efforts associated with cost-based contracting.

Current plans call for a formal and separate Engineering/Manufacturing Development (EMD) at the end of the demonstration. At that point, there will have been extensive technical testing and a user test of demo system. It will be known if JLENS meets a real operational need at that time and is relatively satisfactory to the user. A formal EMD phase for a low-density system appears to be unneeded. The ATD assets should be considered block I production. The PM could allow for a brief production readiness phases during Block I. Program phases and formal milestones would be merged as specifically encouraged in the latest version of the DOD Publication 5000.1. A year could be cut off the 2005 date now scheduled for full capability, resulting in cost savings and increased readiness. During the dialogue with the JLENS PM, there was an impression that the user test might be diminished. We recommend that the user test not be diminished, but be as robust as funds allow. Simulation should be used as a prominent element of the user test, certainly to train the users for live testing.

The inclusion of simulation as a required element of the contract is good. The effort should be to develop a systems simulator which includes detailed engineering, technical, and performance parameters. This model should be used to estimate the impact of CAIV and other tradeoffs. The model should be continually refined as design data and test data become available to represents the system at every stage of development. The use of the simulator model as an element of the Test and Evaluation Master Plan (TEMP) should be insisted upon.

CAIV is a defined requirement during the program. If implemented as described, the likelihood of downstream surprises in risk and costs is low. Because

CAIV may well involve amending key performance parameters, user/operator involvement is critical. As mentioned previously, an accountable, defined user with tradeoff approval authority must clearly be identified.

The Task Force concludes the following:

1. JLENS should be clearly assigned to either JTAMDO or TRADOC for user/operator responsibility authority.

2. Pursuit of formal EMD phase following the ATD must be carefully judged.

D. Space Programs

As the post Cold War world has evolved into more flexible, interdependent and less predictable global relationships space plays an increasingly important role. Recognizing this the U.S. must be able to establish leadership in all space operations to assure our National Security and freedom of action in a dynamic world. This leadership must include the space activities related to communications, surveillance, reconnaissance, tactical warning, space control, attack assessment, navigation (location and positioning), meteorology, launch systems, launch facilities and satellite operations and tracking. Also, this must be accomplished in a very constrained DOD budget environment. Therefore, we must find ways to leverage commercial and allied military investments in space, and use acquisition reform to purchase this increased capability at a lower price.

To examine this situation the Task Force reviewed the unclassified space program activities of several contractors. These included Lockheed Martin, The Boeing Company, Hughes Space and Communications Group, TRW Space and Electronics Group, Kistler Aerospace, Inc., and Space Access, as well as discussing these activities with the appropriate government representatives. It was noted that in space programs DOD has moved further into acquisition reform than in most other areas. However, it is the opinion of the Task Force that more needs to be done to reduce the price we pay for our space activities, both programs and services. In doing so we would keep the cost of our ever-increasing space needs within the constraints of our limited budgets. The following findings and conclusions are not all inclusive, particularly regarding architecture, C^4ISR and interoperability. This is because we did not review the classified space programs.

1. Launch Infrastructure

A key Defense Department requirement is to have assured reliable access to space. This assured access is dependent on an available well-managed infrastructure. Operations are currently too expensive. To provide for the launch infrastructure costs, the DOD had to provide over $520 million in Fiscal Year 1998 funding. Commercial launches are increasingly dominating the overall launch requirements, but could be used to help reduce the DOD costs. Modernization and acquisition streamlining are needed if we are to reduce the price of access to space.

The Task Force concludes the following:

1. DOD must insure that facilities are available which will enable access to various altitudes and inclinations, and allow simultaneous servicing of multiple launch vehicles.

2. The DOD should examine the feasibility of employing an omnibus contract to operate the required facilities, and use the potential saving for modernization.

3. The DOD should plan to transfer the launch operation infrastructure, including safety responsibilities, to a national commercially operated space port authority, if at all possible.

2. Launch Vehicle Programs

The EELV program incorporates some of the best aspects of commercial contracting while keeping enough DOD control to insure the Government's needs will be met. The EELV appears to be a well managed program that will provide DOD assured access, lower costs, and competition between similar capabilities. Reusable launch vehicles, including single stage to orbit, and possible shuttle improvements, offer the DOD the potential of further reduced cost savings, particularly if commercial space business continues to grow at the present rate.

The Task Force concludes the following:

1. The DOD should continue the present approach to the EELV program assuring real competition between similar capabilities in future buys.

2. The DOD should take advantage of commercial launch capabilities, after they are proven in development, and if they provide further cost savings.

3. The DOD should support and monitor NASA reusable launch vehicle technologies, minimizing DOD investment, while insuring that OSD needs are met if the program are successful.

3. Satellite Operations and Tracking

The DOD tracking networks are high cost. The ground environments tend to be proprietary, user unfriendly, and costly to operate. The systems are people-intensive compared to modern commercial systems.

The Task Force concludes the following:

1. DOD should move toward a commercial model and contract out those functions that are suitable.

2. DOD should purchase and employ Commercial and Non-Developmental Item (CaNDI)) tools, and mission software to reduce manpower and cost.

4. Space Systems and Services

More effort is needed on integrated system-of-systems space architecture, including it's continued effectiveness in the presence of countermeasures. This is particularly true when we consider the realities of commercially dominated space communications. Our system architectures should take advantage of these existing and planned commercial capabilities. More effort is needed to employ best commercial practices in our space system acquisition activities.

The Task Force concludes the following:

1. DOD must align the requirements practices to take advantage of commercially-dominated space.
2. DOD should buy commercially first, when trading commercial versus military sourcing.
3. DOD should consider buying services versus systems, where it is logical and feasible, using commercial space more effectively.
4. DOD should apply its own scarce resources to high leverage, military-unique, enabling technologies in those important areas that have no commercial motivation. For example, survivability protection, data encryption, and distributed architecture are such important areas.

E. Joint Tactical Radio

In the second quarter of 1997, OSD, in response to congressional pressures, formed a concept labeled "Programmable Modular Communications System" (PMCS) for a future acquisition program. This was to be an approach to consolidate the various software programmable radio programs that existed in the Services. The PMCS activity was intended as a joint service effort to convey OSD's objectives for PMCS and to identify any constraints related to PMCS implementation. The concept was to provide an open system architecture to satisfy the user domains of Airborne, Ground, Mobile, Fixed Station, maritime, and personal communications. The architecture was to be based on Joint Technical Architecture (JTA) standards and was to develop a Joint Operational Architecture (JOA) for functional requirements. The general objectives were to develop a solution that could accomplish the following:

- Be interoperable with legacy systems
- Be affordable over its life cycle
- Apply software to accomplish waveform generation and processing, encryption, etc.
- Change capability by reinitializing resident software

- Enable implementation of single function communications to multi-channel systems

The Joint Tactical Radio System (JTRS) evolved quickly from the PMRS. This program added the following objectives to those listed above:

- Embrace acquisition reform
- Maximize use of commercial standards
- Enhance competition through multiple vendors

The JTRS joint program office (JPO) is located in Washington DC and has a core staff size of 15 people. The tenets of the JPO strategy follow:

- Evolutionary acquisition and spiral development
- A "single milestone" acquisition program
- Non-traditional oversight and review process
- User and test community buy-in and involvement
- Government and industry teaming

The JPO has established an Architect Steering Group with multi-service/agency participation and various industry consortium working groups.

Of the programs reviewed by this Task Force, the JTRS program has made the most progress in defining open system architecture design. Most technical problems are understood, user requirements are being defined, and participation by industry and all services (although limited), is leading to a technically feasible architecture.

Technical issues still exist in the hardware module packaging area – e.g., determining the unique and /or common packaging constraints and environmental requirements for the families of physical modules that must satisfy the needs of a broad range of radio applications. As stated in the program objectives, these include hand-held, fixed stations, maritime, and airborne radios. The trade-offs between total cost and potential point solutions must be addressed.

Program management problems and issues are related to inadequate funding to fully develop a sound JTRS architecture before program implementation, an unrealistic schedule, and the near term communications needs of the services. Actions to satisfy those needs preempt adequate service participation in the JTRS, and push the launch of next-generation radio designs before JTRS becomes feasible. Additionally, the issues dealing with legacy-federated solutions to the radio communication problems, and the related legacy acquisition infrastructure (military and industrial), present a conflict of objectives that must be addressed.

An additional management issue relates to forecasting the various industry reactions to JTRS that can affect the competitive procurement environment. This includes the problems of defining or identifying the subsystem level (replaceable module level) that will sustain competition on a module-only procurement, and will sustain IR&D investments at the functional level required to support modular upgrade. It is known that companies carefully structure their own radio architectures to enhance reuse and time to market, and that they invest in those technologies that will give them a competitive advantage in total radio or system procurement. Lowering the "competitive content" to a very low level can prove unworkable.

The JPO identifies an acquisition issue that this Task Force supports. There must be a change in the paradigms associated with acquisition budgeting, cost estimating, testing, and reporting to properly execute a JTRS program. This activity can cut across many radio acquisition programs from every service, and cannot be managed as, measured as, a stand-alone program.

This Task Force concludes the following:

1. The JTRS schedule a "decision milestone" within the next six months. At this time OSD, can assemble the proper service and industry executives – technical, acquisition, user, and "business" – to assess the JPO status and recommendations. Any necessary modifications to the JPO strategy can be developed along with the requirements for adequate funding and schedule adjustment. It is believed that this program offers much potential in satisfying DOD's long term communications needs and should be fully supported when the foundation is strong.

F. *Product Support and Sustainment*

In 1996, and again in 1998, the Defense Science Board sponsored summer studies on the DOD logistics system to identify changes that should be made to improve its effectiveness and to reduce its cost. Today's logistics system consumes approximately one third of the DOD budget and employs nearly one half of the Department's personnel.

Each year the military logistics system is consuming a greater proportion of the total DOD budget. The Department leadership has recognized that military logistics and the life cycle support of its systems are consuming a disproportionate part of its dwindling resources. Further, action to date has been inadequate, and operational readiness has diminished. DOD resources continue to be drawn away from critical force modernization requirements. The Task Force strongly believes that action is needed to reverse this on-going diversion of weapon system investment funding. The DOD should direct and incentivize the proactive planning of commercial-like product support plans in the overall acquisition strategy of new and existing weapons systems where possible. This should be initiated at the

beginning of a system's development, and in concert with what may even seem like countervailing regulation and statute.

Specifically, competing teams should design for supportability, minimum total ownership costs, and high readiness. During the System Demonstration Phase, of the proposed Price Based Acquisition discussion from Section IV of this Report, detailed supportability and support cost planning and analyses must be performed. In addition, the competing teams must plan for warranties, total contractor support, and contractor configuration management during design. Interfaces within the design must utilize open systems architecture or "plug and play", and form-fit-function-interface specifications should be met for the subsystems incorporation. This will assure an arena for future competition and demonstration of integration, prior to insertion. For defense-unique items, the prime contractor must motivate lower-tier suppliers to improve the product continuously and to lower the prices. This commercial-like approach must be used for major block upgrades and modifications, as well.

The proposed New DOD Acquisition Model should also be used to substantially affect the procurement of spare parts, especially where the parts are being modified to incorporate technological advances. As part of the generation of best value, system designs should feature transparency to future technology and permit seamless incorporation of upgrades. Spares procurement can demonstrate the following advantages by including the model elements of competition, advanced technology, and price and schedule discipline:

- A means of providing continual upgrades to the latest technology. Upgrades could be accomplished on the basis of complete systems or subsystems;
- Control of prices for spares and upgrades;
- Timely incorporation of upgrades; and
- Timely technical insertion and military advantage.

In short, use of the model for spares procurement could be a path to continuing force modernization on a timely affordable basis, while contributing to a more affordable life cycle and total ownership cost.

In each of the programs that we reviewed the program manager had a sincere interest in finding ways to reduce the system's life cycle, or even the total ownership cost (TOC). However, in no program reviewed by the Task Force were there stated operational requirements for the system's total ownership cost. In other words, the operational requirement was set with little or no consideration for support costs, but the program manager was expected to do the best job possible in minimizing these support costs. Further, making trades among the classical "war-fighting

requirements" and supportability was not in any of the program manager's charters.

Unfortunately, today, the Department's requirements determination, planning, doctrine, training, simulation, financial and accounting, and procurement processes do not adequately integrate the logistics system into top level decision-making. This has resulted in a disconnect of the "tail" from the "tooth" of the system, and missed trade-off opportunities. In addition, program managers still do not consistently have responsibility for system life cycle and total ownership cost.

DOD 5000.1 and current DOD practices fixes responsibility for Life Cycle Support of new systems with program managers. This policy has not been extended to legacy systems or in service systems. Support of these systems is a responsibility diffused among organizations' maintenance managers in the Service Materiel Commands, as well as the Defense Logistics Agency (DLA). The net result is no central focus on total ownership cost for a weapon system within most Service acquisition establishments.

Adding to the challenge is the lack of a standard process for defining and measuring total ownership costs. Such a process must be established, including the rules for allocating indirect costs. To be effective service budgeting and financial procedures should be modified to enable flexible funding between sustainment and investment accounts in new budget years. Investments that reduce operational support requirements should warrant the shifting of sustainment funds to pay for these investments.

The use of commercial support practices is being adopted in several of the programs that we reviewed, but they are being partially implemented. Obtaining the support that has historically been provided by government personnel demands improved contracting sophistication and skills if the potential benefits are to be fully realized. Simply having private industry do the same task that historically was performed by the government will probably not result in significant savings. The total support chain needs to be analyzed to find the most cost effective approach. The high reliability and the extensive use of CaNDI in today's new systems gives DOD the opportunity to in many cases totally redefine the support approach for a system.

The bottom line is the absolute need to make "total ownership cost" a critical element of every new system's operational requirement. Appendix F describes the support approach being used by many commercial airlines where total ownership cost is well understood and well managed. Some of the practices used could have application within the DOD, not only for new systems, but those already deployed operationally. The Task Force gratefully acknowledges and supports the work of the Joint Aviation Logistics Board in this area, and gives them considerable credit for information in this, section and that of the supplementary Appendix F.

VI. Education and Training

A. Background

No other single organization in the United States comes close to the DOD in acquiring as broad a range of products and services over such a diverse range of sophistication and in such large dollar amounts. It is axiomatic that the DOD requires a highly knowledgeable and capable workforce to perform acquisition functions in an effective manner. Whereas historically acquisition skills were developed to a large extent through on-the-job experience, it has become evident that formal education and training are essential in building and maintaining a sophisticated acquisition workforce. The Congress recognized this need in the Defense Acquisition Workforce Improvement Act (DAWIA) passed in 1990.[1]

The Act characterized how the acquisition system should be managed through a professional acquisition corp in each of the Services. In response to the DAWIA, the DOD has implemented an acquisition career management program. This program covers an acquisition workforce of 108,000 Defense personnel, both military and civilian. There is current discussion (somewhat controversial) to expand this coverage to include additional personnel, bringing this number to 149,000.

In order to conduct the acquisition career management program, DOD established the Defense Acquisition University (DAU) to provide education and training (E&T) for the acquisition professional.[2] DAU has taken the lead in coordinating 12 existing Defense E&T institutions in their role of providing acquisition career management subject matter[3] to the acquisition workforce. These Consortium institutions are generally not accredited. The Industrial College of the Armed Forces (ICAF), which is part of the National Defense University (NDU), is a Consortium member and is accredited. DAU funds the Consortium's activities and provides the funds for the four component services for travel and per diem for student attendance at Consortium institutions. Travel and per diem account for a substantial share of the $96 million budget of DAU in FY 1998.

As an economizing measure and to foster other improvements, efforts have been initiated to deliver acquisition related courses through distance learning techniques. Although there are few courses so delivered in FY 1998, the momentum is expected to increase, building to about 25 percent of the curriculum by the close of FY 1999 or early N 2000. Also, planning is in process to transition the current loose structure of the Consortium into a more unified acquisition E&T organization, although no details were provided at the time of this study.

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1 U.S. Public Law 101-510, Title XII, "Defense Acquisition Workforce Improvement Act," 1990.
2 DOD Directive, "Defense Acquisition University," #5000.57, dated October 22, 1991.
3 "Defense Acquisition University," Catalog for FY1998, #ADS-98-Ol-CG

Consortium institutions are generally provided students designated by the Services. Students are both civilian and military as are the faculty within the Consortium. The civilian employees are mainly from the DOD although a few industry personnel are admitted. Military personnel who serve in acquisition E&T roles in consortium institutions do not rotate between operational and teaching tours, and generally have reached a terminal level in rank with little or no possibility for promotion. Five Functional Boards determine E&T requirements. Key Defense executives staff these Boards with full-time duties carrying other responsibilities. The Functional Boards validate the need for specific courses and certify that the courses meet the desired objectives. Working Groups, comprised of diverse DOD membership support the Functional Boards in their determinations. Direction developed by the Functional Boards is in turn implemented through DAU Curriculum Teams, which are responsible for the establishment of course content. In total, there are now 81 courses available through the Consortium member institutions. The quality of the E&T program is substantially controlled by these institutions.

The acquisition workforce, military and civilian, operates under a formal certification and continuing education program, again as derivatives of the DAWIA. Members of the acquisition workforce are required to meet levels of E&T instruction established for the various career fields[4] and to retain proficiency on a continuing basis.[5] The latter is particularly important because it recognizes the evolving nature of acquisition reform and the need for the acquisition professional to maintain currency on a continuing basis.

B. Findings and Conclusions

A series of findings and conclusions follow. Several of these — accountability, civilian institutions of high learning, and distance learning – are similar to the recommendations of a recent study conducted the Acquisition Education and Training Process Action team.[6] Determination of accountability is the key area that needs addressing.

1. **Accountability**

Finding. The acquisition E&T program is operated under an affiliation of separate institutions, and the means by which business is conducted is accomplished through various committee structures. This arrangement requires strong leadership, backed by clear management responsibly not only for overall program execution, but for insuring program outcomes. It was unclear with whom this specific responsibility resided and who (other than the USD(A&T) himself) was accountable for the total E&T program.

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4 'The Acquisition Workforce Certification Program," Descriptive Brochure, #ADS-98-01-BR.

5 "Reform Through Learning: Under Secretary of Defense(A&T) Policy on Continuous Learning for the Defense Acquisition Workforce," Memorandum dated December 15,1998.

6 Final Report of the Process Action Team, "Acquisition Education and Training Structure and Process," Office of the USD(A&T), August 1997.

Conclusions. Responsibility for acquisition E&T should be clarified and strengthened to provide necessary leadership and management authority, but above all to provide accountability for the entire program and its outcome.

2. Metrics for Program Evaluation

Finding: There appears to be a lack of knowledge of the effectiveness of the acquisition E&T process in contributing to strengthening acquisition generally and in promoting acquisition reform in particular. The question simply stated: Is the E&T program making significant inroads in fostering acquisition excellence, and how should the E&T program be modified to accomplish this end? Without objective metrics on outputs, these basic questions cannot be answered and overall program accountability cannot be ascertained in a credible way.

Conclusions: Metrics should be established to measure the effectiveness of the E&T program in contributing to acquisition excellence. Input measures alone are not sufficient, i.e., numbers of courses, numbers of students, classroom hours, etc. Outputs dealing with the impact of the E&T program in advancing acquisition objectives, particularly acquisition reform, are required. These metrics should form the basis for feedback to improve the E&T program.

3. Civilian Institutions of Higher Learning

Finding: One of the great strengths of the United States is its system of civilian post-secondary education. By all measures U.S. institutions of higher education are world leaders. It appears that the DOD acquisition E&T program has elected to operate substantially separate and distinct from this world class resource. There has been no rationale presented during this study for this approach, and there is no indication of a specific plan to alter this approach.

Conclusions: A plan should be developed for contracting E&T services to professional educators at institutions of higher learning in the civilian sector. This plan should result in an appropriate mix between consortium instruction and instruction through outside institutions, taking into account the value of instruction from military personnel in specific instances. The rationale for the approach selected should be made clear. Also the plan should incorporate the Department's approach to distance education, whereby quality E&T could be efficiently obtained from the civilian sector.

4. DOD/Industry Relationships in Acquisition E&T

Finding. Consortium institutions accept limited numbers of industry students, but the institutions do not participate in industry acquisition E&T activities. Conversely, industry undertakes considerable E&T functions to foster greater knowledge and capability of the industrial workforce in the conduct of DOD acquisition. These two acquisition E&T enterprises are operating essentially separate from one another, when, through cooperative activities, both would benefit.

Conclusions: Defense acquisition E&T cooperative activities with industry should be promoted, primarily for purposes of cross fertilization of information but also to promote common awareness of acquisition reform principles and processes. Examples are: sharing courses and instructional materials, comparing lessons learned, problem sharing and gaining improved understanding, and examining opportunities for acquisition improvement.

5. Distance Learning

Finding: Distance education in the civilian sector has been gaining momentum, and is developing into a major source of learning with rapid growth expected to continue into the indefinite future. The educational community outside of DOD is well in the lead in establishing effective delivery infrastructure, and in determining the techniques which best exploit distance education. Thus DOD is in the fortunate position of not having to experience the same learning curve, but needs only to take advantage of it. Although acquisition E&T has been slow in moving in this direction, it now appears there is a recognition of the value of distance learning in serving Defense needs, and there is a move in a direction to take advantage of it.

Conclusions: This Task Force supports efforts within the DOD to take an aggressive approach to distance learning as a means to better utilize funds and to gain other benefits. Plans should be drawn to enlist both educational institutions outside of DOD, and industry acquisition programs, in providing curriculum for DOD acquisition E&T.

6. Military Personnel Policy

Finding: Military personnel engaged in acquisition E&T, suffer in promotions, on a comparable basis with other military assignments. On the matter of rotational assignments, the freezing of military E&T faculty assignments, without interspersed operational tours, is neither rewarding to the faculty nor enriching to the student body, and thus does not serve the overall interest of the Department.

Conclusions: DOD should examine personnel policies relating to promotion and rotation of military personnel engaged in acquisition E&T, and should take appropriate action to strengthen existing shortfalls.

7. Student Prerequisites

Finding. Except for ICAF, consortium institutions accept service-designated students without applying admission requirements. The DAU and the Consortium institutions seem to accept the wide diversity of background understanding that this introduces into the classroom, and the resulting diminution of effective instruction.

Conclusions: As a measure to facilitate the educational process, institutions engaged in the acquisition E&T program should establish criteria for acceptance of students based on their ability to comprehend the material at the required level. The establishment of appropriate preparatory courses may be required. Some of these courses may not currently exist and may have to be created. A well structured program for self-study in advance of entering a course of instruction may be a suitable alternative.

8. Establishment of Mentor Teams

Finding: Acquisition E&T follows the traditional approach of delivering courses from the classroom. As an adjunct to classroom instruction, it would seem advisable to bring acquisition knowledge and experience directly into acquisition offices by employing a "mentor service" approach. Bringing expert knowledge to diverse acquisition activities throughout DOD, provides a means for providing directly relevant material which matches the nature of the acquisition function being performed. Mentor teams could be constituted from faculty in the acquisition E&T community, acquisition professionals who have demonstrated understanding of the principles of acquisition reform, and others who have knowledge of acquisition best practices. This approach will be most productive if mentoring team members where matched to the office being mentored, prior homework was conducted prior to on-site visits, and mentoring was provided on a not-for-attribution basis.

Conclusions: As a means to accelerate the transference of acquisition knowledge, particularly new reform initiatives, directly into acquisition offices throughout DOD, an acquisition mentoring function should be established which augments the formal E and T classroom program. The implementation of this recommendation would need to take into account related mentoring functions ongoing by the Services.

VII. Major Conclusions and Recommendations

A. *The Price Based Acquisition Model (PBA)*

Much work has been accomplished over the last several years on changing the DOD's acquisition process to improve efficiency and reduce cost. Among the changes proposed are the following: improving the requirements process to require more CINC involvement during the entire development process; providing for continuous competition; encouraging commercial vendors by accepting commercial practices and standards within the DOD; making greater use of CaNDI and open systems; reducing cycle time; using cost as an independent variable; using total ownership cost instead of production cost for decision making; using ACTD-like processes; implementing commercial-like innovative product support; and, basing acquisition on price instead of cost, or PBA.

The Task Force believes that the proposal to incorporate PBA is the most significant of these, since it emphasizes the concept of "price to the Government" and "value to the user." This must be accompanied or complemented with commercial-like innovative product support. This is fundamental to true acquisition reform.

The Task Force, therefore, has constructed the Price Based Acquisition Model, which includes all of the significant elements of reform. The Task Force recommends the USD(A&T) designate this model as the principle direction for development and procurement of DOD systems, and insure its timely implementation.

B. Specific Programs

1. Joint Strike Fighter (JSF)

The USD(A&T) should structure the JSF contract to insure that there is continuous competition throughout the procurement and sustainment cycle for the JSF primary airframe and supporting subsystems, should structure the contract consistent with price based acquisition; expand the authorities of the JSFPO to include actual weapon interfaces, dimensions and protocols for the intended stores and armaments; and, designate systems "open architecture" as a fundamental pass or fail JSF procurement contract condition.

2. Shipbuilding

The USD(A&T) should insure that sufficient development funding is designated for each new class of ship to insure inclusion of cost effective innovations that reduce ownership cost without unacceptable reductions in performance. Some candidate innovations should be identified and analyzed prior to formal initiation of each new program. The DD-21 should be designated as the model for this and other acquisition reform initiatives.

3. Space

To provide for the expanding space system needs, and in light of the large commercial investment in space, the DOD should concentrate its limited resources on the high leverage military-unique technologies in those areas that have no commercial equivalent application, as in survivability protection and data encryption. Through the use of space architecture studies the DOD should capitalizes on commercial space capabilities wherever practical. The USD(A&T) should insure the use of competitive commercial practices in acquiring space systems, and in contracting for the operation of the space infrastructure.

4. Joint Tactical Radio Program

The JTRS initiative offers great potential in satisfying the long-term communication needs of the DOD. The ASD(C3I), with the support of the Services

and industry, must complete the effort to define an acceptable technical architecture based on commercial specifications which will continuously encourage competition at the functional module as well as the communication system level. The USD(A&T) must insure adequate budget to support a timely schedule, and insure that all Service priorities are consistent with the programs importance.

5. Education and Training (E&T)

Responsibility for acquisition E&T should be clarified and strengthened to provide necessary leadership and management authority, but above all to provide accountability for the entire program and its outcome.

Appendices

ACQUISITION AND TECHNOLOGY

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON DC 20301-3000

OCT 20 1997

MEMORANDUM FOR DEFENSE SCIENCE BOARD (DSB) ACQUISITION REFORM TASKFORCE MEMBERS

SUBJECT: Follow-up DSB Effort on A Streamlined Approach to Weapons Systems Research, Develop and Acquisition, The Application of Commercial Practices

You now have underway a Phase IV of the DSB Acquisition Reform Task Force, with a focus on the DOD implementation activities. One area that clearly needs further emphasis is the weapon system R&D arena, which you investigated in Phase III. Thus, I would like to request that you follow-up that effort with a sub-Task Force which evaluates progress that we are making and which provides recommendations as to where further actions are required.

Based upon suggestions I have received from some of the USD (A&T) staff most heavily involved in aquisition reform, I would like you to focus your attention on specific DOD programs on which we believe wo have made significant progress.These programs are: the LPD-17 Ship; the New Attack Submarine, the Global Command and Control System (GCCS), the F-22, and the Miniature Air Launched Decoy Advanced Concept Technology Demonstration (ACTD). Additionally, I would like you to follow-up on the five programs selected by the Service Acquisition Executives for analysis during your "Acquisition Reform Phase III" Task Force efforts; specifically: Joint Strike Fighter (USAF), Future Digital Radio (USA), Aerostat (USA), Arsenal Ship (USN) and Evolved Expandable Launch Vehicle (USAF).

In this investigation I would like you to focus your attention on the following acquisition reform issues:

1. Are we stating requirements in terms of mission needs and with sufficient flexibility?

2. **Have we established cost targets and addressed affordability not only for development and production, but also for sustainment?**

3. Have **timeline needs** been **established,** and is **the** development **schedule driven?**

4. what is/are the competitive alternative (s) for the mission and how have we supported their viability?

5. what incentives have bee n established for performance, schedule, cost. and quality?

6, Are we using open systems concepts to increase ease of integration and evolution?

7, What steps have been taken to bring in commercial firms as suppliers (e.g. use of R&D price-based contracts?)

8. Regarding ACTDs, what is the best approach for funding the transition of products or systems from the ACTD to full acquisition7

I estimate that the task will take about nine months to complete and will require meeting one or two days per month to coordinate our efforts. The first meeting will be on the 12th of November in the Pentagon. Please provide me an indication of your availability in the first two weeks of December and the second and third week in January so that we can firm up meeting dates for those months. We will provide you with the location and start time of the meeting along with a package of pertinent information that you can read to familiarize yourself on DSB acquisition reform efforts that have already been completed

I would like Bob Fuhrman to head this sub-Task Force with support from Duane Andrews, William Bowes. Michael Carns, Gil Decker, Gordon England, Robert Everett, and Herbert Rabin *. My staff assistance to the group will be provided by Tom Perdue.

JOSEPH J. EASH, III
Deputy Under Secretary of Defense
(Advanced Technology)

*Potential task force members
Robert Cattoi
Jerry King

B. Members and Advisors

DSB Task Force
DEFENSE ACQUISITION REFORM PHASE IV
SUB-PANEL-RESEARCH AND DEVELOPMENT

Sponsor

Mr.	Joseph	Eash	DUSD/AT

Panel Chair

Mr.	Robert	Fuhrman	Consultant

Panel Membership

VADM	William	Bowes, USN (Ret)	Litton Industries
Gen	Michael	Carns, USAF (Ret)	Consultant
Mr.	Robert	Cattoi	Consultant
Mr.	Dale	Church	Consultant
Mr.	Gil	Decker	Consultant
Mr.	Robert	Everett	Consultant
Mr.	Tom	Perdue	Executive Secretary, DUSD/AT
Dr.	Herbert	Rabin	University of Maryland
Mr.	Chuck	Tiffany	Consultant
GEN	Bill	Tuttle, USA (Ret)	Logistics Management Institute

Government Advisors

Mr.	William	Mounts	ODUSD(AR)
Mr.	Gene	Porter	Center for Naval Analyses
co1	William	Selah, USAF	SAF/AQ
Ms.	Donna	Smith	SARDA/PR

support

LTC	Don	Burnett, USA	OUSD(A&T)/DSB
Col.	George	McVeigh, USAF (Ret)	SAIC
Ms.	Donna	Preski	SAIC

C. *Meeting Dates and Agenda*

The Task Force met between November 1997 and September 1998 for data gathering. Following are the meeting agenda.

November l2, 1997

Panel Chairman Introduction to the Task
Bob Fuhrman)
USD(A&T) Establishing the Charter
Dr. Jacques Gansler
DOD Cycle Time Analysis Tool,
Dr. Su Young Shin
Acquisition Reform Industry Survey,
Mr. Denny Fish
ACTD Issues, Mr. Eash
Member Discussions

December 16,1997

SAE Perspective- Air Force
Mr. Art Money
SAE Perspective-Navy
RADM Dick Ginman, USN
Acquisition Reform Office-Perspective
Mr. Dave Drabkin
DOD Cycle Time Analysis Tool
Dr. Su-Young Shinn
SAE Perspective-Army
Dr Ken Oscar
EELV Update
Lt Col Mike Charney, SAF/AQSL
1998 ACTDs
Tom Perdue

Agenda Jan 15,1998

Progress on Civil-Military Integration
Mr. Bill Mounts, et al.
FY 1998 ACTD Program
Mr. Tom Perdue
Lean Aircraft Manufacturing
Prof. Wesley Harris MIT , et al.
Logistics Acquisition Perspective
VADM Bill Bowes, USN (Ret)
Miniature Air Launched Decoy (MALD)
Lt Col Walt Price, USAF, PM

February 11,1998

Arsenal Ship – DARPA perspective
Mr. John H. Ablard)
Northrop Grumman Team
Mr Mike Zarkowsky
Ingalls/Lockheed Martin Team
Mr. Kevin Jarvis
Mr Tom Johnson
ACTD Update
Mr. Tom Perdue, DUSD(AT)

February 12,1998

Joint Land-Attack Elevated Netted Sensor (JLENS) Update
Mr. Mike Grannon, Huntsville AL
Joint Tactical Radio System (JTRS) Update
Mr. Dick Dyson, ASD(C3I)
An ACTD-based Acquisition Model
Mr. Tom Perdue, DUSD(AT)

March 11 Navy Programs

Shipbuilding Introduction/Overview
CAPT Winkler, USN
DD-21
CAPT Bush, USN
LPD 17
Capt Luebke, USN
NSSN
CAPT Burgess, USN
Charter and Build
Mr. Kaskin & Ms. Stiller

March 12 Navy Programs

CVX
CAPT Manvel
MARITECH
Mr. Schaffran
Office of Naval Research (ONR) Initiatives
Mr. Tucker
DDG 51 Upgrades/Smartship
CAPT Rubel & CAPT Burrill
Shipbuilding Wrap Up
Mr. Hammes

April 8,1998 Army Programs

SCAMP
Mr. Scott Sharp, PM Office
Smart T
Mr. Gary Martin, PM Office
Apache D LRIP
Col Steve G. Kee, USA, PM Apache
Longbow Radar LRIP
Col Steve G. Kee, USA, PM Apache
M1A2 Tank Upgrade Break
Col Christopher Cardine, Abrams Program Manager

April 9, 1998 Modeling and Simulation

Sub-Panel Report Outline
Mr. George McVeigh
Panel Discussions

May 14, 1998 SPACE

Hughes Space and Communication Group
Mr. William Moore, and Bob Rankine
Lockheed Martin Corporation
Mr. Malcolm O'Neill, VP Mission Success and Operations
Space Access, Inc.
Mr. Stephen C. Wurst, President
TRW Space and Electronics Group
Gen Bernard Randolph, USAF (Ret)
Discussion period
Members and Advisors
Kistler Aerospace, Jnc
Mr. Dan Brandenstein, Executive Vice president and Program Manager

May l5, l998 Modeling and Simulation

"Simulation-Based Acquisition from an industry perspective"
Mr. Steve Olson, Raytheon,
"Simulation Based Acquisition - The Ultimate Process"
Mr. Mike Johnson, Boeing
"Simulating New Acquisition Processes, a Real Demonstration"
Dr. Louis Alfeld, Decision Dynamics, Inc.,

June IO, 1998 JSF

Joint Strike Fighter Office Presentations
Maj Gen Leslie F. Kenne, USAF
JSF Program Office
Boeing Team Briefings
Mr Frank Status, PM, et. al.

June 11, 1998 JSF

Lockheed Martin Team Briefings
Mr. Frank Cappuccio, VP-JSF
Program Manager
Dr. Bob Bolz, Mr. Jack Ready
Panel Discussions

July 15, 1998 Education and Training

National Defense University
Ms. Linda Brandt, Industrial
College of the Armed Forces (ICAF)
Defense Acquisition University
Mr. Tom Cream, President DAU
Defense Systems Management College
RADM Vincent, USN
Acquisition Personnel Management
Mr. McMichael
Price Based Procurement Discussion — JSF
Maj Gen Leslie Kenne, USAF, Joint
Strike Fighter Program Office
DSB Open Systems Report
Dr. Wayne O'Hern

July 16, 1998 Foreign Perspective

British MOD Acquisition Reform Discussion
Mr. John Taylor, British Embassy
Outrider ACTD
Col Mike Howell, PM
Boeing Space
Mr. Jay Witzling, The Boeing Co.,
VP Delta II and Titan Programs

Aug 11, 1998 Discussions

Final Report Outline Discussion
Mr. Bob Fuhrman

September 15, 1998 Aircraft Programs

Chairman comments
Mr. Bob Fuhrman
c-17
Mr. Randy Mizer, The Boeing Company
Boeing 777
Mr. John Monroe, The Boeing
Company
"Revolution"
Mr. Joe Eash, DUSD/AT
Reducing Cycle Time
Dr. Robert Buhrkuhl
ACTD process discussions
Members and Advisors

September 16, 1998 Discussions

Task Force discussions
Members and Advisors
Task Force discussions
Members and Advisors

October 20,1998 Discussions

Task Force discussions
Members and Advisors

November 3,1998 Discussions

Task Force discussions
Members and Advisors

December 15,1998 Discussions

Task Force discussions
Members and Advisors

ACQUISITION AND TECHNOLOGY

THE UNDER SECRETARY OF DEFENSE

3010 DEFENSE PENTAGON
WASHINGTON. DC **20301-3010**

OCT 15 1998

MEMORANDUM FOR THE SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDER SECRETARY OF DEFENSE (COMPTROLLER)
ASSISTANT SECRETARY OF DEFENSE (COMMAND, CONTROL, COMMUNICATIONS, AND INTELLIGENCE)
GENERAL COUNSEL OF THE DEPARTMENT OF DEFENSE
INSPECTOR GENERAL OF THE DEPARTMENT OF DEFENSE
DIRECTOR, OPERATIONAL TEST AND EVALUATION
DIRECTOR, PROGRAM ANALYSIS AND EVALUATION
DIRECTOR, DEFENSE CONTRACT AUDIT AGENCY
DIRECTOR, DEFENSE FINANCE AND ACCOUNTING SERVICE
DIRECTOR. DEFENSE LOGISTICS AGENCY

SUBJECT Establishment of a Study Group to Analyze Implementation of Price-Based Acquisition within the Department of Defense

Section 912(d) of the National Defense Authorization Act for Fiscal Year 1998. directs the Secretary of Defense to conduct a review of the organizations and functions of the Department of Defense acquisition activities and of the personnel required to carry out those functions. In his letter to Congress transmitting the implementation plan directed by section 912(c), the Secretary of Defense committed to undertaking a Department-wide effort to identify changes necessary in the Department's basic management systems. The effort would create processes that allow for valuing goods and services, and for focusing on the value the good or service has over its useful life.

Accordingly, I direct the establishment of a study group to be led by Mr. William Stussie, Deputy Assistant Secretary of the Navy (Air Programs) to analyze implementation of a price-based acquisition system on a Department wide basis. The charter for the study group is attached. The study group will require bi-weekly participation on a part-time basis. Please forward the names of your study group members to Ms. Karen Dunn, phone (703) 697-6399, fax (703) 614-1690, or e-mail dunnks@acq.osd.mil, within three days of charter approval.

A final report of the study group will be provided to the Under Secretary of Defense (Acquisition & Technology), as specified in the attached charter, by March 1,1999.

J. S. Gansler

Attachment:
As stated

CHARTER FOR THE PRICE-BASED APPROACH TO ACQUISITION STUDY GROUP

INTRODUCTION AND BACKGROUND

in order for the Department to continue its Revolution in Business Affairs, DoD must eliminate or reduce the differences between the Department and commercial buyers in obtaining goods and services from the national industrial base. Do0 needs to do this in order to reduce the price of military products by enabling Defense companies to integrate their military business with their commercial business or potential commercial business, and to ensure greater access to commercial products, technology and services This will provide the warfighters with the best value goods and services they need to perform their mission.

We have already begun to eliminate the differences by changing the way in which we describe our needs from the use of military specifications and standards to the use of the performance specifications for ail new acquisitions. We also have begun to change the way in which we administer contracts that have already been awarded through the Single Process Initiative. The next step is to determine how price-based acquisition (outcome oriented) works in the commercial environment, as opposed to cost-based acquisition (input oriented) and how it can best be used in the DOD environment.

Cost-based acquisition, i.e., contracts that are based on costs incurred or projected to be incurred by the contractor, require the tracking and allocation of costs, often in Government unique accounting systems, governed by Federal Cost Accounting Standards (CAS) and that an offeror often provides certified cost or pricing data. Both the Government and industry have created and maintained infrastructures to administer the process of determining the allowability and allocability of all contractor costs and compliance with CAS. Defense contractors must maintain a cost accounting system, frequently different from **a** commercial cost accounting system based on generally-accepted accounting principles, in order to meet the CAS requirements. In addition, there is a need to understand what accounting practices commercial firms use to account for costs and track cost/schedule status and how these practices might fit DOD acquisitions.

Price-based acquisition is the establishment of contractual relationships using price instead of cost. Price may be established by comparisons to prices of other offers, market prices, competitive alternatives, and parametric analysis based on price, rather than cost. Price-based acquisition is a well established approach in the commercial world.

AUTHORITY AND DIRECTION

The Deputy Under Secretary of Defense (Acquisition Reform) is directed to establish a study group to analyze implementation of a price-based approach to acquisition. The study group membership shall include representatives from the Office of the Secretary of Defense staff (including Defense Procurement. the CAIG Small and Disadvantaged Business Utilization, and the Comptroller), the Military Departments, the' Joint Staff, DOD/Inspector General, the Defense Contract Management Command, and the Defense Contract Audit Agency). The Defense Finance and Accounting Service shall review issues that may have major impacts on the financial accounting and contractor payments in order to identify any costs that may be incurred

in moving to price-based acquisition. Finally, industry representatives shall be asked to provide their views as part of the study process.

STUDY OBJECTIVES

The study group shall determine how to implement a price-based approach to acquisition within DOD. The study group shall be guided by, but not limited to, the following objectives:

- Develop a set of attributes that would be used to determine value in terms of the performance DOD requires. Develop a methodology that describes'how those attributes would be managed to support a price-based value determination. Consider how Cost as an Independent Variable or Price as an independent Variable should be addressed.

- Determine how to price alternative solutions based upon market alternatives without requiring the supplier to justify its price based upon the component costs of the goods or services being offered and without the need to use cost accounting standards. Determine how to track program progress and estimate future program costs without cost data and cost reports. Include consideration of contract modifications, contract changes, claims, work suspensions/stop work orders, terminations, etc.

- identify alternative acquisition strategy approaches to use price-based acquisition (e.g., incremental development and risk reduction, modular development, dissimilar competition, etc.). identify alternative contracting approaches to use price-based acquisition (e.g., share-in-savings contracts, level of effort contracts with incentives based on performance, time and materials contracts with incentives, other transactions, fixed price with non-cost incentives, non-cost task and delivery order contracts, etc.). identify alternative financing approaches to use price-based acquisition (e.g., milestone billings in place of progress payments, other periodic payments tied to performance, etc.).

- Define "best value contracting" in a price-based acquisition environment and discuss appropriate source selection methodology and approaches.

- Assess the impact of the changes to the Federal Acquisition Regulations resulting from the Federal Acquisition Streamlining Act of 1994 on the number of requests for pricing data versus cost data or cost or pricing data.

- Determine how government-furnished property (currently owned or new property) will be handled in price-based acquisition.

- Identify changes needed in statutes, regulations, policies, and practices necessary to implement a price-based approach to acquisition. Provide draft language to implement the necessary changes.

- Identify methods to incentivize the adoption of price-based acquisition and the training needed to change the behavior of the workforce (and industry).

- Identify expected outcomes and metrics for both Government and industry once price-based acquisition is implemented (to include organizational changes, staffing, lead time, savings, cost of implementation, etc.).

- Develop a schedule and funding requirements, including any DFAS required changes, to move to a price-based environment.

- Determine any risks associated with price-based acquisition and when cost-based contracts are appropriate/required.

- Quantitatively evaluate the projected economic benefits of the price-based approach for different types of contracting actions on different contract types (from services through research and development and production).

- Create examples of how to operate in a price-based environment, including the estimated dollar value of benefits from price-based acquisition, using various types of programs including: development programs (to possibly the Joint Strike Fighter (JSF), Advanced Amphibious Assault Vehicle (AAAV)), a modification program, a non-system component, and a contract for services.

SCHEDULE

The study group shall report its conclusions and recommendations to the Under Secretary of Defense (Acquisition & Technology) by March 1, 1999. The study group will provide interim reports on its progress to the Under Secretary of Defense (Acquisition & Technology) each 60 days after the effort begins. A draft report will be prepared for **the** Under Secretary's review by February 1, 1999.

Appendix E

Joint Strike Fighter Detailed Program Evaluation

I. Introduction

This section of the report addresses the review by the Task Force of the Joint Strike Fighter (JSF). The material for the views expressed was developed during two separate several hour sessions with the Joint Strike Fighter Program Office plus a separate three-hour briefing and discussion block with each of the two contractors, Lockheed Martin and Boeing. The Task Force reviewed program status, major issues, a comprehensive inquiry into the program's jointness, program funding, and the impact of changes in program and schedule.

The Task Force was uniformly impressed by the professionalism and subject matter expertise exhibited by the JSF Program Office Director and staff members. The program appears to be very well managed, utilizing innovative methods to measure progress and performance, and having struck a very constructive and productive relationship with the competitors.

The Task Force also recognizes that the JSF program is perhaps the single largest potential procurement program on the horizon in the next few years. This presents DOD with the unique opportunity to consider prototyping many recently suggested acquisition reform initiatives. For example, the Task Force strongly urges the Department to consider supporting the JSF Program Office employing price based acquisition in E&MD.

II. Key Issues

The Task Force believes that from an **outcomes** standpoint, the five most important specific issues facing the JSF are:

A. Price Based JSF Contract:

Since this program has been in competition, the Task Force is not aware of any steps to use R&D price based acquisition or price based acquisition (PBA). However, the Task Force and JSFPO Leadership have had a long discussion on the merits of price based acquisition and its potential use in the JSF procurement. The JSF is undergoing an extensive risk reduction development phase and a head-to-head fly-off phase using production design concepts. The JSFPO should consider the JSF acquisition as a candidate for a price based acquisition program consistent with the Task Force letter forwarded to the USD(A&T) earlier in Phase IV of this Task Force. The letter recommended adoption of price based acquisition as the rule for DOD developments and procurements.

One step in the direction of experimenting with PBA is the conduct of the advanced concept technology demonstration or ACTD. The JSFPO has developed such an ACTD, and OSD has approved a 1999-start for the JSFPO-sponsored ACTD entitled "Coherent Analytical Computing Environment" (CACE). The Task Force commends the JSFPO for participating in and learning more about the ACTD process. The aim of the specific ACTD will be to gather airframe and experience data from operating units to assess fleet airframe and operating system health. Results will be used to anticipate wear and break cycles and promptly implement preventive repair actions. This should result in higher availability rates and lower life cycle ownership costs.

C. *The failure to consider the JSF a weapons system.*

In general, JSF requirements have been stated in terms of mission needs, but there is a serious limit on flexibility. The program "boundary" within which the Joint Program Director is obliged to operate is limited to the weapons platform, and excludes the munitions to be used. This boundary exclusion results in legacy munitions being a major contributor to determining both airframe sizing as well as limiting 21st century capability.

Virtually billions of dollars are being devoted to leading edge technologies to develop the airframe and supporting avionics. However, the munitions to be carried are undergoing no comparable development. The predominant factor in sizing the weapons bay of JSF is the World War II 2000-pound bomb with a strap-on guidance kit. This is regrettable.

It is shortsighted not to have new munitions development considered part and parcel of a major weapons system development. The Department should insist on a separately funded but parallel and integrated munitions development effort to insure not only an efficient and effective new weapons system, but also an efficient and effective munitions suite to optimize the combination. It is too late to resize the weapons bay, but rather than settling for two 2000-pound bombs for the near term, the Department should be actively seeking to put 10 to 20 high energy, high lethality, high precision bombs in each of the bomb bays.

For example, weapons in the 100-pound to 250-pound range, with guidance and accelerators to increase kinetic impact would be not only more effective, but could be carried in greater numbers in a smaller bay. Conventional thinking appears to be dominating the debate regarding the gun, Investment between now and 2007, could develop a gun with projectiles at two to three to four times muzzle velocity at lower caliber, yet use kinetic energy to offset the design and operating penalty of lower mass.

The Department could remedy the omission of new munitions development by either: (1) expanding the responsibilities of the JSFPO to include new weapons development, or (2) initiating a parallel weapons development for the JSF to insure

the weapons system and the munitions are integrated into this 21st Century platform. The Task Force favors the JSFPO taking the responsibility, rather than parallel development efforts. One office and one senior person would be responsible for developing an integrated capability to achieve effective weapons delivery.

C. Open Architecture

Of all the concepts and issues addressed by the Task Force, open architecture appears to have the most potential for significant long term impact, but is also the least defined and agreed upon concept. It is amply clear that this important concept is still in the earliest stages of definition, with considerable variance as to what it means, as well as how broad are its bounds. Open architecture has two dimensions. There is the dimension which describes the internal standardization of individual components and pieces of an individual system, and the dimension which describes the system environment, and how it is interoperable.

Open architecture is an undefined concept with many meanings. Efforts are underway to agree on its definition but in the interim, JSF avionics and software are moving to finality. The contractor bias is to argue for complex and often proprietary software code as the only way to meet performance standards. For alleged performance reasons, as well as for obvious business advantage, industry has successfully argued the boundary should not be internal to the component or electronic unit, but should be drawn upstream at the subsystem or system level. The Task Force is not convinced of this argument, given the vastly expanded computing power that is now available. Lack of software standards at the lowest levels builds in a lack of "plug and play". This seriously hampers "plug and fight", which leads to constant efforts to devise compatibility, rather than having it inherent to the design. It may also present an overwhelming barrier for small, innovative, agile software firms with new technologies to overcome, thereby denying the DOD access to the best technology available. It may also lead to sole source or proprietary control over software changes in successive blocks of upgrades. True inter-operability, as compared to commonality and compatibility, is essential to this 21st Century weapons system which will likely be in the inventory for over three decades.

The software of airborne avionics and fire control systems has not been subject to architectural standards. The arguments advanced have usually been that any standard architecture would impact performance. This usually leads to the user authorizing or approving handcrafted solutions that take advantage of specific hardware and program characteristics. The resultant product is intricate, idiosyncratic software that is difficult to change, even for the original authors, much less other engineers.

For a prospective alternate contractor, it creates a de facto proprietary situation for maintenance and upgrades. Fortunately, the technology for real-time software has improved dramatically. Hardware technology advances are making it

much easier to achieve real time performance with standard software approaches. The growing use of CaNDI, real-time operating systems and program interfaces has demonstrated the validity of using common underlying software for a variety of very demanding real-time applications.

The USD(A&T) should consider requiring incorporation of architectural standards into both avionics and weapons system software. Care must be taken to advocate standards at the right level, standardizing on system interfaces and performance specifications, not on specific languages or software packages. This task should be undertaken with industry partnership. As a bottom line, an architectural standard approach to all software should be undertaken to create a "plug and play", "plug and fight" environment at all levels of usage.

Digital processing and integration technologies are on an obsolescence cycle of less than three years and decreasing. There is an absolute requirement to insure the JSF is not inadvertently structured to allow proprietary capture or sole source control of what should be a regularly competed sector of capability. The Task Force believes this sector will ultimately constitute the single largest component of the system's total ownership cost. Open architecture of the aircraft's control and weapons system must be a program emphasis, especially as a downselect parameter.

The Joint Technical Architecture (JTA), currently under development, must apply, if JSF is to meet JV2010 joint interoperability goals. The JTA is being formulated now and should be an architecture that avoids specifying hardware and software. It should establish elements such as protocols for C4ISR for all platforms. The JTA should take advantage of, and not inhibit open systems architecture.

JSF should have a leadership role in developing architectures and standards so that the JTA does not inhibit open architecture approaches. The JTA should define elements such as C4ISR protocols, however, it must not specify hardware and software requirements. Such specificity will result in reduced flexibility in avionics suites being able to "plug and play" with future electronics and processor technologies. The Task Force suggests the JSF have membership on the JTA Development Group, JTA Technical Architecture Steering Group, the Architecture Coordinating Council, and the DII COE Architecture Oversight Group. Such involvement by the JSF user will insure the JTA does not inadvertently overspecify the architecture.

There must be an atmosphere that incentivizes continuous competitive innovative improvements to the weapons systems software, as compared to the aircraft control and stability software. Any contractor could demonstrate a potentially improved capability to a host service by plugging in its proposed new operational software capability to a "Windows 98-type utility" weapons system open architecture operating system.

Today, user involvement is essential in the development of wide-reaching standards to balance standardization and open systems architecture. It would be highly desirable to have the avionics and electronics industry directly involved in the formulation of the JTA, since they have the greatest insight as to what standards would help or hurt the progress toward "open systems architectures." Failure to insist on a full JTA will result in avoidable service-unique electronics components.

D. *Maintenance Concepts:*

All U.S. users of the JSF should adopt an "all up" common maintenance and sustainment concept: joint training for all JSF maintenance and logistics personnel; a common condition based maintenance concept; and common practices for daily maintenance. A joint approach to developing common standards and practices in training, flight line maintenance and tertiary level repair hold an enormous life cycle savings potential that needs to be addressed. Once this opportunity passes, it is unrecoverable at a future time.

Despite a JSF aircraft of high design and parts commonality, the weapons system will be subjected to at least four different organizational maintenance concepts (USAF, USN, USMC and RAN). This risks four different ground equipment packages, four different training concepts and training packages, four different spares equipage programs, etc. This is an enormously expensive approach to produce the same outcome -- a combat ready aircraft. The total ownership cost of disparate systems should be calculated to highlight the enormous cost penalty to this approach with the intent of stimulating a commonized approach to the maximum extent possible.

There should be a DOD mandate to use common ground equipment packages, training concepts, spares, etc. Where exceptions are considered necessary, waivers should be submitted to a Secretarial level board to strongly discourage dissimilarities unless absolutely operationally necessary.

Conditioned-Based Maintenance (CBM), a strategy for performing maintenance in response to the development of specific deleterious conditions, should be the goal for all types of aircraft maintenance. Such a strategy will reduce operational maintenance costs and improve operational readiness. This strategy, which is being pursued by the US Navy for ships and helicopters, requires a combination of smart sensors and deterministic models that can monitor and assess the integrity of the airframe on a tail number basis. Micro-sensors that detect the currents associated with galvanic corrosion have been developed and are undergoing field trials by the Navy. Although reliable sensors for detecting fatigue cracking do not exist and are a prerequisite for all-up Conditioned Based Maintenance of combat aircraft, it never-the-less should be a long term goal to pursue the development of such sensors, and that is where a research and engineering emphasis should be placed.

Assuming the development of reliable sensors, their real-time inputs would be incorporated within a maintenance neural network (MNN). An MNN would be assigned to each airplane in the fleet, and would become progressively educated on the unique operating and maintenance issues for that particular airplane. The MNN output would include risks of certain types of failures occurring due to the specific operating conditions that the airplane had been exposed too. This information would then be used to define the inspection needs for the specific tail-numbered airplane on a component by component basis.

The Department should assess the practicality of adopting a Condition Based Maintenance concept using the Maintenance Neural Network philosophy for the JSF weapon system, including the feasibility of developing and acquiring the necessary fatigue crack sensors in a timely manner. The JSFPO should also assess the potential life cycle cost savings associated with such a concept. There is an excellent existing unclassified logistics "internet" with ample computer support to implement this concept and to maintain the central database through decentralized inputs and tracking.

E. *Remedy the Loss of Operational Testing (OT) Concurrency Caused by QDR Decision:*

The JSF availability timeline need has been established and linked to the expiring operational life limits of existing systems. However, actions by the last Quadrennial Defense Review (QDR) have inadvertently detracted from the operational test program of the JSF. This mistake requires prompt remedy.

Timeline needs for the JSF development and delivery are directly linked to the estimated life cycle of the USMC F/A-8A/B/C/D/RN Harrier, the USAF F-16A/B/C/D and the USN F/A-l8A/B/C/D. The development schedule originally had high concurrency, consistent with the development of an aircraft with exceedingly high commonality. The JSF operational testing baseline was to be supported by the USAF, USN and USMC purchasing four aircraft per service in the same year, thereby facilitating the simultaneous conduct of all three service operational assessments (OT) in one year.

The Quadrennial Defense Review (QDR) altered the buy schedule, to a sequential yearly buy of four aircraft by the Air force, Marine Corps and Navy for OT&E. This schedule adjustment now requires three independent and costly operational tests and hinders the opportunity to jointly discover and work operational fixes.

OSD and the Services should direct restoration of coincidence to the procurement of the USAF/USMC/USN operational test aircraft buy. This would also facilitate cross- service coordination and help realize substantial operational testing program cost savings.

III. Other Issues Discussion

In addition to the five specific issues addressed above, there are other issues that require attention:

A. The Lack of a JSF Public Trust Strategy and Public Trust Metrics:

The JPO is very competently discharging its responsibilities in developing a multi-service, multi-purpose aircraft. There is a challenge ahead to convince the public that this costly program adds value to the nation's security and should be funded. A comprehensive DOD-level strategy needs to be thought out and implemented that anticipates and proactively prepares the way for the JSF, rather than reacting in an uncoordinated, ad hoc fashion to unexpected program difficulties.

A "public trust" strategy needs to be considered an integral part of acquisition programs and program reviews. With the end of the Cold War, the importance of military power has receded in the public's eyes. The Department can expect each new major expenditure of funds in the acquisition of new weapons systems, to undergo enormous scrutiny. Should any large procurement program experience a major problem, it will prejudice other ongoing programs as well as jeopardizing funding for future needs.

In cooperation with the policy and public affairs sectors of OSD and the cognizant services, the JSFPO should develop a "public trust" strategy that focuses management attention on those areas that could risk loss of confidence in the Department's discharge of its fiduciary responsibility in development and funding the JSF program. For example, whatever the JSF price is determined to be, it should be explainable and managed to that price, or a lower price. This potential public trust metric suggests others, such as program stability and year-to-year quantity stability. Other "public trust" metrics should be developed and incorporated into the JSF management system.

The JSFPO appears to have a very satisfactory handle on all of the pertinent program particulars. The management focus is internal and primarily process. There is a concentration of energies on meeting contract conditions, acquisition laws, rules, regulations, and practices. The department needs a formal senior group dedicated to a broader perspective and greater involvement in the overall advocacy, but not management, of this effort. This will be the largest potential DOD procurement in the first two decades of the 21st Century. The Task Force recommends the DepSecDef or USD(A&T) establish a team populated by OSD/Joint Service/Contractors and tasked to develop and execute GAO, Congressional and Public Trust strategies. The objective is to anticipate and shape potential arguments, issues and disagreements rather than react and respond to attacks that are certain to materialize with any large DOD procurement program.

B. *Lack of a Common Operational Picture (COP).*

The Task Force is deeply concerned that while the JSF program has been underway for many years, the "all up" operational environment in which the JSF will operate in the next century has not yet been defined. Lacking an approved "Common Operational Picture" in which to develop the JSF denies the Program Office the latitude to produce the best possible weapons system.

As avionics trades proceed, JSF will not be able to take full advantage of on-board vs off-board trades unless the "Common Operational Picture (COP) is stable, and the warfighters are confident that those capabilities will be available. As a matter of priority, the Joint Staff should expedite the effort to define and publish the COP upon which JSF can make appropriate avionics decisions.

C. Requirements Creep After JORD Baselining:

A common program problem has been altered operational requirements during the development cycle, triggering engineering changes and increased program costs. So far, that does not appear to be a problem. Efforts should be devised to discourage any post-JORD operational requirement modifications, unless considered absolutely essential. During the JORD approval cycle, JSF operational requirements must undergo an in depth analysis and assessment by operational subject matter experts from the USAF, USN, USMC and RAN. Once the JORD is agreed, the Task Force strongly recommends that respective service chiefs also sign off the document, acknowledging and ratifying that the JORD meets service equipment needs. Later, should a service determine that the operational requirement for the baseline JSF must be further modified in order to meet a core service need, a high standard should be set. The chief of service should be responsible to advocate that an unforeseen development necessitates alteration of the baseline JSF requirement, along with incremental service funding required to implement the change.

The impression from both SPO and Contractor briefings is that the JSF is being developed and configured to operate in a legacy environment with the full complement of support systems that populate today's battlefield: current tasking models (Frag Order; mission planning); conventional command and control (AWACS; ABCCC); complementary attack packages (escort; EW; etc). This shows a decided lack in environmental forecasting, leading to a design and equipage concept based on a legacy battlefield.

Therefore, the Department should study this developing situation. Specifically, the Department should conduct a high priority end-to-end assessment of the probable battlefield environment of 2015, adjusting the internal capabilities, requirements, and equipage of the JSF appropriately. As a minimum, the DOD should examine command and control concepts, electronic warfare intercept and self-jamming capability, off-board reception of mission tasking, sensor-to-shooter

intelligence and attack materials, and hostile/friendly/unknown classification of all sensor detections.

D. Modeling and Simulation:

The modeling and simulation of the design and production process, plus the logistics support arena seems to enjoy significant investment and the benefit of leading edge processes. On the other hand, employment of modeling and simulation appears to be dependent on legacy systems that date back to the 1970s, and are burdened by inadequate patches to attempt to simulate a transformed operational landscape like stealth, precision weapons, integrated information systems, and sensor-to-shooter data. The worry is that while the development, production and training systems will produce the intended product, there appears to be a distinct risk that the combat applications will not be harmonized with the envisioned 21st Century warfighting environment.

Equal emphasis needs to be devoted to developing new, high fidelity modeling and simulation systems for the battle environment of tomorrow. Funding should be from DOD sources. The owner of the system should be above the service level.

E. JSF Competitive Mission Alternatives:

The alternatives to the JSF are existing, in-production systems: the F-16 Block 60 being funded and purchased by the UAE; the developing of the F/A-ME/F as the USN fleet gap filler; and the RAF/RN Harrier, still in production in UK. This Task Force inquiry has led to the conclusion that with the possible exception of the F-16 Block 60, yet to be produced, all existing alternatives appear to be more expensive on a recurring unit flyaway cost basis and possess less capability than the envisioned JSF. However, this story has not been effectively developed and argued.

The case for the JSF has yet to effectively be made. The Task Force believes explanations and data that express and describe the JSF's significant improvement in capability are needed. With clarity aimed toward the Congress and the public, the DOD must be able to clearly demonstrate why the Congress should fund the JSF aircraft, vice alternatives such as the F-16 Block 60 or the F/A-18 E/F.

At this point in the program, the primary incentive for performance, schedule, cost and quality is the force and impact of competition. At downselect, maintaining such momentum will be a considerable challenge. Innovative thinking following downselect is strongly recommended. One suggestion is to designate a primary or down-selected winner and a second source supplier in the form of the down-selected loser. The annual or biannual purchases from the two sources could be made according to price, similar to the AMRAAM model of procurement.

In the meantime, one area where the Government has control and can exercise considerable incentive for performance, schedule, cost and quality is to insist on program stability. Strong DOD leadership must be exercised to avoid

annual budget perturbations caused by alterations in service lot buys and program taxes or "assessments" to pay other departmental and service bills. Once program stability is disturbed, rigor is lost, and numerous other factors intrude to trigger contract variations in price, cost and capability.

F. Design Usage Spectrum:

The design usage spectrum for the JSF is a composite of a number of different mission profiles and an assumed mission mix. On historical reflection, considering the original F-15 and F-16 spectra, one notes that in their earliest days, these aircraft were not used as originally specified. Some of this disparity is explained by decisions to employ an aircraft for purposes not originally envisioned. However, and especially in the case of the F-16, there was an original bias toward keeping costs down, resulting in a specification for a lighter duty cycle than has actually come to pass. Such practices significantly impact the total ownership cost calculation of a weapon system and result in substantially under-budgeted work requirements. This leads to higher total ownership costs.

As total ownership cost is not only a key metric in JSF affordability evaluation, but also a key contractor selection criteria, it is timely for the Department to convene a high-level operational team to thoroughly scrutinize the JSF planned usage profile. DOD should consider translating the resultant usage profile into a draft warranty document. Solicit contractor comment on designing to a warranty for usage profile liability for defined material deviations. This data point could be useful in assessing airframe candidates in the downselect process. Whether the government decides to exercise a contractual warranty option is a matter to be decided. If the warranty approach were exercised, but a service chose to use the weapons system in a manner substantially different from the user profile, the contractor would be absolved from liability, and the service would be required to budget for the increased total ownership cost.

G. Program Stability:

In discussions with both the JSFPO leadership and the contractor teams, everyone has emphasized the preeminent importance of program stability in order to have high confidence that the program can be conducted and delivered at a predictable (bid) price, on the agreed schedule, and with the required performance and quality.

The Task Force believes the JSFPO should explore options and alternatives to convince Departmental and Congressional decision makers that price and program stability are important budgetary, fiduciary and public trust matters. With agreement reached, the Department should issue necessary directives to keep faith with this decision and commitment.

H. *External Strategies Team:*

The JSFPO described the JSF vision as (1) "develop, produce an affordable strike fighter weapons system and support it worldwide, and (2) "to be a model acquisition program for joint and international cooperation". In contrast, the contractors focused their briefings on current policy emphasis which is focused on acquisition reform or programs emphasizing produceability, affordability, and other 'illities', largely a process focus. One was left with the distinct impression that the contractors saw emphasizing Washington policy thrusts such as acquisition reform as the best selling strategy, rather than concentrating on the raison d'être: production of a war-fighting system that meets national security needs at an affordable price.

IV. Summary Conclusions:

The Task Force believes the JSF Program Office is executing its responsibilities in full accordance with its program direction. The program enjoys excellent leadership and is performing very well. However, this Task Force believes the JSF program guidance is too inflexible. A unique opportunity exists to implement acquisition innovation and reform. Substantial public trust benefits and taxpayer savings can be realized. Accordingly, the Task Force recommends that DOD exercise prompt action to provide revised DOD emphasis, support and direction to the JSF program, and commit to pursue opportunities to implement new acquisition reforms in the JSF program execution. This unusual opportunity probably will not reoccur in the next decade, and DOD Leadership is urged to seize the moment.

The Task Force concludes the following:

- The JSF contract should be structure as a price based acquisition and the contractor payment schedule should be geared to definable output metrics (specific program accomplishment milestones rather than calendar points or cost accumulation points). Standard commercial accounting practices should be used and defense-mandated accounting eliminated.
- Direction to the JSF Program Director should be amended to require development and procurement of the JSF as a weapons system rather than as just an aerial vehicle. The munitions suite should command an interest equal to that of the aircraft.
- JSF should be designated the as the model for an open architecture program and agreement on the definition of open architecture should be expedited, insuring that a "plug and play" philosophy is incorporated and that appropriate systems are interoperable (as compared to compatible or similar).

- A common, cross-service maintenance concept should be developed and implemented to include maintenance training and standardized on-aircraft maintenance procedures and processes, and standard information gathering and tracking for major maintenance events and tertiary level repair. The ultimate goal for all types of JSF aircraft maintenance should be Conditioned-Based Maintenance (CBM).
- Direction to the services procuring the JSF aircraft should be amended to return to the original OT&E airframe procurement program to once again allow conduct of a simultaneous, rather than a duplicative sequential, OT&E Program.

F. *Commercial Aviation Organizational Roles, Responsibilities, Best Practices, and Summary*

Source: Draft Joint Aviation Logistics Board report on "Commercial Support of Aviation Systems Subgroup."

COMMERCIAL AVIATION ORGANIZATIONAL ROLES, RESPONSIBILITIES, BEST PRACTICES, AND SUMARY

Commercial aviation provides an example of the characteristics of product support the DOD should consider for at least its flying systems. Commercial aviation support can be described by considering the three locations from where the service is performed: (1) maintenance base, (2) major maintenance stations, and (3) maintenance stations. The maintenance base is typically one facility that performs major maintenance work and aircraft modifications. The major maintenance stations are slightly less sophisticated facilities that could be located at a major airport, or major military facility in the case of the DOD. These stations perform most of the routine maintenance and stock a supply of emergency spare parts. The third level of support is based at airports where a carrier or a DOD flying unit would have extensive operations, although less than at a hub. These maintenance stations perform some inspections and perform repairs, as needed.

The Task Force is aware of recent emphasis in commercial aviation on Supply Chain Management. The commercial aviation sector, just as DOD, is very dependent upon a wide range of suppliers from various segments of the industrial base. The commercial sector's approach to supply chain management focus is market driven. It has implemented the ability to identify and grow partnerships with preferred suppliers. This ability to identify and grow partnerships with preferred suppliers should be a rule for the DOD as well.

The Task Force also believes in the need for a modernized information support system to help assure DOD product support. The commercial aviation sector's maintenance philosophy requires continuous real-time data on the status and health of their aircraft and all their tracked components. Information support is the fuel that feeds their system that in turn insures the safety and availability of their aircraft, while maintaining a cost-effective support process. Again, the same should be true for DOD.

The priorities of commercial aviation can be categorized into three major categories: (1) safety, (2) reliability, and (3) total ownership cost. The Task Force believes the DOD should consider these priorities, along with setting the performance metrics within DOD to measure the responsiveness and effectiveness of the support system: Safety metrics include: fatal accidents per million miles flown and fatalities per million miles flown. Reliability metrics include the following: mechanical system performance, cancellation performance, pilot-write-ups, and daily utilization. Total ownership cost (TOC) metrics include:

maintenance cost per available seat mile, maintenance cost per available ton-mile, maintenance cost per aircraft, and maintenance cost per flight hour. The first TOC metrics may be most useful in the larger DOD aircraft that have a transport or hauling aspect within their charter. With these metrics in mind, consider the commercial organizational roles, responsibilities, and practices in product support.

AIRLINE ORGANIZATIONAL ROLES, RESPONSIBILITIES, AND PRACTICES

a. Operations. Most airlines have a vice president for logistics who manages and controls all logistics functions and reports directly to the chief operating officer or the chief executive officer. In many airlines, the logistics function includes the scheduling and managing of airline operations. In other words, the logisticians decide what aircraft will be flown to what locations based upon flying hours and maintenance considerations. The managers of all logistics functions usually report directly to the vice president in a very streamlined chain of command. The senior logistics executives may shift funding and resources from one function to another when requirements arise. These executives are evaluated based upon their success in achieving common support goals, including safety, reliability/availability and cost control. These shared incentives contribute to a cooperative environment in which in-service engineering, line maintenance and base maintenance work together to identify and resolve problems.

b. Support Units. The airline logistics organizations typically maintain their own internal procurement and inventory management capabilities. Some airlines have two separate functions for supply support. One organization projects, acquires and manages the material for which demand can be anticipated with a high degree of reliability. Another organization acquires material for unanticipated demand and utilizes a variety of mechanisms to quickly identify and obtain the required parts. This group has more flexibility in contracting and pricing and is driven by reducing the time an aircraft is down due to parts unavailability. The airlines also often maintain a high degree of reliability and accountability for their inventory assets. Some airlines keep track down to the accountable individuals for the last six or seven transactions of an inventoried asset.

c. Quality Systems.

1) Standards Development. The airlines work through organizations such as the Air Transport Association and various national and internal standards organizations to develop mutually beneficial standards. In addition, the FAA serves in an oversight role to ensure that the standards contribute to safety requirements.

2) Standards Application. IS0 9000 is a family of standards that provides a framework for quality management and quality assurance. The commercial aviation industry promotes the use of IS0 9000 as a mechanism that contributes to maximizing aircraft support services and processes. The

aviation industry has also developed a specialized derivative of IS09001 for aviation production and maintenance applications. The specialized standard, AS9000, Aerospace Basic Quality System Standard, has been submitted for approval as an ANSI and ISO-recognized standard. As mentioned earlier, the ATA SPEC 2000 serves as a standard for the electronic interchange of supply data for procurement and repair transactions for aircraft maintenance.

d. Sustaining (In-service) Engineering.

1) Evolving OEM Inspection Requirements. While OEMs provide the airlines with the initial, recommended maintenance program, in-service engineering is responsible for modifying the program to reflect the unique airline's requirements and the actual reliability of the airline's fleet. As such, the in-service engineering program seeks to increase or decrease inspection requirements based upon the demonstrated reliability. Any changes to the recommended maintenance program must be made in accordance with FAA regulations.

2) Identifying "Bad Actors." The in-service engineering organizations monitor and analyze data from various sources, such as mechanic reports, pilot write-ups, OEM service bulletins, FAA directives and other operational reports to identify any negative performance or reliability trends. When problems are identified, a tiger team is often formed and in-service engineering takes the lead in developing the proposed corrective actions. These proposed actions could include, engineering modifications, changes to the maintenance intervals, the introduction of new tasks, or a change in vendor or repair materials.

3) Maximizing Work During Scheduled Downtime. The scheduling of aircraft for specific flights and locations is often driven by the requirement for maintenance or checks and the availability of specific resources at the various airports. In the case of depot-level repairs, the time that the aircraft is out of service is utilized to its fullest. Tasks are scheduled to optimize the downtime. The scheduling and planning is such, that aircraft very seldom, if at all, miss their scheduled departure date. The accountability and incentives/sanctions are such, that every effort is meticulously planned to avoid any unexpected actions that cause delays.

4) Importance of Tracking Items and Performance. The capability to implement reliability-centered maintenance is dependent upon the accuracy and timeliness of operational fleet data. Every action on the aircraft is recorded and tracked. The value of this information is a well-recognized fact by all individuals who play a role in supporting the aircraft.

e. Maintenance.

1) Scheduled Maintenance Activities.

A-checks -- Conducted at the line or maintenance station level approximately every 14-21 days and includes filters, checks, lubrication, servicing and any non-routines necessary. The A-checks typically requires approximately 20 to 40 man-hours and is conducted within 8 - 12 hours.

B-checks -- Conducted at the line or maintenance station level approximately every 60 days and includes A-check tasks plus any other items requiring attention based upon inspection. The B-check typically takes 40-80 man-hours and is conducted within 8 – 12 hours.

C-checks -- Conducted at the either the line or the major maintenance stations approximately every 12 – 18 months and can be viewed as an annual check-up that includes rigging, re-calibration of major aircraft systems, restoration of cabin interiors, and all lower level check tasks. The C-check typically takes 2,000 to 5,000 man-hours and is conducted within 3 to 7 days.

D-checks -- Conducted at the maintenance base approximately every 8 - 10 years and includes the overhaul of major components such as landing gear and engines, as well as structural corrosion tasks. The D-check typically takes 20,000 to 30,000 man-hours and is conducted within 21 to 30 days.

H-checks -- Conducted by some airlines at the maintenance base approximately every 2.5 to 4 years to address the corrosion issues associated with aging aircraft. This includes the timely restoration of expected corrosion zones such as galleys and lavatories. The H-check typically takes 9,000 to 12,000 man-hours and is conducted within 7 to 14 days.

2) Maintenance Business Strategies.

a) In 1997, the major and national airlines spent approximately $10.3 billion on maintenance of their aircraft. Of these costs, 49.8 percent was direct, 29.4 percent was burden and 20.8 percent was line-related. The break-out of the direct maintenance costs: for airframes -- labor - 19.3 percent, material - 19.2 percent and outside contractors - 17.3 percent, and for engines -- labor - 4.7 percent, material - 17.6 percent and outside contractors - 21.9 percent. (Source: ATA)

b) The airline industry is developing leading-edge practices that are primarily focused on reducing the time and complexity associated with logistics pipelines. Airlines are radically re-engineering their logistics systems.

3) In-house vs. Outsourcing.

a) Most established airlines with existing maintenance infrastructure contract out only 10 to 20 percent of their maintenance workload. These carriers may outsource more of their component workload in the coming years, but are likely to forgo full scale outsourcing due to the need to fully utilize existing infrastructure and comply with labor agreements to maintain employment. In contrast emerging airlines outsource virtually all heavy maintenance in order to avoid the cost of establishing and maintaining an organic infrastructure.

b) Outsourcing airlines have moved away from time and materials (T&M) contracts in favor of warranty-based firm fixed priced (FFP) and power-by-the-hour (PBTH) arrangements. (In PBTH arrangements, the airlines contract for performance – number of takeoffs, flight hours, etc. – rather than for spare parts or repairs.) The use of warranty-based FFP and PBTH contracts reflects the desire of the airlines to increase maintenance cost predictability and shift financial risks to the service provider. These arrangements also allow airlines to reduce inventory costs and provide vendors with strong incentives to improve reliability. The vendor fixes whatever breaks for a fixed revenue stream. For the vendor and the airline, PBTH provides for a win-win relationship. Increased reliability means higher dispatch and utilization rates for the airline – more revenues and profit. Since the vendor is paid based on a utilization rate, if he can improve reliability, the fewer repairs he has to accomplish which means more profit.

4) Technician Training/Qualification. The airlines rely on utilization of FAA-certified technicians (e.g., aviation maintenance technician, repairman, repair station) for performing maintenance. People who are interested in entering the commercial aviation job market are responsible for obtaining their own certification training from a FAA-certified school. The FAA does not accept maintenance tasks unless certified technicians sign them off. The FAA can take "certificate action" as an ultimate penalty for malfeasance.

5) Maintenance Data. Maintenance data for aircraft and components are maintained and provided to aircraft owner/operators on an ongoing basis. Due to the high level of training required for certification of maintenance technicians for commercial aviation, the level of detail required in maintenance manuals is less compared to military documentation. Increasingly data is being provided and updated digitally. For the Boeing 777, all manuals were provided concurrently with the delivery of the first aircraft. Also, maintenance data is being delivered with test and diagnostic tools integrated with the system.

5) Inventory Techniques have been implemented such as systems that automatically redistribute inventory when shortages arise, pooling assets among airlines, transferring inventory management responsibilities to third parties, information systems that and distribution centers that respond within a few hours.

f. Supply & Support Chain Management. Leading commercial firms embrace effective supplier relationships as a core business strategy and build organizational with skilled people to carry out the strategy. They use a rigorous supplier selection process to create a strong supplier base that they can more effectively manage. They have established effective communications and feedback systems with their suppliers to continually assess and improve both their own and supplier performance. And, the firms foster an environment in which suppliers realize more significant contributions that are matched with significant rewards. Systems have been implemented that electronically link the airlines to their supplier base.

g. Supplier Base Reduction and Preferred Suppliers. Traditional competition based solely on price has given way to best value and preferred supplier relationships. Companies have found that having fewer suppliers is more manageable and cost effective. By sharing information, risks and rewards, companies working with fewer high performing suppliers on a long term basis can solve problems and reduce costs through continuous improvement more effectively and efficiently.

h. Long-term contracts. The airlines understand that long-term business relationships that serve to further their performance and cost objectives are beneficial. As such, long term contracts with the appropriate incentives and sanctions provide useful mechanisms to help nurture and grow mutually beneficial business arrangements. The longer the contract, the more a supplier will be willing to invest in serving their airline customers.

i. Warranties. A common business practice of commercial aviation is the utilization of warranties. The improvements in information technology have enabled very detailed tracking of aircraft parts. As such, the airlines are able to easily substantiate warranty claims for items that fail to meet the contractual requirements. The long-term impact of this capability is that suppliers will take actions to improve their products based upon the economics of warranty claims filed.

j. Information Support. The commercial airlines support philosophy of reliability-centered maintenance requires accurate and timely integrated data. In addition, many OEMs and vendors have established on-line technical data and support services to support their airline customer's requirements.

a) Sources of Data. Most airlines have information systems that provide life cycle tracking of parts, aircraft system reliability performance and maintenance action recording. Many also have information systems that

support their parts procurement and technical data systems. The data which reflects the life history of the aircraft is gathered on a day to day basis through the aircraft flight logs and often transferred from the manual log to an automated information system which tracks the configuration and maintenance events for a specific tail number.

b) Structure of Systems. All major airlines utilize ACARS, an airborne performance monitoring and data link system, to provide real-time transmission of system performance data from in-service aircraft directly to airline flight operations and maintenance control personnel.

c) Accountability for Data Integrity The issue of data integrity is essential to the maintenance and operational and maintenance decisions that are made. As such, there is a high premium placed upon the accountability for the accurate and timely reports.

SOME BEST PRACTICES

- Corporate focus and culture
- Customer service is primary focus
- Measurements that are tied to customer service and corporate financial goals
- Top management champions of change with full authority to make changes
- Integrated pipeline management
- Performance measurements aligned with corporate goals
- Successful continuous improvement
- Use of third parties to reduce complexity and cost of pipeline
- Information technology
- Accurate information on amount, location, condition, and usage of inventory
- Real-time inventory data
- Extensive use of data systems to track and manage flow of parts
- Timely development and implementation of new systems
- Supplier partnerships, reduced supplier base
- Supply and support chain management

- Long-term contracts
- Performance-base contracting (power-by-the-hour)
- Best value-based decisions for in-house vs. outsourcing
- Supplier-operated local distribution systems to delay purchase of inventory until needed
- Digital maintenance manuals
- Timely update to manuals
- Reliable deliveries to customer demand
- Reduction in layers of inventory
- High fill rates
- Reduction of just-in-case inventory
- Repair to need, not to stock
- Cellular process, fast turnaround times
- Availability of parts when required for repairs
- Reliability-centered maintenance
- Systems that track part consumption and failure data for analysis for reliability improvement
- Facilities reflect new business practices

SUMMARY AND FINDINGS

There are some similarities and differences between DOD and the airline industry in their approach, structure, and metrics to accomplish their respective missions.

a. Approach. The commercial aviation environment promotes much more of a proactive role in aircraft support than the defense environment. The former approaches the support of aircraft in much more of an evolutionary manner while utilizing actual operating performance data to drive and determine the evolving maintenance requirements. The latter approaches the support of aircraft in a much more up-front deterministic manner with maintenance programs often developed and spare parts procured before the aircraft has much of an operational life.

b, Structure. The commercial aviation environment structures its support activities in centralized fashion with one key executive having responsibility for the support of the fleet. The functions that support the logistics mission are integrated by common objectives and clear lines of authority and responsibility. The defense

community has a much more segmented and decentralized approach to aircraft support. Numerous organizations have responsibility for parts of the process, but the ownership and responsibility for the life cycle support of the aircraft is not clearly defined and executed.

c. Metrics. The commercial aviation environment utilizes a few discrete measures of performance that guide their support plans and programs. These metrics include maintenance cost per available seat mile, or ton-mile, maintenance cost per aircraft and maintenance cost per flight hour. The data that supports tracking and evaluating these metrics is an integral component of their management information systems. The defense environment, while data rich, often has no clear, concise mechanisms for measuring support performance and cost. The inability to easily and effectively link cost to support actions limits the defense community's ability to use metrics to guide and structure its support programs.

G. Glossary

AAE	Army Acquisition Executive
ABCCC	Airborne Command and Control Center
ACAT	Acquisition Category
AC1	Analytical Condition Inspection
ACID	Advanced Concept Technology Demonstration
AMRAAM	Advanced Medium Range Air-to-Air Missile
AOA	Analysis of Alternatives
AQ	Acquisition
AR	Acquisition Reform
AT	Advanced Technology
ATD	Advanced Technology Demonstration
AUPC	Average unit Production Cost
AWACS	Airborne Warning and Control System
B&P	Bid and Proposal
C3I	Command, Control, Communications and Intelligence
CAIV	Cost as an Independent Variable
CaNDI	Commercial and Non-Developmental Item
CAS	Cost Accounting Standards
CBM	Condition Based Maintenance
CDRL	Contract Data requirements List
CLIN	Contract Line Item
COE	Common Operating Environment
COP	Common Operational Picture
COSSI	Commercial Operations ans Support Savings Initiative

CPIF	Cost Plus Incentive Fee
DAR	Defense Acquisition Regulations
DAU	Defense Acquisition University
DAWIA	Defense Acquisition Workforce Improvement Act
DCAA	Defense Contract Audit Agency
DCMC	Defense Contract management Command
DII	Defense Information Infrastructure
DOD	Department of Defense
DSAC	Defense System Affordability Council
DSB	Defense Science Board
DTSE&E	Defense Test Systems Engineering Evaluation
E&T	Education and Training
E&MD	Engineering &Manufacturing Development
EW	Electronic Warfare
EXCIMS	Executive Committee on Modeling and Simulation
FAR	Federal Acquisition Regulations
FASA	Federal Acquisition Streamlining Act
FSP	Full Scale production
G&A	General and Administrative
GCCS	Global Command and Control System
GOA	Generic Open Architecture
ICAF	Industrial College of the Armed Forces
IPT	Integrated Product team

IR&D	Independent Research and Development
JLENS	Joint Land-Attack Elevated Netted Sensor
JOA	Joint Operational Architecture
JPO	Joint program Office
JSF	Joint Strike Fighter
JTA	Joint Technical Architecture
JTA	Joint Technical Architecture
JTAMDO	Joint Tactical Missile Defense Organization
JTRS	Joint tactical Radio System
LMI	Logistics Management Institute
LRIP	Low Rate Initial Production
MALD	Miniature Air Launched Decoy
MDA	Milestone Delivery Authority
MDAP	Major Defense Acquisition Program
MMITS	Modular Multifunction Information Transfer System
MNN	Manufacturing Neural Network
MNN	Maintenance Neural Network
NCAT	
NDIA	National Defense Industrial Association
NDU	National Defense University
NPR	National Performance Review
ONR	Office of Naval Research
OSD	Office of the Secretary of Defense

OT	Operational Testing
PE	Program Element
PMCS	Programmable modular Communications System
QDR	Quadrennial Defense Review
QFD	Quality Functional Deployment
RAN	Royal Australian Navy
Ret	Retired
RFP	Request for Proposal
RFP	Request for Proposal
RIW	Reliability Improvement Warranties
RRF	Ready Reserve Fleet
SBA	Simulation Based Acquisition
SCAMP	Single Channel Anti-Jam Man Portable
SMART-T	Secure Mobile Anti-Jam Reliable Tactical Terminal
SPI	Single Process Initiative
SPM	Ship Program Manager
TBD	To Be Determined
TEMP	Test and Evaluation Master Plan
TINA	Truth in Negotiations Act
TOC	Total Ownership Cost
TRADOC	Training and Doctrine Command
TSM	TRADOC Systems Manager

UFP	Unit Flyaway Price
USAF	United States Air Force
	Under Secretary of Defense Acquisition and Technology
USMC	United States Marine Corps
USN	United States Navy