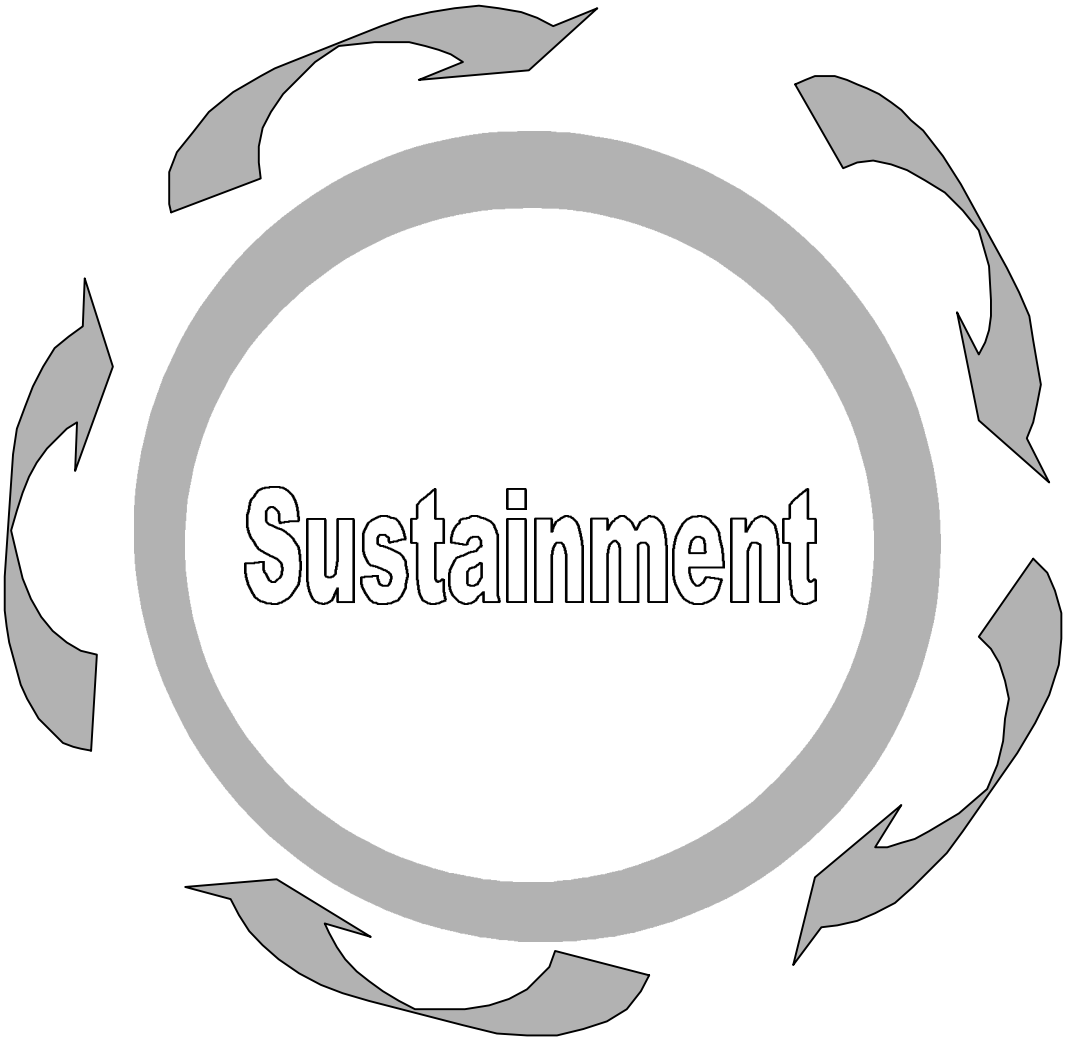
The National Center for Advanced Technologies



Report of the
SUSTAINMENT TEAM
of the
Industry Affordability Task Force
The National Center for Advanced Technologies
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NCAT

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SUSTAINMENT

Proceedings of the Sustainment Team of the Industry Affordability Task Force

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PREFACE

This document was prepared by the National Center for Advanced Technologies (NCAT) for the Office of the Director, Defense Research and Engineering, under a task titled, Affordability Initiatives contained in a grant "Planning of Manufacturing Technology Activities with Industry", and pertains to the objectives of the task to continue support for facilitating industry views on manufacturing issues.

The following NCAT staff members were reviewers of this document: Mr. Mark Gordon.

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Executive Summary

It is time that bold actions be considered by the DoD in a serious attempt to significantly reduce the growing sustainment costs and thus shift funds to new procurement. This paper describes some actions proposed by the "Sustainment Team", which was formed with industry experts from within the resources of the Industry Affordability Task Force (IATF) of the National Center for Advanced Technologies (NCAT). This team proposes a process that would transition DoD from the present “Vicious Cycle”, where deferred modernization means that O&S consumes increasing resources and thus prevents modernization, to a more “Vital Cycle” that would reduce the sustainment costs of legacy systems, and provide for modernization of weapons systems. Pursuing the “vital cycle” came with one caveat: any action taken could not adversely effect warfighters' capabilities.

The recommendations lean heavily on using commercial practices and suggest improvements in reliability/maintainability through industry-DoD partnering. Core competencies of industry and DoD are different. DoD has a long history of maintaining systems, although not at the lowest cost or cycle time. The private sector, however, has built a core competency in both maintaining and improving system components because of different incentives: reducing the costs of warranties and the high cost of lost sales due to defective products.

Generally, the recommended process, shown below in Figure 1, calls for:

- Changing the concept of maintenance from three levels to two levels, except by waiver, and utilizing commercial-depot competition for lowest cost and time.
- Depleting current inventories of low-reliability spares while ordering improved components.
- Reducing sustainment costs by selectively identifying high-cost and low reliability components for industry improvement through total ownership responsibility.
- Applying commercial business decision filters to the support mechanisms of legacy systems.

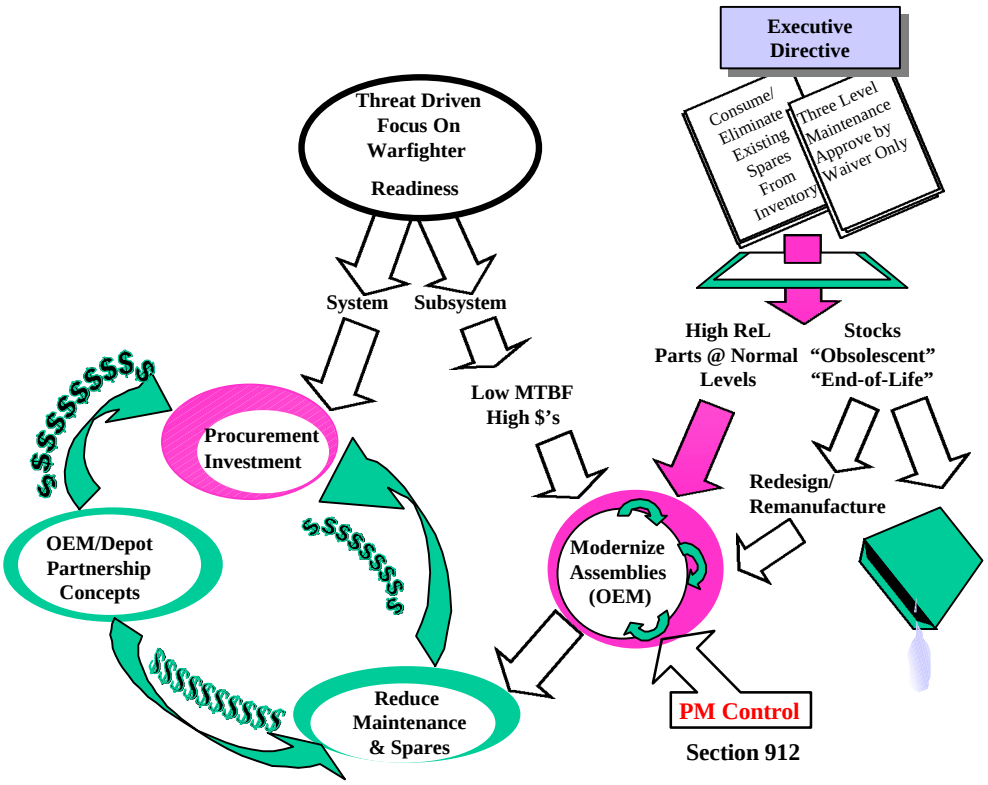

Figure 1- The recommended process for pursuing the "Vital Cycle"

An executive directive, coming from the Secretary of Defense, would be required to effectively jar this process to a start. The directive, similar to the order that curtailed the use of MILSPECs, would curtail further procurement of low reliability, high cost driver spare components and require the competitive sourcing of improved, warranted components. The climate for this sort of bold action idea is favorable. The Defense Systems Affordability Council (DSAC) recently issued goals outlining the levels of improvement to be sought, and actions preferred to achieve them. This paper is in concert with many of the ideas of the DSAC Goals, which the team understands were derived from the Section 912c efforts currently under way.

Goal # 1-	**Field quality defense products quickly and support them responsively**
Goal # 2-	**Lower TOC of Defense Products**
Goal #3-	**Save O&S and Infrastructure monies & move these savings to modernization efforts/accounts.**

DSAC Goals for 21st Century

There is no question of the importance of the goal of shortening of the cycle time of defense acquisition. The idea's time has come. Considering the nominal twenty-year cycle that is prevalent in defense acquisition, a 50% reduction (ten years) is certainly an improvement. However, even greater reductions are possible. The Evolutionary Defense Acquisition (EDA), currently resident in the DoD acquisition desk book, models the development to IOC of a Major System in 5 years, including fielding and user operation evaluation of battle group size production prototype lots.[1] For new systems the compressed acquisition cycle takes into account the corrections needed for their sustainment. This paper deals principally with the sustainment issue of legacy systems, is complementary to the EDA, and also in concert with the DSAC goals in addressing a revolutionary approach to solving the sustainment problem by re-engineering the logistic systems.

Re-engineering the logistic system requires drastic departure from the classical logistic functions. But if it is the desire of the DoD to embrace the ways of the Commercial Sector, then little re-invention of the defense infrastructure need take place. A quicker method of achieving the goal would probably be to totally outsource it to one or a number of existing Commercial “off-the-shelf” operations instead of spending the time and resources modifying the existing DoD system. This would of course entail the realities of DoD infrastructure reduction, similar to the reductions observed in the recent industrial downsizing.

However, significant culture change is required for these mechanisms to result in real, sustained improvements. Lowering total ownership cost and allowing funds to shift from infrastructure to modernizing can only be accomplished if non-traditional provisions to allow the migration are made. Traditionally, "cost savings" and "cost avoidances" do not "flow" back to the individual program nor to the major force program account, but are captured by the general account or go back to the Treasury. This revolutionary change requires assistance through legislation. The lag time for improvements to be recognized

[1] Evolutionary Defense Acquisition, The National Center for Advanced Technologies, 1996

relative to the modernization of fielded weapon systems require time periods longer than normal government personnel rotational periods. System Program Management leadership will have to be in place for longer periods of time, and this will be a major cultural change. A commitment of this level for a uniformed member of the DOD has major career implications, which need to be recognized. Adequate career advancement opportunities must be made commensurate with these sacrifices.

Embracing the methodology in this paper is not dependent on the current issues surrounding the military depots. The team recognized that the military depots retain core competencies relative to specific weapons systems. As this vital cycle methodology proves to be the successful alternative to current processes, it is anticipated that an industry-depot partnering relationship could result in future rounds of business case decisions.

Additionally, an increased exchange of requirements information between the services and the industry must take place to enable the effective use of private sector industry in the integration of the commercial/military industrial base. Future requirements and systems needs must be articulated to round out the total picture of technologies needed to maintain our warfighter "decisive edge". Not all defense program managers and their industry counterparts know where technologies are and what specific technologies are needed to solve particular defense problems. These communities will have to share in the information and knowledge early enough to effect systems conceptualization and development. Industry recognizes the need to plan for and provide surge capability during contingency operations. This capability can be insured through contractual penalties and incentives.

Passing configuration authority of legacy systems and/or their components to original equipment manufacturers should be considered as a method to allow the "freeing up" of resources from infrastructure and support. These types of “power-by-the-hour” arrangements can significantly reduce O&S infrastructure costs. This is by far the most significant revolutionary idea that requires complete paradigm change. Passing weapon

systems ownership to a company and contracting for a service-based requirement fulfillment arrangement can result in immediate cost savings from infrastructure reductions, followed by sustained cost reduction through industry improvements.

This paper illustrates how these revolutionary ideas might work within the DoD system. Actual examples of how these ideas are working for both industry and government are given. The success of the ARC-210, the Caterpillar Alliance, and the "Power-by-the-Hour" concept, initiated by the propulsion companies in their support of the commercial airlines, are provided with supporting data. Direct Vendor Delivery (DVD) is a concept of Contractor Logistics Support (CLS) that has been recently implemented in three different contracts.

Notwithstanding the revolutionary ideas espoused in this paper, there remain many major barriers that must be overcome before any progress is to be made. It will take bold decisiveness to start the action and non-parochial decision making to follow through. The bottom line to all of the ideas presented in this paper is this: the warfighter must not be put at risk but be the beneficial recipient of any change in method or policy that effects this paradigm shift. The adoption and execution of commercial business practices is an outstanding objective, but will require major efforts of partnership and trust with industry and government as key participants. We suggest continued participation of industry teams in the formulation of these goals and executing plans.

Introduction

Recognizing the necessity for providing an industry viewpoint to the issue of sustaining the military forces systems in a business like way, the National Center for Advanced Technologies (NCAT) chartered a team within the Industry Affordability Task Force to examine the situation and report recommendations. This paper reflects that activity, the outcome of the team's deliberations, and the recommendations offered to the executive committee of the industry affordability task force. The team was made up of industry representatives, and chaired by Mr. Ted Pertowski of GEC Marconi[2]. Team members were selected based upon experience in commercial or DoD sustainment processes, and represented a broad industry perspective. The objective of the team was to focus particularly on the "Support" issues incorporated in "Operation & Support" cost. Based upon previous team results, this team would seek to identify potential solutions, assist in the identification of resources needed to improve sustainment technologies, and help to identify sustainment technologies as they apply to procurement of new systems.

The team created a draft charter[3] which was presented to and approved by the executive committee of the task force. In general terms the team was to conduct a thorough examination of weapons systems' sustainment with the aim of identifying barriers, cost drivers, and issues confronting industry in their attempts to reduce sustainment costs, then extrapolate this information to the situation confronting the Department of Defense today and present the findings as an independent, unsolicited industry review of the sustainment issue. In addition, the task force executive committee sought information which could possibly provide methods for reducing the growing cost and effort of sustainability by identifying high cost drivers of major weapons systems, determine what portion of those costs could be effected and identify the barriers or innovative solutions for reducing or eliminating the high cost area. The final report of this analysis effort would be made available to the decision-makers in the Department of Defense in the form of plans or recommendations. The process decided on and followed by the team is at Appendix 4. .

[2] Team membership listed at Appendix 1
[3] Team Charter Appendix 2

The Problem

While there are many facets to the "support" issue in terms of "operations and support", the team saw the real problem as the degradation of "Readiness". Readiness defined by this team was the ability of our armed forces to carry out their mission unimpeded at the current operations tempo and the current funding levels. In the recent past (prior to 1989), funding resources were not an issue directly impacting readiness. There were issues of timing, stability, earmarking and efficiencies, but the forces did not suffer any loss of readiness. During the drawdown from 1990 to the present, modernization funds were severely reduced. Operations and Support activities resulting from increasing deployment activity worldwide and the ever-aging fleet siphoned off resources from the services dwindling Total Obligation Authority (TOA).

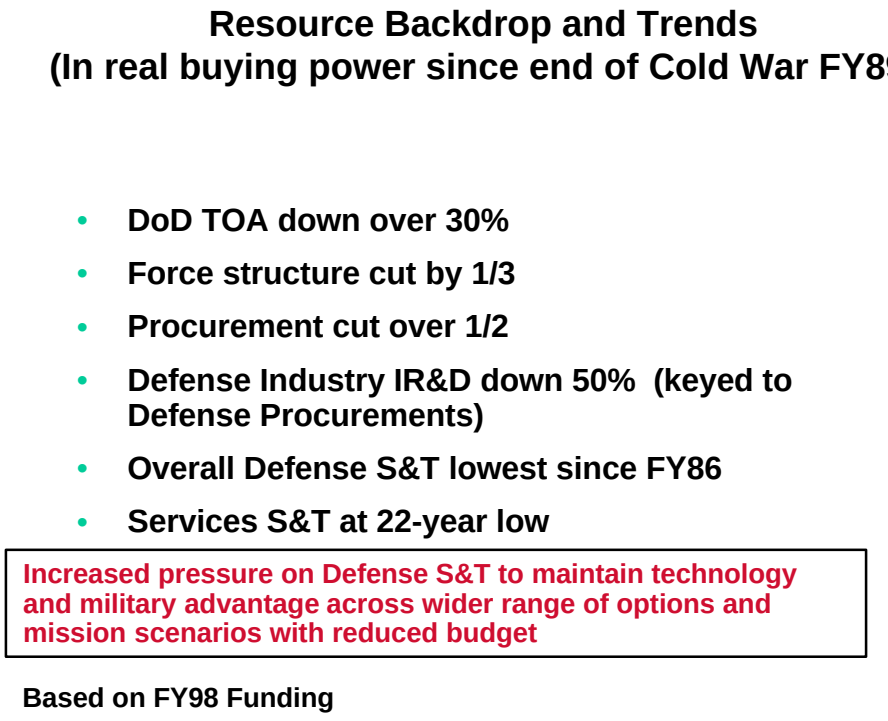

Figure 2. Resource Level Changes

The increasing age of weapons systems further exacerbates the **growing O&S cost** and the **reduction of readiness levels**. Because of this situation a different formula for applying these diminishing resources is needed and is being sought. The new formula,

however, has to be compatible with and not adversely effect readiness. In fact, the current state of readiness of the services would necessitate a sustainment methodology that could indeed raise the level of readiness in spite of the reduced president's budget.

oday's forces are some 45% smaller in mission forces personnel; yet these forces are still fulfilling worldwide tasking and deployments.[4] In fact, from 1990 to 1998, we have almost tripled deployments over the total number of deployments in the prior 30 years. Mission readiness has indeed been degraded in the services. USAF F-15 wings have reported an inability to achieve fully mission capable standards. Navy units are deploying at degraded readiness levels.[5] Support costs have been increasing because of the lack of resources to repair and modernize the aging systems, and these costs accelerate and further eat into the decreasing budget. The remedies to date have been the reduction in non-deployment operations, (e.g. one million-hour reduction in Air Force flying hours in answer to O&S costs exceeding 35% of budget.)[6] This sort of action-reaction has put the defense system in a spiral of degradation.

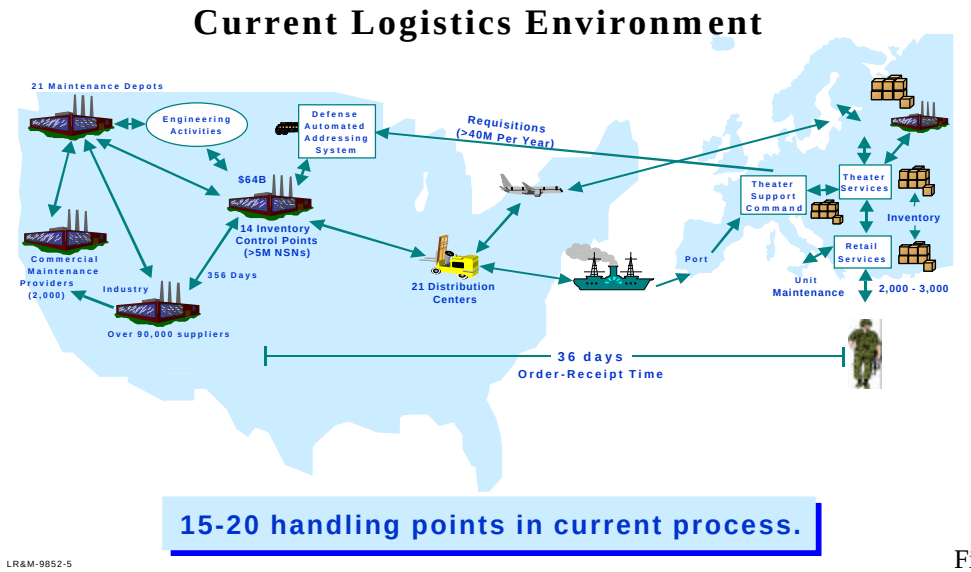

Figure 3. Current Logistics Environment

Further exacerbating this situation of readiness is today's DoD logistics environment. Referring to figure 3, in the logistics environment of today, the average lead time for

[4] JDMTP S/RWG Investment Strategy
[5] Ibid

items in stock is 36 days, brought about by the 14 inventory control points, 21 maintenance depots, and from 14 to 20 handling points from order to receipt. For items not in stock, the average cycle time balloons to 364 days. While resources for spares and maintenance have diminished considerably, the logistics pipeline has not been compacted to adapt. Nor has it become more agile to provide quicker response time or accommodate a lower total inventory of spares and components. In the 1990s industry downsizing, however, the commercial sector did adapt by reducing the logistics cycle times and supported their enterprise more efficiently.

One issue that has always surfaced in the discussion of outsourcing to industry is the capability to surge when needed, including both service and manufacturing capability. Industry recognizes the need to plan for and provide surge capability during contingency operations. This capability can be insured through contractual penalties and incentives.

The Vicious Cycle

The best explanation of the situation that the services find themselves in today has been explained in a not-so-tongue-in-cheek example termed the "Vicious Cycle".[7] The notion is this: with lower-than-normal funds for modernization and upkeep, the aging fleet of "legacy" systems suffers accelerating deterioration. With lesser resources available to maintain the systems, the unabated deteriorating process actually generates the need for increased resources. Unavailable in the President's Budget, these resources are siphoned from other accounts, or deferred from being applied to the operations support accounts such as training, and testing. Resources for replacement systems are virtually non-existent because of the transfer of resources that occurred with the "peace dividend". Reflecting on the representation at figure 4, **"The Vicious Cycle"** of *Deferred Modernization* leads to *Aging Weapon Systems* which require *Increased Maintenance* resulting in *Increased O&S Costs* which must be funded by *Funding Migration from Procurement to O&S.* This situation has been explained by various leaders in defense and in the private sector as the most dangerous situation degrading our readiness levels,

[6] Ibid.
[7] Logistics in the 21st Century

primarily because there **appears to be no current method to break this cycle**. While goals and objectives have been directed that mandate the levels to be reached in order to make the funding equation work[8], no specific implementation guidance to develop a sufficiently different, beneficial **"cycle for modernization"** has been given. This paper postulates an approach to resolving this dilemma. *It poses some risk to DOD as the timing of curtailment of low reliability components and their replacement or upgrade is coordinated, but the concept achieves the primary objective of:* **Maximizing the Availability and Readiness of Weapon Systems for the Warfighter**.

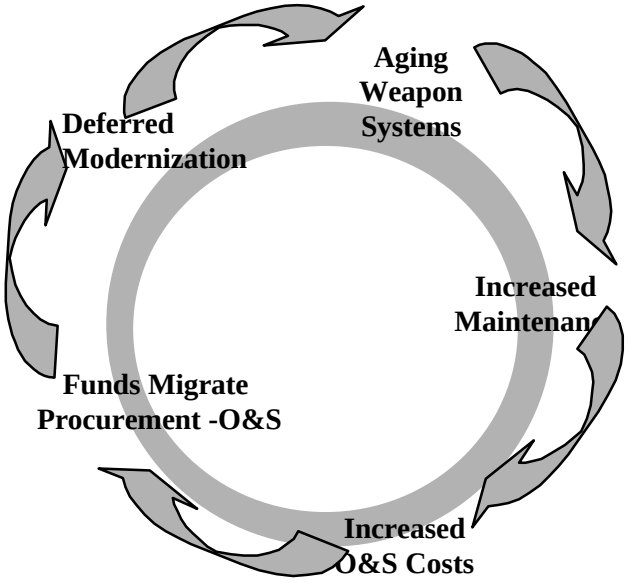

Figure 4 "The Vicious Cycle"

Revolutionary thinking and revised procedures are necessary to break this vicious cycle. Piecemeal or patchwork solutions superficially correct the problem. It will be necessary to radically transform the traditional DOD support systems, allocate funding from the already tight DOD budget to recognize existing and forecast obsolescence in legacy weapon systems and begin a new cycle for their replacement or modernization. There are four major issues to be attacked simultaneously in order to correct the situation: **inventories**, **reliability**, **maintenance concepts, and funding**. Without a concerted,

[8] DSAC Goals

simultaneous attack on all four fronts, the probability of success is minimal. Once this revolutionary step is taken and breaking the traditional way is done, a more "Vital Cycle" can be entered (Figure 5.). This cycle is characterized by Consuming the Existing Lots of Low Reliability Parts and reliance of Two Levels of Maintenance rather than the traditional three. By relying on the private sector to step into the responsible role of supporting the forces, O&S costs can be decreased. Then resources can be freed up to migrate to the procurement accounts and reduce further the costs of maintenance and spares by using innovative methods such as "upgrade spares' which contribute again to the freeing up of resources to the procurement of modernized systems. The cycle begins with the issuance of direction to consume the existing levels of spares without replenishing them with equal low reliability spares.

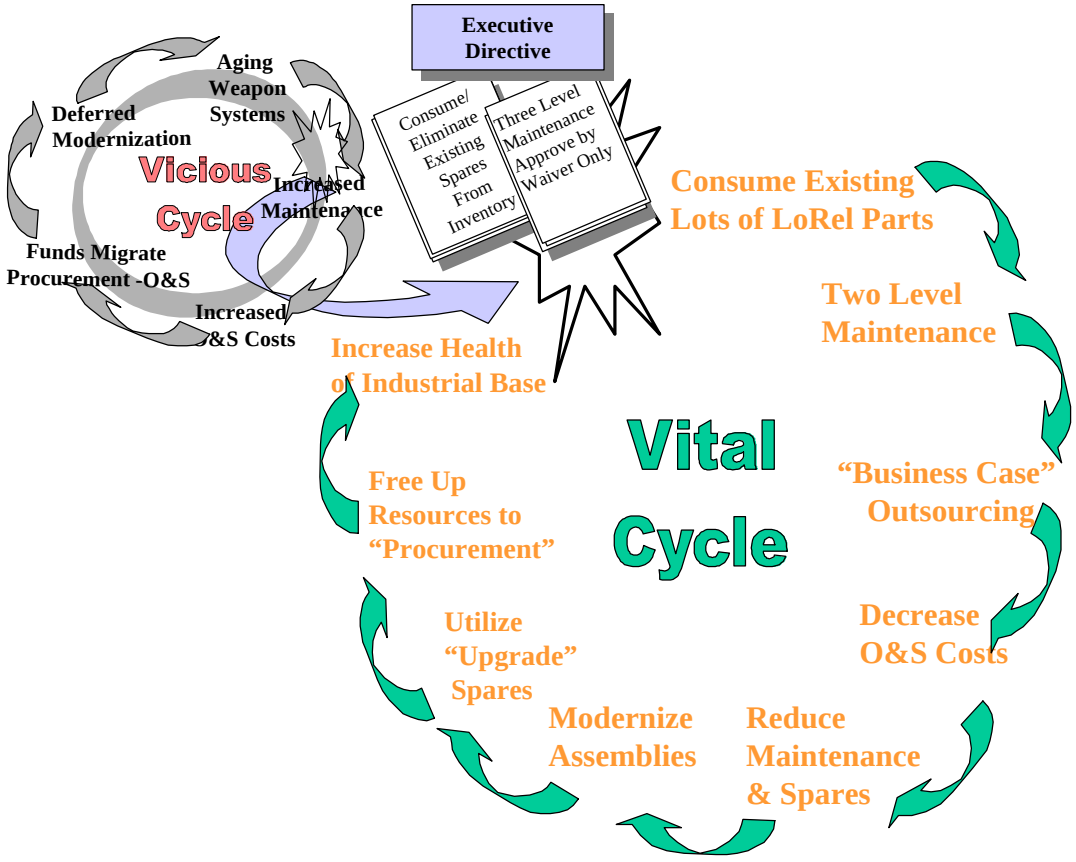

Figure 5. The Transition to a "Vital Cycle"

Setting the Stage for Breaking the Cycle.

The process below will create the opportunity space and funding necessary for DOD to break the current vicious cycle and develop a cycle more beneficial to supporting existing and emerging weapons systems and subsystems.

1. **Analysis:** Conduct an analysis of current O&S costs for each major weapon system within a service's inventory to establish Future Years Defense Program (FYDP) funding levels for the following: Unit/Operational Spares and Maintenance, Intermediate Level Spares and Maintenance, Depot Level Spares and Maintenance. Total Ownership Costs must include all categories of O&S exclusive of those associated with the mission crew, Petroleum-Oil-Lubricants (POL), and consumables. It is imperative that all infrastructure costs be associated with these categories, something that DoD has consistently underestimated in the past.

2. **Categorize: Prioritize** the major weapon systems to determine which subsystems are candidates for modernization. Prioritization includes threat assessment and economic benefit analysis, e.g. mean time between failure (MTBF), decrease O&S support costs. Metrics for this process would include MTBF, cost, technology level, fielded units, present readiness level, improved response to threat, and system importance.

3. **Target:** Based upon the Total Ownership Costs determined from the analysis performed in step 1, establish a target cost reduction and improved system availability goal for each of the subsystems. This could be benchmarked against current commercial technologies for similar commodities or systems.

4. **Implement**: Issue multiyear (5-year minimum) solicitations. Compete the Total Ownership of the systems and subsystems, requiring guaranteed MTBF improvements and a warrantee. Open competition to government depots and the private sector. The company winner of the competition takes title and configuration

control of the system and all existing spares. That company is then required to meet system availability targets or pays penalties until the improved availability is met. Contracts require only FFFI compliance, as well as involving the customer in major design decisions. Use Other Transactions Authority (OTA) or Commercial Operation and Support Savings Initiative (COSSI) program initiatives to reduce contract cycle time.

5. **Reinvest:** Savings accruing from this formula can be applied to replacing, modifying, or upgrading obsolete weapon systems or to the acquisition accounts to procure new systems. Formula sharing of the savings can take many forms to solve defense wide problems. For example, sharing the savings by application to a DOD wide pool of resources (e.g. 60% to the operating service and 40% to the DOD pool).

The Process

This concept can only be achieved by using a drastic starting action. That drastic action is a DOD executive directive, similar to the order that curtailed the use of MILSPECs, that curtails further procurement of low reliability spare components and parts and the funding of maintenance activity beyond the organizational level for high failure rate (i.e. high support cost) systems and subassemblies (identified through the “analyze” explained above). Exceptions to this directive should only be made on a case justified basis in order to force the momentum to change from "sustainment" to "force modernization". Based upon existing Total Ownership Cost Models, (see Appendix 5: References) a twenty percent (20%) reduction of current O&S costs is a conservative estimate of savings that can be made available for reallocation to modernization.

The next step in the process is to perform a Total Ownership System Solicitation (TOSS) which competes the responsibility for total ownership and configuration control of the systems and subsystems starting with the top of the priority list found in “Categorize” above. The following step in the process is to transfer the responsibility and Total Ownership Cost of the sub-system to the private sector. The winning company is now responsible for providing the system the DOD. No restrictions on cost savings are

imposed, except for performance and readiness level requirements. That is to say, the company is now operating the system in a complete profit/loss mode, as would a private sector company. If the company reduces costs of operation through innovative means, the rewards of increased margins accrue to the company. If the company reduces the cost of maintenance through increased MTBF, increased reliability of the system, through upgrade sparing, modification, redesign, or component replacement with advanced technology, the company benefits the increased margins, and is allowed to reinvest, change configuration, or change anything except form-fit-function interface with other systems. The government benefit is reduced cost of operations and support, increased utility of the system, reduced cost of intermediate maintenance infrastructure, and most importantly, the ability to divert resources to other accounts (acquisition, operations, etc). Resources freed at this point in the new cycle can also be applied to the systems/subsystems not economically viable for private sector investing. Eventually, through an iterative process, higher risk, lower reliability systems will re-enter the analysis cycle to determine the persistence of the high cost situation and to form the basis for determining possible greater levels of incentive for the next round of solicitation.

The above process is only one dimension of the solution. The remaining solution areas deal with outsourcing logistical processes to the commercial sector which have demonstrated excellence in global sustainment. The present sustainment situation is not unique to DOD and is in fact a situation similar to that faced by industry with regard to reducing operating costs. Industry has taken the approach of defining core competencies relative to the markets served and then outsourced or formed strategic alliances with other companies for those activities which are not a core competency. The field of logistics has long been considered a core competency by DOD, particularly when there was no other alternatives to providing this capability to the warfighter. However, building and maintaining this logistics capability is prohibitively expensive. Today we live in a global economy and logistical support is a reality for all companies who do business on a global scale. Many of today's global companies have developed significant capabilities to support their products or services and since they have this core

competency they are often willing to sell their knowledge base and infrastructure on a transactional basis to other industries and even competitors.

Embracing the methodology in this paper is not dependent on the current issues surrounding the military depots. The team recognized that the military depots retain core competencies relative to specific weapons systems. As this vital cycle methodology proves to be the successful alternative to current processes, it is anticipated that an industry-depot partnering relationship could result in future rounds of business case decisions.

Actual Alternative Support Concepts

ARC-210

The ARC-210 radio is a case study that illustrates the principles of this **"Vital Cycle".** The Navy achieved both a cost of ownership reduction and a significant improvement in mission availability for the warfighter through an innovative Reliability Improvement Warranty program. Key to achieving these improvements was the retention of configuration management, the depot and intermediate level spares ownership and depot support capability by the contractor (Rockwell Collins), and their commitment to improved reliability and availability of the radio in the field. When the support contractor has the ability to make changes to improve system performance while maintaining form, fit, function and interface conformity, both the military and the contractor win. Modernization occurs, spares and inventory decrease, availability for the warfighter improves and costs go down. However, failure to include any part of this recipe in the solution will have an adverse impact on field availability and will negate the desired affect of improved modernization and decreased cost of ownership.

Caterpillar-Allied Alliance

Another example of a private sector alternative support contract is the Allied Signal - Caterpillar alliance. This idea couples the strengths of two global industries which service

very different markets but effectively support customers in each. The Allied Signal - Caterpillar alliance is based upon Caterpillar's core competency to achieve a 99.99% on time shipment of parts and material to ensure availability rates of 99.8% for fielded equipment. It provides airlines with the ability to reduce inventory and personnel costs while simultaneously achieving the required availability.

The program is based on these key customer expectations.

- **Reduce material costs & cost of ownership**
- **Maximize customer's supply availability**
- **Minimize repair turn around times**
- **Minimize inventory**
- **Incorporate state-of-the-art technology**
- **Provide innovative contracting**
- **Maximize high quality performance**

To support these activities CAT developed a cost competitive logistics information system which focused on customer service while minimizing inventory investment and maximizing personnel productivity. This system is currently operating at user sites on three continents and providing full, real-time visibility of material status. This on-line system has been linked with client information systems, providing seamless functionality with existing maintenance, warehousing, forecasting, planning, purchasing, and material tracking capability. A representative list of companies using the system is at Table A-1.

Table A-1 – CAT Clients and Service Portfolio*

	Contract Mgmt	Trans-port	Ware-housing	Systems	Inventory
Fortune 50 Aerospace Co.	1997	X	X	X	X
Fortune 500 Tool Company	1994	X	X	X	X
U.S. Automotive Manufacturer	1990	X	X	X	X
Midwest Regional Telecom Co.	1990-98		X		
Automotive Parts Company	1997	X	X		
Major Ind Component Manuf	1991		X		
Top 5 Footware Manuf	1989-97		X		
Int'l Auto Component Manuf	1998	X	X	X	X
U.S. Int'l Computer Hdw Manuf	1997	X	X		
Mid East Ind Parts Manuf	1995	X	X		
European Ind & Motorcycles	1996	X	X	X	
Major Ind & Auto Manuf	1996	X	X	X	X
European Auto Manuf	1996	X			
U.S. Specialty Metals Company	1989		X		
UK - N. America Auto Manuf	1987-97	X	X		
UK Parts Distrib & Manuf	1986	X	X		
UK Int'l Ind Components Manuf	1997	X	X	X	
Int'l Ind Machinery Manuf	1992		X		
Japanese/U.S. Ind Mach Manuf	1993	X	X	X	X
U.S. Int'l Transportation Co.	1987	X	X		
European Ind Components Manuf	1993	X	X	X	X
U.S. Int'l Indust. Components Mfr	1992		X		
Major European Automotive Mfr	1996	X	X		
U.S. Industrial Components Mfr	1994	X			
UK Automotive & Indust. Mfr	1991		X		
European/U.S. Automotive Mfr	1992	X	X	X	X

Top 3 Indust. & Electronics Mfr	1994	X	X	
U.S. Int'l Computer Systems Mfr	1992	X	X	X

* Under the terms of the service contract, each one of the above clients must individually approve each occasion when his/her contract with CAT Logistics is explicitly outlined.

The Caterpillar-Allied Alliance then performed a benchmarking of the effectiveness of the DoD product support operation relative to those for nine industrial organizations of various sizes involved in the distribution and product support in a number of different markets such as automotive, computers, communications, electronics, transportation, commercial aircraft and off-road equipment. The analysis of the customer defined drivers revealed six areas of greatest negative impact on efficiency, cycle time and inventory for DoD Inventory Control Point (ICP)/Depot product support operations. These were:

- Multiple Stand-Alone Data Systems: 126 incidences
- Non-Linear Work Loads (Large Percentage of Slack-Time and Unnecessary Overtime During Work Cycle): 96 incidences
- Invisible Assets (Assets Not Accounted for in the Database): 84 incidences
- Late Deliveries and Variability of Requirements: 78 incidences
- Decentralized, but Competing Similar Functions: 68 incidences
- Inadequate/Unsatisfactory Supplier Performance: 54 incidences

Table A-2 -- Benchmarking Study

Category	CAT Logistics	DoD	Typical ICP/Depot
Scale of Operations (hr/day/wk)	**24 /7**	**24 /7**	**8 /5**
Distribution Centers	**38**	**17**	**1**
Part No's Managed	**>3 million**	**>7million**	**26,875**
Ship Vol/Line Items/Day	**123,400**	**82,000**	**2,600**
Distr. Center Sq Ft	**>5 million**	**unknown**	**814,000**
On-Hand Inventory Value	**negligible**	**$68 billion**	**$50-$112 million**
Receipts Vol/Line Items/Day	**28,200**	**Data not tracked**	**474**
Performance - Orders			
On-Hand Shipment Performance	**99.9%**	**Data not tracked**	**Data not tracked**
Order Leadtime (Days On-Hand Items)	**2**	**49**	**8.5**
Receipts Processed Same Day Inventory Received	**99.9%**	**Data not tracked**	**Data not tracked**
Performance - Inventory Management			
Inventory Turns/Year (Avg)	**4.73**	**0.71**	**Data not tracked**
Stock Availability - Avg Fill Rate	**96%**	**Reported @ no better than 85%**	**18-39%**
Items Filled (On-Site Inventory in <11 Days)	**--**	**<20%**	**55-62%**
Cycle Count Accuracy	**99.2%**	**Not tracked**	**Not tracked**
Performance - Personnel			
Distr. Center Personnel (Receive, Store, Pack)	**>2,000**	**>69,000**	**>375**
Performance - Automated Information Systems			
Number of Logistics Systems	**1**	**586**	**>10**

System Availability	**99.8%**	**Not tracked**	**Not tracked**

The results of the benchmarking study are summarized in Table A-2

Commercial logistic support methodologies similar to those benchmarked above are available to improve O&S operations. Improvements made to five representative commercial companies are shown in the performance grades in Table A-3.

Table A-3 -- CAT Logistics Commercial Performance

	Fill Rate		Inventory Turnover	
	Before	**After**	**Before**	**After**
Client A (Automotive)	**94%**	**98%**	**5.8**	**6.8**
Client B (Automotive)	**70%**	**92%**	**1.9**	**3.7**
Client C (Industrial)	**65%**	**95%**	**2.5**	**4.0**
Client D (Mat'ls Handling)	**89%**	**94%**	**0.7**	**1.7**
Client E (Mat'ls Handling)	**89%**	**93%**	**0.9**	**1.5**
Client F (Retail Goods)	**73%**	**91%**	**7.2**	**10.7**

Power-by-the-Hour

Another method currently being used by the commercial airlines industry is Power-by-the Hour. Under this program, the OEM's repair facility accepts responsibility for the day-to-day reliability of the equipment that it designed and manufactured. Airlines depend upon 100% availability of their aircraft in order to maintain schedules and earn revenue. When a multi-million dollar asset is not available due to a component or subsystem failure, the airline is not only losing revenue from the flights which are not being flown, but is also damaged because of the intangible long term adverse impacts of the unhappy customers expecting to be served by those flights. The dilemma for the airlines is what level of support can they afford at each airport or hub. The airline is responsible for proper maintenance of the aircraft, including the accomplishment of recommended maintenance actions stemming from the reliability analysis program to form a true lessons-learned database. This procedure forms the closed-loop relationship between line and shop maintenance, providing more efficient repair of aircraft systems and components. The business basis for this type of partnership is a ***flight-hour maintenance agreement***. Typically, this type of program covers the test and repair of equipment for a fixed price per aircraft flight hour. Participating carriers have seen significant maintenance cost reductions and reliability improvements. The program is most effective when the OEM is

responsible for maintaining all like units in order to develop statistically valid reliability reporting and analysis systems. It represents a win-win partnership between the airline operator and the OEM.

To illustrate how effective such a program can be, Rockwell Collins has initiated component maintenance agreements with major airlines which provides proactive maintenance based on tracking equipment performance, inputting the information to design changes and maintenance inventories. The result over 18 months for one carrier's equipment, such as electronic flight instrument systems, including the cathode ray tube displays and processors, exhibited improvements in performance of 26% to 133% in mean time between unit replacement (MTBUR) and mean time between failures (MTBF). Standard radio equipment showed improvements ranging from 11% to 123%. None of the equipment supported demonstrated a decline in overall performance. During the same period, the resulting reductions in flight-hour costs ranged from 12.6% to 20%. The new reliability performance data have enabled one carrier to reduce its spare requirements for newly delivered aircraft by several million dollars of spare components and significantly reducing administrative time related to component maintenance.

Culture Change for DoD

So what does this mean to DOD, and how might these concepts be applied? Worldwide logistics support is available today from multiple sources within both the defense and commercial industry. This support can be procured on a competitive basis based upon the availability required for various weapon systems. There is very little difference in servicing an F-16 and a Boeing 767 from a logistics support perspective. However, there is a lot of difference between loading munitions and loading passengers. The key point here is understanding the core competencies within the DOD and industry. DOD has developed the core competency of developing, transporting, arming and delivering ordnance. There is very little need for this competency in the commercial world. DOD has not developed the core competency of lean (minimum cost) logistics for service and support and should use industry for this purpose.

To complete the paradigm shift, making the **Vital Cycle** an effective means of modernization, the DOD must also move to a organizational structure which places

control of and responsibility for Total Ownership Costs for the weapon system on the government system program manager. Additional cultural changes must also be sought. The laws that tightly control the resource accounts ("color of money") will have to be amended to permit the government system program manager to reprogram funding as necessary in order to accomplish effective modernization. While change is ultimately in the control of the Congress, the change in accounting and resource control will have to be initiated by the DOD. Control mechanisms should change to measure the effectiveness of investment made by the team to improve the availability and readiness of the managed weapon system to the warfighter. Use of mechanisms such as Force Readiness Status Reports should provide data on the effectiveness of the responsible program management team.

The lag time for improvements to materialize relative to the modernization of fielded weapon systems require time periods that exceed normal government personnel rotational periods (nominally longer than 3 years). System Program Management leadership will have to be in place for longer periods of time, and this will be a major cultural change. A commitment of this level for a uniformed member of the DOD has major career implications, which need to be recognized. Adequate career advancement opportunities must be made commensurate with these sacrifices.

The politics associated with the military depots must also be dealt with and eliminated if the **Vital Cycle** is to succeed. Where military depots have critical core competencies relative to specific weapons systems, they must be capable of partnering with industry or subcontracting to industry at competitive prices. These depots cannot be protected “at any cost” using political manipulations, that action would negate any gains and thwart the competitive nature of cost reduction actions. With few exceptions, modernization of weapon systems is not a competency of the existing military depot system as they have been established to return worn, damaged or failed hardware to the officially recognized configuration regardless of existing or forecast obsolescence. Therefore, military depots should be incentivized to move work into the industrial sector when it is cost effective based upon the executive mandate to modernize the supported weapon system.

A Focus on The Specifics, " The Process & The Filters"

The mechanisms by which these processes proceed are graphically depicted below in Figure 6. Starting at the top right hand corner of Figure 6, a direction from the Secretary of Defense is needed to stop traditional activity and start the revolutionary approach. The proposed directive specifically prohibits intermediate maintenance except by waiver. The second directive orders consumption of all existing low reliability spares after examination for entry into the new commercial arrangements. After the directive to suspend intermediate maintenance and use up existing spares is made, the criteria for pursuing the alternative system is applied to identify low reliability parts, subsystems that are costly to support, items that have reached end-of-life or obsolete, or fall into the margin of diminished manufacturing sources. Much like the Direct Vendor (DVD) concept, the decision is made based on a filtering process to compete the system for long term support by commercial means.

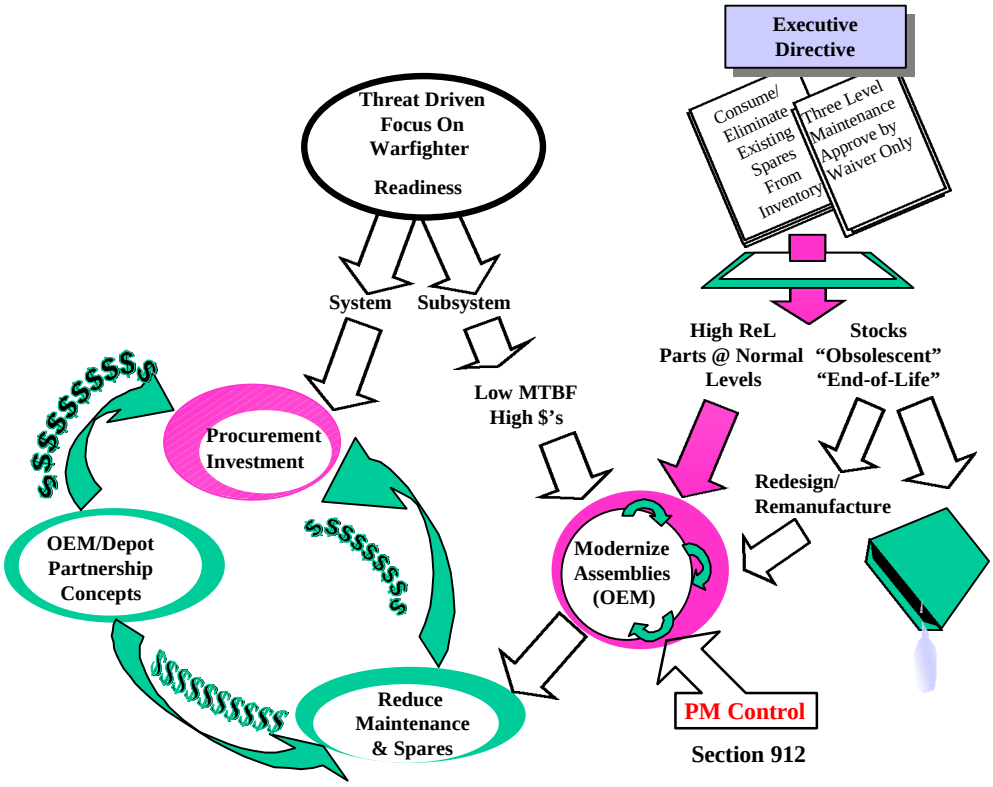

Figure 6. The Mechanisms within the Vital Cycle

Direct Vendor Delivery (DVD) is a procurement technique initiated by the Defense Logistics Agency (DLA). Its purpose was to provide a vehicle to deliver large volume commodities directly to the user. The first instance of this method was the direct delivery of pharmaceuticals from a commercial distributor to the hospital. A similar process was used with commissaries. A variant of the DVD method is the Direct Vendor Delivery – Repairables (DVD-R), which is also referred to as DVD-Plus (DVD+), a joint effort on the part of NAVICP and the Aerospace Industries Association (AIA). The purpose of DVD-R is to reduce the Government's overall cost to provide weapon system logistics support, improve availability and reliability, and to streamline the procurement/administrative process. The differences in this idea and the DVD process is this: the decision must be made solely on cost and reliability from the government view and from return on investment and margin analysis from the industry viewpoint. If the item is entering the "obsolete" realm, then the pathway leads to use of all end items. There will be some cases where redesign or remanufacture is the only method available to provide the system/part/component to the weapon that will sustain the forces. In this case no cost advantage is gained for the immediate situation. The general notion however is to use up the high-cost, low-reliability parts and then enter into a stream of modernization by spares.

An example of a current DVD program is one that provides Auxiliary Power Equipment (APU) to the Navy. This program is a support program which allows the Navy an efficient use of resources. The concept has been recognized by Congress and appears to be a good way of combining skills from Government and Private sectors. This particular effort focuses on the APU equipment for U.S. Navy aircraft: P-3, S-3, C-2, and F/A-18. DVD is a new idea for both the Navy and the company. However, this is a better way to support APU repair, it could also be a model for future direct industry to military logistical support.

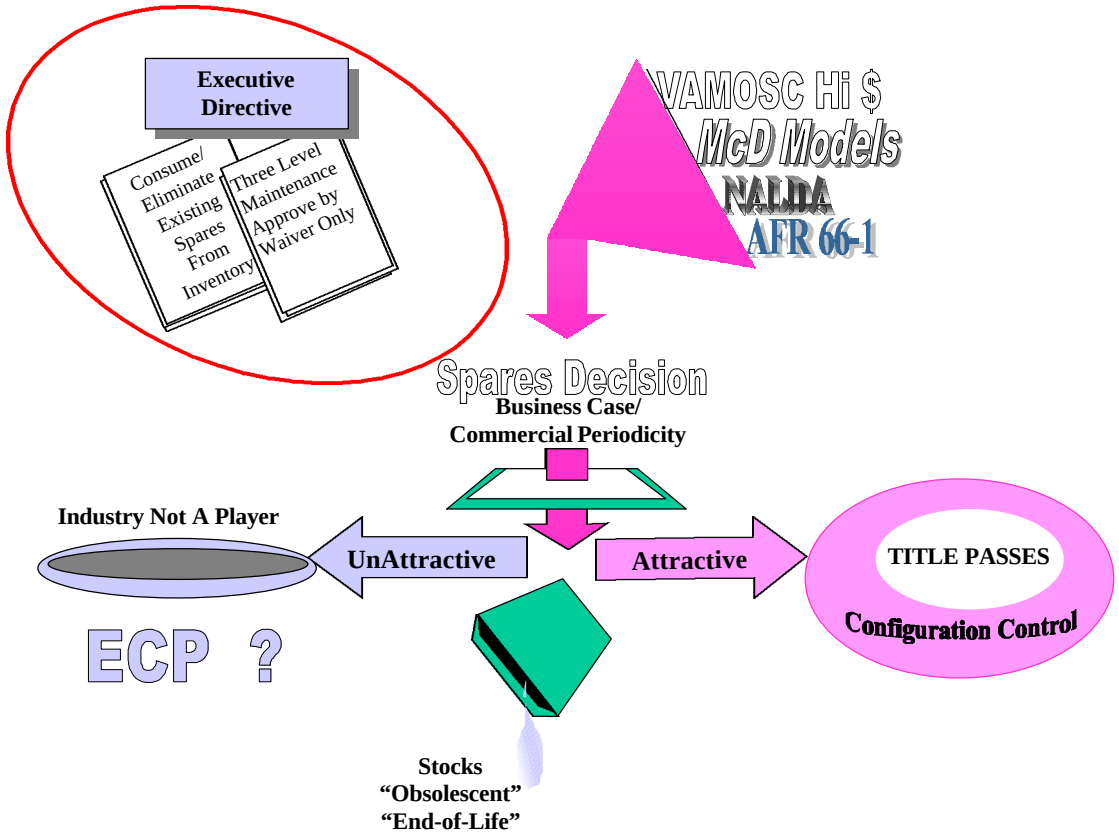

Figure 7. The Decision Process: A Business-case Filter

A central decision process of the mechanism is shown in figure 7, and represents a filter based upon a business case. This decision process includes a review of the low reliability parts and obsolescent subsystems by the private sector company to ascertain the attractiveness of the business. This could be the result of open competition or direct solicitation if the component is provided by only one company, but the decision process then rests with the company. If there is sufficient ROI for the private sector company, the company will have incentive to seek ownership and control of the T.O.C. of the item. A business plan is presented to the government. Then the transition of ownership of the system should be contemplated and solicited by the government. Award of the total ownership (including the configuration control and the risks of profit and loss) is then made on a long-term (five to ten years) basis to the successful bidder. The outcome of this situation is important to understand. The company spends resources to improve the

performance of the system, thereby reducing the need for further costly attention (whether it is maintenance, repair, overhaul, upgrade, etc). The price to the government lowers (because the new efficiencies of the system can afford it). If the business is not attractive, the company in the private sector will more than likely pass. That leaves the item in a situation of more or less the status quo. That is to say, the same infrastructure will be needed to effect the repair or provide service. This service could be supplied at the government depot, or by a defense company under contract to provide traditional cost plus type efforts for the DoD. However, once the revolutionary activity stream is proceeding and growing, the resources freed up by the commercial activity can be applied to the procurement accounts and the modernization accounts either for new systems or reinvestment in legacy system improvements. This, of course, can only happen if there is freedom of movement of resources that have been hindered by the "color-of-money" barrier.

Summary

The Industry Sustainment Team has identified some bold actions to be considered by DoD in a serious attempt at affordable sustainment, and the climate for these bold actions is favorable. The utilization of the "**Vital Cycle Process**" is a major step to provide a **significant reduction of sustainment costs** of legacy systems and additional funds for new procurement. A significant reduction in the growing defense sustainment costs requires a **drastic starting action**, a **business-case filtering mechanism** for continuous product improvement with industry partnering, and the adoption of **commercial logistics concepts**. This proposed mechanism, coupled with an executive directive will:

- Change the concept of maintenance from three levels to two levels, except by waiver.
- Deplete low reliability spares and insert higher reliability, lower cost spares resulting from industry/government partnering.
- Use the Total Cost of Ownership concept within a business-case decision filter.
- Require a change in System Program management tenure and some changes to the "Color of Money" practices.
- Use Best Commercial Practices to identify further methods for sustainment cost reduction through improvement to infrastructure, lower inventory, better logistics turn-around time, and large reductions in acquisition cycle time.

In addition to the above, increased exchange of requirements information between services and industry is recommended to enable the use of current effective technology. Industry is supportive of the idea to make the Department of Defense "operate like a business", but without revolutionary change to the DoD sustainment systems and culture, the objectives from "Into the 21st Century" will be more difficult to achieve**.** The DSAC goal seeks to shorten the cycle time of acquisition by fifty percent. Considering the nominal twenty-year cycle that is prevalent in defense acquisition, ten years is certainly an improvement. For the reduction of system acquisition cycle time, even greater reductions are possible. In the NCAT Evolutionary Defense Acquisition scenario, major system development can be accomplished in 5 years, including fielding and user operation evaluation of battle group size production prototype lots. Development of non-

major items can be 3 years, including fielding of low-rate productions for similar op-eval and continuing warfighter use.[9] Pursuing programs using the Evolutionary Defense Acquisition (EDA) model, currently resident in the DoD acquisition desk book, can reduce the acquisition cycle substantially. The ideas of the EDA, like those of the vital cycle, come from the inventiveness of the private sector. "Re-engineering the logistic system" part of DSAC Goal #1 requires another departure from traditional DoD logistic functions. The Sustainment Team suggests that rather than piecemeal reengineering of the DoD logistics infrastructure, a quicker way of achieving the goal of a world class distribution operation would probably be to outsource to one or a number of existing commercial "off-the-shelf" operations. The DSAC goal of reducing the logistics response time by 50%, including reducing the repair cycle, can be met by doing this. Goals "two" and "three" of the DSAC "Into the 21st Century" paper are closely linked to the concept of a new cycle in this paper. Actually, the resources shift from O&S to modernization relies on the linkage of these two goals.

Lowering total ownership cost and allowing funds to shift to modernizing from infrastructure can only be accomplished if non-traditional provisions to allow the migration are made. Traditionally, "cost savings" and "cost avoidances" do not "flow" back to the individual program nor to the major force program account, but are captured by the general account or go back to the U.S. Treasury. This barrier has been the major stumbling block in past innovations that failed to materialize because of the reluctance to modify the inflexible system of accounting for the department's budgeting and execution process.

Passing title of legacy systems and/or their components to original equipment manufacturers should be considered as a method to allow the "freeing up" of resources from infrastructure and support. These arrangements can significantly reduce O&S infrastructure costs, freeing up resources to fund modernization and new acquisition. This is by far the most significant revolutionary idea that requires complete paradigm change. By passing ownership to a company and contracting for service-based

[9] Evolutionary Defense Acquisition, The National Center for Advanced Technologies, 1996

requirements fulfillment arrangement, the resources traditionally programmed for logistics can be shifted to fund modernization issues.

The adoption and execution of commercial business practices is an outstanding objective, but will require major efforts of partnership and trust with industry and government the key participants. We suggest continued participation of industry teams in the formulation of these goals and executing plans.

APPENDIX 1

SUSTAINMENT TEAM CHARTER

Objective: Focus on the S in the O&S costs. Assist in the identification of resources needed to improve sustainment technologies and attempt to identify these sustainment technologies as they apply to procurement of new systems.

Charter

Conduct a thorough study of weapons systems sustainment. Highlight barriers, cost drivers, and issues confronting industry in their attempts to reduce sustainment costs. Provide methods for reducing the growing cost and effort of Sustainability by identifying high cost drivers of major weapons systems, determine what portion of those costs could be reduced effectively and identify the barriers or innovative solutions for reducing or eliminating the high cost area. Take the results of the analysis to the attention of the decision-makers in the Department of Defense in the form of plans or recommendations.

Possible process to gather needed information:

1. Focus on a single weapons system (e.g. F-16.)

2. Breakout the O&S costs for the system into categories such as: POL, Ammunition, Consumables, Maintenance (Concept plus organic vs. contractor depot), Spares, Personnel, Logistics footprint (mobility), Avionics DMS, Support Equipment, Joint Vision 2010, etc.

3. Achieve an understanding of the systemic causes of the costs.

4. Achieve an understanding of the costs associated with recruiting, training and sustainment of personnel by category: avionics, engines, airframes, weapons etc.

5. Brainstorm a variety of alternative approaches to find existing models, which have tackled these problems to determine what if any cost savings could result.

APPENDIX 2

Sustainment Team Membership

Pertowski, Ted, Chair	GEC Marconi
Berecz, Karen	Raytheon
Birchfield, Burt	The Boeing Company
DeCaire, John	National Center for Manufacturing Sciences
Fernandez, Charlie	Lockheed Martin (Dallas)
Friedericy, Hans	Allied Signal
Francis, Emmett	GEC-Marconi H
Gordon, Mark	NCAT
Lindsey, Paul	Marconi Aerospace
McCarty, Frank	Society of Manufacturing Engineers
McClendon, Eddie	Raytheon
Michel, Fred	Society of Manufacturing Engineers
Schaaf, Cliff	Lockheed Martin
Schwach, Clifton	Rockwell Collins
Shaw, Tom	Anderson
Siegel, Stan	NCAT
Syslo, Joe	NCAT
Wright, Brian	Rockwell Collins

Appendix 3

AN/ARC-210 Cost/Benefit Analysis

The following costs and benefits have been realized by the ARC-210 program since the incorporation of the Reliability Incentivized Warranty (RIW) program.

Government:

Cost:	**Benefits:**
• Establish Contractor Depot/RIW Support	• Reduced Acquisition Cost • Timely Incorporation of Latest Technology • Elimination of Organic Depot (and associated costs) • Improved Reliability (MTBF) • Reduced Number of Spares in the Logistics Pipeline • Personal Pride in Being Part of a Paradigm Busting Program

Contractor:

Cost:	**Benefits:**
• Contractor Funds All Non-Recurring Effort • Contractor Funds Cost To Upgrade Hardware	• Reduced Cost To Manufacture • Increased Market Share • Timely Incorporation of Latest Technology • Longer Product Life Cycle • Contractor Depot • Contractor Receives Timely and Accurate Feedback on Field Problems (Failures - as evidenced by units returned for repair) • Personal Pride In Being Part of a Paradigm Busting Program

Appendix 4

The initial process decided on by the Sustainment Team to gather needed information was simple in concept. It was agreed that initially the team would:

1. Focus on a single weapons system (e.g. F-16.)
2. Breakout the O&S costs for the system into categories such as: POL, Ammunition, Consumables, Maintenance (Concept plus organic vs. contractor depot), Spares, Personnel, Logistics footprint (mobility), Avionics DMS, Support Equipment, Joint Vision 2010, etc.
3. Achieve an understanding of the systemic causes of the costs.
4. Achieve an understanding of the costs associated with recruiting, training and sustainment of personnel by category: avionics, engines, airframes, weapons etc.
5. Brainstorm a variety of alternative approaches to find existing models, which have tackled these problems to determine what if any cost savings could result.

The team did not deviate much from the basic plan and agenda, but discarded the notion to zero in on one weapon system early in the discussions. There were other side discussions. For the most part the team remained focused on the task at hand, that is, to identify methods that would revolutionize the manner by which DoD sustainment proceeds.

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6. Presentation on Commercial Practices – Dilemma or Opportunity – Lt. Cmdr. Anderson
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